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ADDRESSES
PAPERS
ABSTRACTS
MINUTES
BY-LAWS
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ADDRESS
by
O.I. Higgins, General Manager, Peanut Marketing Board,
Queensland, Australia

Mr Chairman, ladies and Gentlemen,

Firstly, I must thank you for the honour and privilege of being asked to address this conference, and for the opportunity thus afforded to meet with so many of the people involved in the peanut industry in your Country.

Production-wise, Australia can by no means claim to be in the big league in peanuts. However, I do hope that a run-down on the Australian industry will be of interest to you.

I have been alloted forty-five minutes of programme time. This is a substantial segment. I am fully conscious of the old truism that the interest of an audience can be maintained only for as long as the assembled posteriors are reasonably comfortable. Therefore, I propose to break this address into several sections, with a few illustrations by way of colour slides, and some opportunities for questions.

History of the Australian Industry

Peanuts are believed to have been first introduced into Queensland by Chinese fossickers in the gold fields of North Queensland - Cooktown, Laura and the Palmer gold fields - some 1,200 miles north of Kingaroy - about the turn of the century.

In South Queensland, where the bulk of the industry is now concentrated, commercial production commenced in the early 1920's.

There has been a gradual increase in production - at a reasonably steady rate - to the current level of about 45,000 tons per year - nut in shell basis.

In peanut production, Queensland virtually means Australia. Some very small quantities are grown in -

(a) Northern New South Wales
(b) Northern Territory (Katherine area)
(c) West Australia (Ord River development)

but these are so small as not to influence the picture at all.

The concentration of production in our South East Queensland area results from the obvious factors -

(1) Suitable climate - summer rainfall - averaging 26 to 27" year - dry autumn and winter.
(2) Loose, friable volcanic soils
(3) Reasonable proximity to principal markets - as against e.g. Katherine and Ord River.

History of the Peanut Marketing Board

In Queensland, we have on the Statute book an enactment entitled "The Primary Producers' Organisation and Marketing Act", which is administered by the Minister for Primary Industries in the State Parliament.

The Act provides for the "orderly" marketing of agricultural commodities, subject to certain formalities. A minimum of 50 growers is required to set the ball rolling. They can request the Minister to "declare" a particular commodity (such as peanuts) under the Act. The minister may then decide that a poll should be taken among all growers of that commodity within the State. Provided that 50% of eligible growers record a vote, and that 60% of the votes are in the affirmative, the minister may then "declare" that commodity as being subject to the provisions of the Act.

In our case, the declaration covers "all peanuts grown for sale in Queensland".

The next step is the formation of a Board, which is elected by growers, usually for a term of three years. Only growers qualify as electors - but Board Members need not necessarily be growers. Again, to quote our case, we have five Board members elected from various areas in Queensland, and a nominee of the Director of Marketing in the Department of Primary Industries is a Board member. The Government nominee has no special powers, voting rights or right of veto.

There are presently nineteen Marketing Boards in Queensland, covering such commodities as -

Maize	Milk	Grain Sorghum
Navy Beans	Peanuts	Butter
Wheat	Cotton	Broom Millet
Sugar Cane	Fruit	Cheese
Barley	Tobacco	Ginger
Eggs	Pigs	Rice

In this respect, Queensland has gone further than other Australian States.

The Wheat and Barley Boards are Commonwealth wide.

Potato and Onion and Egg Marketing Boards exist in most other States.

New South Wales has an oilseeds Board.

The various legislative enactments in the States are not identical, but the principle of Marketing of Primary Produce through grower-controlled Boards is, as you can see, well established in Australia.

Powers and Duties of a Marketing Board

Any Board appointed under the Act is required to be concerned with the preservation and expansion and economic well-being of its industry - and to be the medium of communication between Government and industry.

Each Board is empowered to sell or arrange the sale of the "commodity" and to perform all necessary acts in this connection.

e.g. appointment of staff
engagement of agents
arranging of finance etc., and,

within limits approved by the Minister, to manufacture, process or otherwise treat the commodity to facilitate sale to the best advantage.

On the formation of a Board, growers become obliged to deliver to the Board, all of the commodity grown for sale in Queensland. They are no longer free to negotiate private sales within the State.

On the other hand, the Board may not refuse to accept from any grower, any of the commodity of merchantable quality delivered to it for sale.

To come back specifically to our own case, the Peanut Board was formed in 1924, and will therefore complete 50 years of operation next year.

There is provision in the Act for growers dissatisfied with the system to request a poll to determine whether the Board will continue to function. Such a poll has never been requested in our industry. Other commodities, in particular potatoes and onions, have had a much more eventful history. Boards for these commodities have been formed, dissolved, reformed and abandoned again.

The two major areas in which the Board has no control are -

(1) In production. We have no means of controlling area or tonnage of peanuts produced.

(2) In Sales across the State Borders. A section in the Commonwealth Constitution, which has proved highly contentious and has been productive of great amounts of revenue for the legal profession, provides (among other things) that ".....trade and commerce between the States shall be absolutely free". This wording is in the section of the Constitution relating to Customs and Excise duties, and I believe (and I think most Australians agree), was intended to relate only to the payment of duties at State borders. However, it has been interpreted by the Judiciary (subject to many appeals and counter-appeals) to apply to a multitude of other facets in the Australian way of life.

In the middle 1930's a period of fierce sales competition between the Board and 'independent' operators almost brought the industry to its knees, and an attempt was made to rectify the situation by the passage of another Bill in the Queensland Legislative Assembly called the Peanut Industry Protection and Preservation Act.

The 3 basic aims of this Bill were -

(1) To provide for the control of peanut diseases, by the appointment of inspectors, provision of quarantine regulations, treatment of seed before planting, etc. etc.

(2) To give the Marketing Board the right to grade all peanuts produced in Queensland, irrespective of whether they were for local sale or destined for inter-state trade.

(3) To institute a system of grower tonnage allocations for a No. 1 Pool in each year, the quantity being that required to meet requirements of the Australian domestic market, plus seed.

Growers were still free to produce any quantity in excess of their No. 1 pool allocations, for delivery to a No. 2 pool.

No. 1 pool disposals were directed to the more profitable domestic edible market. No. 2 pool peanuts were sold for export or for oil milling. Any shortfall in production of No. 1 pool allocations was automatically drawn from the No. 2 pool.

These provisions maintained the peanut ship on a relatively even keel until the years following the second World War. There then developed a great pressure for the expansion of No. 1 pool tonnage allocations without there being a corresponding increase in domestic market outlets. The pressure came mostly from young farmers who had no experience of the benefits of orderly marketing and who were quite ready to declare that they were not prepared to produce for a No. 2 pool - and that if the Board could not or would not allocate to them a "satisfactory" No. 1 pool tonnage, they would market outside the Board, interstate, under the protection of section 92 of the Commonwealth Constitution.

It was at about this time (31st March, 1948) that I threw in my lot with the peanut industry "for better or worse, for richer or poorer".

The Peanut Industry Protection and Preservation Act contained provisions for policing the matter of deliveries to the Board - duly appointed inspectors had powers of seizure and detention to enforce delivery and/or grading - and for several years the Board endeavoured to act on these. There ensued a right merry period of all night vigils, hot pursuits down back-country roads, seizures of loadings in likely and unlikely places, with and without the protection of local constabulary - with the opponents of "orderly" marketing joining willingly in the fray, and opportunist farm-gate buyers with large wads of currency making furtive calls in the middle of the night.

The upshot of itall was a challenge, taken to the High Court of Australia, against the Board's legal right to grade peanuts designated for interstate trade. We lost - and the case is recorded in the archives as Bierton V Higgins - because I was the one who authorised the contested seizure. That was the Waterloo of grading enforcement.

Ultimately, and perhaps belatedly, the Board bowed to the inevitable. All attempts at enforcement of grading were abandoned - the legislative provisions for dual-pooling were suspended - growers are now free to produce as they wish and to sell interstate without hindrance - and of course to take returns according to supply and demand.

What is the present position? We still handle 80% or better of Queensland production, because most growers still feel that advantages accrue from organised marketing of their commodity.

How the independents operate - The balance of the crop is sold through a number of outlets, either direct to processors, or via buying agents who set up small grading sheds in the producing districts.

We will always have a percentage of growers who oppose any form of control - and there will always be a number who will take a slightly lower return for cash on the nail.

We are told that healthy competition promotes efficiency in business operations. No doubt this is right. We are meeting competition and maintaining - indeed, improving - our position.

Finance

The Marketing Board completes each year without funds. All crop proceeds, less working expenses, are returned to growers for each crop.

We raise Bank finance each year to permit a payment on delivery of about 80% of eventual proceeds - the balance is paid on completion of crop sales.

Growers' individual payments are based on grade results of their deliveries.

Ancillary Services to Growers

Traditionally the Board provides a multiplicity of services for growers e.g.

(1) We prepare and supply virtually all seed for the planting - on credit wherever a grower has the necessary equity in the previous crop. Repayment is taken ½ from first payment on the new crop and ½ from final payment on the previous crop - which could be 9 - 10 months after planting.

(2) We supply on credit against crop equity, farm chemicals of all descriptions (Treflan, Benlate, Dutar, etc.). Repayment is taken when crop is delivered.

(3) We have at all times maintained an extensive stock of bags for rental to growers who have harvested and delivered in bags.

(4) We retain a Field Officer for experimentation, advice and extension work. Some of you may remember having met Alec Baikaloff, who visited the U.S.A. about three years ago.

We have, in fact, performed services for growers "far beyond the call of duty" over a lengthy period - but without the award of any appropriate medals.

Queensland Peanut Growers' Co-operative Association Limited

The Marketing Board was originally constituted with a life of three years, subject to extension unless growers requested its discontinuance.

Obviously, substantial working assets in the form of buildings and plant are essential to the Board's operations. It was felt that ownership of these assets should be clearly defined, in the event of the termination of the Board's activities at any time.

Accordingly, the Board was given power, under the legislation, to make a Levy each year at a fixed rate per pound of peanuts delivered - the levy being deducted from growers' payments.

Authority was also given for the Levy to be passed by the Board to a Co-operative Association, in which each individual grower has an equity equivalent to his contributions of Levy. The co-operative then established the necessary buildings and acquired necessary plant.

The Co-operative has been and still is, a non-trading organisation - existing merely to hold the assets used by the Board on behalf of growers. The Association's income consists of two items only -

(i) The Levy collected and passed on each year by the Board - currently at the rate of .3125¢ lb. of peanuts delivered.

(ii) A reimbursement from the Board (out of its working funds) equal to the amount of Depreciation written off each year from the Association's assets.

These amounts provide sufficient funds for renewal of plant and for extensions and additions as required. The Board pays no rental, but meets all costs of normal maintenance.

In practice, it becomes necessary to raise loans for any major development projects - these loans being amortized over a period. To ensure a continuation of income to the Association, the life of the Board is extended periodically for terms of ten or twelve years, instead of the three year periods originally envisaged.

Revolving Levy Scheme

With a view to retaining ownership of the Association assets in the hands of relatively recent growers, we devote one half of the levy collected each year to a Revolving Levy Scheme. Funds are utilized to repay to growers the levies contributed in previous seasons. The scheme originated some 17 years after the first levies were collected - and repayments are likely to lag well behind collections. (Presently we have repaid collections made in 1960). The nett effect is that ownership of Association assets is in the hands of those growers who delivered peanuts to the Board in the past twelve or thirteen years.

Field Practices

I shall not attempt to go into detail in regard to our general field practices.

Land preparation - ploughing, discing etc. - are reasonably standard with yours, allowing for differing techniques due to soil types and climatic variations.

Our planting rates in seed per acre are much lower than yours. Because of lower rainfall and lack of irrigation facilities we are unable to support very heavy plant populations.

Again, our harvesting methods are similar, but require some variations due to soil structures and plant types. We do not produce any runner peanuts - our Virginia and Spanish are strictly bunching type plants.

On-farm drying plants are of a multiplicity of shapes and sizes. Very little drying is done in trailers. Because of major distances involved between farms and delivery points, and because of stringent requirements by the Transport authorities on trailer equipment, all bulk transport is in body trucks and or semi-trailers.

Perhaps a few more slides will illustrate these points.

Handling of Intake

Apart from our Branch at Atherton in North Queensland, which has full equipment and facilities, we handle the whole crop at Kingaroy.

We do have depots at Gayndah (about 90 miles North) and at Murgon (30 miles North-East) - but these are only staging facilities for those outlying growers who still deliver in bags. These are stacked temporarily and later tipped to bulk, partly cleaned and transferred to Kingaroy. Both of these areas are currently converting to bulk handling. Bulk trailers come from areas as much as 200 miles from Kingaroy.

At our central plant at Kingaroy, we take peanuts through the usual routine -

1. Weighbridge, and moisture test
2. Tip to unloading hopper
3. Elevator to temporary holding bins
4. Continuous sampling of each load for payment purposes

5. Cleaning
6. Storage
7. Anti-infestation treatment

We are using the rotary sampler of which we obtained details through the U.S.D.A. Possibly the hydraulic samplers in general use in your peanut areas are preferable but we are finding the rotary outfit quite efficient.

Our samples average about 5,000 grams weight. These are analysed for -

1. Extraneous material content
2. Weight of edible grade kernels
   oil milling grade kernels
   mouldy kernels
   shells

Payment to growers is based on a graduated scale working from an f.a.q. point. Growers can earn bonuses and incur penalties in both areas of cleanliness and quality of deliveries.

Unlike yourselves, we do not have a benificent government providing sampling and inspection services. These we must provide for ourselves - and the grades earned do not always go unchallenged by those growers who every year produce "the best peanuts I've ever grown....." and we down-grade their product.

A few of our units may be of interest, because they may not bein common use here-

A small sheller for handling 1,000 gram samples. This we have developed in preference to using the units which are (or were) in use at your inspection stations.

Roller Screens for removal of dirt and sand in the cleaning process. These units were originally developed for use in wheat and barley. We have adapted them for peanuts and find them very useful - if somewhat expensive to maintain.

Triple S Precleaner This year we modified our Triple S precleaners to make stoning more efficient, by removing the stoner chute and outlet, and replacing it with an exact replica of the stoner on the Hobbs Cleaner - to exact scale but of course a bigger size. An additional fan was also required.

This has greatly increased the efficiency of the precleaner. Some of you, who operate cleaning plants, may be interested in a similar conversion.

Malathion Spray

We spray all peanuts going into bin storage, as they carry on the final conveyor, with Malathion, to prevent insect infestation.

Provided shells are relatively undamaged, this spray provides protection for five or six months, or until bin temperatures are high enough to cause a break-down of the Malathion.

Bin Aeration

Aeration of storages is, of course, a common practice. All our major storage bins are fitted with aeration cages in the bottom cones and natural air (convection currents) moves through the bins as temperatures vary.

We do have one special item, developed by the C.S.I.R.O. and thoroughly tested by us. This is an automatic controller which controls a fan on each bin, to bring it into operation for a regular number of hours each week, at the optimum times when temperature levels are lowest and aeration is most effective.

Deshelling and Grading

Procedures are similar to your own.

Standards for all edible kernel grades are laid down in our Peanut Industry Protection and Preservation Act - and are not greatly different from your grades. Checking is continuous, with appropriate controls if grades are showing off-standard.

Storage

Final product storage is in Cold Stores of about 9,000 tons kernel capacity. We sought information in a visit here in 1965 and took advantage of your experience in this regard. Temperature and humidity levels are similar to your own.

Aflatoxin

This has not been a major problem with us. We are very particular with our gradings and reject all suspect material. In the last 12 months of checking both home consumption and export materials, we have not had one Aflatoxin positive reading (5 p.p.b.)

By-Products

In common with most other shellers, our principal bug bear has always been the disposal of shells. Traditionally, these have been carted away and ploughed back into the farms, with only small quantities utilised as feed.

Three years ago we established our own stock feed mill, using shell as the main base for a number of formulations. These have had a good reception, and currently we are using about one half of available shells through the mill, together with additives where necessary such as molasses, peanut meal, salt etc.

I do not know to what extent your shells are used here as fodder, but if anyone is interested, will be happy to give you the formulations we use.

Our mill includes a pellet press, as some buyers prefer meal in pellet form. To anyone who has not attempted to pelletize peanut shells, I would say that this process offers the experience of a life-time.

With or without steam injection, molasses, peanut meal and other additives, peanut shells would be about the most highly abrasive substance known to man. We have tried straight-through dies, counter bored dies, ¼" dies, ⅜" dies - the wear and tear on hammermills and dies has to be seen to be believed and proves that peanut shells are a very difficult commodity to handle.

To our delight we are now finding much greater interest in raw shells straight from the shellers.

A major lot feeder wants to contract for virtually all the shell we are not milling in our own plant - and is talking of wanting to double his offtake in the near future. So perhaps our disposal problems are coming to a happy ending.

Marketing

As a commodity marketing board, handling the primary commodity, and not involved in processing the product which appears on the supermarket shelves, we have not been intimately concerned in market research and development. This has been considered the province of our customers - the processers of salted peanuts, peanut butter, peanut confectionery etc. - who have brand names to which they can tie their advertising and sales promotion.

Perhaps this has not been over successful. Our per capita consumption of peanuts in Australia is I believe about half your usage here.

Our range of outlets is limited, and is growing less each year, as take-overs gradually remove the smaller and more promising firms into the hands of the biggest few. Currently, this is the position -

Our top 3 customers utilize	33% of our total sales
Our top 7 customers utilize	58% of our total sales
Our top 20 customers utilize	87% of our total sales

So, although we as a Board sell direct to perhaps 200 customers, it is evident that the majority of these operate in a very small way.

We may be forced to take a direct interest in the processing field before we are much older.

Disposal of Surpluses

I have been asked to express an opinion on the possible avenues open to us all in this regard.

Regretfully, I am ill-qualified by experience to touch on the subject.

In our own case, we have, until last year, always had a ready outlet to the oil mills at a reasonable price for any surplus kernels. This was because Australia had not produced sufficient oilseeds to meet domestic requirements for soft oils. We - the Peanut Board - had a happy working arrangement with the Department of Customs and Excise, which involved the waiving of duties on imported oil provided all our milling stock was taken up by the millers at an agreed price.

This utopian state of affairs came to an end with a great upsurge in production of sunflower seed, cotton seed, rape seed, safflower and soya beans. Although not wholly self-sufficient in all these oils, Australia now has substantial exportable surpluses in Sunflower and cotton seed - and plenty of local oils to substitute for imported peanut oil.

As a consequence, we entered the export field last year in a substantial way for the first time. Our relatively limited regular export of about 1,000 tons per year to New Zealand was expanded by a further 6,000 tons to Japan - following a visit I made to that country last year.

I claim no great expertise in overseas marketing, but we have achieved very satisfactory returns from Japan, particularly for large Virginia kernels which compete with Chinese H.P.S.

We have again committed some quantities to this market from the current crop at good prices - no doubt greatly assisted by shortfalls in major peanut-producing areas of the world.

Because we do not have a government support price for peanuts, production will be regulated by the adequacy or inadequacy of returns to growers - and the alternatives available in other crops.

Given a continuance of current export returns, we could expand production without difficulty. Although domestic prices are well above export returns, the gap is currently not so great that the return to growers would be averaged down too far by a substantial proportion of export trade.

In rain-grown areas which are now the principal peanut producing areas, we can never guarantee a regular quantitive standard of production. Australia is a dry country and droughts crop up with agonising frequency.

Major irrigation areas in Australia which could produce big quantities of peanuts now concentrate on more profitable crops - fresh and dried fruits, cotton, tobacco, small crops - and this situation is likely to continue.

In spite of existing potential, unless returns to producers can be stepped up dramatically, it is unlikely that Australia will make any major impact on world peanut markets in the foreseeable future.

Market Research

The greatest need for the peanut industry in Australia is the development of a new product which would give a really major lift to consumption on the domestic market.

I know that work is constantly being done here in this regard. We have had correspondence with Mrs Kay McWatters of the University of Georgia Experiment Station and have received samples of her work towards an acceptable "peanut chip" or"peanut flake" to compete with potato flakes. We have done some limited experimentation towards the same objective.

A big break-through in a new product would give the industry a tremendous lift and for all our sakes I trust is just around the corner.

Conclusion

Let me conclude by saying that we in Australia who rate in peanut production as little fish in a great big pond, very greatly appreciate the always ready help and co-operation available from all our contacts in this country.

If I have been able even in a very small way to convey to you some items of interest relating to our operations, I shall feel very pleased indeed.

My wish is that you may all, individually and collectively, experience great satisfaction and reward from the various aspects of the peanut industry with which you are most intimately connected.

NATIONAL PEANUT COUNCIL

PROGRAMS AND PROJECTIONS
FOR PEANUT RESEARCH

by
George F. Hartnett, Chairman
National Peanut Council
Research Committee

As usual, it is a real pleasure for me to attend an A.P.R.E.A. meeting, and I thank the program committee for allowing me the honor of speaking to the members and guests for a few minutes this morning. You'll note that I began my opening sentence by saying "as usual" because I have always enjoyed your meetings. Or perhaps I should say "our" meetings since my brokerage company has been a member of A.P.R.E.A. since its inception. I also had the privilege of addressing our predecessor organization, the Peanut Improvement Working Group, in 1964 at Auburn, Alabama as well as the honor of participating in a panel discussion at the first annual meeting of A.P.R.E.A. in Atlanta, Georgia in 1969.

In the course of my remarks I will clearly prove to you that I am a lowly layman who has none of the technical expertise which you gentlemen possess. After struggling thru the required science courses in high school and college, I eased into more familiar ground that produced degrees in English in college and later in law in graduate school, thus totally disqualifying myself as one who should be chairman of an industry research committee. But I have noticed in our committee meetings that I am often the only tranquil water in the midst of seas of technical dissent and disagreement. And so, perhaps there is an inverted yet canny logic in handing the gavel to the only one at the table who realizes and freely admits that he is often confused and uncertain.

Today I would like to sketch very briefly for you a picture of the National Peanut Council, then describe some of the work done by the Research Committee, and finally offer some thoughts on areas where research work might be initiated or continued.

The National Peanut Council was organized in 1940, some 33 years ago, when in-shell Virginia peanuts cost 5¢ per lb., #1 Spanish and #1 Runner shelled peanuts cost nearly 6¢ per lb., and the grower received an average of 3¢ per lb. from the sheller for his farmer stock peanuts. The size of the total peanut crop that year was 465,000 tons, or 29% of our current crop, and those peanut prices were about 20-25% of what they are today. The Runner crop that year, by the way, was 80,000 tons - compared to 712,000 tons this year!! The Council's membership is composed of all the peanut grower associations, all the edible peanut shellers, all the peanut brokers, most of the major peanut food manufacturers and a large number of allied members. Its board of directors is made up of representatives from the ten major industry segments: each of the three growing areas, each of the three sheller organizations, the brokers and the three main manufactured product areas of peanut butter, salted peanuts and peanut confections. Its primary purposes are to promote raw peanuts, peanut products, peanut research and peanut information and to foster industry cooperation. During the past fiscal year the National Peanut Council's income was approximately $90,000., plus an additional $100,000. which was raised on behalf of its committees, notably the Export Committee, the Promotion Committee, the Research Committee, and the Committee that administers the Golden Peanut Research award.

The Research Committee of the National Peanut Council became increasingly active in 1964 when it undertook the initial work for the industry in response to the alarming report that a toxic substance produced by certain molds had been found in South American Peanuts and other raw commodities. In fact, when I spoke to this group in 1964 as the new Chairman of the Research Committee, my entire speech was concerned with the aflatoxin problem. And in rereading it the other day, I again relived the initial concern and sense of foreboding that engulfed us all in that

period that began this recent decade of enormous change in the long history of the peanut industry. Our immediate response was to establish long range and short term goals while keeping such a highly explosive problem at the technical level where it belonged and away from the uncontrolled area of public relations. Fortunately for all, a sensible and proper approach to the problem was successfully established and has been followed ever since that time by the industry and the governmental agencies. Throughout the intervening ten years every association, group, company, committee and individual in the peanut industry has been involved in the joint efforts to overcome the mycotoxin problem, and our progress has been remarkable and impressive. One of the roles of the Research Committee has been to keep abreast of the times and to work within the industry segments to promote understanding and information about aflatoxin. An example of this has been our production and publication of ten editions of the Voluntary Code of Good Manufacturing Practices, a brochure that acquaints all 500 or so manufacturers of edible peanut products with improved techniques for peanut purchasing, handling, storage, sampling, processing, sanitation and testing. Our eleventh edition will be produced early this Fall and will contain the newest and most accurate information that can be furnished to the companies that buy our peanuts and convert them into the sales that keep us all in business.

The success of our Voluntary Code encouraged us this past year to issue three new Codes, one for peanut shellers, one for peanut warehousemen and one for the cold storage of peanuts. Included in the Warehousing Code was an insert on proper artificial drying of farmer stock peanuts as well as a three-page insert on a Rodent Control program. In this way we are reaching all segments of the industry that can affect and maintain the wholesomeness of our raw peanuts and peanut products.

Another of our major functions has been to counsel and cooperate with the U. S. Department of Agriculture and the Food and Drug Administration concerning industry efforts and progress in the fight to control and eliminate aflatoxin contamination. We have held many formal and even more informal meetings with these other agencies in a continuing effort to share information and compare notes in our mutual desire to advise the peanut industry and protect the consumer. Some of you have joined us in our meetings with the Agricultural Research Service, for instance, where we have jointly reviewed existing research work and discussed new areas where help was needed.

In recent years our committee has examined the possibility of peanut contamination by salmonella, and we concluded that no such problem exists in peanuts per se. For peanuts are not associated with unusually moist or wet procedures and the normal roast used to produce our peanut products will effectively destroy all viable salmonella. Salmonella could, of course, be found in any raw material or processing plant if proper sanitary procedures were not followed and we did issue a report advising the industry of proper sanitation techniques. In earlier years we labored long and hard to improve the aflatoxin methodology and throughout the years we have continued the efforts to improve the sampling and testing procedures for both raw peanuts and finished peanut products.

At present we are working with industry and the F.D.A. in response to the new look being given by F.D.A. to its longstanding guidelines for Unavoidable Defect Action levels in many food products. This refers to, of course, the possible presence of rodent hairs, insect fragments and water insoluble inorganic residues. Our work includes both recent and proposed industry surveys to determine if these problems exist and, if so, how to correct them. While our experience so far has been excellent, I expect that we will be doing more in this area in order to keep pace with the F.D.A.'s logical reaction to the strong consumer demand for better quality products.

In all of our work we have been ably assisted by the Arthur D. Little Co. under the direction of senior Vice President Dr. Charles J. Kensler. His input and that of his associates has been most valuable to the peanut industry and is regarded most highly by the agencies with which we do our work. His common sense mixed with technical knowhow and the broad span of information that is obtained and obtainable by his company are rong assets for our committee.

Perhaps I should explain at this point that our Research Committee operates on an extremely meager budget that is funded only by contributions from the peanut growers, shellers and manufacturers. We do not, in fact we cannot, supply monies for research projects. The members of the committee contribute their time and expenses gratuitously and our primary expenditures are for the time and advice given us by the Arthur D. Little Company and other technical groups.

And now I would like to comment on peanut research, present and future. In so doing, I am reporting to you the results of a letter I wrote to all of our committee members, both growers, shellers and manufacturers, asking them to highlight those areas of concern that affect them most directly at the moment and are expected to be vital to their future. Some of these areas have received and are receiving research work at the present. Others may sound ridiculous to you and may appear as if we are reaching for the moon. But remember, man is now on the moon, and the neverending list of accomplishments that have been achieved while all of the experts were saying "It couldn't be done" is strong evidence that today's idealism is tomorrow's accomplishment for those who have vision and persistence.

Mycotoxins. I use the broad term because U.S.D.A. mycotoxin research, as reported by Dr. Fred Senti of A.R.S. at a recent conference in Mexico City, now includes investigations of aflatoxin and at least half a dozen other mycotoxins. So they are still obviously a prime concern of our industry even though we have control of the problem and are producing the most wholesome peanut products in our history. But the controls and safeguards are incredibly expensive and drain off far too much of our financial and human resources. The problem requires too much of the time that we should be devoting to peanut improvements in other areas. So who among you will develop a fungicide to neutralize molds without destroying the peanuts? Who will innoculate the soil or spray the peanut with a substance that will prevent mold invasion? Who will discover a way to detect aflatoxin with an ultra-violet light or other visible scanner? Who will develop a mechanical sniffer that will detect mold or aflatoxin or the chemical or odorous properties that they possess? Who will genetically develop a peanut seed that is resistant to aflatoxin but still is commercially acceptable to the consumer? All of these improvements are badly needed and, I feel, quite within the realm of accomplishments.

An immediate need is to increase peanut consumption. Do we assume that today's peanut has the best flavor it will ever produce? I suggest we might improve the flavor of the peanut, not only by the way we process it but also by learning more about its composition. We also need to extend the shelf life of peanut products so that the incredible desirability of a freshly roasted peanut may be maintained for a longer period of time in the finished product.

We are highly pleased with the nutritional value of the peanut, but are we satisfied? Can it be improved through genetic research, through more enlightened processing, through more knowledge of its properties? We need to better understand and utilize its value and find new ones to exploit.

The world is now in short supply of oil seeds and so the peanut is in great demand. But when oilseeds are in oversupply how will we market the peanut in competition with all the other oilseeds, most of which are considerably cheaper than the peanut? What does the peanut have that other oilseeds do not? Let's find out if it has inherently higher values, better proteins, for instance. We must discover and improve its advantages. But we must do it so that the peanut is economically competitive. Approximately one-third of our 1972 crop was surplus -- i.e., not needed for domestic use. Thus we must discover new uses for the peanut. Can't we discover how to adapt peanut butter to the taste of the Europeans, the Asians, the Scandanavians? If we give them a product they want and need, they will buy it. That is our market and we must go out and compete successfully for it. But we need your help.

Peanut skin slippage and splits. For too many years these problems have cost the grower, sheller and user of sound whole kernels a proverbial fortune. Artificial drying saves crops, but can still be improved. I realize that the technique and concept is right and that the human operator often abuses them. Could we then develop techniques that force safety upon the operator or allow him to operate more effectively when the harvest rush is upon him? Can we improve our knowledge of

those harvesting and curing practices which will provide better handling and protection of the peanut kernel? The results would be a finer product with less financial penalty to the major segments of the peanut industry.

Sampling and testing. I suspect we will forever require more accurate sampling and testing of raw peanuts and peanut products, so research efforts in these areas should and must continue. As the consumer's concern for higher quality grows and translates itself into governmental regulations, the accuracy and veracity of our sampling and testing must improve. This, of course, includes methodology, too. We need to eliminate the false positives in mycotoxin testing. We need to more accurately define and identify a rodent hair as opposed, for instance, to a strand of burlap from the peanut bag. In short, this area must retain a high priority rating in peanut industry research.

Peanut hulls. There has always been a need to find new uses for peanut hulls. Their lack of nutritive value has forever plagued them, but hopefully research can develop uses in non-food items. This need is particularly true today when the sheller is hard-pressed to obtain a fair return from a ton of peanuts, when his costs of disposing of hulls are increasing, and when the air pollution standards in his community usually prevent him from burning them at a reasonable cost. In this period when all industries are looking for lower cost materials, it seems opportune for us to find an economical use for peanut hulls.

You realize that the need for research is infinite. It could and will go on forever. But the finest work will be that which satisfies the highest needs, and does so accurately and economically.

A.P.R.E.A. can do much to accomplish this worthy goal. We in the commercial end of the business need you and your knowledge and your patience very badly. So bear with us, and let's keep the doors open for ideas and communications. And again, my thanks for inviting me here today.

EFFECT OF CURING AND STORAGE ENVIRONMENT ON SEED DORMANCY OF SEVERAL GENOTYPES OF VIRGINIA-TYPE PEANUTS, ARACHIS HYPOGAEA L.

by

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ABSTRACT

A wide range of seed dormancy was found among 28 genotypes of Virginia-type peanuts. These differences persisted regardless of whether the seeds were cured promptly (in 8 to 16 days) or in 6 to 7 wk in field stacks. However, dormancy of most genotypes was sharply reduced in stack-cured seed. Generally, genotypes with the least dormancy when promptly cured showed the greatest reduction when cured in stacks. Dormancy among promptly cured genotypes ranged from 3% to 100%. Storage of promptly cured seed for 28-30 days at 29.4 C broke dormancy of all but three genotypes. Seed dormancy of most genotypes decreased substantially during storage at 4.4 C. Of 28 genotypes tested, nineteen required special conditioning to break dormancy after 4 to 6 months storage at 4.4 C.

INTRODUCTION

We undertook these investigations to determine the levels of seed dormancy in genotypes of Virginia-type peanuts, Arachis hypogaea L. ss. hypogaea var. hypogaea, and the extent to which methods of curing and storage affected dormancy.

When peanut seeds intended for planting were cured in field stacks and stored at ambient temperature, growers had no major problems with seed dormancy. However, recent experience has shown that seeds of certain Virginia genotypes, cured promptly (over a period of 5 to 14 days) and then placed in cold storage, might retain appreciable levels of dormancy at planting time the following spring.

In 1937 Hull (1) published information indicating that the extent of dormancy in peanut seeds was temperature-dependent and that lower temperatures prolonged dormancy. Hull states that, as a result of his tests, "it has become a regular practice to store hybrid seed at 30 C for 30 days after harvest when quick germination is desired." Bailey et al. (2), in 1958, reported that the dormant period of Virginia Bunch 67 peanut seed was about 40 days when the seeds were held at 30 C, but that the period could be shortened to 15 days by holding the seed at 40-50 C for 15 days. Later research results indicated that holding freshly cured seeds at 40 C for 15 days did not always release all seeds of certain genotypes from dormancy. Little published information is available on the general level of dormancy that can be anticipated in the cured seed of present-day commercial varieties and promising advanced breeding lines and new accessions of Virginia-type peanuts.

MATERIALS AND METHODS

Seeds used in these studies were produced at the Tidewater Research and Continuing Education Center, Holland, Va. during 1969, 1970, and 1972, using cultural practices recommended for production of peanuts in Virginia. Plants were dug near optimum maturity with a mechanical digger-shaker. Pods for the prompt-curing treatment were handpicked from part of the plants of each genotype immediately after digging. The remainder of the plants, with pods attached, were placed in field stacks for curing. Handpicked pods were cured at Beltsville in thin layers on the floor of an attic, where the air temperature ranged from about 21 to 35 C. Curing time for the various lots of seeds under these conditions was from 8 to 16 days. Plants were cured in field stacks for 6-7 wk and were picked with a carding-type picker. Seeds for the dormancy studies were hand-shelled and graded, and sound mature seeds were used in all experiments.

Within a few days after completion of prompt curing, seeds of each genotype were planted to determine their initial dormancy. The remaining promptly cured seeds were stored for various time intervals at about 4.4 C, 21.1 C, 29.4 C, or at 29.4 C

after storage at 4.4 C. Seeds of stack-cured peanuts were planted to determine dormancy within a week or 10 days after picking.

Seeds were tested for dormancy in a greenhouse sandbed, where the air temperature ranged from 22-32 C. Seeds were planted 1.4 inches apart and 1 to 1.25 inches deep in moist, medium-fine sand, in rows 3 inches apart. Additional moisture was applied as needed. Dormancy counts were made 10 days after planting. A seed was considered to have germinated when the radicle had penetrated the seed coat. A sound seed that had not germinated was considered to be dormant. Sandbed plantings consisted of four replications of 25 or 50 seeds each, or eight replications of 25 seeds each for each genotype, curing, and storage environment combination.

Differences in treatments of interest in this study were so obvious that data were not analyzed statistically. Data for treatment replicates were highly consistent.

RESULTS AND DISCUSSION

A striking aspect of results from our study is the wide range of seed dormancy among the genotypes, whether cured promptly or in field stacks (Table 1).

TABLE 1.--Percent dormant seed of Virginia peanut genotypes grown at Holland, Va., subjected to different curing environments and planted in greenhouse sandbed at Beltsville, Md.

Genotype	Dormant seed					
	1969 crop		1970 crop		1972 crop	
	Promptly cured	Field stack	Promptly cured	Field stack	Promptly cured	Field stack
	%	%	%	%	%	%
NC Acc. 344 1/	100	96	96	99	99	98
Virginia Bunch 67	99	68	95	64	..	..
Georgia 119-20	99	34	93	20	..	..
Holland Station Runner	98	40	85	42	95	55
Dixie Runner	98	36	96	70	..	..
Virginia 61R	98	53	96	38	..	..
Virginia 56R	97	45	98	42	..	..
Virginia Bunch 46-2	97	57	98	32	..	..
NC 4X	91	43	99	32	..	..
NC 5	88	39	93	43	..	..
Early Runner	86	46	92	57	..	..
Southeastern Runner 56-15	85	59	90	49	..	..
Florunner	82	48	88	57	98	93
F 439-16-6 1/	74	39	82	46	94	85
Florigiant	61	7	68	28	57	38
F 393-6 1/	40	9	49	3	45	8
F 393-9 1/	26	1	55	8	32	7
Florispan	25	35	48	18	48	25
NC 2	11	5	49	1	44	9
NC 17	..	..	..	..	71	16
Altika	..	..	..	..	61	19
NC-Fla. 14	..	..	..	..	53	12
Shulamit	..	..	..	..	42	16
UF 714021 1/	..	..	..	..	18	3
UF 70115 1/	..	..	..	..	3	0

1/ Advanced breeding line.
Promptly cured seeds were planted in sandbed a few days after completion of curing. Stack-cured seeds were planted a week or 10 days after picking.

Most genotypes showed sharply reduced seed dormancy when cured in stacks. Generally, genotypes with the least dormancy when cured promptly showed the greatest reduction of dormancy when cured in stacks. After stack-curing, less than 10% seed dormancy was found in some genotypes including NC 2, Florigiant, F 393-6, F 393-9, UF 714021, and UF 70115. Seed-dormancy levels of less than 30% were recorded one or more years for Florigiant, Florispan, NC 2, NC 17, NC-Fla. 14, Altika, Shulamit, Georgia 119-20, F 393-6, F 393-9, UF 714021, and UF 70115 after stack-curing. Genotypes showing least reduction in seed dormancy after stack-curing included NC Acc. 344, Florunner, Virginia 72R, Virginia Bunch 67, Dixie Runner, and F 439-16-6. Dormancy in these genotypes ranged between 68 and 99%. Dormancy extremes for promptly cured seed ranged from 3% for UF 70115 and 11% for NC 2, to 100% for NC Acc. 344.

When promptly cured seed of 19 genotypes grown in 1969 were stored at 29.4C for 28 days, only NC Acc. 344 (17%), Early Runner (12%), and Florunner (10%) had any appreciable dormancy remaining (Table 2). With duplicate lots of seeds of 18 of

TABLE 2.--Percent dormant seed of promptly cured Virginia peanut genotypes grown at Holland, Va. in 1969, subjected to different storage environments and planted in a sandbed at Beltsville, Md.

Genotype	Dormant seed after						
	Completion of curing	28 days at 29.4C	56 days at 21.1C	90 days at 4.4C	90 days at 4.4C plus 28 days at 29.4C	150 days at 4.4C	150 days at 4.4C plus 28 days at 29.4C
	%	%	%	%	%	%	%
NC Acc. 344 1/	100	17	..	93	3	64	9
Virginia Bunch 67	99	3	6	64	4	50	2
Georgia 119-20	99	0	1	39	0	17	3
Holland Station Runner	98	0	1	52	0	29	0
Dixie Runner	98	0	2	54	1	54	0
Virginia 61R	98	0	0	58	2	41	1
Virginia 56R	97	1	1	62	1	33	2
Virginia Bunch 46-2	97	0	1	46	0	26	0
NC 4X	91	0	0	48	0	25	0
NC 5	88	0	8	25	1	16	0
Early Runner	86	12	22	49	17	47	16
Southeastern Runner 56-15	85	1	0	26	1	15	0
Florunner	82	10	19	38	10	36	22
F 439-16-6 1/	74	5	17	30	3	18	6
Florigiant	61	0	0	20	0	8	0
F 393-6 1/	40	0	2	6	0	1	2
F 393-9 1/	26	0	1	3	0	4	1
Florispan	25	0	0	10	0	2	1
NC 2	11	0	0	4	0	3	0

1/ Advanced breeding line

these genotypes stored at 21.1C for 56 days, only NC 5 (8%), Early Runner (22%), Florunner (19%), and F 439-16-6 (17%) showed dormancy higher than 6%. After storage for 90 days at 4.4C, promptly cured seeds of 12 of the 19 genotypes had dormancy levels of 30% or higher. When seeds were stored at 4.4C for 150 days, dormancy levels of only 7 genotypes were above 30%. After the 90-day storage at 4.4C plus 29.4C for 28 days, Early Runner (17%) and Florunner (10%) were the only two genotypes with appreciable dormancy.

In 1970, dormancy of promptly cured seeds of 22 genotypes ranged from 48% for Florispan to 99% for PI 277188. Storage at 29.4C for 30 days virtually eliminated dormancy of all but three of genotypes tested (Table 3). When stored at 21.1C for

TABLE 3.--Percent dormant seed of promptly cured Virginia peanut genotypes grown at Holland, Va. in 1970, subjected to different storage environments and planted in a greenhouse sandbed at Beltsville, Md.

Genotype	Dormant seed after					
	Completion of curing	30 days at 29.4C	60 days at 21.1C	178 days at 4.4C	178 days at 4.4C plus 28 days at 29.4C	290 days at 4.4C
	%	%	%	%	%	%
PI 277188	99	1	10	66	0	17
NC 4X	99	0	2	29	0	1
Virginia 56R	98	1	4	34	0	..
Virginia Bunch 46-2	98	0	2	29	0	..
PI 290650	97	..	..	62	2	13
Dixie Runner	96	1	25	73	0	19
Virginia 61R	96	1	2	29	0	..
NC Acc. 344 1/	96	0	12	90	0	44
Virginia Bunch 67	95	1	8	45	0	6
Georgia 119-20	93	..	..	19	0	..
NC 5	93	1	5	19	0	5
Early Runner	92	15	26	42	10	18
Southeastern Runner 56-15	90	0	2	24	0	11
Florunner	88	12	24	35	10	14
Holland Station Runner	85	..	..	52	0	9
F 439-16-6 1/	82	9	20	26	1	4
Florigiant	68	..	..	13	0	..
NC 17	63	1	3	7	0	..
F 393-9 1/	55	0	0	1	0	..
NC 2	49	0	3	2	0	0
F 393-6 1/	49	0	1	0	0	0
Florispan	48	..	..	2	0	0

1/ Advanced breeding line

60 days, no appreciable dormancy remained in seeds of more than one-half of the genotypes tested. However, about one-fourth of the seeds of Early Runner, Dixie Runner, Florunner, and F 439-16-6 remained dormant. Dormancy of the 22 genotypes stored at 4.4C for 178 days, ranged from 0 for F 393-6 to 90% for NC Acc. 344. When seeds of the 22 genotypes were stored for 178 days at 4.4C and then transferred to 29.4C for 28 days, the only appreciable dormancy that remained was 10% for Early Runner and Florunner. After storage of 15 of these 22 genotypes at 4.4C for 290 days, 6 genotypes showed dormancy of 0 to 5%, with dormancy ranging up to 44% for NC Acc. 344.

In 1972, promptly cured seeds of 16 genotypes showed dormancy ranging from 3% for UF 70115 to 99% for NC Acc. 344 (Table 4). After storage at 4.4C for 120 days, little dormancy (0-5%) was found for NC 2, Shulamit, UF 714021, UF 70115, F 393-6, Florispan, NC-Fla. 14, Florigiant, F 393-9, and NC 17. Dormancy in the other 6 genotypes ranged from 15% for Virginia 72R to 33% for NC Acc. 344.

Storage of promptly cured 1969 seeds at 4.4C for as short a period as 90 days resulted in a substantial reduction in dormancy for all genotypes except NC Acc. 344, which required up to 150 days for an appreciable reduction. With 1970 seed of NC Acc. 344 at 4.4C, no appreciable reduction in dormancy had occurred after nearly 6 months. With 1972 seeds of NC Acc. 344 at 4.4C, a substantial reduction in dormancy was evident after only 120 days (Tables 2, 3, and 4).

Although cold storage substantially reduced dormancy, only four genotypes posed no dormancy problem after 5 months at 4.4C for the 1969 crop or 6 months for the 1970

TABLE 4.--Percent dormant seed of promptly cured Virginia peanut genotypes grown at Holland, Va. in 1972, stored at 4.4C for 120 days and planted in greenhouse sandbed at Beltsville, Md.

Genotype	Dormant seed after	
	Completion of curing	120 days at 4.4 C
	%	%
NC Acc. 344 1/	99	33
Florunner	98	30
Virginia 72R	95	15
Holland Station Runner	95	17
F 439-16-6 1/	94	17
NC 17	71	5
Altika	66	19
Florigiant	57	3
NC-Fla. 14	53	2
Florispan	48	1
F 393-6 1/	45	1
NC 2	44	0
Shulamit	42	0
F 393-9 1/	32	3
UF 714021 1/	18	0
UF 70115 1/	3	0

1/ Advanced breeding line

crop. These were NC 2, Florispan, F 393-6, and F 393-9 (Table 3). The following additional genotypes of the 1972 crop posed no dormancy problem after 4 months at 4.4C: NC 17, Florigiant, NC-Fla. 14, Shulamit, UF 70115, and UF 714021 (Table 4).

All of the other 18 genotypes included in the study retained sufficient dormancy to cause a potentially serious stand problem for growers after storage at 4.4C for 4 months for the 1972 crop, 5 months for the 1969 crop, and 6 months for the 1970 crop. Included among the genotypes with a dormancy problem after 4-6 months storage at 4.4C are the commercial varieties Florunner, Early Runner, Virginia Bunch 67, Holland Station Runner, Virginia 56R, Virginia 61R, Virginia 72R, Virginia Bunch 46-2, NC 4X, NC 5, Southeastern Runner 56-15, Georgia 119-20, and Altika, with Florigiant marginal in certain seasons.

Our data indicate considerable year-to-year variation in dormancy of cured seeds of the various genotypes, and in the ability of the genotypes to retain dormancy under different storage environments. We consider this evidence that the production environment can influence cured-seed dormancy of Virginia-type peanuts. Spanish peanuts appear to be even more responsive than Virginias to production-environment influence on dormancy of cured seeds (3).

Storage of seed peanuts at low temperature helps to insure maximum retention of germination potential and seed vitality. Consequently, leaving seeds in cold storage until a few days before planting can help insure a favorable stand of vigorous plants. Results of our study indicate that with all but a few of our commercial varieties of Virginia-type peanuts, a practical procedure is needed for breaking seed dormancy if seeds are promptly cured and are retained in cold storage until shortly before planting. We have investigated a procedure that appears promising for such a purpose (4).

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SEARCH FOR A PRACTICAL PROCEDURE FOR BREAKING DORMANCY OF PEANUT SEEDS, ARACHIS HYPOGAEA L.

by

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ABSTRACT

Ethephon (2-chloroethylphosphonic acid), used as a water solution or as a slurry in conjunction with thiram [bis(dimethylthiocarbamoyl)disulfide] dust as a preplanting seed treatment, shows promise as a practical procedure for breaking dormancy of peanut seeds. The chemical was applied with full effectiveness either immediately before or as long as 60 days before planting. Ethephon appeared to have no detectable adverse or beneficial effect on early growth of seedlings, pod yield, or market grade of the crop produced.

INTRODUCTION

This paper reports results of our efforts to find a practical procedure for breaking the dormancy of peanut seeds.

In 1937 Hull (1) published information indicating that the extent of dormancy in peanut seeds was temperature-dependent and that lower temperature prolonged dormancy. Hull states that, as a result of his tests, "it has become a regular practice to store hybrid seed at 30C for 30 days after harvest when quick germination is desired." Bailey et al. (2), in 1958, reported that the dormant period of Virginia Bunch 67 peanut seeds held at 30C was about 40 days, but the dormant period could be shortened to 15 days by holding the seeds at 40-50C for 15 days. Later research results (unpublished) indicated that holding freshly cured seeds at 40C for 15 days did not always release all seed of certain genotypes from dormancy. In addition, the above heat treatment appears to be a drastic one for seed peanuts, and it is not easy to apply to large quantities of seed.

In 1964, V. K. Toole et al. (3) reported that exposing freshly cured seeds to ethylene during imbibition was highly effective in releasing Virginia Bunch 67 peanuts from dormancy. Release from dormancy was effected by the use of ethylene gas (100 ppm in air) or by sealing the imbibing seeds in a container with firm ripe apples, which are known to produce ethylene gas during ripening (3).

In 1969, Ketring and Morgan (4) showed that as little as 3.5ppm of exogenous ethylene was sufficient to induce imbibed dormant seeds of NC 13 (NC Acc. 344) to germinate. Later Ketring and Morgan (5, 6) reported that the dormancy of cured NC 13 peanut seeds could be broken by soaking them for 16 hr in ethephon (2-chloroethylphosphonic acid) at $1X10^{-3}$M concentration.

MATERIALS AND METHODS

Seeds from the 1970 crop at Tifton, Ga., Holland, Va., and Beltsville, Md. and from the 1971 and 1972 crops at Holland, Va. were used in this study. Varieties tested were NC Acc. 344 (NC 13), Florunner, Virginia Bunch 67, and Early Runner, which are known to be genotypes with high proportions of dormant seeds.

Georgia-grown Florunners from the 1970 crop were partly cured in a windrow and then

combined. Curing was completed in a commercial crop drier, all during a 10-day period. All other lots of pods were handpicked from the plants and cured to a seed moisture of about 6-7% in thin layers on the floor of an attic at Beltsville, where air at temperatures ranging from 21 to 35C was circulating rapidly. All seeds used in the study were carefully handshelled and graded, and only sound, mature seeds were included in the tests.

Seeds were tested for dormancy in a greenhouse sandbed. Seeds were spaced 1.4 inches apart and 1.0-1.25 inches deep in moist medium-fine sand, with rows 3 inches apart. Greenhouse air temperature ranged from 22 to 32C. Dormancy counts were made after 7 to 10 days. A seed was considered to have germinated when the radicle had penetrated the seedcoat. Sound seeds without emerged radicles were counted as dormant.

Certain lots of seeds were allowed to imbibe for 2 to 16 hr by placing them between layers of paper toweling moistened with water or a glycol carrier-base formulation of ethephon (2-chloroethylphosphonic acid) in water at concentrations of $1X10^{-3}M$ or $1X10^{-2}M$, with pH adjusted to 6.0 by addition of 0.1N NaOH. Some seeds were planted in the sandbed immediately after imbibition; others were redried for 48 hr at 21C and then planted. For some tests, one half of a seed lot was treated with thiram [bis(dimethylthiocarbamoyl)disulfide] dust before planting, and the other half was untreated. In other tests, ethephon at $1X10^{-2}M$ concentration was sprayed directly onto the seeds with an atomizer, and they were planted immediately. Tests in 1971 and 1972 involved treatments with ethephon at $1X10^{-3}M$ concentration applied to the seeds as a slurry in conjunction with thiram. Some lots were planted immediately after treatment; others were redried and stored at 4.4C for as long as 2 months before planting.

Appropriate untreated, water, thiram-dust, or thiram-slurry checks were used in all tests. Each variety treatment was replicated 4 to 8 times, with 25 seeds per replicate.

To determine if ethephon applied to peanut seeds might influence subsequent plant development, nondormant seeds of uniform weights of NC Acc. 344, Tifspan, and Florunner were treated with ethephon-thiram slurry and planted along with untreated checks in a randomized-block arrangement in soil in a greenhouse bench or in 4-in pots. The oven-dry weight of the above-ground portion of the plants (top growth) was determined after 3 to 7 weeks of growth.

In 1972, nondormant ethephon-treated and untreated seeds of uniform weights of Tifspan, Florigiant, and Florunner were planted in alternate hills (1 ft apart for Tifspan and 2 ft apart for the Virginia-type varieties) in rows 3 ft apart in the [illegible]land, Va. At harvest, contiguous plants of each treatment in each variety were grouped into replicates of 5 plants each. Pods were picked and dried, and yields and market grade were recorded.

Differences in treatments of interest in this study were so obvious that data were not analyzed statistically. Data for treatment replicates were highly consistent. Differences in seedling development, pod yield, and market grade attributable to ethephon were negligible.

The ethephon used was obtained from Amchem Products, Inc., Ambler, Pennsylvania[1/]. Formulation Amchem 68-62, used in 1970 and 1971, was unrefined technical ethephon, which contained ethephon in several different but chemically related forms. Formulation 68-240, used in 1972, was refined technical ethephon, which contained only 2-chloroethylphosphonic acid as the ethylene-producing ingredient.

RESULTS AND DISCUSSION

In a preliminary experiment in 1970, Florunner seeds imbibed ethephon for 2, 4, 8, and 16 hr at concentrations of $1X10^{-3}M$ and $1X10^{-2}M$. An average of 10% of the seeds

1/ Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U. S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

remained dormant with ethephon at $1X10^{-3}M$, and only 4% at $1X10^{-2}M$. These seeds were planted immediately after imbibition (Table 1). Results were about the same

TABLE 1.--Percent dormant seeds in 1970-crop Florunner peanuts subjected to different ethephon treatments and planted in greenhouse sandbed at Beltsville, Md.

Ethephon treatments	Dormant seed when			
	Planted immediately after treatment		Redried 48 hr and then planted	
	Treated with thiram dust	Untreated	Treated with thiram dust	Untreated
	%	%	%	%
Untreated	26	41	14	26
Ethephon $1X10^{-3}M$				
2 hr	15	16	9	9
4 hr	9	6	14	6
8 hr	9	8	10	6
16 hr	7	8	5	3
Ethephon $1X10^{-2}M$				
2 hr	3	5	5	5
4 hr	10	2	4	3
8 hr	2	2	3	1
16 hr	3	5	6	6

when seeds were redried at 21C for 48 hr after imbibition and then planted. Differences in dormancy associated with imbibition time were slight.

In a later test, when Florunner seeds imbibed ethephon 4 and 8 hr at $1X10^{-2}M$, and were planted immediately, only 1% were dormant, in contrast to 82% dormant for the untreated control (Table 2). In a later similar planting with this same lot of

TABLE 2.--Percent dormant seeds in promptly cured 1970-crop Florunner peanuts when subjected to different treatments and planted in greenhouse sandbed at Beltsville, Md.

Ethephon[1/] treatments	Treated with thiram dust	Untreated
	%	%
Planting 1		
Untreated	75	88
Ethephon 4 hr	0	5
Ethephon 8 hr	0	0
Planting 2		
Untreated	37	66
Ethephon 4 hr	0	0
Ethephon 8 hr	0	1

1/ Ethephon at $1X10^{-2}M$ concentration.

Florunner seeds, less than 1% of ethephon-treated seeds were dormant, but 52% of the untreated control were dormant (Table 2).

In a later test involving 7 lots of seeds (2 each of Florunner, Virginia Bunch 67, and Early Runner, and one lot of NC Acc. 344) 7-hr imbibition of ethephon at $1X10^{-2}M$ was as effective as in the two tests above, with only 3 ethephon-treated

seeds that remained dormant among the 1,400 seeds tested, in contrast to 75 to 98% dormancy for the untreated controls (Table 3).

TABLE 3.--Percent dormant seeds in promptly cured 1970-crop peanuts allowed to imbibe ethephon at $1X10^{-2}M$ and planted in greenhouse sandbed at Beltsville, Md.

Genotypes and treatments	Dormant seeds when grown at	
	Holland, Va.	Beltsville, Md.
	%	%
Florunner		
Untreated	75	93
Ethephon 7 hr	0	0
Early Runner		
Untreated	88	86
Ethephon 7 hr	0	0
Virginia Bunch 67		
Untreated	91	86
Ethephon 7 hr	0	0
NC Acc. 344		
Untreated	98	..
Ethephon 7 hr	0.5	..

In tests with Florunner seeds grown in Georgia and Virginia, which were sprayed directly with ethephon at $1X10^{-2}M$ and planted immediately, an average of 4% of Georgia-grown seeds remained dormant, while untreated controls showed 55% dormancy. With Virginia-grown seeds showing 75% dormancy, 6% remained dormant after treatment.

In these 1970 tests, treating seeds with water tended to reduce dormancy, as did treatment with thiram dust. However, both water and thiram fell far short of being fully effective in breaking seed dormancy. Furthermore, thiram used in conjunction with ethephon failed to potentiate ethephon alone under the conditions of our experiments.

When 1971 Virginia-grown Early Runner seeds that showed 78% seed dormancy were treated with ethephon spray at $1X10^{-3}M$ and planted immediately, only 1 seed of 175 was dormant. Similarly, when 1971 Virginia-grown Florunner seeds that showed 73% dormancy were treated with ethephon at $1X10^{-3}M$ and planted immediately, or 30 min. 4 hr, and 24 hr after treatment, all 700 seeds germinated.

Under the conditions of our tests, allowing seeds to imbibe an ethephon solution or applying the solution directly onto the seeds immediately before planting in a sandbed was highly effective in breaking seed dormancy. However, neither of these procedures is practical for extensive use. Inasmuch as a seed protectant is considered essential to insure an adequate stand of plants when machine-shelled peanut seeds are planted, we explored the effectiveness of an ethephon-thiram slurry for breeking seed dormancy. Ethephon solution at $1X10^{-3}M$ was applied with an atomizer to seeds that had been treated with thiram dust at a rate of about 8 ounces per 100 pounds of seeds. Agitation produced a slurry that completely coated each seed.

With 1971 Virginia-grown NC Acc. 344 seeds, which showed dormancy ranging from 96 to 98% when treated with thiram dust, only 2 seeds of 600 treated with ethephon-thiram slurry remained dormant when seeds were planted immediately after treatment or were planted 1, 2, 4, or 8 weeks after treatment.

Results with promptly cured seeds of the 1972 crop of Virginia-grown Florunner and NC Acc. 344 were somewhat at variance from those of the 1971 NC Acc. 344 seeds (Table 4). Seed treated with ethephon-thiram slurry showed from 4 to 16% dormancy

TABLE 4.--Percent dormant seeds in promptly cured 1972-crop Florunner and NC Acc. 344 peanuts when subjected to different treatments and planted in greenhouse sandbed at Beltsville, Md.

Treatments	Plantings							
	First		Second 1/		Third 1/		Fourth 1/	
	NC 344	Flor.	NC 344	Flor.	NC 344	Flor.	NC 344	Flor.
	%	%	%	%	%	%	%	%
Untreated	94	90	90	90	79	79	80	81
Thiram-H_2O slurry	93	71	93	82	89	69	87	52
Ethephon-thiram slurry, fresh 2,3/	14	6	7	7	9	4	1	2
Ethephon-thiram slurry, 30 min	9	4	..	..	..	..	..	..
Ethephon-thiram slurry, 24 hr	26	13	..	..	..	..	..	..
Ethephon-thiram slurry, 15 days	..	..	16	16	..	..	..	..
Ethephon-thiram slurry, 30 days	..	..	..	..	13	7	..	..
Ethephon-thiram slurry, 60 days.	..	..	..	..	..	..	8	13

1/ Seed used in these plantings were stored in sealed fiber drums at 4.4C until planting time, with ethephon-treated seeds and seeds not so treated in separate drums.

2/ Ethephon at $1X10^{-3}$M concentration.

3/ Seeds were planted immediately after treatment.

for Florunner and from 7 to 26% for NC Acc. 344 when planted immediately after treatment or 30 min, 24 hr, 15 da, 30, or 60 da later. When the promptly cured seeds were stored at 4.4C for 60 days before treatment with the slurry and were planted immediately after treatment, results were comparable to those with NC Acc. 344 seeds from 1971. NC Acc. 344 had only 1% and Florunner 2% dormant seeds.

Excellent release from dormancy resulted from use of the ethephon-thiram slurry on other lots of promptly cured NC Acc. 344 and Florunner seeds that were stored at 4.4C for 90 days before treatment (Table 5). Only 1 to 3% of NC Acc. 344 and Florunner seeds were dormant when planted immediately after the slurry treatment or when planted 24 hr and 39 days later.

The failure of ethephon to release all, or essentially all, of promptly cured 1972 seeds from dormancy was puzzling, because two years of nearly perfect results had been obtained from use of this ethylene-producing chemical. Reports of a similar failure fully to release promptly cured seed of NC Acc. 344 and Florunner from dormancy came through personal communication with K. M. Rogers, Agricultural Research Service agronomist at Auburn, Alabama.

Inquiry revealed that the ethephon formulation used on 1970 and 1971 seed, Amchem 68-62, differed chemically from that used on the 1972 seed, which was Amchem 68-240. Formulation Amchem 68-62 was unrefined technical ethephon, which contained ethephon in several different but chemically related forms, all of which were active in releasing ethylene in biological systems. Formulation 68-240 was refined technical ethephon, which contained only 2-chloroethylphosphonic acid as the ethylene-producing ingredient. Apparently the purer acid was not as effective as

TABLE 5.--Percent dormant seeds in promptly cured 1972-crop Florunner and NC Acc. 344 peanuts that were stored at 4.4C for 90 days, then subjected to different treatments and planted in greenhouse sandbed at Beltsville, Md.

Treatment	First planting 2/23/73		Second planting 4/3/73 1/	
	NC 344	Flor.	NC 344	Flor.
	%	%	%	%
Untreated	51	35	40	41
Thiram-H_2O slurry	45	21	41	25
Ethephon-thiram slurry, fresh 2,3/	2	1	1	1
Ethephon-thiram slurry, 24 hr	3	1	..	..
Ethephon-thiram slurry, 39 days	..	..	1	3

1/ Seed for this planting were stored in sealed fiber drums at 4.4C until planting time, with treated seed and those not so treated in separate drums.
2/ Ethephon at $1X10^{-3}$M concentration.
3/ Seeds were planted immediately after treatment.

the mixture of ethylene-releasing substances.

When nondormant seeds of NC Acc. 344 were planted in soil in a greenhouse bench, and seedlings were harvested 23 days later, ethephon-thiram slurry seed treatment had no adverse affect on seedling development as measured by dry weight of top portions of the plants. Similar results were obtained when nondormant seeds of Florunner and Tifspan were grown in soil in 4-in clay pots in the greenhouse and harvested 45 days from planting. When plants of Tifspan, Florunner, and Florigiant were grown in uniformly spaced hills in the field at Holland, Va., ethephon-thiram slurry treatment of the seeds had no significant effect on pod yield or on market grade of the crop produced.

Under the conditions of our tests, ethephon-thiram slurry treatment of seeds from representative varieties of our three principal market types of peanuts (Spanish, runner, and Virginia) had no discernible detrimental or beneficial effect on early seedling development or on yield and market grade of the crop. Ethephon used on NC Acc. 344 seeds in the seedling-development study and on seeds planted in the field for yield and market grade data was Amchem formulation 68-62. Ethephon used on seeds of Tifspan and Florunner in the seedling development study was Amchem 68-240.

Our results with Amchem 68-62 suggest that this material used as a slurry in conjunction with thiram (or perhaps other fungicides) might be the answer to our long search for a practical procedure for breaking peanut seed dormancy, both in research and on a commercial basis. Additional research will be needed to determine whether the form of ethephon now commercially available will be equally as effective for such a purpose.

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EARLINESS OF FLOWER OPENING AND POTENTIAL FOR POD DEVELOPMENT IN PEANUTS, ARACHIS HYPOGAEA L.

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ABSTRACT

A high proportion of the first 25 flowers to open on plants of diverse peanut genotypes developed into mature pods. As flowering progressed on plants of four genotypes representing a wide range of maturity, the potential for a flower to give rise to a mature pod decreased. Copious flower production by peanuts over a period of 6 to 8 or 10 weeks provides a continuing opportunity for the development of additional pods anytime during the flowering period that the plants are capable of supporting such development.

INTRODUCTION

The peanut, Arachis hypogaea L., has an indeterminate habit of flowering and fruiting. One striking characteristic of plants with such a growth habit is the production of many more flowers than the plants can support in the production of fruits and seeds. The peanut is no exception. A number of authors have noted that only a small proportion of peanut flowers give rise to mature pods (1, 2, 3, 4, 5, 6). Many investigators lament the low reproductive efficiency of the peanut and urge that something be done to remedy the situation so that full advantage may be taken of the copious flower production of the plants.

Few of the flowers that open late produce mature fruits on plants that are indeterminate in flowering and fruiting, unless something in the production environment prevents the early flowers from functioning. We undertook this research to determine the relationship between early flowering and pod development in peanuts.

MATERIALS AND METHODS

Plants for this study were grown in the field and in compost soil in benches and in ½-bu or 1-bu wood-veneer baskets in the greenhouse at Beltsville, Md. Each planting consisted of genotypes representing the full range of maturity available in United States peanut varieties. Within each planting, individual plants or small numbers of plants of each genotype were arranged in a random manner within replications to let each fully sample the production environment. The number of plants of each genotype in the plantings ranged from 4 to 32 in the greenhouse, and 48 in the field. Plants were spaced 30 inches apart in 3-ft rows in the field. Spanish and Virginia-type plants were spaced 12 and 16 inches apart, respectively, on the greenhouse benches. A single plant was grown in each basket. Spanish and erect-growing Virginias were grown in ½-bu baskets, and the runners were grown in 1-bu baskets. Two seeds were planted per hill or basket. After seedling emergence, the plants were thinned to one per hill or basket. Air temperature in the greenhouse ranged from about 22C to 32C.

Daily flowering records were made for individual plants in all plantings. In all plantings except the first, after a given number of flowers had opened on each plant, flowers that opened subsequently for 30-60 days were removed each day before 9:00 am by detaching the calyx tube (hypanthium) near its base. This operation left the ovary intact. For convenience, the detachment of the calyx tube near its base is referred to as deflowering or flower removal.

Plants were dug individually 50 to 75 days after opening of last flower before the beginning of flower removal. After being washed and dried, the pods were opened, and records were made of the number of mature pods on each plant. A pod was considered mature if one or more seeds therein was well developed and appeared free of seedcoat wrinkles, and the interior of the shell was dark or brown-splotched.

In the first planting, daily flower records were made for each plant, but no flowers were detached. Plants were dug 52 to 75 days after the days on which the 25th flower opened, and records were made of the number of mature and almost-mature pods on each plant.

In a later test with 30 plants of each of 4 genotypes, representing a wide range in maturity and planted early in July in baskets in the greenhouse, flower production on individual plants of the 2 earlier-maturing lines was limited to the first 15, 25, or 35 flowers that opened; and on the 2 later-maturing lines the first 15, 25, 35, or 50 flowers. All flowers above the predetermined numbers were removed.

In this work we assumed that peg elongation began soon after the flowers opened. The temperature was favorable continuously for plant development, and the plants were maintained free of obvious moisture stress. The use of evaporative cooling to reduce temperature in the greenhouse during the late spring, summer, and early fall helped to maintain relative humidity at a favorable level during daylight hours.

RESULTS AND DISCUSSION

In a preliminary experiment, plants of 12 genotypes, grown in greenhouse benches, produced an average of 24.5 mature pods each when dug 52 to 75 days after the day on which the 25th flower opened on each plant (Table 1). Results of a later

TABLE 1.--Mature pods produced from 25 flowers on genotypes of peanuts planted in greenhouse, Beltsville, Md. June, 1972

Genotype	Days from 25th flower to harvest	Mature pods 1/	Range
	No.	No.	No.
Chico (PI 268661)	52	32	27-39
Tifspan	55	24	22-26
Tennessee Red	55	21	18-23
Spancross	55	24	19-29
Goldin 1	65	25	24-25
Florigiant	65	23	17-25
Florunner	65	28	18-42
Florispan	65	25	23-26
Virginia 61R	65	2/ 31	27-37
NC 4	65	26	23-30
NC 4X	65	2/ 19	10-25
Southeastern Runner 56-15	75	16	9-20

1/ Average 4 plants.

2/ 3 plants only.

planting, reported elsewhere (7), suggest that all genotypes except Chico and Southeastern Runner 56-15 require about 5 days more time from flowering to mature seeds than was provided in the first planting. Compensation for this deficiency was provided by including in the mature-pod category those pods classified as almost-mature. On the basis of our experience, such pods would have been considered mature 5 days later.

Results of this preliminary test, in which no flowers were removed from the plants, indicate strongly that a very high proportion of the first 25 flowers on all but

a very few plants of these 12 genotypes developed mature pods. The presence of more than 25 mature pods on certain plants probably resulted from additional flowers that opened on these plants on the day the 25th flower opened, or from flowers that opened the day or two after the 25th flower appeared. An average of 5.5 flowers opened on the day the 25th flower opened on each plant.

In the July planting, where only 4 genotypes were involved, the first 15 flowers that opened produced an average of 88% mature pods (Table 2); the first 25 flowers

TABLE 2.--Mature pods produced from various numbers of flowers on four peanut genotypes planted in greenhouse, Beltsville, Md. July, 1972, with 22 to 29 plants per genotype.

Genotype	Number of flowers per plant							
	15		25		35		50	
	Pods	Range	Pods	Range	Pods	Range	Pods	Range
	No.	No.	No.	No.	No.	No.	No.	No.
Chico (PI 268661)	12	9-15	17	13-21	20	15-25	..	..
Tifspan	12	9-15	16	7-28	21	17-28	..	..
Florunner	15	14-17	21	10-27	24	19-32	26	21-34
Southeastern Runner 56-15	14	10-16	20	14-27	22	11-30	23	17-27

that opened produced an average of 74% mature pods; the first 35 flowers produced an average of 62% mature pods; and the two later-maturing genotypes produced 49% mature pods from the first 50 flowers. Although an average of 88% of the first 15 flowers to open produced mature pods, only 53% of the next 10 flowers that opened, 33% of the next 10, and 10% of the next 15 produced mature pods (Fig. 1).

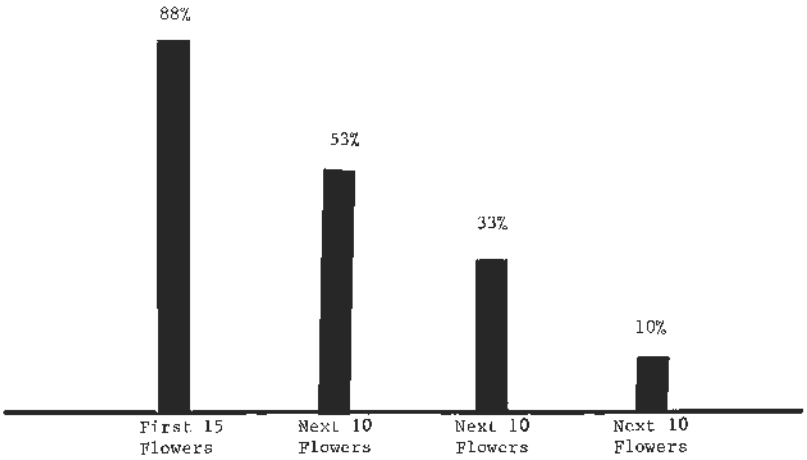

Fig. 1. Proportion of flowers on four peanut genotypes that developed mature pods

Thus, as flowering progressed, the likelihood that a flower would give rise to a mature fruit decreased.

The occasional excess of mature pods over the number of flowers left on the plants probably resulted from our failure to remove certain flowers with short calyx tubes before the pollen tubes resulting from self-pollination had passed the point of detachment. Such flowers probably opened just a few days (1-3) after deflowering on a given plant began. Otherwise fruits would not have matured by digging time. In this test, plants of Chico were dug 50 days from beginning of deflowering,

Tifspan at 55 days, and Florunner and Southeastern Runner at 65 days. When a later test (7) showed that 5-10 days more time was needed for all genotypes except Chico to mature, pods judged almost-mature were added to the matures.

With such striking evidence that the first flowers to open on a peanut plant have potential for developing into mature pods, we calculated the number of mature pods with two seeds each of 11 genotypes that would be required for a yield of 2,000 lb per acre at a given plant population (Table 3). The number of pods ranged from an

TABLE 3.--Mature peanut pods per plant required for a yield of 2,000 pounds per acre

Variety	Av wt/pod	Plant population/A	Pods per plant to give 2,000 lb/A
	gm	No.	No.
Chico (PI268661)	0.8	72,600	16
Tifspan	1.0	54,450	17
Florunner	1.5	29,040	21
Southeastern Runner 56-15	1.35	29,040	23
Florigiant	2.5	20,040	12.5
Virginia 72R	"	"	"
NC 17	2.5	34,800	10
Shulamit	"	"	"
Virginia Bunch 67	1.5	34,800	17
Goldin 1	"	"	"
Florispan	"	"	"

average of only 10 per plant for large-seeded Virginia bunch varieties such as NC 17 and Shulamit with 34,800 plant per acre, to 21 and 23 per plant for varieties such as Florunner and Southeastern Runner 56-15 with 29,040 plants per acre. The other varieties were intermediate.

In a subsequent planting in baskets in the greenhouse, we had planned to begin deflowering the large-seeded Virginias after appearance of the 15th flower, and other genotypes after the 20th flower. However, because of time limitations, deflowering began after the 12th flower for UF 70115, the 13th for Shulamit and Florispan, the 14th for Virginia 72R and Southeastern Runner 56-15, and the 18th for Florunner and Goldin 1. The other genotypes were deflowered on schedule. More than 84% of the flowers left on the plants in this test produced mature pods (Table 4). An average of 92% of the flowers on genotypes with an erect or decumbent habit of growth produced mature pods, in contrast to only 64% for the runner genotypes. For plants of the runner genotypes growing in the 1-bu baskets, space was inadequate to achieve normal development. The other genotypes, which grew in ½-bu baskets, were not as restricted in their development. Perhaps this observation accounts for the difference in their respective performance in our test.

To determine whether or not our experience with peanuts in the greenhouse might have relevance in the field, we planted 48 hills each of Chico, Tifspan, Florunner, and Southeastern Runner 56-15 in the field. We removed flowers from individual plants after the appearance of the 25th or 50th flower. Chico plants were dug individually 55 days after deflowering began, Tifspan at 65 days, and Florunner at 75 days. Southeastern Runner 56-15 plants were not dug, because they were still immature when the test was terminated. This time the pods required 5 days longer to develop than the greenhouse tests had indicated would be necessary (7). The extra time was given to compensate for the cool night temperatures that prevailed in the field late in the growing season. Night air temperatures in the greenhouse were rarely lower than about 22C.

Results of this test confirmed results of greenhouse tests, which indicated a high potential of early-opening flowers for pod production (Table 5). Substantially more pods were found on plants of all three genotypes than flowers that had been left on the plant, especially when plants were restricted to 25 flowers each. A similar situation existed for certain, but not all, plants with 50 flowers each.

TABLE 4.--Mature pods produced from various numbers of flowers on greenhouse-grown peanut genotypes planted February, 1973, Beltsville, Md.

Genotype	Flowers 2/ per plant	Mature pods per plant	Range in pods per plant
	No.	No.	No.
Chico (PI 268661)	20	21	13-25
Tifspan	20	19	13-28
AU-3 1/	20	19	7-24
TP-716-2-1 1/	20	19	15-22
Goldin 1	18	15	12-19
Florispan	13	12	7-20
Shulamit	13	11	8-16
Florigiant	15	9	6-12
Florunner	18	11	9-14
NC-Fla. 14	15	10	8-15
UF 70115 1/	12	13	7-15
Virginia 72R	14	10	7-13
Southeastern Runner 56-15	14	9	6-14

1/ Advanced breeding line.
2/ 9 to 11 plants per genotype.

TABLE 5.--Mature pods produced from 25 and 50 flowers per plant on three peanut genotypes grown in field at Beltsville, Md. 1972

Genotype	Number of flowers per plant			
	25		50	
	Pods	Range	Pods	Range
	No.	No.	No.	No.
Chico (PI 268661)	43	25-62	54	43-73
Tifspan	56	14-79	50	25-73
Florunner	31	16-38	53	1/

1/ One plant only.

The calyx tubes of flowers on plants in the field were considerably shorter than those on plants in the greenhouse. Apparently, pollen tubes of some of the flowers that opened during the first few days (1-3) of deflowering must have been below the point of detachment of the calyx tubes. Despite this situation, these results suggest that a high proportion of the first 25 flowers that open on peanut plants growing under favorable conditions in the field can be expected to produce pods.

We suggest that in future research of this sort, in either the field or greenhouse, detachment of flowers be no later than about 7:00 am. This procedure should help avoid possible pod development from flowers with short calyx tubes.

Peanut plants are small when flowering begins and presumably can support the development of only a limited number of pods. As plant size increases, plants are able to support the development of additional pods. Shibuya (5) reported a steady increase in the number of matured fruit on plants of the Java Shoryu No. 3 variety, beginning with the 11th week after sowing (4.6 av) and continuing to the 17th wk (51.2 av).

Under field conditions in the United States, peanut plants flower over a period of six to eight or ten weeks. Consequently, any time after flowering begins that the plant can support the development of additional pods, the flowers to provide the additional fruit are on hand, over a period of 6 to 8 wk or more. From this standpoint, the peanut can be considered to have a highly flexible, efficient reproductive system. Perhaps we should concentrate on the development of peanut varieties with sufficient plant metabolism to support increasingly heavier fruit loads and

disregard flowers that are nonfunctional in fruit production.

Shear and Miller (8) showed that the peanut plant quickly restores the number of fruits it will bear when fruits are artificially removed. In commenting on the surplus of flowers on peanut plants, Gregory et al. (9) state: "Thus it appears that the over-production of flowers is related to a survival mechanism coming down from pre-cultivation times and does not necessarily represent the stupendous opportunity for production — commonly implied in some discussions of this subject. It is more likely that it is evolutionally related to frequent depredations of wild pigs and climatic disasters, possible in the long season of growth in the tropics."

This evolutionary survival mechanism in cultivated peanuts serves a useful purpose today, because it insures that flowers are available over a long period of time to enhance the fruit load any time the plant is capable of sustaining the development of additional fruit. This unique mechanism enables peanuts to produce bountiful yields under seasonal conditions that tend to curtail yield of crops with determinate habits of flowering. Thus the heavy production of flowers by peanut plants over a long period of time is a boon to production, rather than evidence of an inefficient reproductive system.

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COMPONENTS OF EARLINESS OF MATURITY IN PEANUTS, *ARACHIS HYPOGAEA* L.

by

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ABSTRACT

We identified four characteristics of very early-, early-, medium-, and late-maturity classes of peanuts, *Arachis hypogaea* L., that contribute to difference among them in time from planting to optimum maturity. These are average number of days (a) from planting to opening of the first flower on each plant; (b) from opening of the first flower to opening of a given number of flowers from 15 to 30 per plant; (c) from opening of a flower to maturation of seeds in the pod that develops from that flower; and (d) from maturation of seeds in a pod to major deterioration of strength of the peg by which the pod is attached to the plant. Our data enable us to account for differences in maturity of up to 50 days among the maturity classes. However, our data are inadequate to account fully for the 15 days differences in maturity between the medium- and late-maturity classes.

INTRODUCTION

Earliness of maturity in certain varieties of peanut, *Arachis hypogaea* L., ranges from about 100 days for Chico (PI 268661) to about 150 days for Southeastern Runner 56-15, when both are planted in south Georgia in mid-April to early May. Little published information is available on the characteristics of different types and varieties of peanuts that contribute to differences among them in length of time from planting to optimum maturity. We report herein results of research in which we seek to identify some components of maturity in representative varieties of Virginia (ss. *hypogaea*, var. *hypogaea*), Spanish (ss. *fastigiata* Waldron, var. *vulgaris*, Harz), and Valencia (ss. *fastigiata* Waldron, var. *fastigiata*) type peanuts.

MATERIALS AND METHODS

The general materials and methods used in this study are the same as those described elsewhere (1). An additional procedure was used, which was designed to provide information on how long pegs might be expected to remain reasonably strong after the seeds in appended pods had matured. Here we deferred the digging of individual plants of the representative genotypes included in our study until as many as 100 days after deflowering began. At digging, observations were made on relative peg strength of attached pods and on the apparent physical condition of seeds in the attached pods and in the comparatively few detached pods encountered.

In another aspect of the study, we detached all early flowers that appeared on plants of Chico, Tifspan, Florunner, and Southeastern Runner 56-15, grown in the greenhouse, until 4 to 5 flowers opened the same day on a given plant. These flowers, along with those that appeared the next day, were left on the plant to develop. After the second day of undisturbed flowering, deflowering was resumed for 30 days. Thirty, 40, 50, 60, and 70 days after the resumption of deflowering for the individual plants, three or four plants of each genotype were dug. The pods were washed, and photographs were made of representative fresh whole pods and seeds on the half-shell. The pods were then dried, and photographs were made of the dried pods and seeds on the half-shell. Included in this study were representatives of four fairly distinct maturity groups of peanuts. These groups and the variety we chose to represent each are: (a) unusually early, Chico; (b) early, Tifspan; (c) medium, Florunner; and (d) late, Southeastern Runner 56-15. When planted between mid-April and early May in south Georgia, Chico is usually ready to dig in about 100 days, Tifspan in about 120, Florunner in about 135, and Southeastern Runner 56-15 in about 150 days. In this study we sought, for each genotype, information on the number of days (a) from planting to opening of first flower; (b) from opening of first flower to opening of a given number of flowers on the same plant; (c) from opening of a flower to maturation of seeds in pod developed therefrom; and (d) from maturation of seeds in a pod to major

deterioration of strength of peg by which the pod is attached to the plant.

Deflowering or flower removal as used herein consisted of detaching the calyx tube (hypanthium) near its base before 9:00 am. This operation left the ovary intact. In this work we assumed that peg elongation began soon after the flowers opened. The temperature was favorable continuously for plant development, and the plants were maintained free from obvious moisture stress. The use of evaporative cooling to reduce temperature in the greenhouse during the late spring, summer, and early fall helped to maintain relative humidity at a favorable level during the daylight hours.

RESULTS AND DISCUSSION

Generally, genotypes that mature early began flowering earlier than those that mature late (Tables 1 and 2). Chico, which matures about 20 days earlier than

TABLE 1.--Days from planting to initial flowering for peanut genotypes of four maturity classes planted in the greenhouse in June and early February at Beltsville, Md.

Maturity classes and Genotypes	Days from planting to first flower in			
	Greenhouse bench in June		Greenhouse baskets in early February	
	Average	Range	Average	Range
	Days	Days	Days	Days
Very early-maturity				
Chico (PI 268661)	22.8	22-24	28.6	27-34
Early-maturity				
Tifspan	25.0	0	30.8	27-37
Spancross	26.0	25-27	..	..
Tennessee Red	23.8	22-25	..	..
TP-716-2-1 1/	..	..	28.5	26-32
AU-3 1/	..	..	30.9	29-34
Medium-maturity				
Goldin 1	30.5	29-32	35.2	30-39
Florispan	30.3	29-32	39.0	32-45
Florunner	28.3	27-30	35.3	31-41
Florigiant	28.3	28-29	33.4	31-38
NC 4 1/	32.3	31-34	..	..
NC 4X	31.0	28-35	..	..
Virginia 61R	30.5	29-31	..	..
Virginia 72R	..	..	34.1	32-37
NC-Fla. 14	..	..	33.8	29-39
Shulamit	..	..	36.7	34-40
UF 70115 1/	..	..	37.6	34-41
Late-maturity				
Southeastern Runner 56-15	29.3	28-31	34.5	33-38

1/ Advanced breeding line.

commercial Spanish varieties, began flowering about 2 days earlier than the early group. This could account for 10% of the 20-day difference in earliness of maturity between these two groups. The early group began flowering an average of 3.8 days earlier than the medium-maturity group, which includes most commercial varieties of the Virginia type. This could account for 25% of the 15-day difference in maturity between these two maturity groups. Southeastern Runner 56-15, which requires about 15 days longer to reach full maturity than varieties of medium maturity, began flowering at about the same time as the medium-maturity representatives. Chico began flowering 6 days earlier than Southeastern Runner 56-15. This could account for about 12% of the 50-day difference in days to maturity between the two.

TABLE 2.--Days from planting to initial flowering for peanut genotypes of four maturity classes planted in the greenhouse in early July and in the field in early June at Beltsville, Md.

Maturity classes and Genotypes	Days from planting to first flower in					
	Greenhouse bench in early July		Greenhouse baskets in early July		Field in early June	
	Average	Range	Average	Range	Average	Range
	Days	Days	Days	Days	Days	Days
Very early-maturity						
Chico (PI 268661)	18.8	18-20	23.6	22-31	37.0	35-41
Early-maturity						
Tifspan	20.5	19-21	26.0	24-31	39.4	37-42
Medium-maturity						
Florunner	..	..	28.7	25-30	40.0	36-43
F 439-16-6 1/	25.3	22-27	..	..	..	..
Late-maturity						
Southeastern Runner 56-15	25.0	23-28	31.2	28-37	41.0	38-45

1/ Advanced breeding line.

Generally, genotypes that began flowering early accumulated a given number of flowers in a shorter time than genotypes that began to flower later. Once flowering began, Chico accumulated 10 flowers per plant an average of 1.3 days sooner than the early group (Compiled from table 3). The early group accumulated 10 flowers per plant an average of 3.6 days sooner than medium-maturity genotypes. Medium-maturity genotypes accumulated 10 flowers per plant only 0.7 day sooner than late-maturing Southeastern Runner 56-15. Very early-maturing Chico accumulated 10 flowers per plant within 3.3 days after flowering began, in contrast to an average of 8.9 days for Southeastern Runner 56-15.

Chico accumulated an average of 20 flowers per plant 0.9 day sooner than the early group (Compiled from tables 3 and 4). The early group accumulated 20 flowers per plant 4.4 days earlier than medium-maturity genotypes. Medium-maturity genotypes accumulated 20 flowers 2.2 days earlier than Southeastern Runner 56-15. Chico accumulated 20 flowers per plant 4.4 days after flowering began, whereas Southeastern Runner 56-15 required 11.8 days.

Chico accumulated 30 flowers per plant within an average of 5.4 days after flowering began, but an average of 14.0 days were required by Southeastern Runner 56-15 (Compiled from table 5). Chico accumulated 30 flowers per plant an average of 1.2 days sooner than Tifspan, an average of 4.6 days sooner than medium-maturity genotypes; and medium-maturity genotypes an average of 2.8 days sooner than the late Southeastern Runner 56-15.

Under our test conditions in the greenhouse during the summer, seeds of Chico were mature in about 50 days after the flower opened; Tifspan required about 60 days; Florunner about 70 days; and Southeastern Runner 56-15 an estimated 75 days or more (Fig. 1 and 2). Our observations did not extend beyond 70 days after flowering. Our estimate of 75 days or more for Southeastern Runner 56-15 seeds to mature is based on the appearance of the seeds and the interior of the shells 70 days after flowering.

Differences among the genotypes in seed development were strikingly evident 30 days after flowering. Fresh pods of all genotypes appeared to be near full size. At 30 days, fresh seeds of Chico appeared to be full size, seedcoats were thick and fleshy, and collapse of fleshy endocarp inside the shell was about complete. Fresh seeds of Tifspan were approaching full size, seedcoats were very thick and fleshy, and endocarp inside the shell had not all collapsed. Fresh seeds of Florunner were about one-third to one-half full size, seedcoats were very thick and fleshy, and endocarp had just begun to recede. Fresh seeds of Southeastern

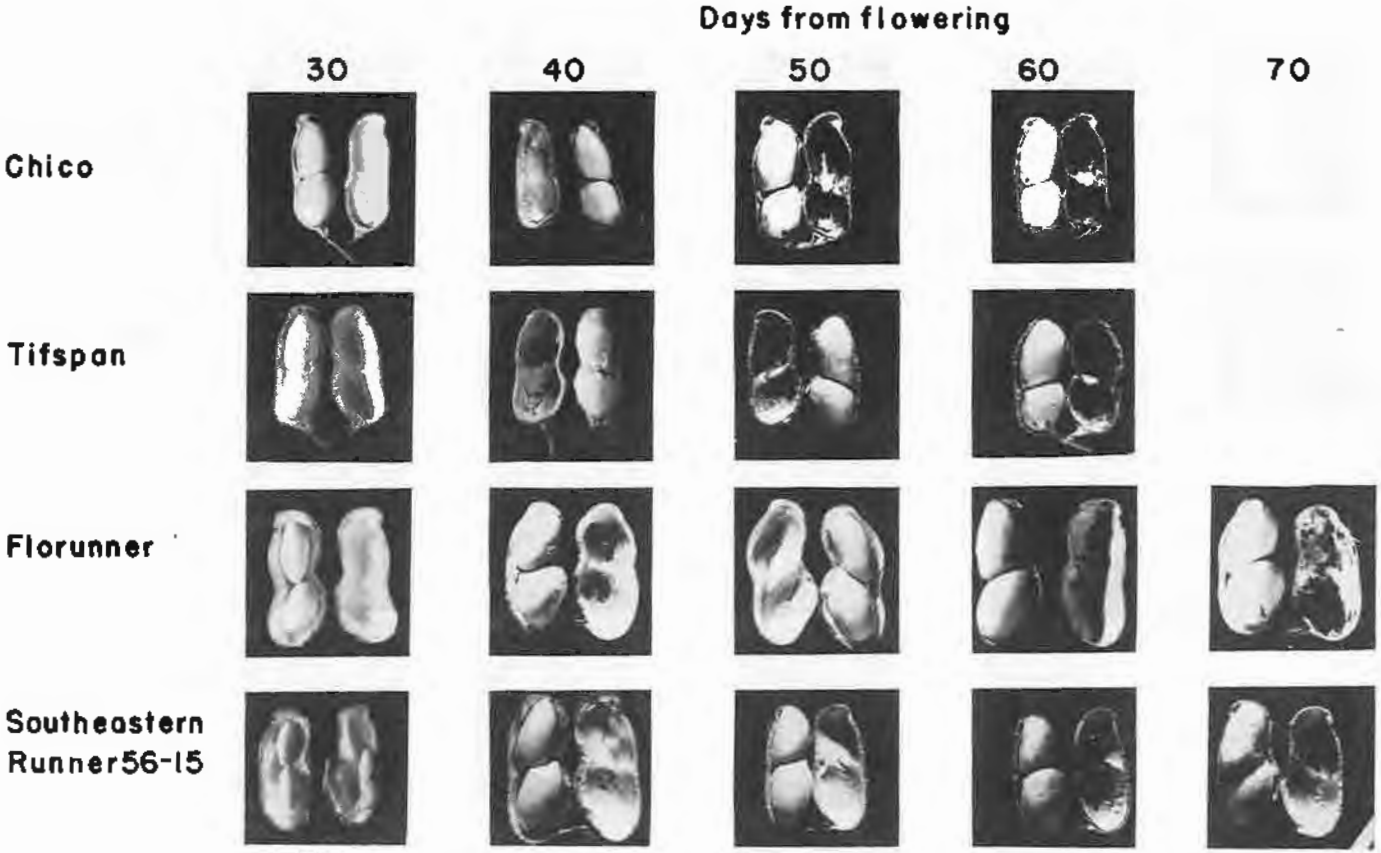

Fig.1. Rate of seed development in peanut genotypes-fresh seeds

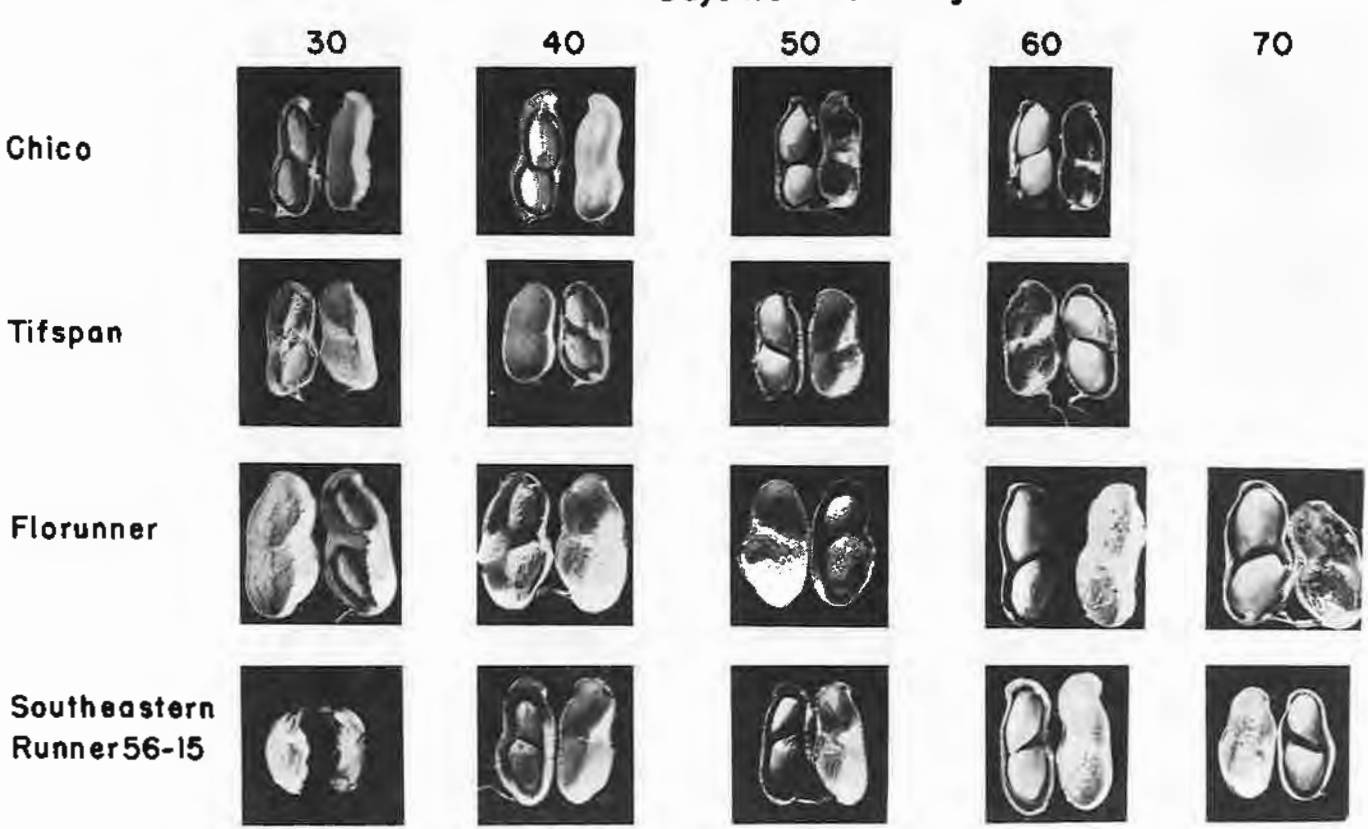

Fig.2. Rate of seed development in peanut genotypes-air dried seeds

TABLE 3.--Days from first flower to 10th and 20th flower for peanut genotypes of four maturity classes planted in the greenhouse in June and early February at Beltsville, Md.

Maturity classes and genotypes	Days from first flower to 10th flower in Greenhouse baskets in early February		10th flower in Greenhouse bench in June		20th flower in Greenhouse bench in June	
	Average	Range	Average	Range	Average	Range
	Days	Days	Days	Days	Days	Days
Very early-maturity						
Chico (PI 268661)	3.5	2-5	3.0	2-4	5.0	4-6
Early-maturity						
Tifspan	5.3	3-8	5.0	4-8	8.3	6-13
Spancross	..	..	4.3	4-5	6.8	6-7
Tennessee Red	..	..	4.5	4-6	8.0	6-10
TP 716-2-1 1/	3.7	4-10	..	..	..	..
AU-3 1/	4.8	3-7	..	..	..	..
Average	4.6	..	4.6	..	7.7	..
Medium-maturity						
Goldin 1	7.5	5-10	6.8	6-8	9.8	9-11
Florispan	6.2	4-8	7.0	6-9	9.8	8-12
Florunner	8.5	7-11	8.5	7-10	11.5	10-13
Florigiant	8.5	7-10	9.0	8-10	12.5	11-13
NC 4	..	..	7.5	5-9	11.5	9-13
NC 4X	..	..	9.8	8-11	12.8	10-15
Virginia 61R	..	..	10.0	7-11	13.0	11-15
Virginia 72R	8.3	7-12	..	..	..	..
NC-Fla. 14	7.2	5-15	..	..	..	..
Shulamit	9.4	6-11	..	..	..	..
UF 70115 1/	7.2	5-15	..	..	..	..
Average	7.9	..	8.4	..	11.6	..
Late-maturity						
Southeastern Runner 56-15	8.9	7-10	8.8	7-11	12.8	11-15

1/ Advanced breeding line.

TABLE 4.--Days from first flower to 20th flower for peanut genotypes of four maturity classes planted in the greenhouse in early July and in the field in early June at Beltsville, Md.

Maturity classes and genotypes	Days from first to 20th flower in Greenhouse bench in early July		Greenhouse baskets in early July		Field in early June	
	Average	Range	Average	Range	Average	Range
	Days	Days	Days	Days	Days	Days
Very early-maturity						
Chico (PI 268661)	4.3	2-6	4.2	2-7	3.9	2-5
Early-maturity						
Tifspan	4.9	2-8	5.0	2-7	3.4	2-7
Medium-maturity						
Florunner	..	..	9.7	6-11	6.8	4-12
F 439-16-6 1/	10.5	9-12	..	..	..	..
Late-maturity						
Southeastern Runner 56-15	12.6	11-14	11.4	9-15	10.5	7-15

1/ Advanced breeding line.

TABLE 5.--Days from first flower to 30th flower for peanut genotypes of four maturity classes planted in the greenhouse in early July and in the field in early June at Beltsville, Md.

Maturity classes and genotypes	Days from first flower to 30th flower					
	Greenhouse bench in early July		Greenhouse baskets in early July		Field in early June	
	Average	Range	Average	Range	Average	Range
	Days	Days	Days	Days	Days	Days
Very early-maturity						
Chico (PI 268661)	5.4	3-8	5.7	3-9	5.1	3-7
Early-maturity						
Tifspan	7.9	4-12	7.3	4-9	4.7	3-10
Medium-maturity						
Florunner	..	..	12.0	9-15	8.9	5-16
F 439-16-6 1/	12.7	12-14	..	..	..	..
Late-maturity						
Southeastern Runner 56-15	14.9	14-17	13.6	12-17	13.4	9-18

1/ Advanced breeding line.

Runner 56-15 were tiny with very thick seedcoats, and were imbedded in thick fleshy endocarp inside the shell.

Thirty-day pods of Southeastern Runner 56-15 collapsed during drying, but the shells of the other genotypes retained their shape. Dried seeds of Southeastern Runner 56-15 at 30 days were tiny and consisted largely of seedcoats. Dried seeds of Florunner were quite small but some development of cotyledons had occurred. Dried seeds of Tifspan approached one-fourth size of mature seeds. Dried seeds of Chico were about one-half the size of mature seeds of this genotype.

Our results agree reasonably well with findings of Pickett (2) and Schenk (3). Pickett reported that Virginia Bunch 67, a representative of our medium-maturity group, required about 65 days from the time pegs entered the soil to maturity of the seeds. Schenk reported that Dixie Spanish, the equivalent in maturity of our early group, produced mature seeds 49 days after pegging. However, Schenk states that the pegs of Dixie Spanish that he tagged were in the soil already at the time he tagged them. Schenk's Virginia Bunch 67 required about 70 days to develop mature seeds, but the pegs that he tagged of this variety were still aerial at the time he tagged them. After tagging, Schenk piled soil around the pegs.

Our estimates of the number of days that pods remained strongly attached to the plants after the seeds in the appended pods had matured, ranged from about 30 to 35 days for Chico and other Spanish genotypes to 38 to 59 days for the later maturing genotypes (Table 6). Our data on this characteristic are from a single planting and are not extensive. Consequently, these estimates should be considered tentative. The comparatively low values for Spanish are based on diggings made 80 days after deflowering began. A longer delay in digging might have increased substantially the values for Spanish and made them more comparable to those for the Virginia genotypes.

We consider as highly significant our finding that pegs can remain firmly attached to peanut plants for 30 to 60 days after seeds in the appended pods have matured. Only an occasional pod or two from a few plants of certain genotypes were detached when digging of individual plants was delayed up to 67 days after the first flowers that opened on these plants had ample opportunity to develop into mature pods. The occasional pods that were detached at digging may have been located in the vicinity of mini-hotspots for peg-decaying microorganisms in the highly organic greenhouse compost soil. We cannot predict how long pegs might remain firmly attached to plants after the seeds in attached pods have matured, if the soil were comparatively free of peg-rotting microorganisms.

The ability of pegs to remain attached to plants long after the seeds in attached pods have matured, allows the plants to set and mature fruit over a comparatively

TABLE 6.--Days from estimated maturation of oldest pod to digging for peanut genotypes representing four maturity classes planted in the greenhouse in November at Beltsville, Md.

Maturity classes and genotypes	Days from maturation of oldest pod to digging		Plants involved
	Average	Range	
	Days	Days	No.
Very early-maturity			
Chico (PI 268661)	29.7	25-33	3
Early-maturity			
Tifspan	35.6	33-37	7
Argentine	30.0	28-32	4
Starr	31.5	27-33	4
Comet	29.5	24-37	8
Spanhoma	31.7	27-37	7
TP 931 1/	32.7	30-36	6
TP 716-Z-1 1/	32.6	26-36	7
Medium-maturity			
Goldin 1	58.2	56-63	6
Florispan	59.0	54-64	6
Florunner	57.5	45-67	6
Florigiant	49.7	41-59	6
Shulamit	50.8	43-56	6
NC 17	37.8	35-41	5
Virginia 72R	46.4	42-52	5
F 439-16-6 1/	56.0	42-63	6
UF 714021 1/	50.8	44-57	5
Late-maturity			
Southeastern Runner 56-15	54.3	43-60	6

1/ Advanced breeding line.

long time without loss of the early fruit. In our tests, seeds inside pods that had remained attached to plants 30 to 60 days after the seeds had matured, appeared to be in excellent physical condition. A sizable portion of seeds in the few pods that were detached at digging showed obvious evidence of deterioration. These observations suggest that little seed deterioration need be anticipated as long as the seeds are in pods that are firmly attached to vigorous plants. The bleaching of seedcoat pigments that many investigators associate with "over-mature" seeds was almost absent in the seeds in the attached pods in our study.

Our results suggest that a practical procedure to determine the optimum time for digging peanuts would be to wait until the pegs of the oldest pods on the plants begin to show evidence of weakening, and then dig them promptly. The senior author has used this as his principal guide in determining the optimum time for digging peanuts grown under a wide variety of conditions over a period of 31 years.

The data presented herein suggest a possible explanation for the difference in time from planting to digging required for representatives of the four general maturity groups of peanuts when grown under field conditions. These data do not adequately explain the reasons for differences in maturity between the late-maturing Southeastern Runner 56-15 and other Virginia-type varieties.

The results of this study are highly suggestive and not conclusive. The results are presented at this time because our peanut research at Beltsville is being discontinued. We hope that our data and the inferences drawn from them will be sufficiently challenging to stimulate others to do additional research on the problem.

For literature citations see page 47.

SEED DORMANCY OF DIFFERENT BOTANICAL TYPES OF PEANUTS, ARACHIS HYPOGAEA L.

by
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ABSTRACT

Spanish and Valencia-type peanuts (ss. fastigiata Waldron, vars. vulgaris Harz and fastigiata) are frequently described as lacking seed dormancy. When seeds were cured to a moisture content of 5-7% in 8-16 days, certain Spanish and Valencia genotypes showed as much as 70% seed dormancy, and one Virginia genotype as little as 3%. Fresh, decidedly immature seeds of all genotypes failed to germinate when seedcoats were removed and naked embryos were exposed to ethylene. As maturity progressed, an increasing proportion of fresh seeds of all genotypes germinated when naked embryos were exposed to ethylene. As soon as seedcoats became thin, a portion of fresh seeds of all genotypes could be induced to germinate by exposure of imbibed seeds to ethylene with seedcoats intact. Dormant, fresh mature, and cured seeds of all maturity classes of all genotypes germinated when imbibed seeds were exposed to ethylene, or when seedcoats were removed and naked embryos were exposed to ethylene.

INTRODUCTION

The cultivated peanut, Arachis hypogaea L., consists of two subspecies: ss. hypogaea, which includes the Virginia type; var. hypogaea; and var. hirsuta Kohler; and ss. fastigiata Waldron, which includes Spanish, var. vulgaris Harz; and Valencias, var. fastigiata (1). Difference in seed dormancy is often cited as one of the principal distinguishing characteristics of the two subspecies. Gregory (2) lists among the characteristics for Virginia, "seeds... usually germinating only after 30-360 days "rest period..."; for Spanish, "seeds..., germinating immediately upon maturity."; and for Valencia, "seeds..., germinating immediately upon maturity." Krapovickas (1) states "Groundnuts of subspecies hypogaea..., their seeds have considerable dormancy, ... In subspecies fastigiata..., the seed has no dormancy ....".

Our experience in germinating Virginia, Spanish, and Valencia peanut seeds that had been cured in field stacks over a period of 4 to 7 weeks largely confirms these statements about the seed-dormancy differences in these botanical varieties. However, we encountered considerable dormancy (up to 70%) in seeds of certain Spanish and Valencia genotypes when they had been cured to 5-7% seed moisture in 8-16 days. With this in mind, we investigated the nature and extent of dormancy in fresh and cured seeds of representative genotypes of these three botanical types of peanuts.

MATERIALS AND METHODS

Seeds used in these studies were grown at Holland, Va. and Beltsville, Md. Plants were harvested at different stages of maturity to provide seeds with a range of physiological development from decidedly immature to fully mature. Pods were handpicked from plants and washed in water. Some seeds were shelled immediately after digging or after the washed pods had dried in thin layers overnight at 21.1C. Such seeds are identified as "fresh." Others were shelled after curing for 4 to 16 days. Curing was with pods in thin layers in an attic at 21-35C, with air circulating vigorously.

Shelled seeds were graded into classes, based on stage of physiological development as judged by appearance of the seeds and the interior of the shells. Principal seed classes were: (a) "decidedly immature" — up to one-third mature size when fresh, with seedcoats thick and fleshy, and seeds imbedded in thick fleshy endocarp that filled the cavity between the inner shell and the seed; (b) "immature" — between one-third and one-half mature size when fresh, with seedcoats thick and fleshy, and endocarp beginning to recede in direction of the inner shell; (c) "large

immature" — near full mature size when fresh, seedcoats thick and fleshy to thin, fleshy endocarp collapsed against the inner shell, with inner shell still white; (d) "mature" — full mature size, with very thin fully pigmented seedcoats, and interior of shell dark splotched to completely dark.

Germination tests were made in a greenhouse sandbed where air temperature ranged from 22-32C, or in a seed germinator at 25-27C. In the germinator, the seeds were placed between layers of moist paper toweling on wire trays or in sealed plastic boxes. Firm ripe apples were included in some of the plastic boxes to provide ethylene gas to stimulate germination (3). In other boxes, the paper toweling was moistened with a water solution of ethephon (2-chloroethylphosphonic acid) at $1X10^{-3}M$ concentration, adjusted to pH 6.0 with 0.1N NaOH, to provide ethylene. Seedcoats were removed from portions of certain lots of seeds before they were placed in the germinator with and without a source of ethylene. Seeds that remained dormant when planted in a sandbed or on trays in germinator were handled similarly, and they were placed back in the germinator with and without a source of ethylene.

In greenhouse tests, each variety treatment was replicated 4 to 8 times, with 25 seeds per replicate. In tests in the germinator, the number of replications ranged from 2 to 4, depending on the quantity of seeds of the different maturity classes available. Greenhouse test plantings were dug, and seed dormancy counts were made after 7-10 days. Dormancy counts for germinator tests were made after 3 or 4 days. A seed was considered to have germinated if the radicle had pierced the seedcoat. A sound seed that had not germinated was considered to be dormant. Seeds without seedcoats were considered to have germinated when radicles elongated 1/16 inch or more.

Differences in treatments of interest in this study were so obvious that data were not analyzed statistically. Results for treatment replicates were highly consistent.

RESULTS AND DISCUSSION

Dormancy of Spanish and Valencia genotypes, after prompt curing and planting in a greenhouse sandbed, ranged from 29 to 70% in 1970, from 33 to 64% in 1971, and from 8 to 27% in 1972 (Table 1).

TABLE 1.--Dormant seeds in Spanish peanuts after prompt curing and planting in a greenhouse sandbed at Beltsville, Md.

Genotype	1970	1971	1972
	%	%	%
Argentine	65	63	27
Spanhoma	70	57	21
Spancross	58	64	16
Tifspan	46	54	10
Starr	53	51	18
Comet	30	37	4
Tennessee Red	29	33	8
Improved Spanish 2B	56	46	..

Dormancy levels for 1970 and 1971 were substantial. The dormancy levels for 1972, when cured seeds were conditioned for 6 days at 21.1C and 11 days at 4.4C before planting, were much lower than those for 1970 and 1971, but these seeds could scarcely be considered to have "no dormancy." Dormancy levels for a select group of 11 Virginia genotypes, after prompt curing and planting in the greenhouse sandbed, ranged from 11 to 61% in 1969, from 28 to 68% in 1970, and from 3 to 71% in 1972 (Table 2). Under the conditions of our tests, occasionally certain Spanish and Valencia genotypes showed seed-dormancy levels as high as or higher than certain Virginia genotypes.

TABLE 2.--Dormant seeds in Virginia-type peanuts after prompt curing and planting in a greenhouse sandbed at Beltsville, Md.

Genotype	1969	1970	1972
	%	%	%
NC 2	11	49	44
NC 17	..	63	71
Florigiant	61	68	57
Florispan	25	48	48
F 393-6 1/	40	28	45
F 393-9 1/	26	55	32
Shulamit	..	..	42
NC-Fla. 14	..	..	53
Altika	..	..	61
UF 714021 1/	..	..	18
UF 70115 1/	..	..	3

1/ Advanced breeding line.

The 11 Virginia genotypes with comparatively low levels of cured-seed dormancy all have Spanish germplasm in their breeding history. Florunner, Early Runner, and Dixie Runner, with comparable seed-dormancy levels ranging from 82 to 98%, also have Spanish in their breeding history. Consequently, a generalization that the presence of Spanish germplasm in the breeding history of a Virginia-type variety is responsible for or can insure a comparatively low level of cured seed dormancy seems untenable.

There perhaps is merit in a claim that Virginia genotypes derived as selections from crosses between the two subspecies of cultivated peanuts cannot be considered as clearly belonging to the subspecies *hypogaea*. However, insofar as we know, (with the exception of Spancross) the Spanish genotypes and Tennessee Red used in our tests have never been involved in crosses between the two subspecies. The presence of a substantial amount of cured-seed dormancy in these representatives of subspecies *fastigiata* suggests that current conceptions about seed dormancy in this subspecies might need modification.

When seeds of 5 Spanish genotypes with 45 to 78% seed dormancy were stored for 30 days at 29.4C and planted in a greenhouse sandbed, dormancy was reduced to 15 to 36% (Table 3). The residual dormancy in these Spanish seeds averaged considerably

TABLE 3.--Dormant seeds in promptly cured Spanish peanut genotypes planted in greenhouse sandbed soon after curing and after storage for 30 days at 29.4C at Beltsville, Md.

Genotype	Initial 1/	30 days 29.4C
	%	%
Improved Spanish 2B	56	28
PI 248759	66	24
PI 268644	78	36
PI 268684	45	15
PI 268771B	66	30

1/ Within a few days after completion of curing.

higher than that for comparably treated seeds of Virginia genotypes with initial dormancy levels of 82 to 100% (4). The seed dormancy in these cured Spanish

peanuts was not ephemeral in nature, and its dissipation by warm-temperature storage was no more rapid than for dormancy of Virginia-type peanuts.

Within 2 or 3 weeks after peanut-pod development starts, pods attain full size (5). At this stage, seeds are still quite small, with thick turgid seedcoats, and are imbedded in the fleshy parenchymatous tissues (endocarp) of the inner shell. As the seeds enlarge, the endocarp recedes and finally collapses completely by the time the seeds attain full size. Seedcoats remain thick and turgid until seeds attain full size. Soon thereafter, or concurrent with attainment of full size, the fleshiness of the seedcoats begins to disappear. At full maturity, the seedcoats are very thin and fully pigmented.

In research on fresh-seed dormancy of Virginia Bunch 67 peanuts, Toole et al. (3) found that 80% of imbibed, dormant, fresh seeds of Virginia Bunch 67, which were one-half to two-thirds mature size, were induced to germinate by a combination of seedcoat removal and exposure to ethylene (100 ppm in air). In other results (unpublished), less mature seeds (fresh, one-third mature size or smaller) could not be induced to germinate by such treatment.

Our results with 1967 Beltsville-grown Virginia Bunch 67, Early Runner, and Argentine peanuts confirm this latter finding. When fresh one-third mature size seeds of these 3 genotypes had seedcoats removed, were sealed in plastic boxes with firm ripe apples, and were placed in a germinator, only 3 seeds of 90 Virginia Bunch 67, 2 of 70 Early Runner, and zero of 100 Argentine germinated. No germination occurred for a comparable number of seeds of each genotype placed on trays in the germinator with seedcoats intact. The reaction of fresh, immature Spanish (Argentine) peanuts to seedcoat removal and exposure of imbibed seeds to ethylene was the same as that of the 2 Virginia genotypes. These seeds were from pods in which the fleshy endocarp was still largely intact.

Results with decidedly immature (up to about one-third fresh mature size) seeds of Tennessee Red and 7 Spanish genotypes grown at Holland, Va., confirm the earlier finding (Table 4). Spancross and Comet with 8 and 7% germination, respectively,

TABLE 4.--Dormancy in fresh, immature and decidedly immature seeds of Spanish peanuts grown at Holland, Va., in 1970 and tested in germinator with ethephon at $1X10^{-3}M$ at Beltsville, Md.

Genotype	Dormant seeds			
	Immature 1/		Decidedly immature 2/	
	Seedcoats on	Seedcoats off	Seedcoats on	Seedcoats off
	%	%	%	%
Argentine	100	50	100	100
Spanhoma	100	56	100	100
Tifspan	100	56	100	100
Spancross	100	72	100	92
Comet	100	50	100	93
Tennessee Red	100	100	100	100
Improved Spanish 2B	100	80	100	100
Georgia C 32S-39 3/	100	95	100	100

1/ Fresh seeds 1/3 to 1/2 mature size, from pods in which endocarp was beginning to recede.

2/ Fresh seeds up to about 1/3 mature size, imbedded in fleshy endocarp inside pods.

3/ Advanced breeding line.

were the only genotypes that responded at all to seedcoat removal and exposure to ethylene generated by ethephon.

With seeds that were slightly more mature, but comparable otherwise, response to seedcoat removal and ethylene was appreciable for all genotypes, except Tennessee Red with zero, and Ga. C 32S-39 with 5% germination. These seeds were between one-

third and one-half mature size when fresh (Table 4). The fleshy endocarp in which the seeds were imbedded had begun to recede.

Seeds of comparable maturity (between one-third and one-half fresh mature size) of 7 Spanish genotypes grown at Beltsville, Md., gave a roughly similar response to seedcoat removal and exposure to ethylene (Table 5). Argentine and Spanhoma, with

TABLE 5.--Dormancy in fresh, immature [1/] seeds of Spanish peanuts grown at Beltsville, Md., in 1971 and tested in a germinator untreated and exposed to ethephon at $1X10^{-3}M$

Genotype	Dormant seeds			
	Untreated		Exposed to ethephon	
	Seedcoats on	Seedcoats off	Seedcoats on	Seedcoats off
	%	%	%	%
Argentine	100	96	100	96
Spanhoma	100	100	100	92
Tifspan	100	100	100	84
Spancross	100	96	100	72
Starr	100	92	100	64
Comet	100	92	100	72
Spantex	100	100	100	64

1/ Fresh seeds 1/3 to 1/2 mature size, from pods in which endocarp was beginning to recede.

Argentine, 4 and 8% germination, respectively, were the least responsive. /Spancross, Starr, and Comet gave a modest response to seedcoat removal alone, with 4 to 8% germination. When large immature and mature seeds of these same 7 Spanish genotypes were subjected to the same treatments as the less mature seeds above, response to seedcoat removal alone was substantial (18 to 54% germination), and seedcoat removal plus exposure to ethylene induced from 48 to 90% of the seeds to germinate (Table 6).

TABLE 6.--Dormancy in fresh, large-immature and mature seeds of Spanish peanuts grown at Beltsville, Md., in 1970 and tested in a germinator untreated and exposed to ethephon at $1X10^{-3}M$

Genotype	Dormant seeds			
	Untreated		Exposed to ethephon	
	Seedcoats on	Seedcoats off	Seedcoats on	Seedcoats off
	%	%	%	%
Spancross	100	82	92	36
Spantex	100	74	76	10
Starr	100	46	84	26
Comet	96	82	80	52
Tifspan	96	76	78	38
Spanhoma	96	48	60	36
Argentine	88	54	82	48

In view of these results, in 1971 we investigated the response of Beltsville-grown fresh and cured seeds of three different maturity levels of Argentine, Tennessee Red, and Early Runner to seedcoat removal and exposure to ethylene. The seed-maturity classes were decidedly immature, large immature with fleshy seedcoats, and fully mature. None of the fresh, decidedly immature seeds responded to seed-coat removal alone (Table 7). Tennessee Red and Early Runner gave a negative response to seedcoat removal plus exposure to ethylene, but 25% of Argentine seeds so treated germinated. It seems possible that the Argentine seeds in this category might have been a little more advanced in maturity than the other genotypes.

TABLE 7.--Germination of fresh seeds of three botanical varieties of peanuts at different stages of maturity when tested under different conditions in a germinator at Beltsville, Md.

Treatments	Germination		
	Argentine	Tennessee Red	Early Runner
	%	%	%
Seedcoats fleshy - pods fleshy 1/			
H_2O - seedcoats on	0	0	0
H_2O - seedcoats off	0	0	0
Ethephon - seedcoats on 2/	0	0	0
Ethephon - seedcoats off	25	0	0
Seedcoats fleshy - pods not fleshy 3/			
H_2O - seedcoats on	3	0	0
H_2O - seedcoats off	40	6	0
Ethephon - seedcoats on	9	0	0
Ethephon - seedcoats off	64	3	2
Mature seeds			
H_2O - seedcoats on	18	28	0
H_2O - seedcoats off	100	60	55
Ethephon - seedcoats on	72	50	0
Ethephon - seedcoats off	90	99	86

1/ Decidedly immature seeds.
2/ Ethephon at $1X10^{-3}M$.
3/ Large immature seeds.

With the fresh, large immature seeds, Argentine responded to seedcoat removal alone with 40%, to ethylene alone with 9%, and to seedcoat removal plus ethylene with 64% germination (Table 7). Response of large immature seeds of Tennessee Red and Early Runner to the treatments was negligible.

Removal of seedcoats of mature, fresh seeds gave 100% germination with Argentine, 60% with Tennessee Red, and 55% with Early Runner (Table 7). Seedcoat removal plus ethylene gave 90% germination with Argentine, 99% with Tennessee Red, and 86% with Early Runner. Argentine and Tennessee Red gave 72 and 50% germination, respectively, when exposed to ethylene with seedcoats intact; response of Early Runner to ethylene was nil.

Following curing of decidedly immature seeds, Argentine and Tennessee Red gave 92 and 71% germination, respectively, with seedcoats intact and no exposure to ethylene, in contrast to zero for Early Runner (Table 8). However, 26% of Early Runner seeds germinated when seedcoats were removed. Germination of these decidedly immature cured seeds was not enhanced further by exposure of the seeds to ethylene.

With cured large, immature seeds, Argentine and Tennessee Red gave 100% germination without special treatment (Table 8). Seedcoat removal alone gave 30% germination of Early Runner, and seedcoat removal plus ethylene 60%.

Cured mature seeds of Argentine and Tennessee Red germinated 92 and 80%, respectively, without special treatment; 100% germinated when seedcoats were removed (Table 8). Respective germination percentages for Early Runner were 9 and 61. All seeds of each genotype germinated when seedcoats were removed and seeds were exposed to ethylene. Exposure to ethylene with seedcoats intact gave 90% germination for Argentine, 83% for Tennessee Red, and 60% for Early Runner.

Results presented herein are representative of numerous other tests with the genotypes listed and others, conducted during the past 8 years. Evidence was found substantiating the report of Toole et al. (3) that the production enviroment can influence the extent of seed dormancy in peanuts and the ease with which the dormancy can be broken. Consequently, the maturity parameters described herein

TABLE 8.--Germination of cured seeds of three botanical varieties of peanuts at different stages of maturity when tested under different conditions in a germinator at Beltsville, Md.

Treatments	Germination		
	Argentine	Tennessee Red	Early Runner
	%	%	%
Seedcoats fleshy - pods fleshy 1/			
H_2O - seedcoats on	92	71	0
H_2O - seedcoats off	93	85	26
Ethephon - seedcoats on 2/	87	79	2
Ethephon - seedcoats off	94	84	27
Seedcoats fleshy - pods not fleshy 3/			
H_2O - seedcoats on	100	100	2
H_2O - seedcoats off	100	100	30
Ethephon - seedcoats on	100	100	11
Ethephon - seedcoats off	100	100	60
Mature seeds			
H_2O - seedcoats on	92	80	9
H_2O - seedcoats off	100	100	61
Ethephon - seedcoats on	90	83	60
Ethephon - seedcoats off	100	100	100

1/ Decidedly immature seeds.
2/ Ethephon at $1X10^{-3}M$.
3/ Large immature seeds.

should be considered general rather than highly specific.

Under certain environmental conditions late in the growing seasons, seeds of Spanish and Valencia peanuts may sprout prematurely while still in the soil in pods attached to living plants. Seeds of Virginia-type peanuts rarely sprout prematurely, except when the plant on which they develop is severely affected by soilborne disease-causing organisms. One could assume that these disease-causing organisms could be a source of ethylene production in the vicinity of the seed and could stimulate germination. Seeds of the Virginia-type cultivars and breeding lines in our tests have not been observed to sprout prematurely, except occasionally on plants under disease stress as indicated above. During the past 31 years, the senior author has tested or observed some 5,000 to 6,000 genotypes representing named varieties, breeding lines, and peanuts introduced from countries throughout the world, without noting an exception to the above statement regarding the prevalence of premature sprouting. Perhaps the critical difference in seed dormancy between the two subspecies of cultivated peanuts is the inherent capacity of the seeds to sprout prematurely while in the soil within pods attached to living plants.

Our results suggest that the difference in fresh- and cured-seed dormancy between the representatives of the two subspecies of cultivated peanuts used in our tests is largely one of degree. Careful critical research that identifies the molecular basis for dormancy in peanuts is needed to resolve the questions posed by our results.

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Aflatoxin-Contaminated Peanuts Produced on North Carolina Farms in 1968

by

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INTRODUCTION

Examination for visible Aspergillus flavus growth on kernels in official grade samples is a simple, effective method to detect lots of farmers' stock peanuts which probably contain high concentrations of aflatoxin (1). Since 1968 this method has been used for all farmers' stock peanuts marketed in the United States (2). Peanut lots found to contain kernels with suspected A. flavus growth are placed in segregation-3 storage. These peanuts are crushed for oil, which is aflatoxin free after refining, and the meal is used for non-food purposes. The general appearance and market grade of segregation-3 peanuts are usually as good as for others.

The segregation-3 program described above provided an opportunity to study the production history and geographical distribution for large numbers of aflatoxin-contaminated lots of farmers' stock peanuts. In 1968, fields which produced segregation-3 peanuts in North Carolina were inspected and samples of the peanuts were analysed. Samples of peanuts from an irrigation experiment also were analysed to determine the effects of soil moisture on A. flavus growth and aflatoxin contamination.

PROCEDURES AND RESULTS

Geographical Distribution of Segregation-3 Peanut Production. Records of the Growers Cooperative Marketing Association, Franklinton, Virginia, show that 282 lots of segregation-3 peanuts, a total of 1,107 tons, were marketed in North Carolina during the 1968 marketing season. These peanuts constituted only about 0.7% of the total peanut production in the state.

The producing farm for each lot of segregation-3 peanuts was located from its marketing card number. The farms could be precisely located because the North Carolina Agricultural Stabilization and Conservation Service records show state highway map coordinates for the farm assigned each marketing card number. Figure 1 shows the geographic distribution of segregation-3 production for most of the northern peanut-production area in North Carolina and the total peanut acreage produced in each county. Total rainfall for the period between August 18 through September 26 is shown for each U.S. Weather Station within the area. Table 1 gives a daily record of rainfall at each location.

Figure 1 indicates a positive relation between the incidence of segregation-3 peanuts and long periods of drought after the peanuts reach marketable size and before digging. Nearly all of the North Carolina peanut crop was marketed during October and thus had been harvested in late September or early October. Table 1 shows rains during the harvesting season, but they fell over the entire area and are not considered to be a factor in the geographic distribution of segregation-3 peanut production.

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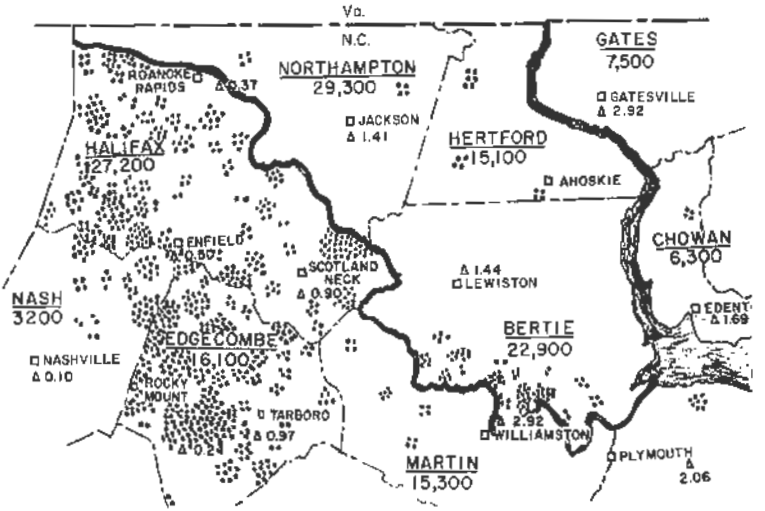

Figure 1. Geographic distribution of segregation-3 peanut production in the northern portion of the North Carolina peanut production area in 1968. Each dot locates the production area for 1 ton of peanuts. The total peanut acreage is indicated for each county. Total rainfall between August 18 and September 16, 1968, is indicated for each U.S. Weather Station represented by the triangles.

Most of the segregation-3 peanuts were produced south of the Roanoke River, which divides Northhampton and Bertie counties from Halifax and Martin counties, although more peanuts were produced north of the river. One exception is the southern portion of Bertie County where segregation-3 peanuts were produced in a drought area along the northern side of the river. Many of the segregation-3 peanuts along the western border were produced in areas with a low density of peanut acreage and few peanuts are produced west of those areas.

Visits to Farms that Produced Segregation-3 Peanuts. To get production histories for the peanuts, we visited 25 growers, who produced about 25% of the segregation-3 peanuts marketed in North Carolina, within 2 days after the peanuts were marketed. While they were in the windrow, most peanuts did not receive rain. All peanuts had been subjected to an extended period of drought before digging. Estimated moisture contents of the peanuts at combining ranged from 12 to 20% with an average of 17%. Time between combining and drying ranged from 3 to 12 hours with an average of 6 hours. Depth in the dryer was between 4 and 5 feet, and time in the dryer averaged 40 hours.

Lesser cornstalk borer, Elasmopalpus lignosellus (Zeller), infestations seldom are found in the northern peanut production area of North Carolina, but drought conditions in 1968 favored infestation (3). Peanut pods with typical lesser cornstalk borer (LCB) damage (4) were found in all but one of the 33 fields examined where segregation-3 peanuts were produced. The infestation often was confined to small areas in the field, and the growers did not consider the amount of damage to be economically important.

Table 1. Daily rainfall (in tenths of an inch) at selected weather stations in North Carolina during August, September and October of 1968. (t indicates less than .05 inches of rainfall).

	Month and Location[1/]																		
	August							September							October					
Date	We	SN	En	RM	Ja	Le	Wi	We	SN	En	RM	Ja	Le	Wi	We	SN	En	RM	Ja	Le	Wi
1									t			t	1	2							
2									t	4	t	12		t							
3								1	1				10	9							
4					t	1	t								3	4	1	1	1	2	t
5	3	7	t				t														
6											1	2	2								
7								t	2	1	t			14	10	17	11	8	9	13	6
8	1														t	t					t
9			2	2	12						t		t								
10	11	1		4	6	t	t				t		t	4							
11	3	7	10	1	6	3	5	3	6	t		t	1					3		t	
12	5	3	8			t	4											t			1
13															t			t			
14					5										t	8				4	
15	9	3	8	6	3	4	2								t	t		1	t		
16	t	3	1	t	t	11	t									t	t	t	t	t	1
17	t	26	t	t		1	t									t	t			t	1
18																		t	t		t
19					t			t	t					t	3	3	2	24	20	12	1
20															7	23	17	9	2	5	30
21																		t			
22																					
23																					
24													t							t	
25																					t
26																					t
27								3	2	11	t	5	1								
28																		3	3	2	
29															2	2	5			t	t
30																					
31																					

[1/] We-Weldon, SN-Scotland Neck, En-Enfield, RM-Rocky Mount, Ja-Jackson, Le-Lewiston, Wi-Williamston

Pods containing kernels with visible A. flavus growth were found in all of the fields. Nearly all pods with visible A. flavus growth were damaged by LCB. In two fields green plants were pulled from the soil with attached pods which had LCB damage and visible A. flavus growth. Aflatoxin analysis of the kernels from these pods showed a concentration of 2200 parts per billion (ppb) aflatoxin[1/].

Nearly all fields that produced segregation-3 peanuts were near other fields that produced peanuts apparently free of visible A. flavus growth. No differences in cultural practices were noted. Several fields were found that were infested with LCB, but did not produce segregation-3 peanuts, and in which pods with visible A. flavus growth were not found.

Analysis of Samples from Segregation-3 Peanuts. A sample weighing about 2 pounds was taken from each of 277 lots of segregation-3 peanuts for subsequent examination and analysis in the laboratory. Ninety-six percent of the samples contained some pods with typical LCB damage (4). Some farms produced several lots of segregation-3 peanuts. Ten composite samples were prepared each of which contained samples from 5 or more lots produced on the same farm. Peanuts in each composite sample were separated into the following categories: sound-mature pods; pods with insect damage (mostly LCB); pods that appeared to have mechanical damage; kernels that had been inadvertently shelled by harvesting and handling (loose shelled kernels, LSK); and pods that were discolored, immature, or had other defects. These subsamples were shelled and the kernels were examined for visible A. flavus growth.

Table 2 gives the distribution of kernels from the composite samples according to pod condition and visible A. flavus growth. The average total kernel weight (TKW) of the samples after shelling was 3.3 kg. The kernels from the sound-mature pods constituted 21% of the TKW but had no kernels with visible A. flavus growth (AFK). Kernels from the insect-damaged and LSK categories constituted 19% and 10% of the TKW and had an average count of 7.6 AFK and 9.4 AFK per kg of kernels, respectively. Kernels from pods with mechanical damage constituted 11% of TKW and had an average count of 2.5 AFK/kg. Other types of pods contained 39% of the TKW and a count of 0.8 AFK/kg.

After the determinations listed in Table 2 were completed, the kernels from each pod category were screened over a 15/64-inch slotted screen. All moldy, discolored, or decayed kernels were removed from those that rode the screen (R15) and placed with the kernels that passed through the screen (T15). Because the sound-mature pod category contained only a few T15 kernels, those, from all 10 samples, were combined. Aflatoxin concentrations in the samples are given in Table 3.

The average concentration of aflatoxin in all of the samples was 1,328 ppb. On the average, aflatoxin contents of the R15 kernels, from all pod categories, ranged from 29 ppb for kernels from sound-mature pods to 417 ppb for LSK. Except for the sound-mature-pod category, the T15 kernels contained much higher concentrations of aflatoxin, ranging from 6,953 ppb to 14,159 ppb. The average percentages of R15 and T15 kernels from each pod category (data not given) and the corresponding average concentrations of aflatoxin shown in Table 3 were used to compute the weighted-average concentrations of aflatoxin, which were 149 ppb and 10,018 ppb, respectively in the R15 and T15 kernels. When R15 kernels from the LSK were excluded, as is sometimes done in commercial shelling operations, the remaining R15 kernels contained 122 ppb aflatoxin rather than 149 ppb.

Effect of Irrigation on Insect Damage, A. flavus Growth, and Aflatoxin Contamination. Samples of shelled peanuts were obtained from a 1968 irrigation experiment conducted in a drought area northeast of Scotland Neck, North Carolina. Five varieties of peanuts (NC-2, NC-15718, NC-5, Florigiant and Va-61-R) and 5 irrigation treatments were used in the experiment. The irrigation treatments were (A) no irrigation (B) irrigation each time soil moisture dropped below 20% of field capacity throughout the growing season, (C) irrigation each time soil moisture dropped below 20% of field capacity from July 1 through July 31, (D) irrigation each time soil moisture dropped below 20% of field capacity from August 1 through August 31, and (E) irrigation each time soil moisture dropped below 20% of field

[1/] All aflatoxin analyses given in this paper were according to Pons' method (5).

Table 2. Distribution of kernels in composite samples of segregation-3 peanuts from 10 different farms according to pod condition and visible Aspergillus flavus growth.

Sample Number	Number of Samples in Composite Sample	Pod Category: Sound Mature		Insect Damage[1]		Mechanical Damage		LSK (Pods Removed)		Other[2]		TKW (kg)
		% of TKW[3]	No. AFK[4]	% of TKW	No. of AFK	% of TKW	No. of AFK	% of TKW	No. of AFK	% of TKW	No. of AFK	
1	5	19.1	0	12.7	7	9.8	1	8.4	3	50.0	4	3.3
2	5	6.8	0	36.0	8	4.6	1	7.8	9	44.6	0	3.1
3	6	26.7	0	37.6	1	10.4	2	10.9	2	14.3	1	3.8
4	7	22.6	0	4.3	1	10.7	0	8.1	2	54.3	0	4.0
5	5	24.2	0	16.1	3	12.3	0	4.3	1	43.1	0	2.8
6	6	31.7	0	20.0	5	8.1	1	4.9	2	35.3	3	2.9
7	5	15.7	0	11.8	4	13.6	1	23.6	3	35.4	0	3.5
8	5	25.7	0	14.6	10	9.2	1	10.0	5	40.5	1	2.4
9	6	12.7	0	19.6	6	16.2	1	12.3	1	39.2	0	2.9
10	7	28.9	0	14.8	2	13.1	1	10.1	3	33.0	1	3.9
Average	5.7	21.4	0.0	18.8	4.7	10.8	0.9	10.0	3.1	39.0	1.0	3.3
Avg. incidence of AFK		0.0 AFK/kg		7.6 AFK/kg		2.5 AFK/kg		9.4 AFK/kg		0.8 AFK/kg		

[1] Most insect damage was typical of lesser cornstalk borer damage (13).
[2] Immature, shriveled, and discolored pods.
[3] TKW designates the total kernel weight of the sample.
[4] AFK designates kernels with visible Aspergillus flavus growth.

Table 3. Concentrations of Aflatoxin in Groups of Kernels Shelled from Segregation-Peanuts and Grouped According to Pod Condition, Kernel Size and Kernel Condition.[1/2/]

Sample Number	Pod Category										Aflatoxin Concentration in Total Sample
	Sound-Mature		Insect Damage[3/]		Mechanical Damage		LSK (Pod) Removed)		Other[4/]		
	R15	T15	R15	T15	R15	T15	R15	T15	R15	T15	
1	0	*	119	17,963	28	8,025	175	1,090	61	42,817	1,921
2	85	*	85	8,933	339	12,348	923	16,520	132	2,510	5,243
3	13	*	25	1,409	46	899	503	11,950	76	4,129	375
4	43	*	204	646	109	284	14	4,561	14	0	125
5	6	*	6	8,464	113	292	63	21,500	103	446	483
6	4	*	134	6,207	73	33,446	1,697	38,064	1,173	10,540	1,372
7	34	*	76	4,356	55	1,204	181	10,935	23	146	250
8	7	*	14	46,177	1,051	20,058	477	25,291	159	5,164	2,257
9	84	*	13	10,872	50	310	76	11,036	97	265	1,060
10	9	*	23	2,368	12	7,717	61	640	14	3,510	191
Average	29	0[5/]	70	10,740	188	8,458	417	14,159	185	6,953	1,328

[1/] Concentrations expressed in parts per billion (ppb).

[2/] All kernels from each pod category were screened over a 15/64-inch screen. Kernels that passed through the screen and all moldy, decayed or discolored kernels (T15) were analysed separately from sound kernels that rode the screen (R15).

[3/] Most insect damage was typical of lesser cornstalk borer damage (4).

[4/] Immature, shriveled and discolored pods

[5/] Only a composite sample for all 10 samples was analysed.

capacity from August 16 through September 15. Irrigations were made to field capacity and were applied when the soil moisture dropped below 20% of field capacity in the upper 2 feet of soil.

Soil moisture was measured with Delmhorst gypsum blocks placed 18 inches below the surface in each plot (4 replications for each treatment). Percent field capacities were calculated from these measurements made in July, August, and September (Table 4). The peanuts were dug on September 26, combined on October 2, and dried immediately thereafter.

Twenty-five 2-kg samples of kernels were obtained from the irrigation study (5 varieties X 5 treatments). In each sample kernels with visible A. flavus growth and insect damage were counted. Some kernels with both visible A. flavus and insect damage were counted in each category. Although the type of insect damage could not be identified on the shelled kernels, most damage appeared to have been caused by LCB (4). Table 5 gives the counts and aflatoxin concentrations of the samples. The incidence of kernels with visible A. flavus growth (AFK) appears to be related to soil moisture in the period after the peanuts were formed and before digging. For irrigation treatments A and C AFK averaged 15 and 10 per 2-kg sample, respectively. These peanuts were subjected to extremely dry soil conditions from July 26 through September 12 (Table 4). In treatments B, D and E average counts of AFK were 1, 0, and 0, respectively. In treatments B and D soil moisture was at least 20% field capacity for most of the period between July 8 and September 12. For treatment E, the percent field capacity fell below 20% between July 26 and August 16, but this period of drought apparently did not cause the development of AFK.

The average count of kernels with insect damage and the average concentration of aflatoxin in the samples also were maximum for treatments A and C in which the soil was extremely dry between July 26 and September 12. In treatment E the extremely dry period between July 26 and August 16 did not cause higher insect damage or aflatoxin concentration than found in treatments B and D where the field capacity was above 20% for most of the period between July 8 and September 12. Because aflatoxin test results are highly variable (6) the average of 49 ppb for treatment B probably does not differ significantly from the 13 and 11 ppb concentrations for treatments D and E.

SUMMARY AND DISCUSSION

The geographical distribution of rainfall and of farms which produced segregation-3 peanuts in North Carolina suggest that drought after peanuts are formed but before they are dug is conducive to their infection with A. flavus before digging. Damage from the lesser cornstalk borer (LCB) also might favor this infection. However, many drought-area fields infested with LCB did not produce segregation-3 peanuts.

The segregation-3 peanuts were harvested and cured according to generally accepted practices; most were harvested under dry conditions which are considered to prevent mold growth in the windrow. Aspergillus flavus growth and aflatoxin contamination probably occurred before the peanuts were dug. Some peanuts which contained visible A. flavus growth and high concentrations of aflatoxin were found on freshly-dug plants in two fields.

Typical LCB damage was found on some pods in 96% of the samples taken from lots of segregation-3 peanuts. The incidence of kernels with visible A. flavus growth (AFK) appeared to be related to pod condition. There were 9.4, 7.6, 2.5, 0.0 and 0.8 AFK per kg of kernels from LSK, insect-damaged pods, mechanically-damaged pods, sound-mature pods and other pods, respectively. Many of the LSK probably came from LCB-damaged pods which are easily shelled by harvesting; so kernels from LCB-damaged pods apparently had a much higher incidence of AFK than did kernels from pods with any other type of damage.

Aflatoxin analyses of shelled kernels indicate that sizing and sorting operations in commercial shelling plants would not have removed all aflatoxin-contaminated kernels from these segregation-3 peanuts. Kernels with no visible damage that passed over a 15/64 inch slotted screen (R15) contained an average of 149 ppb

Table 4. Percent field capacities based on soil moisture measurements with Delmhorst gypsum blocks placed 18 inches deep in each experimental plot.

Treatment[2/]	Date of Measurements[1/]																		
	JULY							AUGUST									SEPTEMBER		
	8	12	15	19	23	26	30	2	6	9	12	16	19	23	27	30	4	9	12
A	18	22	37	39	24	4	1	0	0	0	0	0	10	2	0	0	0	0	0
B	28	30	38	40	25	12	27	24	50	50	41	28	29	24	29	26	41	37	29
C	25	25	33	27	22	9	18	13	4	2	1	1	2	1	0	0	0	0	0
D	29	39	45	35	28	15	19	16	36	43	35	28	39	27	40	30	50	52	38
E	26	28	44	35	20	6	3	1	1	0	1	0	45	36	52	35	47	40	29

[1/] Readings made with 4 different blocks were averaged for each measurement except for July 19 when only 3 readings were made.

[2/] Treatment designations:

A. No irrigation
B. Irrigation each time soil moisture dropped below 20% of field capacity throughout the growing season.
C. Irrigation each time soil moisture dropped below 20% of field capacity from July 1 through July 31.
D. Irrigation each time soil moisture dropped below 20% of field capacity from August 1 through August 31.
E. Irrigation each time soil moisture dropped below 20% of field capacity from August 16 through September 15.

Table 5. Number of kernels with visible *Aspergillus flavus* growth, number of insect-damaged kernels and concentration of aflatoxin in 2-kg samples of shelled peanuts from 5 irrigation treatments (1968)[1/]

Variety	No. kernels in sample with visible *A. flavus* growth					No. kernels in sample with insect damage					Aflatoxin concentration in sample (parts per billion)				
	Treatment					Treatment					Treatment				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
NC-2	34	3	4	0	0	190	18	71	14	17	1278	94	139	7	0
NC-15718	12	0	34	0	0	127	14	110	11	16	856	100	2279	16	0
NC-5	20	0	8	0	0	124	16	90	18	8	684	18	914	0	12
Florigiant	8	0	2	0	0	80	8	34	13	12	914	0	572	44	0
Va-61-R	1	3	4	0	0	84	12	101	17	24	450	34	166	0	44
Average	15	1	10	0	0	121	14	81	14	15	836	49	814	13	11

[1/] Treatment designation:

A. No irrigation
B. Irrigation each time soil moisture dropped below 20% of field capacity throughout the growing season.
C. Irrigation each time soil moisture dropped below 20% of field capacity from July 1 through July 31.
D. Irrigation each time soil moisture dropped below 20% of field capacity from August 1 through August 31.
E. Irrigation each time soil moisture dropped below 20% of field capacity from August 16 through September 15.

aflatoxin. The portion that consisted of all damaged kernels in the samples and all kernels that passed through the screen contained an average of 10,018 ppb aflatoxin. Even the R15 kernels from only the sound pods contained an average of 29 ppb aflatoxin.

Analyses of peanut samples from the irrigation experiment also indicate that incidence of AFK, amount of LCB damage, and concentration of aflatoxin in farmers' stock peanuts might be related to drought conditions before digging. In treatments A and C, not irrigated from July 26 through September 12, soil moisture averaged less than 4% of field capacity. For the same period in treatments B and D, soil moisture averaged over 32% of field capacity. Treatment E averaged less than 2% of field capacity from July 26 through August 16 and over 41% of field capacity from August 19 through September 12. Incidence of AFK and LCB damage and the concentration of aflatoxin in peanuts dug from these plots on September 26 were much higher for treatments A and C than for the other treatments. These mesurements for treatment E were not markedly different than for treatment B and D. Perhaps the drought from July 26 through August 16 was too short for A. flavus inoculum to build up in the soil and for the LCB populations to increase. Also peanuts might have been so small and immature during this period that those which were damaged by LCB and/or invaded by A. flavus either deteriorated or did not become large enough to be included in the harvest. Other researchers have reported that peanuts grown under drought stress accumulated more aflatoxin before digging than irrigated peanuts (7).

Most peanuts produced in drought areas are not segregation-3; so drought alone does not cause infection with A. flavus. Hot, dry soil conditions favor the buildup of lesser cornstalk borer (LCB) and possibly other insects in the soil, and apparently favor an increase in the inoculum potential of A. flavus. The LCB may transport A. flavus spores through the pod to ideal sites for infection where the LCB feeds on the kernel. LCB damage to plants under drought stress may cause the pods to lose moisture and weaken the plant so that the peanuts are susceptable to infection by A. flavus.

A simultaneous buildup of A. flavus inoculum potential and LCB populations may be necessary before the incidence of AFK becomes important. Since the A. flavus inoculum potential and LCB populations are probably independent and subject to rapid fluctuations, the simultaneous buildup of these two populations during the critical period just before digging is probably subject to chance. Measurements of A. flavus inoculum potential in soil are valid only for the time of measurement; so it is difficult to determine prior conditions in fields which produce segregation -3 peanuts.

The relationship between LCB damage and segregation-3 peanuts might be casual because drought conditions could favor both LCB infestation and A. flavus infection by other means. Kernels from pods not damaged by LCB often contained aflatoxin. Other research has shown that Astigmated mites can enter peanut pods through small openings and dessiminate A. flavus spores while feeding on the kernels (8). Damage to pods by the LCB and other insects would facilitate entry by the mites.

Further studies are needed to determine those conditions associated with drought which cause aflatoxin contamination of peanuts.

ACKNOWLEDGEMENTS

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A SIMPLIFIED TECHNIQUE USED TO STUDY THE SHELF LIFE OF PEANUT BUTTER[1/]

by
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ABSTRACT AND PAPER

ABSTRACT

A simplified procedure was devised for direct gas-chromatographic analysis of volatiles of peanut butter. A glass rod is twisted in a jar of peanut butter until 0.2 to 0.3 gram of peanut butter adheres. The rod is then inserted into a glass inlet liner plugged at the bottom with glass wool, and the liner is placed in the heated inlet of a gas chromatograph. After 20 minutes the inlet liner with the spent sample is removed from the inlet. The volatiles that have been eluted from the peanut butter and collected on the top portion of the cool Porapak P column are resolved by gas chromatography temperature programmed between 40 and 200° C. This procedure eliminates the tedious procedure of preparing a slurry of peanut butter in a nitrogen atmosphere as previously described and also eliminates complications that may result when large amounts of water are injected into a gas chromatograph.

Gas-chromatographic profiles of volatiles were determined for 17 samples of one brand of peanut butter and 29 samples of another. These peanut butter samples had been flavor scored by their manufacturers on a hedonic scale of 0 to 10. A linear regression of flavor score on the natural logarithm of the ratio of methylbutanal to hexanal was calculated for peanut butters of each brand. For both brands, the correlation coefficients were statistically significant at the 0.5% level, and the standard errors were comparable to those of taste panels.

PAPER

INTRODUCTION

At the 1972 APREA meeting we described a direct gas-chromatographic method for the preparation of peanut butter profiles of volatiles and also discussed the correlation of volatile components of peanut butter with flavor score (1). In that method, water was added to prepare an aqueous slurry of peanut butter in a nitrogen atmosphere and an aliquot was injected onto volatile-free glass wool in the heated inlet of a gas chromatograph. The volatiles that were eluted from the peanut butter were resolved by temperature-programmed gas chromatography. The linear regression of flavor score against the ratio of the methylbutanal to the hexanal (MBA to HA) peak area yielded a correlation coefficient of 0.96 for a series of 14 peanut butter samples.

This paper describes a simpler and more versatile technique which eliminates both the use of water and the preparation of the slurry in a nitrogen atmosphere. Some results obtained with the new method are also reported.

MATERIALS AND METHODS

Flavor-scored samples of peanut butter were obtained from two manufacturers. The gas-chromatographic packing, Porapak P, 80-100 mesh, was obtained from Waters Associates, Inc.,[3/] Framingham, Mass. Silicone O-rings from TekLab, Inc., Baton Rouge, La., were conditioned for two hours at 200° C before they were used. Pyrex brand glass wool, manufactured by Corning Glass Works, Corning, New York, was heated at 200° C for about 16 hours to remove volatiles. Liners approximately 10 x 84 mm (3/8 x 3-3/8 inch) and rods 4.5 x 65 mm were cut from borosilicate glass tubing and rod, respectively.

1/ Presented at APREA Meeting, Oklahoma City, Okla., July 1973.
2/ One of the facilities of the Southern Region, Agricultural Research Service, U. S. Department of Agriculture.
3/ Use of this or other company or trade name by the Department does not imply approval or recommendation to the exclusion of others that may also be suitable.

Gas Chromatographic Procedure

A MicroTek 2000 MF gas chromatograph which was equipped with flame ionization detectors, a Westronics recorder and an Infotronics CRS integrator were used. A silicone O-ring was placed at the base of the inlet of the gas chromatograph. A glass rod was twisted in a freshly opened jar of peanut butter to a depth of about 50 mm until 0.2 to 0.3 gram sample of peanut butter adhered.

The rod with sample was placed immediately in an inlet liner that had been plugged at the bottom with glass wool, and the liner was inserted into the heated inlet of the gas chromatograph. Then the liner was tightened in position with the inlet retainer nut to produce a seal between the lower lip of the liner and the base of the inlet. When the inlet system was closed with the septum and septum nut, the carrier gas was forced to flow upward and through the liner as shown in Figure 1.

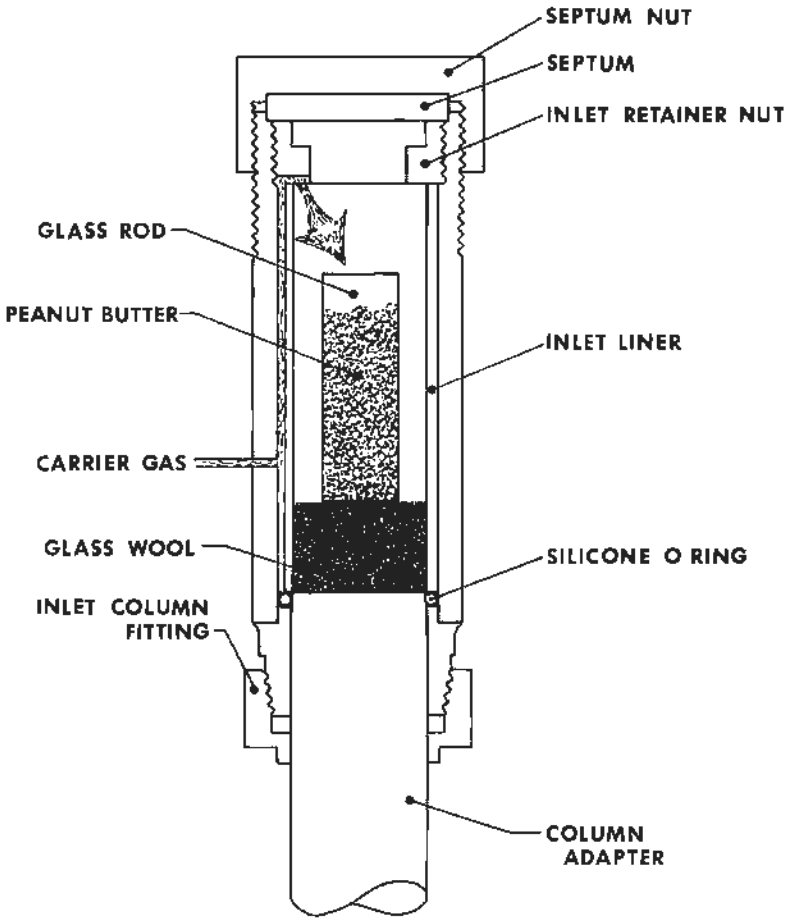

Figure 1. Cross section of gas-chromatographic inlet with inlet liner containing glass wool and glass rod.

The sweep of the carrier gas and the heat from the inlet promoted rapid and efficient elution of the volatiles, which were swept onto the top portion of the

column maintained at 40° C during an initial hold period of 20 minutes. The liner containing the spent sample was then removed from the inlet, and the volatiles were resolved by temperature programming the column oven from 40° to 200° C.

A 1/8" x 9' stainless steel U-tube packed with Porapak P was used to resolve the volatiles. The column oven was programmed for 5° per minute for 15 minutes, 2° per minute for 37 minutes, and then 200° C for 30 minutes. The temperature of the inlet was set at 120° C and that of the detector at 300° C. The flow of the nitrogen carrier gas was set at 70 ml per minute, the hydrogen at 60 ml per minute, and the air at 1.2 cubic feet per hour.

Storage and Sampling

Samples from each of eight lots of freshly prepared commercial peanut butter furnished by two processors were stored in the dark at approximately 75° F. As soon as possible after the samples were received, profiles of volatiles were obtained from one sample of each lot by the simplified gas-chromatographic method. Other samples were analyzed at intervals of about a month. The shelf life of 17 samples obtained from three lots of peanut butter from one manufacturer and 29 samples obtained from five lots of peanut butter from the second manufacturer were examined over periods of four to eleven months. Samples from the same lots were stored by the manufacturers, and the members of their taste panels also flavor-scored a sample from each lot at intervals of about a month, using a hedonic scale of 0 to 10 with 10 as the best score.

RESULTS AND DISCUSSION

As seen in Figure 2, which shows a profile of volatiles for a nine-day old peanut butter and another for a seven-month old peanut butter, storage results in a marked increase in peaks that have the same retention times as pentane and hexenal. The gradual decreases in panel flavor score and in ln of the ratio of MBA to HA peak areas for this lot of peanut butter samples upon storage are plotted in Figure 3. A similar trend was observed in the seven other lots of peanut butter.

For replicate gas-chromatographic determinations of the ratio of the MBA to HA peak areas ranging from 0.65 to 21.4, the standard error was 0.82. The standard error for samples having a ratio of less than 8 was 0.2 and for those above 8 was 1.2. It is understandable, however, that the standard error is greater for samples with higher ratios since higher ratios are associated with relatively small denominators which have relatively larger area measurement errors.

Since the panel flavor scores were not obtained on the same day that the volatiles profiles were, estimated flavor scores were calculated from the least square line for the linear regression of taste panel flavor scores on storage time for each lot of peanut butter. The estimated panel flavor scores plotted against the ln of the ratio of the MBA to HA peak areas for 17 samples of brand A from three lots of peanut butter are shown in Figure 4. In Figure 5, comparable data are plotted for 29 samples of brand B from five lots of peanut butter.

The regression analysis data are tabulated in Table I. The coefficient of correlation between the estimated flavor scores and the ln of the ratio of the MBA to HA peak areas was statistically significant at the 0.5% level. The standard error of regression indicates that this method is nearly comparable to taste panel results. The standard error of the mean taste panel flavor score was estimated from the individual flavor ratings of the panel members for each of the taste tests for samples of peanut butters from brand A. The estimated standard error of the mean taste panel score ranged from 0.274 to 1.204 with an average value of 0.552. The standard error for the linear regression of flavor score on the ln of MBA to HA for brand A was 0.765. Although higher, statistically it is not significantly different from the taste panel standard error. Further data will be required before it can be stated with a high degree of confidence that the ratio of MBA to HA can be used to predict flavor score as accurately as taste panels, but the initial data indicate there is a relationship.

Although the correlation coefficients for these subjective and objective tests of samples of two brands of peanut butter are statistically significant at the 0.5% level, further studies will be made to ascertain whether a multivariate analysis

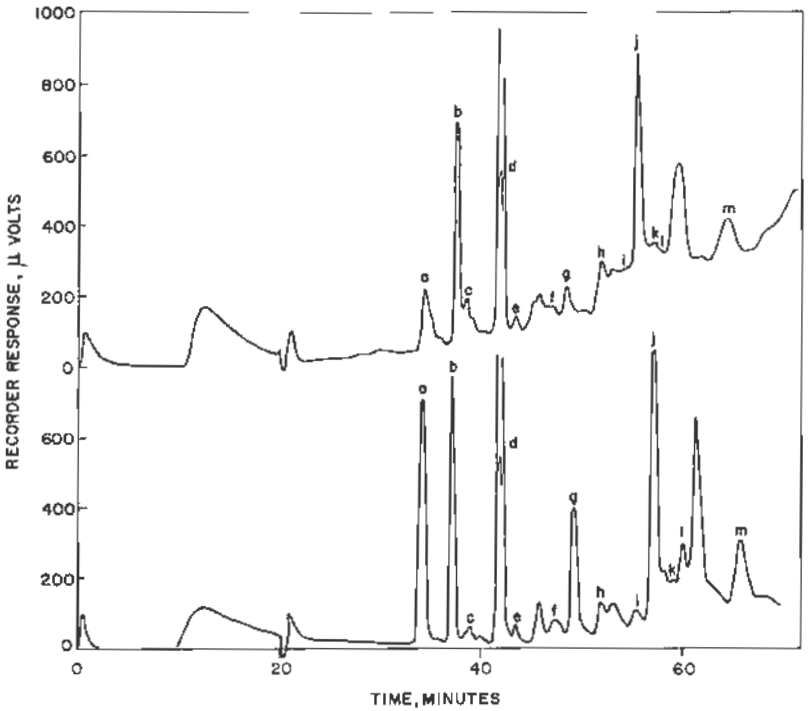

Figure 2. Gas-chromatographic profiles of volatiles from two samples of the same lot of peanut butter upon storage. The upper chromatogram was produced by a nine-day old sample, and the lower chromatogram was produced by a seven-month old sample. Tentative identification of peaks: (a) propanal, acetone, and pentane, (b) methylpropanal, (c) butanal, (d) methylbutanal, (e) pentanal, (f) pyrazine and pyridine, (g) hexanal, (h) methylpyrazine, (i) heptanal, (j) dimethylpyrazine, (k) octanal, (l) benzaldehyde, (m) phenylacetaldehyde.

TABLE I

Regression of Analysis of Estimated Flavor Score and Ln of Ratio of Methylbutanal to Hexanal Peak Areas of Peanut Butters

Data	Brand A	Brand B
Number of samples	17	29
Correlation coefficient	0.85	0.62
F-value	38.0	17.1
Significance level (%)	0.5	0.5
Standard error of estimate	0.77	0.56

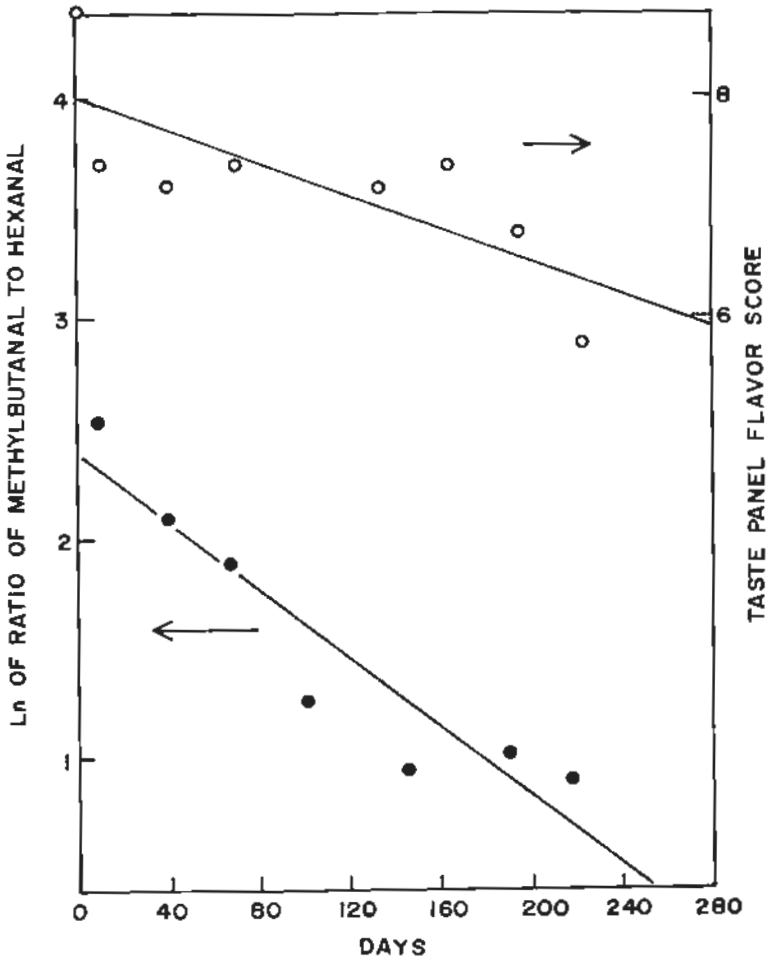

Figure 3. Linear regression lines of plots of ln of ratio of methylbutanal to hexanal and taste panel flavor score against days stored for one lot of peanut butter samples.

using more of the peaks from the profiles of volatiles yields better agreement. It will also be necessary to determine if the linear relationship between the flavor score and the ln of the ratio of MBA to HA peak areas persists during longer storage.

Since this simple technique does not require added water, it will be possible to evaluate a variety of column packings to obtain better resolution of volatiles. It should also be useful to analyze other food products, such as butters, cheese dips, jams, jellies, and spreads.

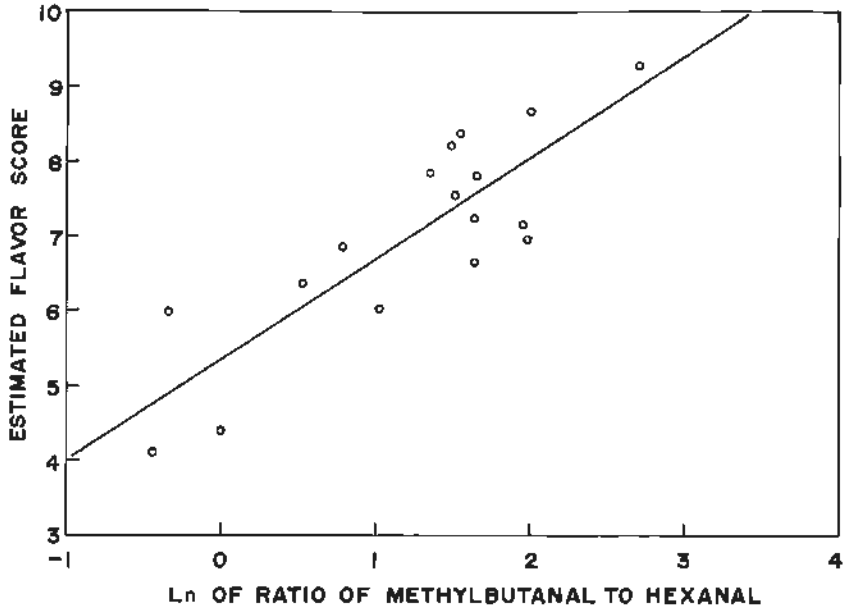

Figure 4. Linear regression line of plot of estimated flavor score against ln of ratio of methylbutanal to hexanal for samples of peanut butter from brand A.

ACKNOWLEDGMENT

We are grateful to Nancy Meadows and J. H. Conkerton for drawing the figures.

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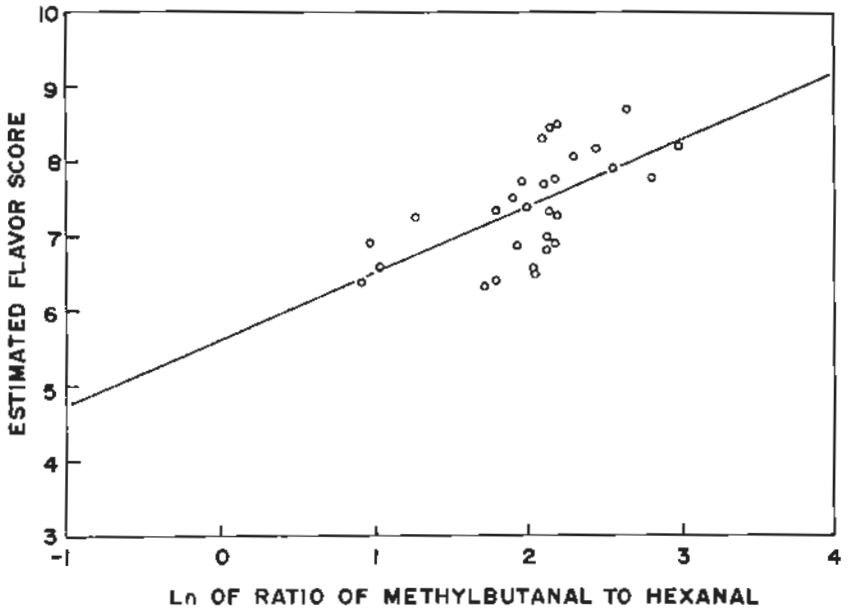

Figure 5. Linear regression line of plot of estimated flavor score against ln of ratio of methylbutanal to hexanal for samples of peanut butter from brand B.

AERODYNAMIC CHARACTERISTICS OF PEANUT COMPONENTS

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ABSTRACT

A determination of the relative flotation velocities of peanut pods and vine stems of three sizes show that size had little measurable influence on flotation velocity. However, variations in moisture content caused considerable differences in flotation velocity. Green pods and vine stems had different flotation velocities but the range of flotation velocity for dry pods and vine stems overlapped for approximately 11 percent of the velocity range.

Although the immature kernels had a lower average flotation velocity than mature kernels, the range of flotation velocity for the two groups overlapped for approximately 21 percent of the velocity range. The flotation velocity for mature kernels was highest for Spanish-type peanuts and lowest for Virginia-type peanuts. Runner-type had an intermediate flotation velocity.

Split and whole kernels had different flotation velocities, which indicated the feasibility of pneumatically separating these components.

INTRODUCTION

The aerodynamic characteristics of various peanut components determines, in part, their behavior in the separating sections of combines and cleaners, and their handling characteristics in pneumatic conveying systems. Pneumatic separation is dependent partly upon component shape, weight, and orientation in relation to the direction of airflow. Generally, components will assume a position of maximum resistance in turbulent air (1)[1/]. This means that pods, vine stems, and kernels that are longer than they are wide, tend to become orientated with their length perpendicular to the direction of airflow.

The aerodynamic property most meaningful in determining the relative separating characteristics of components in air streams is that of the component's flotation velocity. The flotation velocity is the minimum velocity required to maintain a component in suspension in an air stream or the maximum velocity a component would achieve in free-fall. If adequate differences in flotation velocity exist between components, pneumatic separation may be feasible. The objectives of this study were to construct an apparatus for measuring flotation velocities and to determine flotation velocities for several peanut components.

EXPERIMENTAL PROCEDURE

A negative pressure, variable airflow apparatus (Figure 1) was constructed to measure flotation velocities. The apparatus consisted of a tractor-powered, adjustable airflow blower, a 10.5 ft. long, 3.855-in. inside diameter pipe, a recovery hopper, a 11.5 ft. long, 5.75-in. inside diameter clear, plastic flotation tube, and a removable specimen container. Honeycomb-type air straighteners were installed in the inlets of the flotation tube and measurement pipe to nullify spirals caused by upstream disturbances. Air velocity in the measurement pipe was determined by use of a Pitot tube connected to a micromanometer. The air velocity in the flotation section was computed from this velocity and the ratio of internal areas of the two tubes. The smaller diameter measurement pipe increased the air velocity to a measurable level for light components, such as hulls.

To determine a component's flotation velocity, it was placed in the specimen container which was attached to the flotation tube. Airflow was then gradually increased by opening a motor-driven damper at the blower outlet until the component was balanced in the air stream. A complete balance could not be achieved. However,

1/ Numbers in parentheses refer to appended references.

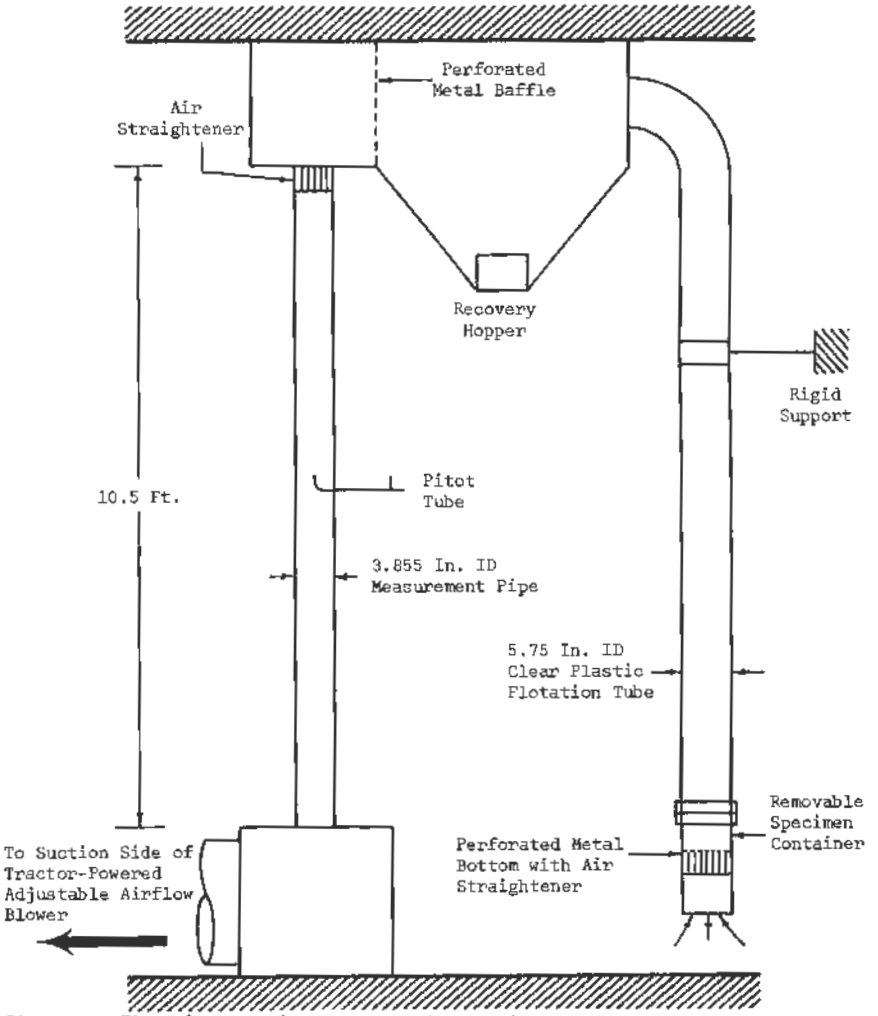

Figure 1. Flotation velocity measurement apparatus.

a component could be retained midway in the tube with a slight tumbling action and rotation about the tube's perimeter.

A slight increase in airflow above the balance point would send the component into the hopper where it could be easily recovered. A perforated metal baffle prevented the component from being forced into the blower.

Initial pitot tube traverses were made at several airflows within the range of intended measurement. A correction factor was determined to apply to center reading. In all subsequent tests, only the center measurement was obtained.

Flotation velocities were determined for various size groups of peanut pods, vine stems, mature kernels, immature kernels, split kernels, and hulls. Ten specimens of each group were tested, and an average value of flotation velocity was determined.

Freshly dug pods, 40-46 percent moisture content (mc), of Spancross and Florigiant varieties were each divided into three groups. Pods of the Florunner variety were divided into four groups with a standard presizer commonly used by the Federal-State Inspection Service. Table 1 shows the range of thickness measurements within each size group. Flotation velocities were determined for the various groups of each variety. Pods were allowed to air dry to an intermediate moisture content (24 to 31 percent mc) and the flotation velocity was again determined. Pods were then allowed to dry to approximately 7.5 percent mc and a final determination of flotation velocity was made.

TABLE 1.--Range of pod thickness within size group

Variety	Size group			
	Extra Small	Small	Medium	Large
		-Inches-		
Spancross		.354-.398	.386-.448	.443-.478
Florunner	.407-.450	.469-.502	.509-.558	.549-.611
Florigiant		.472-.521	.532-.589	.576-.688

To determine the effect of stems on the flotation velocity of pods, measurements were obtained of dry pods (7.5 percent mc) with attached stems ranging from 1 to 2 1/2 inches in length. The stems were removed and measurements were again obtained.

Kernels of Tiftspan, Florunner, and Florigiant varieties were sized with slotted screens into groups of 1/64-in. increments ranging from 11/64-in. to 24/64-in. Flotation velocities were determined for the 11/64-in. and the 14/64-in. groups of Tiftspan and Florigiant varieties since that size is representative of the immature range. Size groups 11/64-inch and 15/64-in. were selected as being representative of Florunner immatures. For the mature kernels, size groups 15/64-in. and 22/64-in. were selected for Tiftspan, 16/64-in. and 24/64-in. selected for Florunner, and 15/64-in. and 24/64-in. selected for Florigiant. Flotation velocities were determined for each of these groups. In addition, measurements were made of the 20/64-in. group for each variety tested.

The kernels representing the mature groups were split into halves and their flotation velocity determined and compared to that of the corresponding whole kernels.

Flotation velocities were also determined for Tiftspan hull halves.

RESULTS

Flotation velocity of pods: Figures 2, 3, and 4 show the range of flotation velocities of Spancross, Florunner, and Florigiant pods of various size groups and moisture contents. The small pods had 3 feet per second (fps) lower flotation velocity than the larger pods. The extra small group of the Florunner variety required an average velocity of 1 fps more to float than the small group. The velocity ranges of the different size groups overlapped for a large percentage of the velocity range.

The average flotation velocity of all varieties of green pods was 53.8 fps, 22 percent greater than the average flotation velocity of dry pods (44.0 fps). The flotation velocity of green and dry pods overlapped for approximately 13 percent of the velocity range.

The average flotation velocity of Florunner pods was 51.8 fps, 10-percent greater than the average flotation velocity of Spancross and Florigiant pods (47.3 fps). The flotation velocity of the three varieties overlapped for a large percentage of the velocity range.

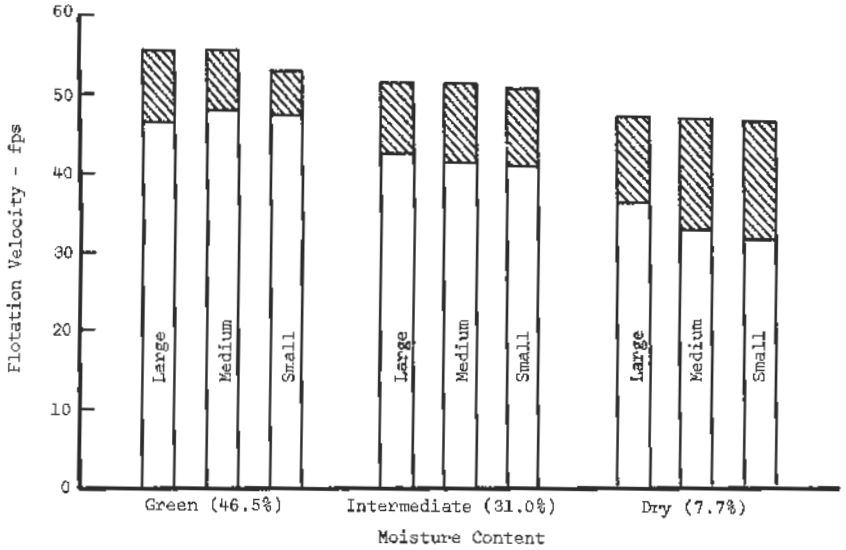

Figure 2. Flotation velocities of Spancross pods. (Shaded areas indicate range of individual measurements.)

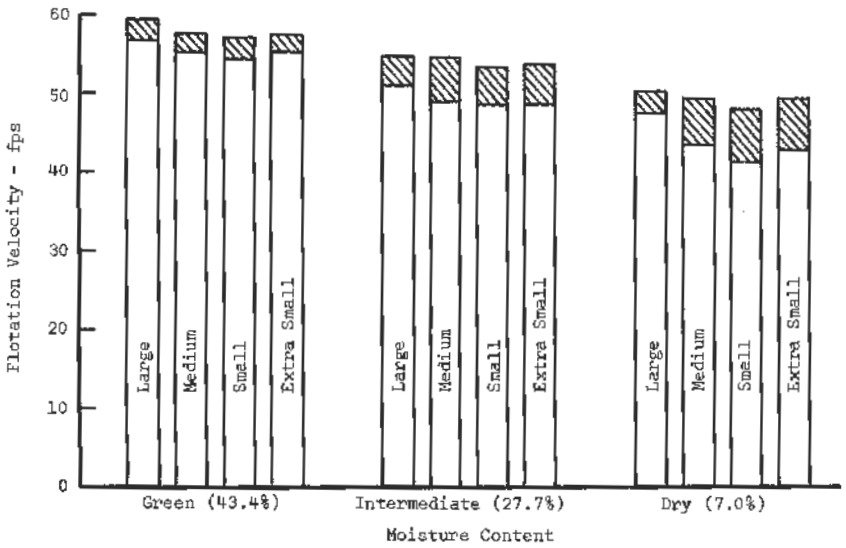

Figure 3. Flotation velocities of Florunner pods. (Shaded areas indicate range of individual measurements).

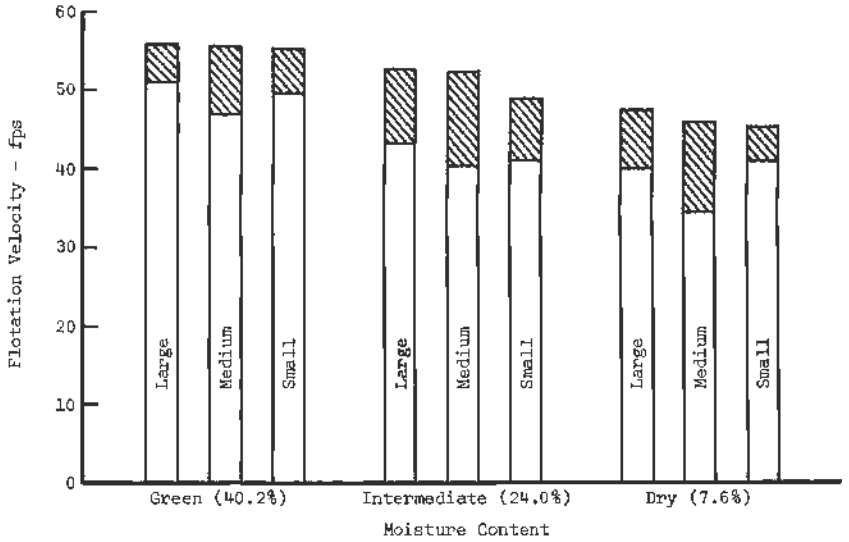

Figure 4. Flotation velocities of Florigiant pods. (Shaded areas indicate range of individual measurements.)

Stems ranging from 1 to 2-1/2 inches in length may possibly have a stabilizing effect on pods by causing pods to become orientated with maximum frontal area, thus minimizing tumbling action in the direction of airflow. The average flotation velocity of pods without stems was 46.1 fps, 2.5-percent greater than the same pods with stems (45.0 fps). These averages were not significantly different ($p>.05$).

Flotation velocity of vine stems: Figure 5 shows the flotation velocities of 1, 2, and 3-in. long vine stems at 64 and 11.5 percent mc. Green stems measured 14/64-in. in diameter, but shrank to 11/64-inch when dried. The length (1 to 3 in.) did not affect the flotation velocity for green stems. However, with dry stems (1 to 3-in. long) there was a slight trend toward higher flotation velocities for the longer stems. The average flotation velocity of green vine stems (37.6 fps) was 27 percent greater than that of dry vine stems (29.9 fps).

The flotation velocities for green pods and green vine stems were different. The green vine stems had a 30 percent lower flotation velocity than green pods.

The flotation velocities for dry pods and dry vine stems overlapped for approximately 11 percent of the velocity range. Dry stems had a 32 percent lower flotation velocity than the dry pods.

Flotation velocity of whole kernels: Figure 6 shows the average flotation velocities for Tiftspan, Florunner, and Florigiant kernels sized by slotted screens. For mature kernels (thickness >16/64-in.), the Tiftspan variety required the highest average air velocity to float a designated size group, Florunner required an intermediate air velocity, and Florigiant required the lowest air velocity.

The average weights and approximate frontal areas of 20/64-in. kernels are shown in Table 2. The frontal areas were calculated as the area of an ellipse, using the kernel length and average thickness as the major and minor axes respectively. The frontal areas and weights were representative of the area-weight relationships of all mature kernels. Florigiant kernels had approximately twice the frontal area

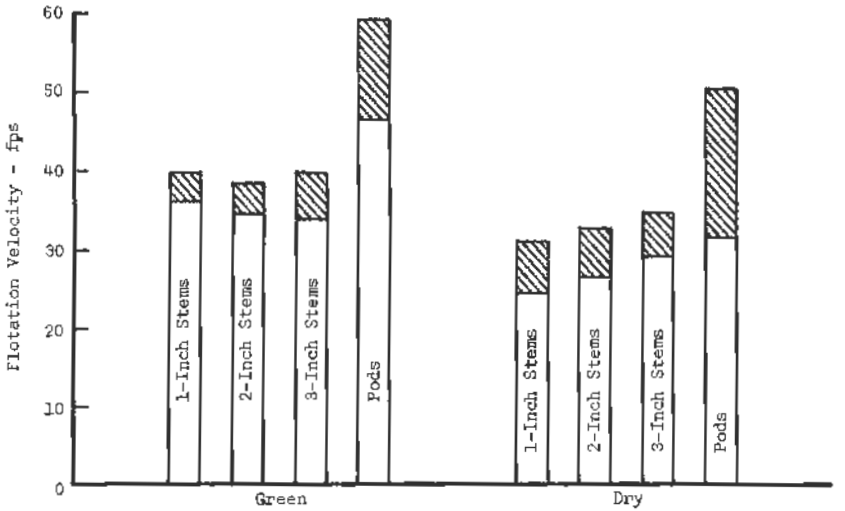

Figure 5. Flotation velocities of vine stems and pods. (Shaded areas indicate range of individual measurements.)

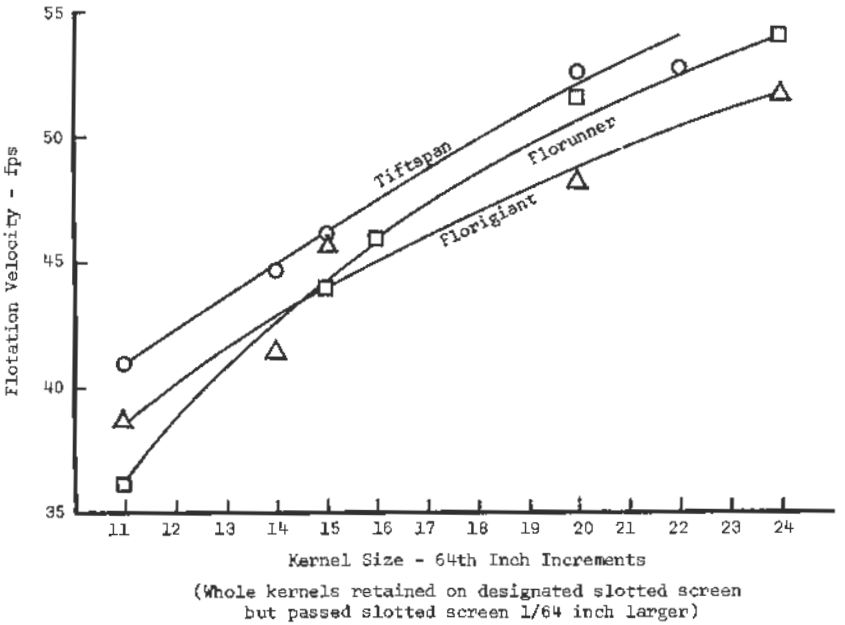

Figure 6. Average flotation velocity of whole kernels.

and weight as Tiftspan kernels. Florunner kernels were intermediate in both frontal area and weight.

TABLE 2.--Average weights and approximate frontal areas of 20/64-in. kernels

Variety	Weight	Frontal area
	(Grams)	(Inches)
Tiftspan	.481	.123
Florunner	.693	.160
Florigiant	.964	.244

Figure 7 shows the range of flotation velocities for mature and immature kernels (maturity determined by sizing). The average flotation velocity of immature kernels (40.9 fps) was 17 percent less than the average flotation velocity of mature kernels (49.3 fps). However, the range of flotation velocities for mature and immature kernels overlapped for approximately 21 percent of the velocity range.

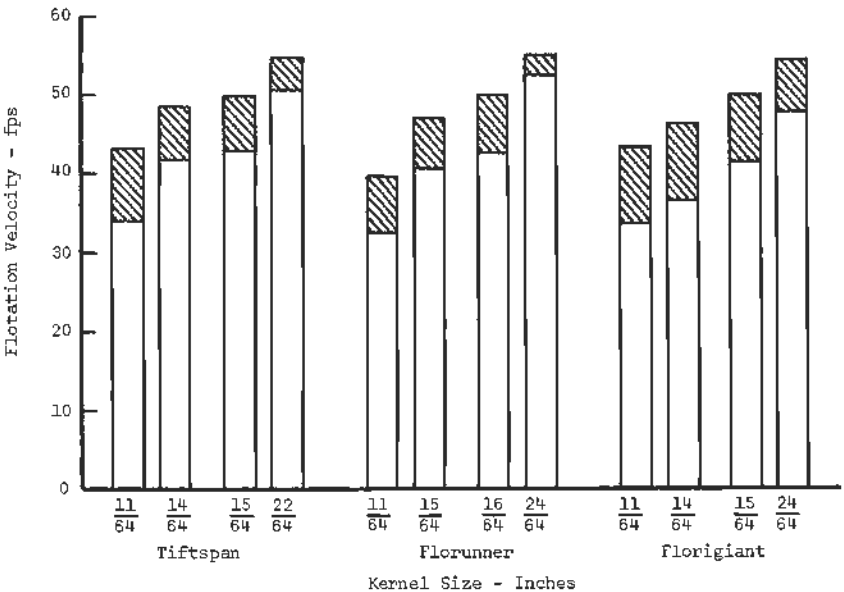

Figure 7. Flotation velocities of whole kernels. (Shaded areas indicate range of individual measurements.)

Flotation velocity of split kernels: Figure 8 shows the flotation velocity of mature whole and split kernels. Little difference in flotation velocities was indicated between like components of the three varieties. However, there is a highly significant difference ($p<.005$) between the average flotation velocity of split kernels (33.7 fps) and whole kernels (49.3 fps). This agrees closely with results of Aristizabal et al. (2). The average flotation velocity for split kernels was 32 percent less than for whole kernels. More important, however, is the fact that the flotation velocity ranges of the two components did not overlap.

This indicates the potential feasibility of pneumatically separating split and whole kernels, and deserves more research attention.

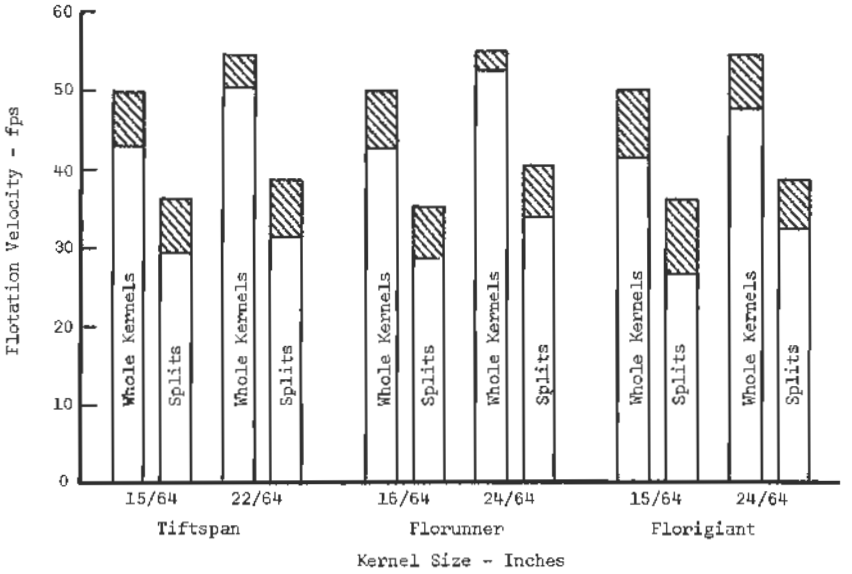

Figure 8. Flotation velocities of whole and split kernels. (Shaded areas indicate range of individual measurements.)

Flotation velocity of hulls: The average flotation velocity of Tiftspan hull halves was 14.4 fps, and individual measurements ranged from 13.5 to 15.7 fps. Hull flotation velocities (Figure 9) were compared to the overall range of flotation velocities of other peanut components.

CONCLUSIONS

The three sizes of pods and vine stems had little measurable influence on flotation velocity. However, variations in moisture content caused considerable differences in flotation velocity. Green pods and vine stems had different flotation velocities, but flotation velocity of dry pods and vine stems overlapped for approximately 11 percent of the velocity range.

Although the immature kernels had a lower average flotation velocity than mature kernels, the range of flotation velocity for the two groups overlapped for approximately 21 percent of the velocity range. The flotation velocity for mature kernels was highest for the Tiftspan variety and lowest for the Florigiant variety. Mature kernels of the Florunner variety were intermediate in flotation velocity.

Split and whole kernels had different flotation velocities, which indicated the feasibility of pneumatically separating these components. This separation deserves more research attention.

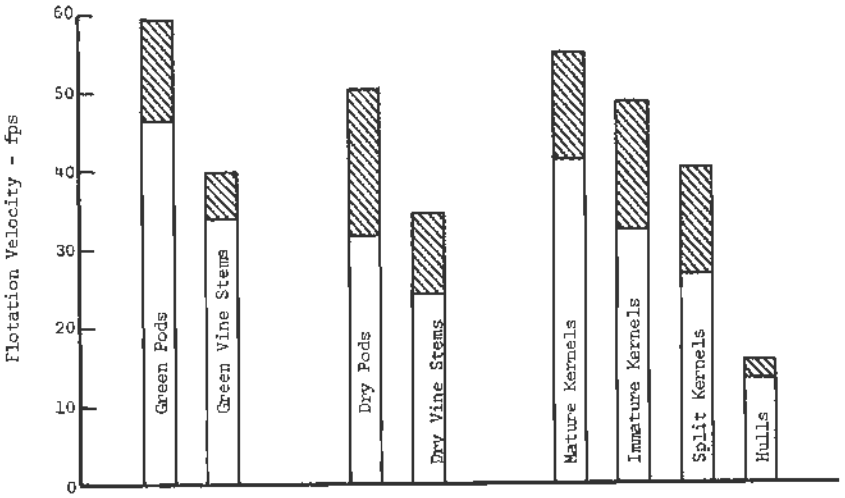

Figure 9. Flotation velocities of various peanut components. (Shaded areas indicate range of individual measurements.)

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1. Orr, Jr., Clyde. 1966. Particulate technology. MacMillan, New York.

2. Aristizabal, L., E. E. Burns, and O. R. Kunze. 1969. Physical, chemical and organoleptic properties of peanuts separated in a controlled air stream. TRANSACTIONS of ASAE. 12(3):298-301, 304.

ANALYSES OF SAMPLE QUALITY DATA FROM A GEORGIA PEANUT RECEIVING STATION

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ABSTRACT

A total of 1210 samples from the 1972 peanut crop were collected from one receiving station with the cooperation of the Federal-State Inspection Service and subjected to the quality analysis which included percentage of sound mature kernels (SMK), sound splits (SS), SMK + SS, damage, foreign matter (FM), loose shelled kernels (LSK), other kernels (OK), and moisture and dollar value per ton. Approximately 10% of these peanuts were classified as segregation 3. Spanish type peanuts appeared to have less SMK, SMK + SS, damage, FM, dollar value per ton but had more SS, hulls, and moisture than Runner type. Segregation 1 peanuts had significantly lower damage, FM, and LSK and had higher SMK, SMK + SS, total kernels, and dollar value per ton than segregation 3. The relationships among the different quality factors were evaluated and comparisons between the quality of Spanish peanuts vs Runner peanuts and between the quality of Segregation 1 vs Segregation 3 were also examined.

INTRODUCTION

Peanuts are the most important cash crop in Georgia. The State's farmers produced more than 670,000 tons and over 40 percent of the nation's peanut crop in 1972.

Over 70 percent of the Georgia acreage was planted with Florunner, with the remainder being Starr, Argentine, Tifspan, Spancross, Florigiant, and other varieties. Despite Georgia's record yield, the 1972 peanut crop had more segregation 3 peanuts than in 1971 (1).

Through a joint effort of the Oklahoma Peanut Commission, Oklahoma State Department of Agriculture and U. S. Department of Agriculture, a comprehensive report on the quality of the 1970 Oklahoma peanut crop was compiled and published in 1971 (2). The purpose of this quality survey was to enable the growers and the purchasers of Oklahoma peanuts to know more about the quality of their crop. It also pointed up that information regarding peanut quality of Georgia farmers' stock peanuts was limited and not readily available. Such information is important to the maintenance and improvement of this State's peanut quality.

The objective of this study was to examine and evaluate data for the various factors related to peanut market quality based on samples collected from Federal-State Inspection Service at DeSoto, Georgia during the 1972 harvesting season. A related study to be published later will relate these "market" quality values to certain chemical composition changes that are being determined on the same samples.

MATERIALS AND METHODS

Detailed market quality data were obtained for 1210 samples of 1972 peanut crop collected by the Federal-State Inspection Service at one receiving station located at DeSoto, Georgia. The peanuts were grown in the DeSoto area. The samples included 556 of the Spanish type and 654 of the Runner type.

The samples were received for inspection during the period of August 22 to October 5. Data for the accumulated tonnage of 1972 peanut crop (10) for the same period were also collected from Georgia and Texas in order to provide comparisons between these two states and between the state and DeSoto area.

All loads of peanuts were sampled for inspection mechanically according to the method reported by USDA (6). The market quality factors, used to determine the grade of a peanut sample, were sound mature kernels (SMK), sound splits (SS), damage, other kernels (OK), total kernels, moisture, foreign material (FM), loose shelled kernels (LSK), and hulls. The data were recorded on Form MQ (7) as percentage of the total for each peanut sample. Definitions for each of these terms has been set forth by USDA (6). Any samples contaminated with Aspergillus flavus were classified as non-edible (Segregation 3).

According to Farmers' Stock Quality Regulations (8) for peanuts which were established jointly by the Marketing Agreement Administrative Committee and the Peanut Price Support Agency of the USDA, the peanuts were classified as follows:

Segregation 1 shall include all farmers' stock peanuts with not more than 2.49% damage, not more than 1.00% concealed damage caused by rancidity, mold or decay, and no visible A. flavus.

Segregation 2 shall include all farmers' stock peanuts with 2.5% or more damaged kernels, and/or more than 1.00% concealed damage caused by rancidity, mold or decay, no visible A. flavus, and offensive odor.

Segregation 3 peanuts include any amount of A. flavus regardless of the percentage of damaged kernels or whether offensive odor is found in the load.

Statistical analyses on each of the quality factors were conducted, including Student's t-tests (5) for the difference between two means. Correlation coefficients between any two quality factors were estimated.

RESULTS AND DISCUSSION

Table 1 shows the number of samples and tonnage for each type of peanut and each segregation. These were from 77 peanut producers in the DeSoto area who produced nearly 6 thousand tons of peanuts which made up approximately 0.9% of Georgia's total 1972 production. Individual growers produced less than 3 tons up to 200 tons. The samples from the DeSoto area had slightly more of the Runner type than of the Spanish type peanuts. However, the Runner type contained more than twice the incidence of segregation 3. Among the 77 producers, 44 produced one or more loads of segregation 3 peanuts.

Table 1. Samples and tons of 1972 peanut crop collected by the Federal-State Inspection Service at DeSoto, Georgia

Type	Segregation	No. of Samples	No. of Tons
Spanish	1	511	2470.53
	3	45	179.70
Runner	1	558	2830.52
	3	96	463.41

Fig. 1 shows that the trends for the accumulated tonnage from the DeSoto area and the state of Georgia were essentially similar for both segregations 1 and 3. While the delivery dates in the DeSoto area were from August 22 to October 5, the receiving dates for the entire state of Georgia covered a longer time period. No segregation 2 peanuts were inspected at DeSoto and only a relatively small quantity of this group of peanuts was produced on a state wide basis. However, both the DeSoto area and Georgia produced substantial amounts of segregation 3 peanuts which amounted to more than 10 percent of the total tonnage from either

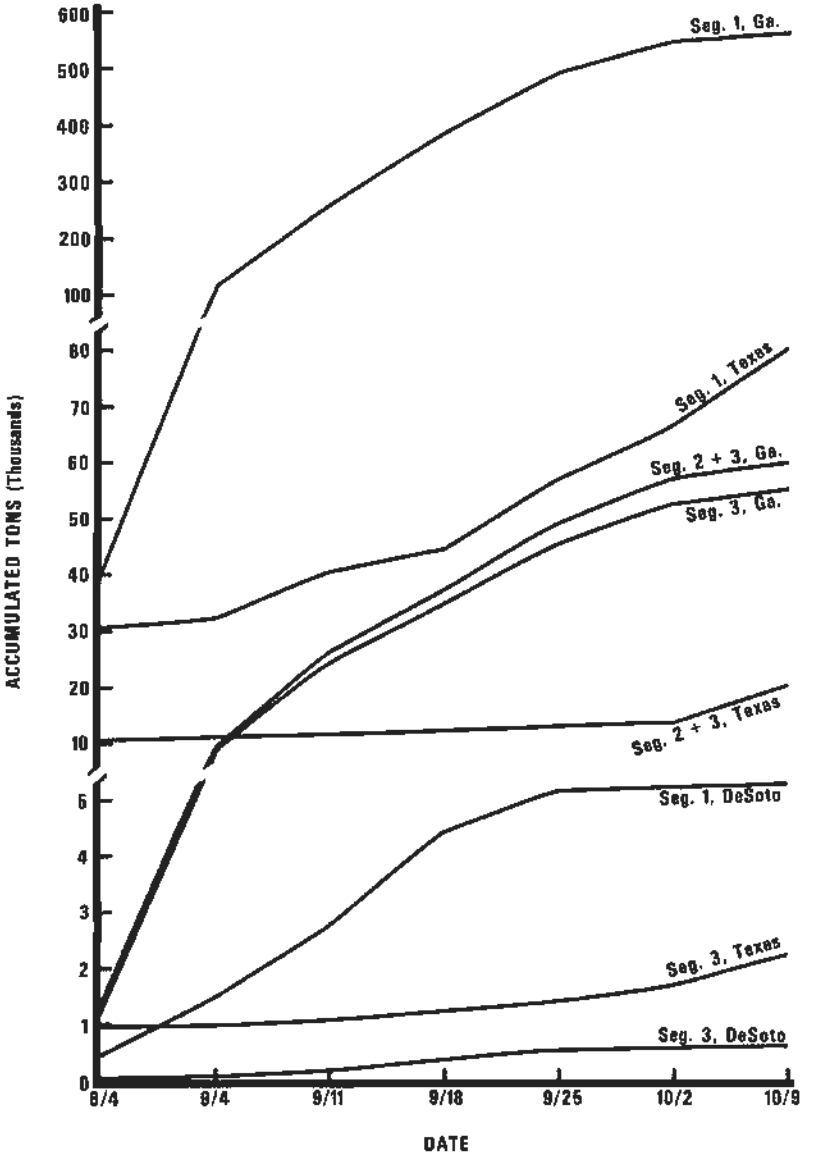

Figure 1. Accumulated tonnage of 1972 peanut crop from August 28 through October 9 at DeSoto, Georgia, and Texas.

DeSoto or the entire State. In the similar period of harvesting season from August 28 through October 9, 1972, Texas had relatively lower quantities of segregation 3 peanuts than did Georgia and this category of peanuts did not significantly increase during the harvesting season. However, Texas produced a larger quantity of segregation 2 peanuts than segregation 3. At least part of the difference may be attributed to the fact that over 70 percent of Georgia peanut acreage was planted with Florunner; whereas, in Texas, nearly all of the peanut acreage was of the Spanish type. Also, Georgia had unusually dry weather in most peanut producing areas during the 1972 growing season, particularly during the latter half.

Mean values for quality factors and dollar value per ton for two peanut types and two segregations and mean values for the 1970 Oklahoma crop are shown in Table 2. The difference between Spanish and Runner types was highly significant in SMK, SS, SMK + SS, damage, total kernels, hulls, FM, and dollars per ton. There were no significant differences between these two types on OK, LSK, and moisture. Spanish type samples had lower average values for SMK, SMK + SS, damage, FM, dollar value per ton than Runner type, but higher mean values for SS, hulls, and moisture.

Table 2 also shows that the differences between segregations 1 and 3 were highly significant for all variables except SS and OK. Segregation 1 peanuts had higher dollar value per ton but less damage, hulls and LSK than that of segregation 3. The results indicated that damage and SS were closely related with segregation 3 peanuts. Segregation 1 peanuts had significantly lower damage, FM, and LSK and higher SMK, SMK + SS, total kernels and dollar value per ton.

Table 2. A comparison of mean values for quality factors and dollars per ton for two peanut types and two segregations and mean values for Oklahoma 1970 crop

	DeSoto Area (1972)						Oklahoma[a]
	Spanish	Runner	(R-Sp)	Seg. 1	Seg. 3	(Seg. 1-Seg. 3)	1970 Crop
SMK	68.68	72.03	**	70.59	69.73	**	60.54
SS	5.57	3.55	**	4.48	4.47	NS	5.12
SMK + SS	74.25	75.58	NS	75.07	74.21	**	65.66
OK	3.29	3.24	**	3.27	3.22	NS	6.42
Dam.	0.22	0.31	**	0.22	0.67	**	0.56
Total K	77.76	79.14	**	78.56	78.10	**	72.64
Hulls	22.00	20.84	**	21.31	21.87	**	27.38
FM	3.29	3.95	**	3.58	4.14	**	5.01
LSK	5.82	6.11	**	5.83	7.07	**	3.01
Moist.	8.75	8.41	NS	8.60	8.33	**	8.67
Dollars/ton	301.71	306.92	**	304.94	301.38	*	243.45

*Significant at 5%; **Significant at 1%; NS non-significant.
[a]Reported in Oklahoma 1970 Peanut Quality Report (2).

The mean values for each type and each segregation are shown in Table 3. Spanish type peanuts showed less difference between segregations 1 and 3 in most of the quality factors than did the Runner type. Segregation 1 peanuts in both Runner and Spanish types generally had more SMK, SMK + SS, total kernel, moisture, and dollar value per ton, but had less SS, damage, hulls, FM and LSK than segregation 3. These results support the fact that only LSK, OK, and damaged kernels are examined separately for A. flavus is essentially adequate and valid. Further evidence from Porter, Wright, and Steele (3) also supported this conclusion. They reported that peanut seed from fruit with visible damage (shell damage detected visually) and invisible damage (shell damage detected by a staining technique) were colonized more frequently by A. flavus than those from sound fruit (no visible or invisible damage). They also pointed out that seed from invisibly damaged fruit were colonized almost as rapidly as seed from visibly damaged fruits. If in the future, the invisible damage is considered to be as important as visible damage, then the proportions of segregations 2 and 3 peanuts will likely be increased.

Table 3. Mean values for various quality factors and dollars per ton for four groups of peanuts

	Spanish Type			Runner Type		
	Seg. 1	Seg. 3	(Seg. 1-Seg. 3)	Seg. 1	Seg. 3	(Seg. 1-Seg. 3)
SMK	68.77	67.62	NS	72.26	70.72	**
SS	5.55	5.87	NS	3.51	3.81	NS
SMK + SS	74.32	73.49	*	75.75	74.54	**
OK	3.31	3.13	NS	3.25	3.27	NS
Dam.	0.18	0.67	**	0.25	0.67	**
Total K	77.80	77.29	*	79.26	78.48	**
Hulls	21.95	22.67	NS	20.73	21.49	**
FM	3.28	3.38	NS	3.86	4.50	**
LSK	5.82	5.89	NS	5.85	7.63	**
Moist.	8.79	8.31	NS	8.43	8.34	NS
Dollars/ton	302.00	298.42	NS	307.64	302.77	**

NS non-significant; *significant at 5%; **significant at 1%.

Aflatoxin produced by the fungus Aspergillus flavus is still the most serious threat to the U. S. peanut quality. Fig. 1 indicates that more than 10 percent of the 1972 peanut crop in Georgia was classified as segregation 3. This is substantially higher than for the 1971 crop (1). The extremely dry growing season may have been an important contributing factor. Sellschop (4) pointed out that peanuts become visibly infected by fungi when they are damaged by certain animals, insects, or when the pods burst in the soil as the result of alternating humid and drought conditions. The present results showed that the amounts of damage, FM, and LSK were higher in segregation 3. The increase of damage might have been due to the dry growing season and the concurrent increase in activity of the insects.

Table 4 shows that there was considerable variability for each of the quality factors and dollar value per ton among the 77 peanut producers. Primarily, this variability would be due to differences in peanut types, varieties, maturity, soil

and weather conditions, cultural practices, pesticide use, harvesting, and curing. If Oklahoma's statewide peanut quality contest standards (2), in which the peanut could not exceed 1% sound split, 1% LSK, 3% FM, and "0 %" damage, were applied to the present study, only one out of 1210 samples could meet all these qualifications and weight requirement.

Table 4. The means and ranges for various quality factors and dollars per ton for 77 peanut producers at the DeSoto area

	Mean	Range
SMK	69.96	60.00 - 73.53
SS	4.38	1.00 - 10.43
SMK + SS	74.91	69.80 - 78.85
OK	3.55	1.43 - 6.12
Dam.	0.34	0.00 - 1.00
Total K	78.23	75.20 - 82.00
Hulls	21.66	18.00 - 25.50
FM	3.36	1.50 - 5.74
LSK	5.76	2.00 - 11.53
Moist.	8.50	6.83 - 10.00
Dollars/Ton	302.40	287.35 - 318.27

The correlation coefficients between 12 variables for 1069 samples of segregation 1 peanuts and for 141 samples of segregation 3 are shown in Tables 5 and 6, respectively. SS have a negative significant correlation with SMK. OK also have negative significant correlations with SMK, SS, and SMK + SS, in both segregations 1 and 3 peanuts. The percentage of damaged kernels is closely related with SMK and SMK + SS, but not with SS and OK.

Hulls have, as expected, highly negative correlations with SMK, SMK + SS, and total kernels, but their relationship with SS is nonsignificant in segregation 1. Hulls have been found to have positive, significant correlations with OK and damage. Florunner peanuts, for instance, have a lower percentage of hulls than most of the Spanish type peanuts. This thinner shell might contribute to the higher incidence of segregation 3 peanuts found in the 1972 Georgia Runner crop as compared to the Spanish crop.

In both segregations 1 and 3 peanuts, LSK and FM have a positive, significant correlation. It also indicates that the positive correlation between LSK and SS is highly significant. This relationship shows that these two factors might be controlled by the common peanut shell characteristics and environmental factors which would produce either more or less SS and LSK. The correlation between LSK and SMK is negative, significant in both segregations 1 and 3. These relationships indicate that by reducing the LSK, one could expect a significant increase in SMK.

The moisture content of the peanut kernels shows a significant, positive correlation with SMK, and a negative correlation with SS in both segregations 1 and 3 peanuts. This relationship is small when SMK and SS are pooled. When a peanut sample is of a rather low moisture content, one will obtain a relatively higher SS and lower SMK. Woodward and Hutchison (11) pointed out that all three types of

Table 5. Correlations between 12 variables for Segregation 1 samples from DeSoto

	SMK	SS	SMK + SS	OK	Dam.	Total K	Hulls	FM	LSK	Moist.	Tons	Value/ Ton
SMK	1	-.699	.646	-.417	-.116	.657	-.648	-.100	-.227	.353	.101	.658
SS		1	.130	-.247	-.016	.006	.000	.191	.384	-.475	-.046	.096
SMK + SS			1	-.808	-.170	.881	-.862	.065	.091	-.016	.085	.973
OK				1	-.013	-.488	.509	-.132	-.164	.018	-.079	-.732
Dam.					1	-.020	.082	.117	.102	-.015	-.073	-.208
Total K						1	-.936	.023	.037	-.014	.054	.901
Hulls							1	-.026	-.031	-.037	-.070	-.896
FM								1	.264	-.046	-.069	.043
LSK									1	-.208	.034	.079
Moist.										1	.048	-.010
Tons											1	.090
Value/Ton												1

Significance for 1067 degrees of freedom; <.062 (5%): <.081 (1%).

Table 6. Correlations between 12 variables for Segregation 3 samples from DeSoto

	SMK	SS	SMK + SS	OK	Dam.	Total K	Hulls	FM	LSK	Moist.	Tons	Value/ Ton
SMK	1	-.697	.664	-.240	-.247	.677	-.724	-.196	-.335	.469	.185	.686
SS		1	.071	-.259	-.089	-.122	.211	.203	.397	-.575	.010	.033
SMK + SS			1	-.600	-.440	.815	-.786	-.059	-.048	.052	.267	.988
OK				1	-.044	-.210	.193	-.067	-.066	.018	-.136	-.479
Dam.					1	-.124	.208	.030	.065	.080	-.144	-.491
Total K						1	-.919	-.124	-.077	.134	.227	.857
Hulls							1	.162	.128	-.217	-.276	-.830
FM								1	.524	-.059	.025	-.079
LSK									1	-.345	.014	-.069
Moist.										1	.025	.061
Tons											1	.271
Value/Ton												1

Significance for 139 degrees of freedom; <.165 (5%): <.216 (1%).

peanuts, Virginia, Runner, and Spanish, followed the same trend in which percent split kernels decreased as the relative humidity (%) increased. The correlation between moisture content and LSK is negative and significant in both segregations 1 and 3 peanuts. This indicates that drier peanuts will give more LSK.

It was of interest to determine if the weight of each load of peanuts had any influence on the quality of farmers' stock peanuts. The present results indicated that tonnage was not correlated with SS, total kernels, LSK, and moisture. In segregation 1 peanuts, tonnage showed a significant negative correlation with OK, damage, hulls, and FM.

The value of peanut dollars per ton was calculated using the 1972 Peanut Price Support Schedule issued by ASCS-USDA (9). Whether or not deduction for damage, FM, and SS was charged depended upon the percentage of each factor. This variable had highly significant, negative correlations with OK, damage, and hulls. Dollars per ton were positively correlated with SMK, SMK + SS, and total kernels.

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CHANGES IN GRADE FACTORS OF VIRGINIA AND NORTH CAROLINA FARMER STOCK PEANUTS DURING STORAGE

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SUMMARY

A study was conducted to investigate changes in grade factors of farmer stock peanuts during storage. Changes in grade factors and quantity loss were defined as "shrinkage". The effects of controlled drying conditions, simulated warehouse storage, and warehouse storage on changes of grade factors were studied.

Two controlled drying conditions and two harvesting dates were investigated in Part I of the study to determine the effect of these variables on the shrinkage of peanuts during storage. Samples of these peanuts were graded after drying and storage for selected periods of simulated warehouse conditions.

For Part II of the study, samples of peanuts were collected from two commercial buying points (Holland, Virginia and Conway, North Carolina) to determine when and how much shrinkage occurred in farmer stock peanuts. Samples were collected over a 5-week period, divided into subsamples and graded after 1, 7, 14, 28, and 92 days of simulated warehouse storage.

For Part III, peanut samples were placed in a bulk peanut warehouse, stored for 72 days and graded when the warehouse was emptied. Samples of the same peanuts were stored under simulated conditions at the Tidewater Research and Continuing Education Center, Holland, Va., and graded after 0, 7, 14, 28, and 72 days of storage to compare actual warehouse storage to simulated warehouse storage.

Under simulated storage, grade factors other than kernel grade moisture deteriorated only gradually with time. Grade moisture decreased approximately one percentage point during the first 24 hours after removal from the dryers and continued to decrease gradually for 28 to 30 days. Grade moisture stabilized at approximately 6½ percent.

Peanuts stored in the warehouse had no significant deterioration in grade factors.

The observed gradual deterioration in grade factors and kernel moisture loss does not explain the quality and quantity losses reported by the shellers which are reported to cost $15 to $20 per ton. Based on results from simulated warehouse storage, a $5 per ton loss was explained by grade factor deterioration and kernel moisture weight loss. Other factors such as handling, sampling, grading precision, and dry weight loss resulting from respiration must contribute to the consistent storage loss reported by peanut shellers.

INTRODUCTION

Since peanuts are bought and sold by commercial grade, any degradation of the grade factors and/or quantity losses during storage are direct losses to the peanut warehouse operator. To the warehouse operator, "shrinkage" may be defined as the total dollar value of the peanuts placed in the warehouse less the value of the peanuts when removed from storage. A study was conducted to determine that portion of "shrinkage" which is attributable to changes in the grade factors of farmer stock peanuts during storage. Quantity losses resulting from changes in moisture content during storage were also investigated, but quantity losses resulting from respiration, handling, rodents, etc. were not investigated. Changes in grade factors for farmer stock peanuts and peanuts dried under controlled conditions were determined after selected periods of simulated warehouse storage. Changes in the grade factors of farmer stock peanuts were also determined

for actual warehouse storage.

PROCEDURE

In Part I of the study, Florigiant peanuts were dug and combined from adjacent rows in the same field on October 9, 1972 and October 23, 1972. Peanuts from each digging date were dried in the laboratory at 95°F and 120°F to determine the effect of maturity and drying temperature on the shrinkage of peanuts. Both drying temperatures had a drying potential equal to 15°F wet bulb depression. The peanut depth was 3 ft and the airflow rate was 20 cfm/ft^3 of peanuts.

The peanuts from each harvest date and each drying condition (4 lots) were divided into 48 subsamples which were subsequently graded at the following 12 intervals, there being four replications for each interval: 0, 2, 4, 8 hours, 1, 2, 4, 8, 16, 32, 64, and 92 days. Three technicians graded all samples. Each technician had specific responsibilities which were performed throughout the study to minimize human inconsistency.

Peanuts were stored in containers with holes in the side and top for adequate air circulation. The containers were stored in an unheated cinderblock building. This type of storage is referred to as simulated warehouse storage.

For Part II of the study, samples of farmer stock peanuts were collected from a buying station in Holland, Virginia, and also from one in Conway, North Carolina, over a five week period. Samples were collected from the two grading stations in approximately the proportion of the North Carolina-Virginia peanut acreage, i.e. 60% from North Carolina and 40% from Virginia. Twenty samples were collected from Virginia, 4 per week for 5 weeks, and 30 samples were collected from North Carolina, 6 per week for 5 weeks. These samples were brought to the Tidewater Research and Continuing Education Center, divided into subsamples, and graded after 1, 7, 14, 28, and 92 days of simulated storage from the time the samples were collected. Each sample was divided into ten subsamples and then graded in duplicate. A total of 500 grade determinations were scheduled for this part of the study. The thirty grade determinations scheduled for the first collection date in North Carolina were incomplete and were excluded from the analysis because of insufficient sample quantity.

For Part III of the study, peanut samples were placed in a bulk peanut warehouse, stored for 72 days and graded when the warehouse was emptied. Eighteen samples were placed in the warehouse prior to the time the warehouse was filled. The samples were supported with nylon rope in a diagonal and vertical plane through the warehouse. Five vertical lines of peanuts were placed in the warehouse. Lines 1 and 5 supported three samples of peanuts, the first of which was 2 ft from the floor with the vertical distance between samples being approximately 4 ft. Lines 2, 3, and 4 supported four samples per line because the ceiling height in the middle of the warehouse was approximately 4 ft higher.

Each of the 18 samples placed in the warehouse was retrieved when the warehouse was emptied, divided into four subsamples and graded at the Tidewater Research and Continuing Education Center. Samples of the same peanuts were stored at the Tidewater Research and Continuing Education Center under simulated storage conditions and graded at different intervals to compare actual warehouse to simulated warehouse storage.

RESULTS AND DISCUSSION

Figure 1 shows the percent ELK, Mediums, and No. 1's plotted against storage time for peanuts dried under controlled conditions. These results are from the second digging date and 95°F drying temperature. Trends from the other three conditions were similar. As shown in this figure, the percent ELK gradually decreased with time whereas the percent mediums and number 1's increased gradually with time. Values for percent SS, OK, and damaged kernels were essentially the same after 92 days of simulated storage.

Figure 2 is a plot of grade moisture versus time for peanuts dried under controlled conditions. Kernel grade moisture was essentially constant for the

first 8 hours, but lost one percentage point after removal from the driers for 24 hours. The peanuts lost another percentage point during the following week.

Figure 3 shows selected weighted average grade factor values versus time for peanuts collected from Virginia and North Carolina. These results parallel those from the peanuts dried under controlled conditions. Except for kernel grade moisture no drastic change in grade factors occurred with time for the peanuts collected from Virginia and North Carolina. A comparison of official Government grade factors with results obtained from this part of the study showed no bias.

The average kernel moisture for the peanuts collected from Virginia and North Carolina decreased from 8.8 to 7.8 percent in one week as shown in figure 3. The average kernel moisture for these samples at the grade stations was 9.7 percent. The kernel moisture content decreased approximately 20 percent or about two percentage points during two weeks of simulated storage, a result which also occurred in Part I.

Linear regression analyses were completed on selected grade factors with time. These results are summarized in Table 1. The A value, Y intercept, for percent ELK for the combined Virginia and North Carolina samples was 29.70 percent which means that the average percent ELK for the Virginia and North Carolina samples was estimated at 29.7 percent at time 0. The B value or slope was -0.023 which is the average daily decrease in percent ELK kernels from Virginia and North Carolina. From these results, the expected decrease in percent ELK after 100 days is 2.3 percentage points to approximately 27.4 percent. During the same period, mediums increase 0.9 percentage points to 27.84 percent and number 1's increase 0.5 percentage points to 6.44 percent.

Table 2 shows grade factor values for the 0 time sub-samples, grade factor values for subsamples stored at the station and corresponding values for the samples stored in the warehouse for 72 days. Peanuts used in the warehouse portion of the study (Part III) were initially at 8.0 percent moisture. After 72 days of warehouse storage, the average kernel moisture was 8.3 percent indicating the sample peanuts picked up moisture from the peanuts that surrounded them in the warehouse. The average grade factor values for the peanuts stored in the warehouse showed no reduction indicating kernel moisture to be a very important consideration regarding grade factors. Subsamples stored at the station and graded after 72 days under simulated warehouse condition exhibited a slight amount of grade deterioration.

The gradual deterioration in grade factors and the moisture loss that occurs in the kernels does not explain losses in the magnitude of $15-$20 per ton shellers report they experience between the in grade and out grade of peanuts stored in warehouses.

Based on results from Parts I and II of this study, the percent ELK may decrease approximately 2-3 percentage points in 100 days of storage. This represents a price reduction of about $.0006 per pound or $1.20 per ton. The small decrease in SMK was nearly offset by slight increases in sound splits and other kernels.

If peanuts having 70 percent meat and a value of $0.15 per pound enter a warehouse at 8 percent kernel grade moisture and leave the warehouse at 6.5 percent grade moisture, a loss of approximately $3.60 per ton based on the in grade moisture occurs.

Peanuts respire in storage which results in a dry weight loss. This type of loss was not considered in the study. This loss would also cost the sheller a certain amount of money in addition to the two above-mentioned losses.

Results obtained from this study do not explain all of the quality and quantity losses reported by the shellers. The effect of handling peanuts with elevators, dumpsters, belts, etc. on grade factors was not taken into consideration in this study. Sampling and grading precision must also be considered. In addition, grade factors obtained by using sample sheller equipment may not correlate with results obtained by actually processing peanuts with commercial shelling equipment. Since the sample sheller is reported to be more gentle than mill processing equip-

Table 1. Values for various factors vs. time for Virginia and North Carolina samples.

Factors (%)	Virginia			North Carolina			Va. & N. C. Combined		
	A 1/	B 2/	T 3/	A	B	T	A	B	T
Meat	72.28	.0002	0.04	71.75	-.0010	-0.30	71.97	-.0005	-0.20
SMK	64.52	-.0115	-1.49	61.14	-.0067	-0.78	62.58	-.0087	-1.38
BLK	27.89	-.0289	-2.52	31.03	-.0186	-1.99	29.70	-.0230	-3.02
Medium	30.12	.0088	0.89	24.59	.0095	1.59	26.94	.0092	1.38
No. 1	6.51	.0086	2.28	5.52	.0025	0.85	5.94	.0051	2.07
SS	3.24	.0044	0.97	4.87	.0060	1.28	4.17	.0053	1.51
OK	3.23	.0056	2.02	3.12	.0007	0.33	3.17	.0028	1.68
Damage	1.27	.0016	0.78	2.62	-.0010	-0.36	2.05	.0001	0.05

1/ A = Y Intercept

2/ B = Slope, percent per day

3/ T = 1.98 or above reject null hypothesis that B = 0 at 95% confidence interval

ment, sound peanuts when graded by the sample sheller may become splits if processed by a commercial sheller.

Table 2. Average grade factors of peanuts used in warehouse part of study.

Factors (%)	0 time sample	72 day sample stored at station	Avg. 72 day samples from warehouse
Meat	70.7	70.5	70.7
Grade moisture content	8.0	7.0	8.3
ELK	34.5	34.2	36.0
Medium	21.6	21.2	21.0
No. 1	7.2	7.0	6.4
SS	2.5	3.1	2.1
OK	4.6	4.2	4.1
Damage	0.6	0.6	0.9

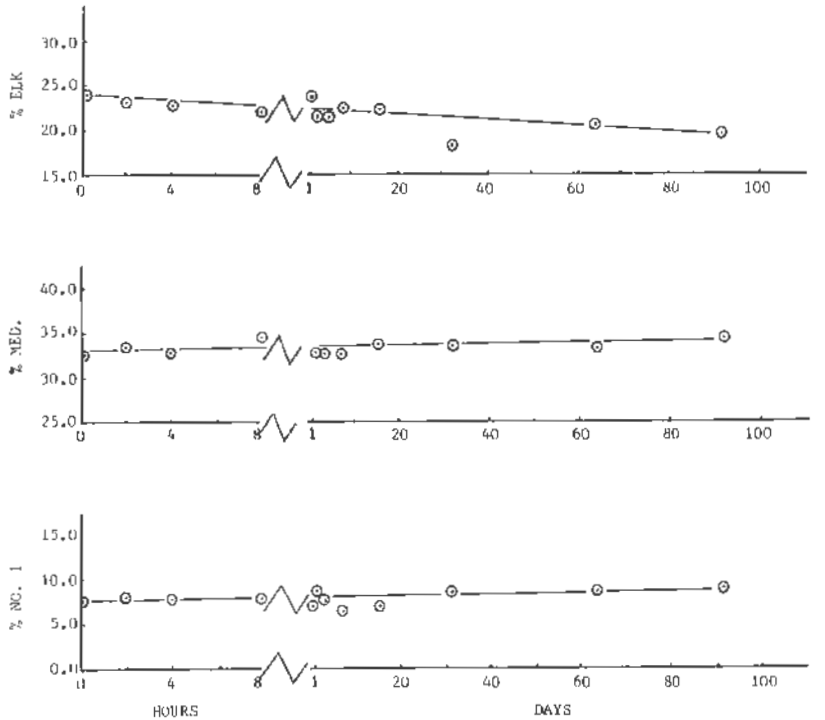

Figure 1. % ELK, Medium, and No. 1 peanuts versus time for Florigiant peanuts dried at 95°F.

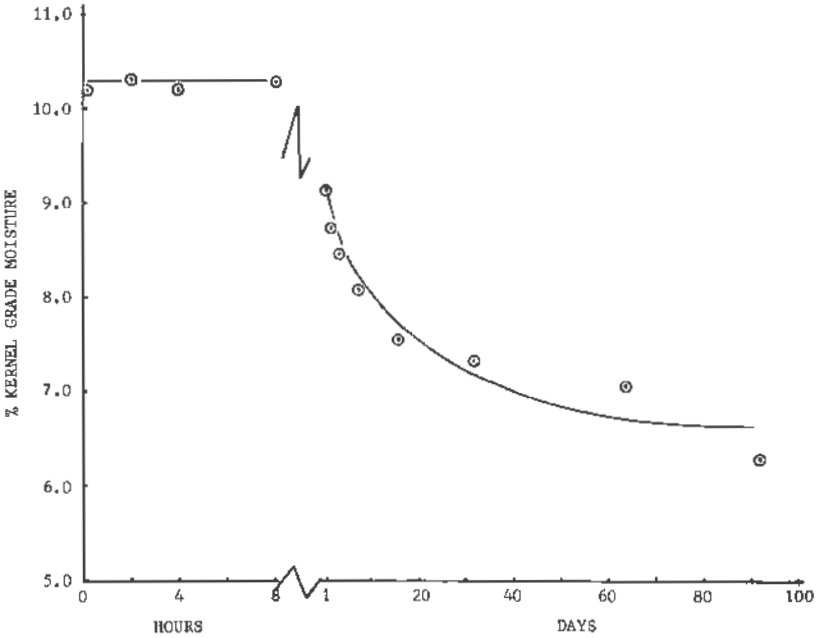

Figure 2. % kernel grade moisture versus time for Florigiant peanuts dried at 95°F.

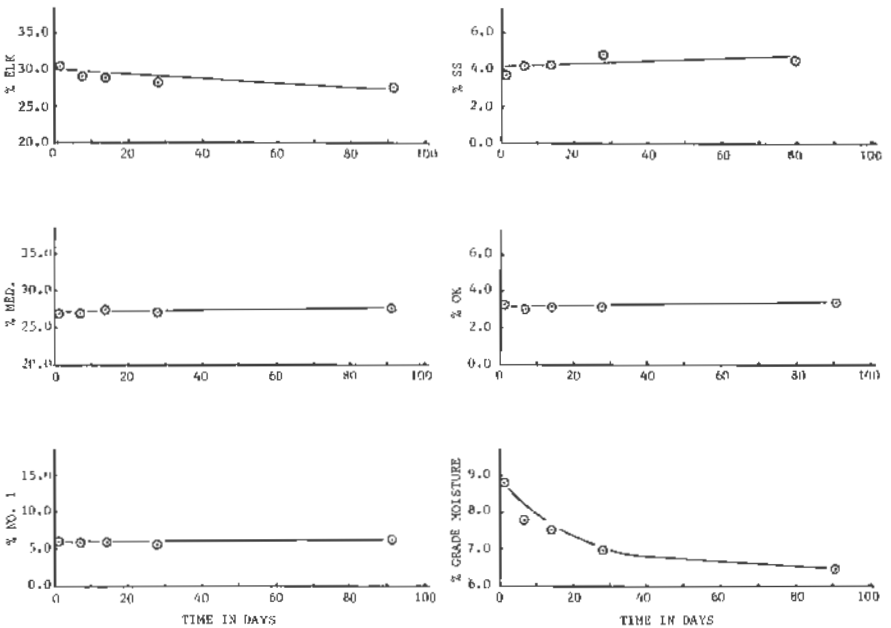

Figure 3. Average selected grade factor values versus time for peanuts collected from Virginia and North Carolina.

CORRELATION OF PEANUT SEED-COAT SURFACE WAX ACCUMULATIONS WITH TOLERANCE TO COLONIZATION BY *ASPERGILLUS FLAVUS* [1/]

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ABSTRACT & PAPER

ABSTRACT

Wax-like accumulations were noted in scanning electron micrographs on the testas of dried peanut seed. Seeds from breeding lines which were tolerant to colonization by *Aspergillus flavus* (N.R.R.L. isolate 2999) appeared to possess more of the wax-like accumulations than did several which were highly susceptable. Extraction of waxes and lipids from intact seeds with chloroform: methanol, 2:1 (V/V), for up to five minutes increased the susceptability of the extracted seeds. No reduction in germination percentage of the seeds extracted for five minutes was noted. A suspension of *A. flavus* conidia was placed on the dried solvent residue from a two hour extraction of intact tolerant peanut seed. Germination of *A. flavus* conidia was slightly stimulated by the residue, compared to distilled water. It appears that the wax-like accumulations help prevent *A. flavus* from penetrating the intact seed coat.

PAPER

INTRODUCTION

The use of peanut varieties resistant or tolerant to colonization by *Aspergillus flavus* has been suggested as one method of reducing the incidence of aflatoxin in stored peanuts, Bailey (1970). A program to find peanut breeding lines with low colonization levels has been underway at the University of Florida for three years. Colonization ranged from less than 4.0% up to 100% for different peanut genotypes screened under ideal colonization conditions. Three different statistical categories were determined by Duncan's multiple range at the 5% level for the 1971-72 screening data. Breeding lines from these data with less than 16% colonization were referred to as tolerant. Cultivars colonized at a level of from 16% up to 60% were considered moderately tolerant, while a colonization level above 60% was considered indicative of highly susceptable cultivars. The tolerance mechanism encountered among these breeding lines has been suggested to be purely mechanical, LaPrade and Bartz (1972).

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PROCEDURE AND RESULTS

Screening Technique

N.R.R.L. isolate 2999 of Aspergillus flavus was used in all screening tests for resistance or tolerance to colonization. This isolate has been shown to produce large quantities of aflatoxin, Shotwell et. al. (1966). All inoculations were made on dried, hand-shelled peanuts in the laboratory. Approximately 8×10^3 conidia in a suspension of 0.5 ml sterile distilled water with 1.0% Tween 20(V/V), was introduced to each of three 15 g replications per line in a 200 X 20 mm petri plate. All replications were standardized to a 20% moisture level prior to inoculum introduction. After one week of incubation at 25C the percentage of colonized peanuts was recorded (Table 1). The data were converted to arc sin values for statistical analysis. Peanut cultivars designated as Fla. lab. number 85, 4, and 24 were statistically more tolerant than no. 200 or no. 82.

Table 1. Percent colonization of 5 peanut breeding lines. Aspergillus flavus (N.R.R.L. isolate 2999).

Fla. lab. #	Fla. entry #	Mean Percent Colonization 1/
85	UF71513	3.7 a
4	UF71104	13.2 a
24	UF71206	15.6 a
200	UF711441	90.3 b
82	UF71510	89.5 b

1/ All mean percent colonization values followed by the same letter are not significantly different at the 5% level by Duncan's multiple range.

Since previous work by LaPrade and Bartz (1972) suggested that tolerance to A. flavus was purely mechanical, a scanning electron micrograph study of intact peanut seeds from the above breeding lines was conducted. Hand shelled seeds of the test lines were observed in the mid cotiledonary region, with the seed coats oriented perpendicular to the electron flow and parallel to the lens plane.

Seeds from cultivars which were highly tolerant to colonization by A. flavus appeared to possess more of the wax-like accumulations (Fig. 1) than did several which were highly susceptable. Wax continuity was more uniform with fewer breaks observed in the cuticle of tolerant lines than in the cuticle of susceptable lines, while the seed coat cellular continuity appeared intact for all peanuts observed.

Extraction of seed coat surface waxes

To determine if seed coat surface waxes helped reduce colonization of peanuts by A. flavus, portions of the waxes were removed by extracting intact tolerant peanuts with 25 ml chloroform: methanol, 2:1 (V/V) at 45C for up to five minutes. Ten seeds from each treatment were germinated as a test of viability. After extraction the seeds were washed for one minute in distilled water, air dried for five minutes, and inoculated using the standard technique described above. There were four treatments of three replications of 15 g each that were inoculated. Table 2 shows mean percentage colonization, mean seed germination and mean aflatoxin levels determined by millicolumn chromatography, Cucullu, A. F., et. al. (1972). The statistical analysis was performed on converted arc sin values from percentage values while only percentage values appear in Table 2.

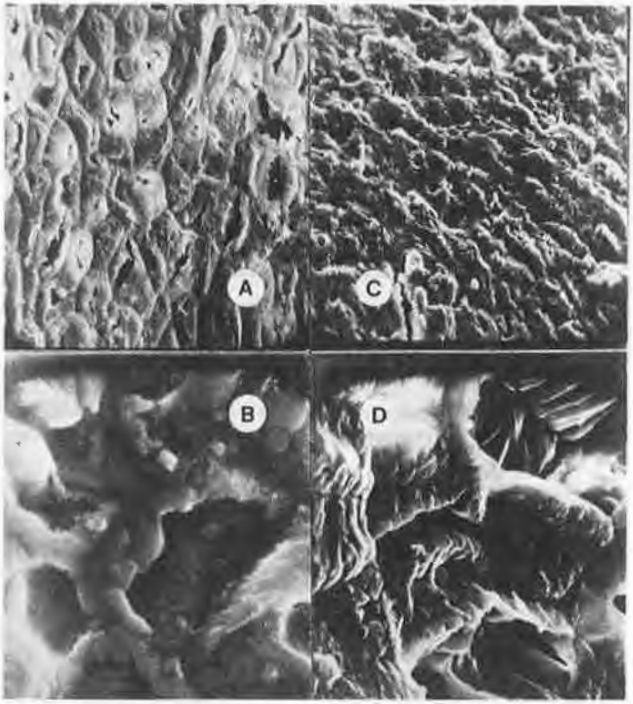

Figure 1. Scanning electron micrographs of the surface of intact peanut seeds. A and B are Fla. lab. no. 200 (highly susceptable to A. flavus colonization) at 500 and 2150 X respectively. C and D are Fla. lab. #4 (highly tolerant to A. flavus colonization) at 500 and 2150 X respectively.

Table 2. Effect of differential wax extraction of intact peanut seed on A. flavus colonization, aflatoxin production, and seed viability.

Extraction Period	Mean % Colonization 1/	Mean % Germination	Mean Toxin Level 2/
(min)			
0	28.8 a	96.7 a	31.7 a
0.5	37.9 b	93.3 a	
1.0	42.4 b	100.0 a	
5.0	51.3 c	90.0 a	50.0 b

1/ All treatment means followed by the same letter are not significantly different at the 5% level.

2/ Toxin values are p.p.m. aflatoxin B_1.

To determine if the wax-like accumulations noted in Fig. 1 were removed by the wax solvent, scanning electron micrographs were taken of extracted peanuts in a manner similar to that used for Fig. 1.

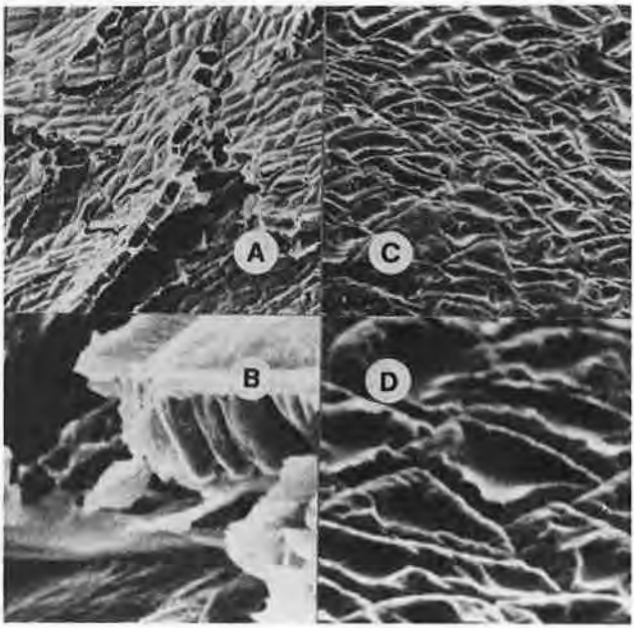

Figure 2. Scanning electron micrographs of intact and solvent soaked peanut seed. A and B are Fla. lab. #85, soaked in chloroform: methanol, 2:1 (V/V) at 45C for five minutes. C and D are Fla. lab. #85 (highly tolerant to A. flavus colonization) intact, not soaked in wax extraction solvent, at 500 and 2150 magnifications respectively.

The wax-like accumulations shown in figure 2A and 2B were partly removed by the solvent. Numerous breaks in the wax continuity of the cuticle were observed while cellular continuity appeared to remain intact.

Conidia germination inhibition

One tenth ml of a suspension of A. flavus conidia at a concentration of 10^3-10^4 spores/ml was placed on the dried wax extract from a two hour chloroform: methanol, 2:1 (V/V) extraction and a five minute chloroform extraction of intact tolerant peanut seed. After 12 hours, spores were counted in 10 microscope fields taken at random for both extraction periods and for a similar conidia suspension placed in sterile distilled water.

A stimulation in conidia germination occurred for the peanut extracts compared to distilled water. No difference in conidia germination occurred between the 5 minute and the 2 hour wax extraction periods.

Table 3. A. flavus conidia germination on wax extracts from tolerant seed vs. distilled water.

Treatment 1/	Mean % Conidia Germination 2/
5 minute extraction	66.7 a
2 hour extraction	78.0 a
sterile distilled water	52.7 b

1/ All treatment means followed by the same letter are not significantly different at the 5% level by Duncan's multiple range.

2/ Conidia are considered germinated if the germ tubes extend approximately one spore diameter.

SUMMARY AND CONCLUSIONS

Heavier cuticular wax accumulations occurred on selected peanut cultivars highly tolerant to an isolate of A. flavus, capable of producing high quantities of aflatoxin. These wax accumulations can be partially removed by soaking the seed in hot chloroform for up to five minutes. The differential removal of surface waxes increased susceptability to colonization by A. flavus. Subsequent production of aflatoxin was also increased. Extraction of waxes did not significantly affect seed germination. Residues from the evaporation of wax extracts were not fungistatic or fungitoxic, even when the extraction period was increased to two hours. The wax present on the surface of intact peanut seeds apparently prevented penetration and subsequent colonization by A. flavus conidia. Peanuts from tolerant lines seemed to possess more wax with less breaks in the cuticle than peanuts from susceptable lines or solvent extracted tolerant lines.

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DEVELOPMENT OF A SMALL LABORATORY SHELLER FOR DETERMINING PEANUT MILLING QUALITY

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ABSTRACT

A small mechanical sheller was modified, tested, and improved to provide an accurate and reliable method of determining milling quality as well as a fast and efficient method for shelling small samples of peanuts. Design, performance, and some potential uses of this sheller are discussed. The sheller may be constructed in any local machine shop at a very low cost (approximately $300). It can be a very useful tool for both research and industry.

INTRODUCTION

Milling quality, as used in this report, is defined as a measure of the ability of the kernels to resist splitting and skinning by commercial shelling and processing equipment. The amount of splitting is important to shellers, since it is a major factor in determining market value. However, methods have been unavailable to determine the true milling quality except in very large (500 lb. or greater) lots. In recent years, industry and researchers have continually requested the development of an accurate method for determining the milling quality of small samples. In 1971, McIntosh, et al. (3) reported the successful development of a one-quarter size commercial shelling apparatus for determining the milling quality of samples as small as 20 lb. The reference also reported that a small experimental sheller appeared to have potential for determining milling quality of smaller samples.

This paper describes the design and development of the experimental sheller and provides performance data to illustrate the accuracy of this method for determining milling quality of different peanut lots, and for detecting slight changes in milling quality of specific lots. Shelling rate and shelling efficiency data are also presented to extend the potential use of the sheller to other applications.

MATERIALS AND METHODS

The one-quarter or full-size commercial-type shellers with steel T-bar grates were used to determine the actual milling quality of each lot. These shellers were adjusted and operated to obtain a maximum whole kernel outturn. In numerous performance tests of the four types of commercial shellers, the sheller with steel T-bar grates provided "average" outturns. The outturns of the other three types of shellers would not differ greatly if these shellers were operated to obtain a maximum whole kernel outturn.

The basic design of the 6-in. diameter experimental sheller was similar to the design of commercial-type shellers (see Figure 1). This similarity was necessary to obtain the same kind of shelling actions for both type shellers (3). Primary components of the experimental sheller were the 6-in. diameter sheller grates, the shelling cylinder, and the sheller enclosure with feed gate and internal deflectors. Other associated parts of the complete experimental sheller include the supporting framework, mechanical drive system, aspiration system, and transfer tray for carrying the peanuts from the sheller enclosure to the hood.

Several modifications in sheller design were required before a reliable model was developed. The design and operation of each model was refined and the shellers tested for consistency and reliability. Final evaluations of each sheller model

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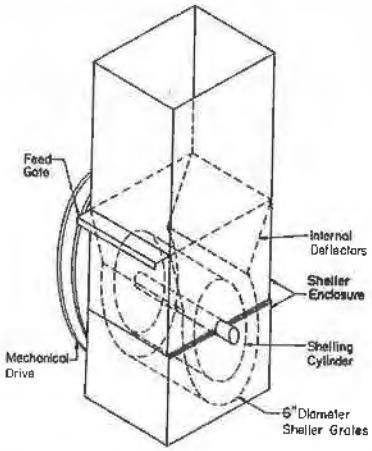


Figure 1.--Basic design of 6 in. diameter experimental sheller.

included the comparison of its split and skinned (bald) kernel outturns with the respective outturns of the commercial-type sheller. Bald kernels were those whole kernels that had at least 50 percent of the skin detached. Shelling efficiencies and shelling rates for the experimental and commercial-type shellers were also compared to provide information for other applications, such as a sample sheller for farm, laboratory, and industry, and as an aid for setting up and operating commercial shelling plants.

DATA AND RESULTS

The first experimental sheller, model 1, was a small sheller developed by Mr. Herbert Wehlitz of Cordele Sheetmetal Works, Cordele, Georgia. This sheller is used by several farmers and commercial dryers to shell samples of peanuts for determining moisture content of the kernels. The split and bald kernel outturns of this sheller were extremely high and variable, and it was modified extensively before any consistent outturns were obtained. Based on the experience gained with this sheller, a second design, model 2, was developed and another sheller was fabricated (Figure 2). Several tests were conducted with this sheller to determine

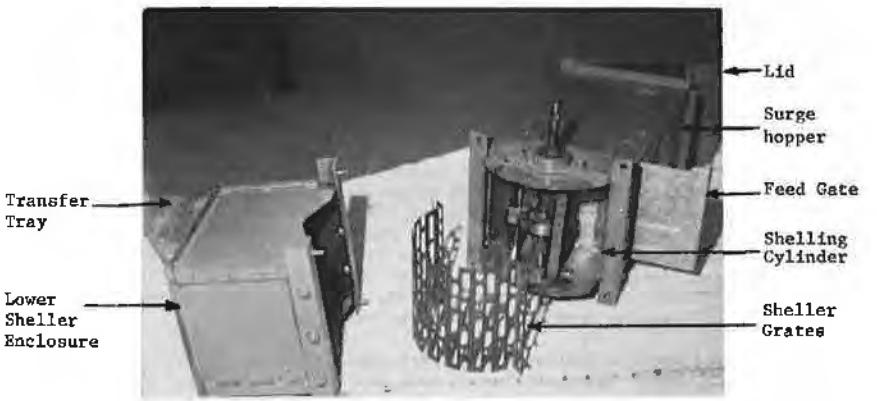


Figure 2.--The general design of the model 2 sheller

the spacing between cylinder and grates, width of slots in sheller grates, and cylinder speeds needed to provide a maximum whole kernel outturn. Optimum sheller

performance was obtained by using a cylinder-grate spacing of 1 in. for all three types of peanuts, a shelling cylinder speed of 300 r.p.m., and sheller grates selected to have same slot width as those normally used in the commercial-type sheller.

At optimum settings, the split kernel outturn of the model 2 sheller was still higher than the commercial-type sheller, but a correlation of the outturns was apparent. This sheller, shelling 2.2-lb. samples, was used effectively in several research studies to indicate the shelling properties of peanuts. In later tests, a 4-lb. sample provided more consistent results than the 2.2-lb. sample. Several 4-lb. sample lots of peanuts were evaluated to determine the correlation of outturns of the model 2 sheller with those of the commercial-type sheller (see Figures 3, 4, and 5). The reliability of the model 2 sheller for detecting small

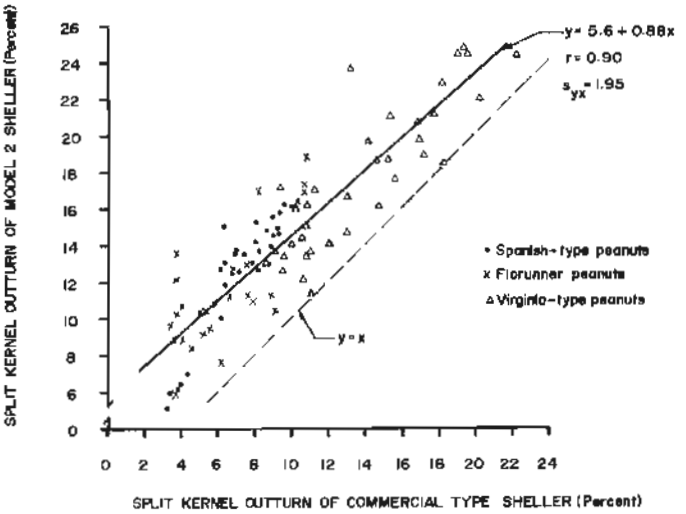


Figure 3 Correlation of split kernel outturns for model 2 and commercial-type shellers.

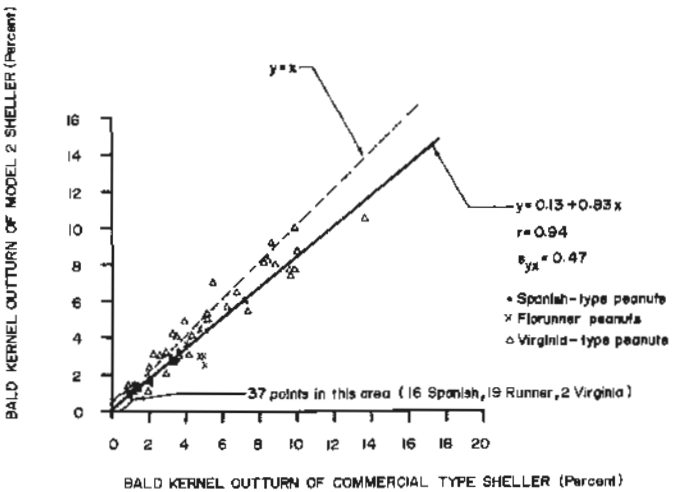


Figure 4 Correlation of bald kernel outturns for model 2 and commercial type shellers.

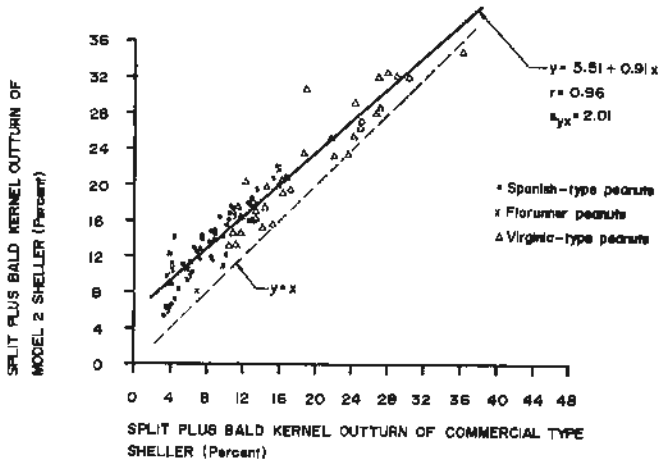


Figure 5 Correlation of split plus bald kernel outturn for model 2 and commercial type shellers.

differences in milling quality of peanuts from the same lot was demonstrated by shelling peanuts that had been subjected to slightly different drying treatments (Figure 6). Sample sizes for these later tests were 4 lb. for the model 2 and approximately 900 lb. for the full-size commercial sheller.

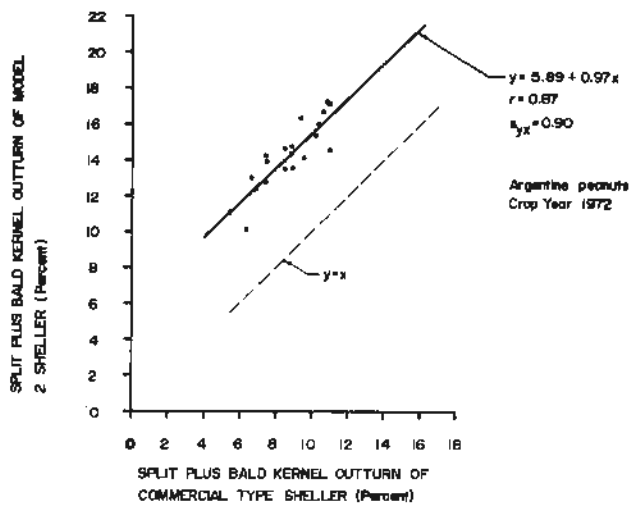


Figure 6 Evaluation of model 2 sheller for detecting differences in milling quality produced by small variations in drying treatments.

Although the performance of the model 2 sheller was satisfactory, modifications of this sheller were needed to provide a faster cleanout and better stability and concentricity of the sheller grates and shelling cylinder. Thus, model 2 was redesigned and a new model, model 3, fabricated. The design of the model 3 sheller and its associated equipment are shown in Figures 7, 8, 9, and 10. Shelling tests confirmed that optimum sheller settings were the same as those for model 2. Several tests were run to determine the proper design for the slotted openings in the sheller grates. The grate design (Figure 8) was selected because it provided approximately the same shelling efficiency as obtained with the commercial-type sheller.

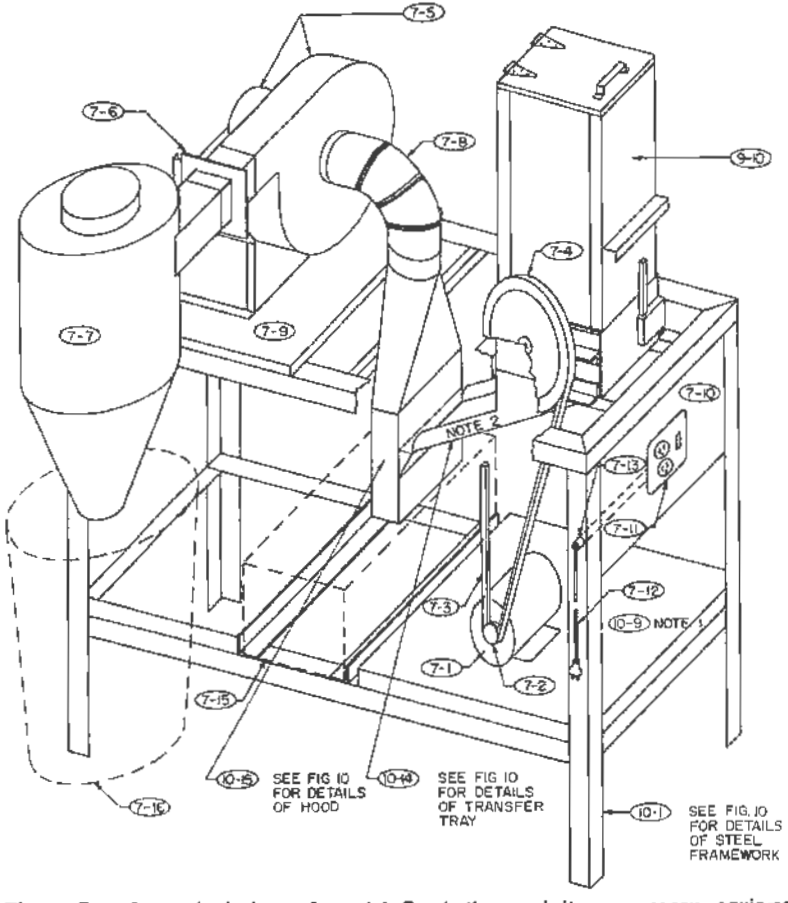


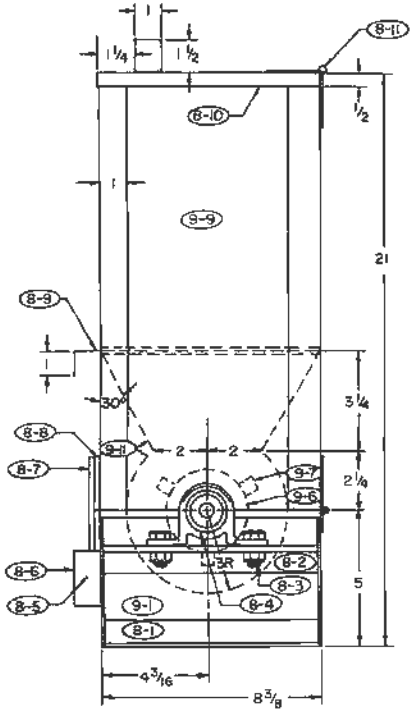
Figure 7.--General design of model 3 sheller and its accessory equipment

Bill of Materials

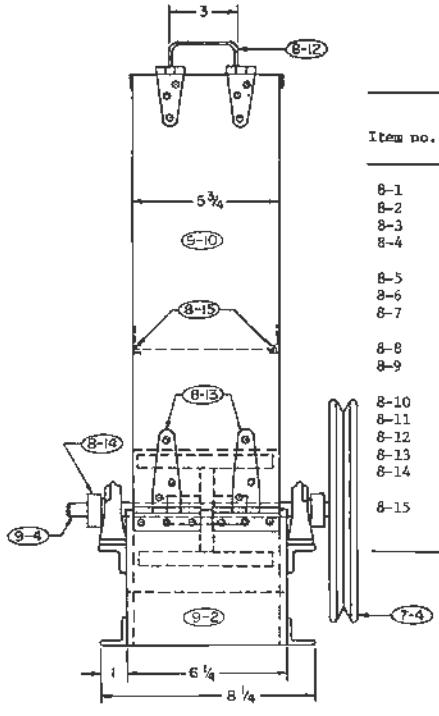
Item no.	Number required	Description
7-1	1	Electric motor, 1/3 HP, 1140 RPM, 120V, 1 P, Dayton Model 6 K 214 or equal
7-2	1	Pulley, 2" dia.
7-3	1	V-belt, type A, approx. 60" long
7-4	1	Pulley, 8" dia. with 1/2" dia. bore
7-5	1	Fan motor set, W. W. Grainger Model 7 C 650 or equal
7-6	1	Blast gate to fit 3" x 3" duct
7-7	1	Cyclone separator, approx. 10" dia. x 24" long
7-8	1	Elbow, 4" dia. adjustable, 28 ga. minimum
7-9	1	Support for 7-5, 19" x 17 1/2" x 3/4" plywood
7-10	1	Support for 7-11, 13" x 10 1/2" x 3/8" plywood
7-11	1	Switch and junction box, Westinghouse or equal
7-12	1	Extension cord, heavy duty, 3 wires #14, length as required
7-13	6.5'	Flexible conduit, 1/2" with fittings
7-14	26'	Wiring (not shown) single strand #14 to connect 6-5, 7-1 and 7-5 to 7-11
7-15	1	Container for shelled peanuts - convenient size
7-16	1	Container for hulls - convenient size
7-17	1	Belt guard, as required

Notes:

1. The first set of numbers in the part number denotes the figure where the part is described and the second set of numbers is the part number.
2. Belt guard, 7-17, has been removed and portions of 7-3, 7-4, 10-4, and 10-6 are cut away to show more assembly details of transfer tray and hood.
3. Maximum overall dimensions are 41" x 32" x 55"



RIGHT SIDE ELEVATION



REAR ELEVATION

Bill of Materials

Item no.	Number required	Description
8-1	2	Angle iron, 1" x 1" x 1/8" x 8 3/8"
8-2	2	Angle iron, 1" x 1" x 1/8" x 8"
8-3	4	Machine bolt (with nut) 5/16" 18 x 1"
8-4	2	Pillar block bearings, light duty to fit 1/2" dia. shaft
8-5	1	Microswitch, 20A, 120V, normally open
8-6	1	Sheetmetal cover for 8-5
8-7	1	3/16" keystock or equal to mechanically actuate 8-5
8-8	1	Spacer for aligning 8-7 with hole in 8-6
8-9	1	Feed gate, 10" long x 5 3/8" wide, 18 ga. sheetmetal (galvanized)
8-10	1	Lid, 18 ga. galvanized sheetmetal
8-11	2	1" strap hinge, rivet to 9-10 and 8-10
8-12	1	Handle, 18 ga. galvanized sheetmetal
8-13	2	Tee hinge, 2 1/2". Rivet to 9-2 and 9-10
8-14	2	Standard collars with set screws to fit 1/2" dia. shaft
8-15	2	Guide for feed gate, 22 ga. galvanized sheetmetal

Figure 8.--Design details of model 3 sheller.

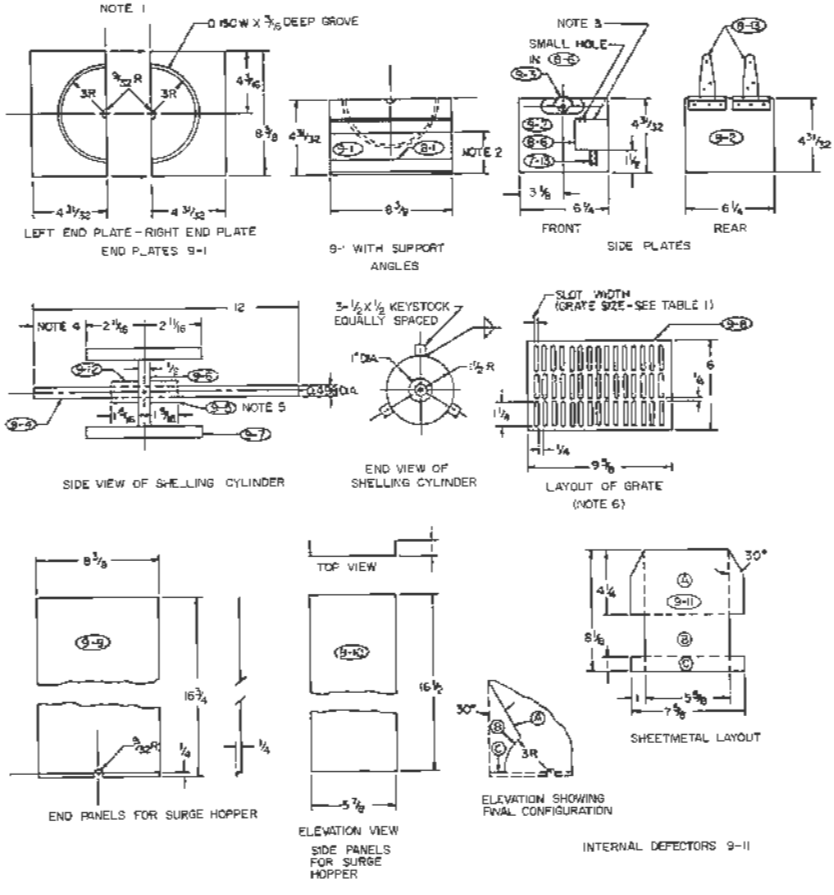


Figure 9.--Details of sheller components.

Bill of Materials

Item no.	Number required	Description
9-1	2	1/4" thick steel plate
9-2	2	1/8" thick steel plate
9-3	1	Latch, cam type
9-4	1	1/2" dia. steel shaft
9-5	1	1" dia. steel sleeve
9-6	1	3" dia. x 1/2" wide steel bushing
9-7	3	Sheller bars, standard 1/2" x 1/2" keystock, 5 3/8"
9-8	1 (each grate size)	Sheller grates, perforated metal, 14 or 16 ga.
9-9	2	22 ga. galvanized sheet metal
9-10	2	22 ga. galvanized sheet metal
9-11	2	18 ga. galvanized sheet metal
9-12	2	1/4"-20 x 3/8" set screw

Notes:

1. Part 9-1 can be easily fabricated by taking a 10" x 8 3/8" x 1/4" plate, drilling a 9/16" dia. hole in the exact center of the plate, cutting the concentric groove and then sawing the plate into two equal parts as shown.

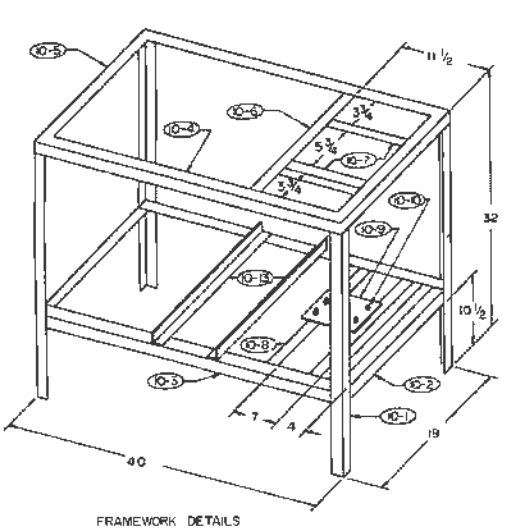
2. Position of 8-2 will depend upon size of 8-4. In securing 9-1 to 9-2 and 8-2 to 9-1, concentricity of cylinder and grates should be within ± 1/32".

3. Parts 8-5, 8-6, 8-7, 7-13, and 7-14 should not be installed until the assembly of the sheller has been essentially completed.

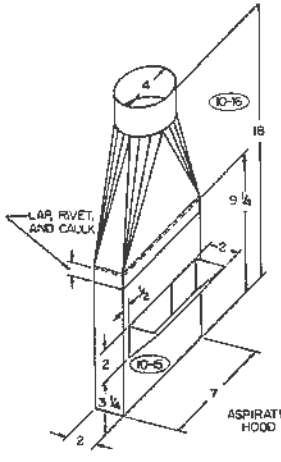
4. Install shelling cylinder in sheller and center 9-7 before tightening 9-12.

5. Parts 9-5 and 9-6 may be fabricated as one part by machining a 3" dia. x 3 1/8" long stock to the specified dimension or the parts may be fabricated separately and welded together concentric and true to centerline within ± 1/64".

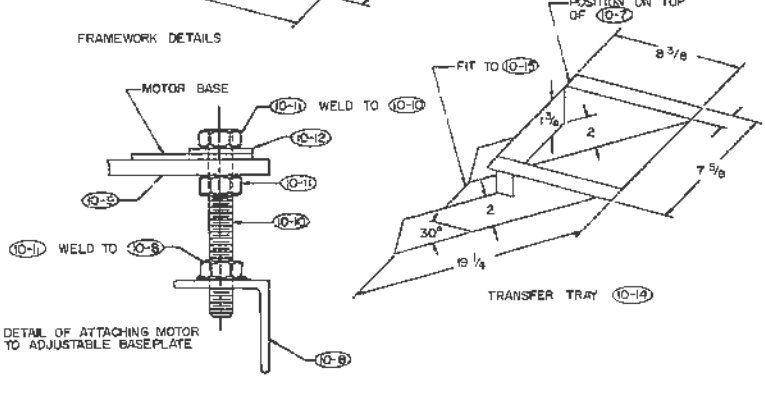
6. Form grates into 6" diam semi-circle and fit to groove in 9-1.



FRAMEWORK DETAILS



ASPIRATION HOOD



DETAIL OF ATTACHING MOTOR TO ADJUSTABLE BASEPLATE

Figure 10.-- Framework and sheetmetal detail for model 3 sheller.

Bill of Materials

Item no.	Number required	Description
10-1	4	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 31 7/8"
10-2	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 18 3/4"
10-3	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 39 3/4"
10-4	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 40 1/4"
10-5	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 19 1/4"
10-6	1	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 19"
10-7	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 12 3/4"
10-8	2	Angle iron, 1 1/2" x 1 1/2" x 1/8" x 18 1/2"
10-9	1	Flat plate, 5" x 7" x 3/16", with four 7/16" dia. holes
10-10	1	3/8" 16 threaded rod x 3" long
10-11	12	Nut for 3/8" 16 bolt
10-12	4	Flat washer for 3/8" bolt
10-13	2	Angle iron, 1" x 1" x 1/8" x 18 3/4" for supporting 7-15
10-14	1	Transfer tray, 22 ga. galvanized sheetmetal
10-15	1	Hood, 22 ga. galvanized sheetmetal
10-16	1	Transition, 22 ga. galvanized sheetmetal

The proper grate size selections were generally the same as those listed in Table 1.

Table 1.--Grate size selections of model 3 sheller

Type of peanut	Normal grate size		
	First stage sheller	Second stage sheller1/	Third stage sheller1/
		Inches	
Spanish	24/64	20/64	16/64
Runner	26/64	22/64	18/64
Virginia	30/64	24/64	20/64

1/ Second and third stage shellers are not needed for determining milling quality, but they may be used for other applications that require the shelling of essentially all the peanuts.

The effect of sample size on the performance of the model 3 sheller was investigated and generally found to be insignificant for representative samples of 2 lb. or more. The split outturns of the 1-lb. samples were sometimes several percentage points lower than for the 2-lb. and larger samples. Of course, for a given sampling method, the larger the sample, the better chance of getting a representative sample.

The performance of the model 3 sheller was excellent and split outturns of this sheller were consistently lower than for the model 2 sheller. Thirteen lots of peanuts were obtained from various warehouses (in Southeast, Southwest and Virginia-Carolina areas) and shelled in both the one-quarter size commercial-type sheller (50-lb. samples) and model 3 sheller (4-lb. samples). Correlations of splits, balds, splits plus balds, and shelling efficiency for these tests are presented in Figures 11, 12, 13, and 14. The data are summarized in Table 2.

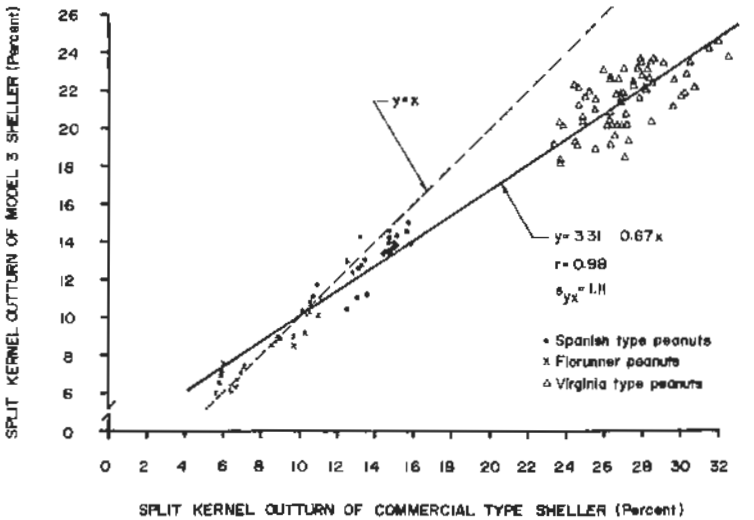


Figure 11 Correlation of split kernel outturns for model 3 and commercial type shellers.

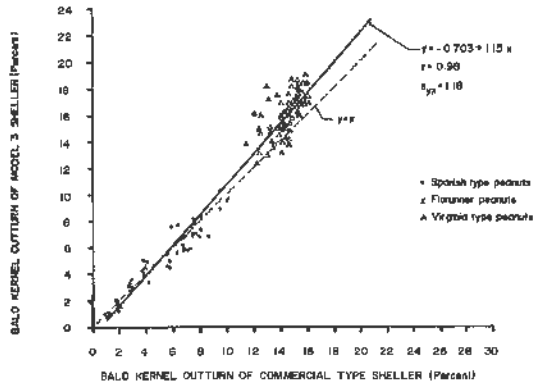


Figure 12 Correlation of bald kernel outturns for model 3 and commercial type shellers

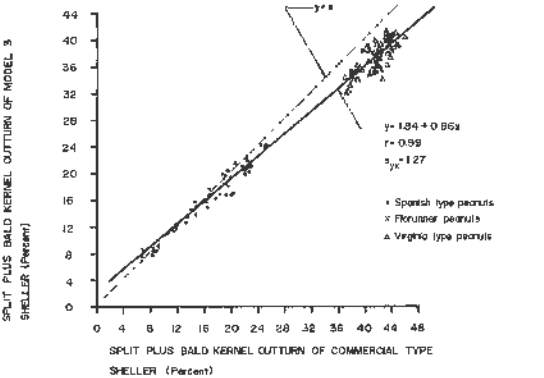


Figure 13 Correlation of split plus bald kernel outturns for model 3 and commercial type shellers.

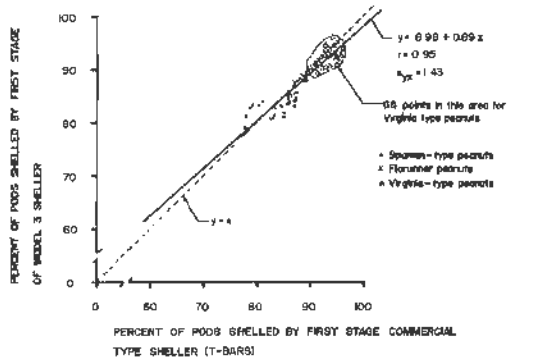


Figure 14 Correlation of shelling efficiencies for model 3 and commercial-type sheller.

Table 2.--Summary of the correlation of outturns for the model 3 and commercial-type shellers

Type of peanuts	Number of lots evaluated	Approximate number of samples shelled per lot	Split outturns			Bald outturns			Split plus bald outturns		
			Regression equation	r[1]	s_{yx}[2]	Regression equation	r[1]	s_{yx}[2]	Regression equation	r[1]	s_{yx}[2]
Spanish	6	4	$y = 3.47 + 0.69x$	0.82	0.77	$y = 0.21 + 0.93x$	0.84	0.82	$y = 1.79 + 0.86x$	0.91	1.15
Runner	6	4	$y = 0.98 + 0.90x$	0.96	0.62	$y = 0.34 + 0.89x$	0.96	0.51	$y' = 1.25 + 0.90x$	0.98	0.79
Virginia[3]	1	66	$y = 8.46 + 0.48x$	0.64	1.19	$y = 2.35 + 0.95x$	0.62	1.32	$y = 2.37 + 0.84x$	0.76	1.45
Composite	13	-	$y = 3.31 + 0.67x$	0.98	1.11	$y = 0.70 + 1.15x$	0.98	1.18	$y = 1.84 + 0.86x$	0.99	1.27

1/ r is the correlation coefficient.

2/ s_{yx} is the standard error of estimate.

3/ The Virginia peanuts had an exceptionally poor milling quality. The grades showed 7 percent freeze damage and hand shelling a representative sample of these peanuts resulted in a split kernel outturn in excess of 5 percent.

Shelling rate of the model 3 sheller showed no correlation with the shelling rate of the commercial-type sheller. Shelling rate of the model 3 sheller was approximately 200 lb./hr. for all samples, but shelling rate of the one-quarter size commercial-type sheller ranged from 1000 to 1900 lb./hr.

DISCUSSION

Shelling small representative samples with the model 2 sheller was an effective method for determining milling quality. The model 3 sheller was a definite improvement over the model 2 sheller and provided a more precise method of determining milling quality as well as shelling efficiency.

Generally, linear regressions adequately described the correlation of outturns for the experimental models 2 and 3 and commercial-type shellers. With few exceptions, the outturns and shelling efficiencies of the model 3 sheller were approximately the same ($y = x$) as for the commercial-type sheller. Since the bald kernels are usually split in commercial shelling plants by subsequent conveying and sizing equipment, the best index of milling quality as determined by the model 3 sheller is the summation of bald and split kernels. For all three types of peanuts tested, the regression equations for correlating the bald plus split kernel outturns of the model 3 and commercial-type shellers were essentially the same ($y = 0.9 x + 2$).

Errors in the sampling of farmers stock peanuts were reported by Penny, et al. (4). Obtaining representative samples for shelling is an important prerequisite to the successful use of this method for determining milling quality. Sampling methods used in these studies included cutting a flowing stream, scooping from a thoroughly mixed lot, or sampling by an approved spout-type automatic sampler. The best results (based on variation in the data) were obtained with the spout-type automatic sampler developed by Kramer and Associates (2). A good sampling procedure is to take a relatively large sample, mix thoroughly, and use an approved farmers stock divider to obtain at least a 2-lb. sample (preferably a 3- or 4-lb. sample).

The potential use of the model 3 sheller by plant breeders, research scientists and engineers, and industry in determining milling quality is almost unlimited. These uses include a machine for evaluating the milling properties of new varieties and for evaluating the effects of variables (such as drying) on milling quality. Variables that affect milling quality can now be more easily identified, better defined, and perhaps better controlled to produce a maximum whole kernel outturn.

Because of its high shelling rates, high shelling efficiencies and high shelling outturns, the model 3 sheller has potential uses other than for determining milling quality. These potential uses include a sample sheller for farm, laboratory, and industry. This sheller will shell peanuts two to ten times faster than the commonly used official grade sheller (1), and is essentially maintenance-free. Since the outturns and shelling efficiencies of the model 3 sheller correlate well with the commercial-type sheller, the small sheller can also be used effectively in commercial shelling plants in setting up and operating the shelling equipment, and in improving current shelling plant methods and techniques. The use of this sheller by commercial shelling plants should not only result in higher whole kernel outturns, but it will also be an excellent labor-saving device for eliminating expensive trial and error methods used in setting up the shelling plant. Selecting grate and screen sizes and proper sheller setups can be accomplished in a much shorter time by running tests with the experimental sheller rather than running tests with the commercial shelling plant. The model 3 sheller will also be useful in the cleaning, drying, and storing of farmers stock peanuts. Shelling outturns of commercial shelling plants would be much higher if farmers stock peanuts were segregated (in storage) on the basis of their milling properties.

The model 3 sheller is currently being used at the National Peanut Research Laboratory, Dawson, Georgia, to set up the pilot shelling plant, to identify problems in commercial shelling plants, to evaluate the shelling properties of new varieties, and to evaluate other proposed methods (5) for determining the shelling properties of peanuts.

The design of the experimental sheller is relatively simple and it can be fabricated at most local machine shops. Based on June 1, 1973 prices, the cost of the

sheller and associated equipment should not exceed $300. Figures 7 through 10 provide all the necessary details for fabrication of this sheller.

The sheller is also easy to operate. The proper sequence of operations for determining milling quality is described in the attached "Operating Instructions."

For other applications that involve complete shelling of all the peanuts, the sequence of operations is essentially the same as described in the attached instructions, except that the unshelled peanuts (which did not shell in the first pass through the sheller) must be recycled through the sheller (second stage), using a sheller grate with smaller openings. Sometimes a third stage of shelling will be required to shell the unshelled peanuts remaining from the second stage and a small amount of peanuts will be left for hand shelling or discarding after the last stage of shelling. A small vibrating screen installed underneath the exhaust hood would eliminate much of the handpicking. For shelling large samples or for continuous shelling, a presizing operation similar to that used by the Federal State Inspection Service is recommended in order to obtain a 100 percent shelling efficiency.

CONCLUSIONS

A small experimental sheller was developed to determine milling quality of peanuts. This sheller provides the first known method for accurately determining milling quality by evaluating very small representative samples of peanuts. There was an excellent correlation of the outturn and shelling efficiency of this sheller with the outturn and shelling efficiency of the commercial-type shellers. The small sheller will be extremely useful to researchers and industry by providing them with a machine for evaluating better varieties, methods, techniques, and equipment that will result in a maximum shelling outturn.

In addition to its good correlation with commercial-type shellers, the small sheller's high shelling rate, high efficiency, low maintenance and low cost make it especially suitable for numerous other applications. The design and operation of this sheller is relatively simple and it can be further improved for large uses in order to reduce labor requirements.

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Operating Instructions for Determining Milling Quality of Peanuts Using Small Sheller

1. Install proper sheller grate (see table 1 in the report).

2. Latch surge hopper in shelling position.

3. Position containers to catch kernels and shells.

4. Weigh peanut sample (50 g).

5. Pour sample into surge hopper and close lid.

6. Start sheller and fan.

7. Remove gate at bottom of surge hopper.

8. When shelled peanuts no longer fall from sheller, switch off sheller and fan.

9. Screen and pick out each segregation - unshelled (W_u), balds (W_b), splits (W_{sp}), and wholes (W_w)--and weigh them.

10. Remove sheller grate and weigh peanuts remaining in the sheller (W_c).

11. Determine weight of shelled peanuts, W_s, by substracting from W_T the sum of the weight of the W_u and W_c ($W_s = W_T - W_u - W_c$).

12. Determine efficiency (E) of sheller by dividing W_s by W_T and multiplying by 100 ($E = \frac{WS}{Wt} \times 100$).

13. Determine approximate milling quality (M^1) by adding the weight of balds (W_b) to the weight of split kernels (W_{sp}), dividing by the weight of the shelled peanuts (W_s) and multiplying by 100, ($M^1 = \frac{W_b + W_{sp}}{W_s} \times 100$). Since the sheller shells most of the peanuts in the first pass, the first stage outturns (percent) will be essentially the same as the outturns for shelling the whole sample in several stages of shelling.

14. For a more precise milling quality index (M), enter the value obtained above (M^1) on the ordinate (vertical axis) of Figure 13 of the report, then proceed across the vertical axis horizontally to the solid curve, then proceed vertically downward to the abscissa (horizontal axis) and determine the value that is the best estimate of milling quality.

ACKNOWLEDGEMENTS

The authors wish to offer special thanks to Mr. Herbert Wehlitz of Cordele Sheet-metal Works, Cordele, Georgia, for loan of the first sheller, model 1, for preliminary evaluations and to Mr. Tom Beaty and Stevens Industries for excellent cooperation in loaning many of the peanuts for testing the model 3 sheller. Appreciation is also expressed to Dr. James L. Butler, U. S. Department of Agriculture, Agricultural Research Service, for an excellent idea for faster cleanout of the model 3 sheller.

In addition, the authors wish to acknowledge the contributions of the following personnel of the National Peanut Research Laboratory:

Clyde T. Bennett, engineering draftsman and technical assistant, conducted most of the experimental tests, fabricated the sheet metal components, and contributed ideas toward improving the design and operation of the sheller. Larry S. Creel, agricultural commodity grader, conducted some of the shelling tests, and William G. Ferguson and Robert A. Tennille, engineering technicians, assisted with the computations and plotting of the data. J. Marvin Frierson, machinist, fabricated major parts of the sheller and contributed ideas toward simplifying the fabrication techniques. John Woodward, mechanical engineer, brought to the attention of the authors the model 1 sheller and its potential and also helped with the statistical analysis of the data.

FULL SEASON WEED CONTROL SYSTEMS IN PEANUTS

by
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Control of weeds with herbicides in peanuts is essential to peanut production in Oklahoma for most farmers. Labor is not available to hoe the weeds out of the peanuts and the cost is prohibitive when hoe hands can be found. If weeds are left to compete with peanuts they reduce yields drastically by using water and nutrients and by interfering with pegging and harvest.

When the peanut farmer in Oklahoma started using dinitroaniline herbicides such as trifluralin, benefin, or nitralin during the mid-sixties, he was satisfied with the results since the hoe bill was greatly reduced. The major weeds were crabgrass (Digitaria spp.), pigweeds (Amaranthus spp.), and Texas panicum (Panicum texanum) which a dinitroaniline herbicide would control if used correctly (1,2,7,8). However, in recent years weed species resistant to the dinitroaniline herbicides have invaded many fields. There are some differences in phytotoxicity of dinitroaniline herbicides to different weed species but in general all of these chemicals are poor for control of many broadleaf weeds (1,5).

Several different herbicides have been studied with some of the major weed problems in Oklahoma (1,5,8). There have also been experiments conducted to determine how to properly incorporate and use the preplant herbicides for maximum effectiveness (7,8). In addition, yield experiments have been conducted to determine the effect of different herbicides on peanut yields (2,3,4). Information on herbicide performance from many of these studies was reported at the APREA Annual Conference in 1972 (6). From this information weed control systems for southwestern peanuts have been developed using a variety of herbicides.

Three dinitroaniline herbicides are approved for use in peanuts at this time - trifluralin, benefin, and nitralin. Several others are being evaluated and will possibly be available before long. Vernolate is also used in mixtures with many of the dinitroaniline herbicides to improve control of certain weeds such as morningglory (Ipomoea spp.) and yellow nutsedge (Cyperus esculentus). However, vernolate is ineffective on many common southwestern weeds.

Five preemergence herbicides are approved for weed control in peanuts. These are alachlor, chloramben, diphenamid, fluorodifen, and naptalam. Some of these may be applied at grounderacking in combination with dinoseb (dinitro or DNBP). In addition, 2,4-DB has been evaluated to determine its value for postemergence application (4).

Experiments have been conducted over the past several years in Oklahoma to determine the effect of each of these herbicides and how they can be used together for a total weed control program.

METHODS AND RESULTS

Pure stands of weeds were established in blocks whereever possible for each of the major weeds that is a problem in peanuts in Oklahoma. This included such weeds as broadleaf signalgrass (Brachiaria platyphylla), Texas panicum (Panicum texanum), prickly sida (Sida spinosa), cocklebur (Xanthium pensylvanicum), several types of pigweed (Amaranthus spp.), and crabgrass (Digitaria sanguinalis). Major herbicides that have been labeled or new herbicides that showed potential for peanuts were evaluated on these weeds. These experiments were established near Stillwater or in areas of the state where specific stands could be located. In addition, experiments with yellow nutsedge (Cyperus esculentus), hophornbeam copperleaf (Acalypha ostryaefolia), and horsenettle (Solanum carolinense) were studied in areas of the state where a specific stand could be located. Weed control data was collected on all of the weeds present in these studies and in peanut yield experiments. In addition to these experiments with specific weed studies, some experiments were designed to compare the relative phytotoxicity of

several dinitroaniline herbicides (5) and to study the time and depth of soil incorporation of all herbicides used preplant in Oklahoma (7,8). The influence of environmental conditions, seed size, quality, and other factors that might influence herbicide injury or performance were also considered (2,6).

An experimental plot tractor sprayer was used to apply the herbicides to plots which were in a randomized block design. Injury ratings were used for evaluation with a scale rating of 0 (no injury or weed control) to 100 (complete plant kill) and expressed as percent control. In addition, hoe time and weed count data were collected in many of the plots. These data for several preplant and preemergence studies are summarized for an average of several years in Table 1. In general these data indicate average early control for approximately one month after planting.

TABLE 1. Average of four years of control from some preplant and preemergence herbicides used in peanut experiments in Oklahoma.

Weed Species	Herbicide					
	Benefin	Nitralin	Trifluralin	Vernolate	Chloramben	Alachlor
Brachiaria	G*	E	E	P	G	G
Texas Panicum	E	E	E	F	G	F
Annual Morningglory	P	P	P	F	P	F
Hophornbeam Copperleaf	P	P	P	P	F	F
Prickly sida	P	P	P	F	F	G
Cocklebur	P	P	P	P	P	P

*Degree of control
Excellent - E = 90-100% control
Good - G = 80-90%
Fair - F = 50-80%
Poor - P = less than 50%

The first three are dinitroaniline herbicides that do a good to excellent job of controlling annual grasses in Oklahoma. These herbicides will also usually control pigweed and some of the other common annual broadleaf weeds. They are excellent for control of seedling johnsongrass (Sorghum halepense) and appear to be almost necessary in a weed control program if johnsongrass or Texas panicum is present. However, they will not give adequate control of yellow nutsedge, morningglory, hophornbeam copperleaf, or prickly sida, all of which are problems in some areas of Oklahoma peanuts. Vernolate is a broad spectrum herbicide but gives poor control of Texas panicum and signalgrass. However, this herbicide is helpful where yellow nutsedge is present and gives some early control of morningglory. Since vernolate neither lasts very long nor controls some grass species, it is not a very useful herbicide for peanuts in Oklahoma used alone. The peanuts do not fill in fast enough to shade the ground by the time vernolate has broken down. Mixtures of vernolate with a dinitroaniline herbicide is effective when certain weed problems exist.

Alachlor and chloramben are two preemergence herbicides that were found to be at least partially effective for control of copperleaf and prickly sida. Alachlor also gave fair control of yellow nutsedge, but was not usually found to be adequate for control of Texas panicum, morningglory, and cocklebur. Seedling johnsongrass was only controlled a short time after application.

Chloramben when used alone has the same weakness of rapid breakdown that vernolate has. It is also soluble and can be leached below the weed seed zone quickly. Severe stunting of peanuts occurs when the herbicide is leached to the peanut seeds before they emerge. For this reason chloramben was used in studies with dinitro as mixtures at the groundcracking stage.

Naptalam is used mostly in combination with dinoseb and a groundcracking postemergence application because of the possibility of peanut injury if hard rains occur when it is used as a preemergence herbicide. Diphenamid was not included in some

of these studies because of the amount required to be effective for preemergence use is too expensive compared to some of the other herbicides. It is used mostly in combination with dinoseb as a grounderacking treatment in Oklahoma. Both of these herbicides have been used in the systems approach when looking at a total program for weeds in peanuts, but dinoseb was used with them.

A mixture of naptalam and dinoseb was effective in partial control of annual morningglory. It was also effective against many of the broadleaved weeds that might escape a preplant herbicide or come up later in the season. However, it was not usually as effective for copperleaf control as were chloramben and alachlor. A mixture of diphenamid and dinoseb was most effective when seedling grasses were present at the grounderacking stage, but this mixture was ineffective for control of morningglory.

When peanut growers started using some of the grounderacking herbicides sometimes good control would be obtained, but it was often erratic. Those weeds that had already germinated were often missed if weather was adverse and results would be poor. Temperature was found to be one of the leading factors that affected the performance of these herbicides. If the temperature at the time of application of these herbicides or herbicide combinations was 85 to 90 degrees F or above, rates of 1½ lb of dinoseb were adequate to control the small weeds that had germinated. However, if the temperature was in the seventies when the herbicides were applied it was necessary to use 2 lb or more of dinoseb to get adequate control.

Three areas in Hughes County were used to study the specific weed problems with a systems approach of using several different herbicides in weed control programs in one season. Study 1 was an area where morningglory and cocklebur were the chief problems, but several other weeds were also present. Study 2 was located where prickly sida was a major problem and Study 3 where hophornbeam copperleaf was the major problem. These studies were designed for two to three years to accumulate the adequate information for use of herbicides in a farming system. In addition to these, specific studies were designed for evaluating herbicides on yellow nutsedge, horsenettle, and johnsongrass. Blocks were set aside for the study of the herbicide in an undisturbed situation with no crop planted and other areas were studied where the peanuts were planted in normal farming operations. All of the herbicides were applied with the tractor sprayer described above.

In Study 1 chloramben and diphenamid gave poor results. Alachlor and naptalam controlled many of the morningglory and cocklebur plants that germinated after the application of these herbicides. If used at the adequate rate according to the maximum temperature at the time of application, dinoseb controlled small morningglory and cocklebur plants immediately after application. If morningglory was larger than the two leaf stage dinoseb would not control it. Naptalam was the only herbicide that gave any residual control of the cocklebur. Early evaluations indicated that this herbicide was not giving good control of cocklebur because there was always some in the plot area. However, these weeds appeared to stay small at all times. After flagging the plants to determine what was happening, it was found that the weeds were often killed after they had come up and it was a new crop of weeds the observer saw each time he returned to the plots. Later studies with 2,4-DB at 0.4 lb/A as a postemergence treatment showed this herbicide to be effective for control of morningglory and cocklebur without permanent peanut injury if applied when weeds were small. These experiments indicate that if morningglory and cocklebur are the main weed problems along with crabgrass, pigweed, and johnsongrass, a dinitroaniline herbicide followed by a postemergence application of 2,4-DB will control the weeds.

In Study 2 on prickly sida, some control was obtained from both chloramben and alachlor. In some years a grounderacking application of dinoseb in mixtures with chloramben, alachlor, or naptalam was adequate to give full season control. In other years when rainfall occurred late in June differences among these herbicides could be established. The herbicide that appeared to perform best in all the seasons tested was alachlor. This would indicate that peanut growers who have prickly sida along with annual grasses should use a dinitroaniline herbicide preplant and alachlor preemergence. Fluorodifen was not included in these evaluations.

In Study 3 on hophornbeam copperleaf, naptalam gave some early control when used in combination with dinoseb but was not adequate. Diphenamid gave poor control when used either as a preemergence herbicide or in combination with dinitro. Chloramben and alachlor gave at least fair control. This weed species germinates throughout the summer and the alachlor appeared to give the longest lasting control of any of the preemergence herbicides used throughout this study. However, in the copperleaf experiments where peanuts were not planted, fluorodifen gave the best and longest lasting control of any herbicide used. 2,4-DB was not adequate for control of copperleaf in these studies. It damaged the copperleaf plants and killed a few of them, but even rates of 0.8 lb/A were not adequate to kill the entire population. From these studies with copperleaf, it would appear that a dinitroaniline herbicide used preplant and alachlor or fluorodifen preemergence would be a good program. Dinoseb at groundcracking and cultivation will also help when some of the weeds escape the preemergence herbicide.

Some field studies were conducted with leading peanut farmers in 1972 where several of these weeds were a problem on the same farm. Since johnsongrass was a major problem in these areas, a dinitroaniline herbicide was incorporated into the soil for grass control. Alachlor was applied preemergence over the rows after the peanuts were planted. Some escaped copperleaf and morningglory were present after the peanuts had come up. Dinoseb was applied once as a groundcracking herbicide soon after emergence of the peanuts. Two later applications of 2,4-DB at 0.4 lb/A were adequate to control the morningglory. It was also helpful in reducing horsenettle growth and control of later germinating broadleaf weeds such as pigweed. In one case the peanuts were grown without any cultivation or hoeing. However, in some situations it was found that one or two light cultivations may be needed. If adequate moisture does not occur within one week to activate the alachlor, a light cultivation will help to incorporate the chemical and kill small weeds that have germinated. This should be done with a rotary hoe or some other tool that will not throw a lot of soil around the peanuts and will not incorporate the chemical very deep. Dinoseb can be used to kill the escaped weeds soon after this early cultivation. Fluorodifen was not included in these field studies in 1972 but has been included in 1973.

There are several new herbicides that will possibly fit into this program. Some of these are the new dinitroaniline herbicides that could be used as the early incorporated herbicide. Fluorodifen has shown good results in preemergence applications for control of copperleaf. More detailed studies will be conducted in 1973 to determine if this herbicide will continue to be better than those previously used for control of prickly sida or copperleaf. Another new herbicide that shows some promise used as a postemergence herbicide that is not approved for peanuts at this time is 3-Isopropyl-1H-2,1,3-benzothiadiazin-(4)3H-one2,2-dioxide which will be sold as Basagran. Additional research will also be done with this herbicide in the 1973 season.

SUMMARY AND CONCLUSION

There are many weed problems in Oklahoma where no one herbicide will give adequate control. By using several herbicides and the choice of the right herbicides based on the weed problem that is present, adequate weed control can be obtained to grow a good peanut crop. If several of the major weed problems are present in a peanut crop, the program may involve a preplant herbicide, a preemergence herbicide, use of dinoseb as a contact herbicide in the groundcracking stage, and use of 2,4-DB to control such weeds as morningglory and cocklebur. Some new herbicides may replace those that can now be used in the systems approach if label approval is granted and if additional research show them to be better than those now used. Some cultivation is necessary in many situations to give adequate control. It is also very important to do a good job of incorporation of the preplant herbicide and to base the use of dinoseb on the temperature at the time of application.

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ETHYLENE PRODUCTION, GERMINATION, AND VIGOR OF STARR VARIETY SPANISH-TYPE PEANUT SEEDS STORED AT HIGH AND LOW HUMIDITIES[1/]

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ABSTRACT AND PAPER

ABSTRACT

Two series of germination tests were performed with Starr variety Spanish-type peanut seeds stored at 3C and either 10 or 100% relative humidity (RH). The first tests (Series 1) were made without fungicide. The second tests (Series 2) were made with fungicide (Captan 50 WP) applied to the seeds. In Series 1 at 100% RH, germination declined from 100 to 63% in 8 months and then to 31% at 9 months of storage. Percentage of vigorous seeds declined from 95 to 13% at 8 months and 13 to 0% at 9 months. (Vigorous seeds were defined as those attaining a hypocotyl-radicle length > 20 mm by 72 hr). After 9 months of storage at 10% RH, 100% of the stored seeds germinated, and 90% were still vigorous. Ethylene and CO_2 production were greatly reduced in 8 months at 100% RH, but slightly at 10% RH. Between the initial assays and those made at 8 months, the maxima for ethylene and CO_2 production also shifted from 24 to 48 hr and 48 to 72 hr respectively, at 100% RH. Series 1 of these tests was terminated because of mold invasion in the late stages of storage (8 months) at 100% RH.

Using fungicide-treated seeds in Series 2, we extended and substantiated the results of Series 1. Germination and vigorous seeds declined to 44 and 0%, respectively, by 11.5 months of storage in 100% RH. Ethylene and CO_2 production were reduced 99 and 72% at 24 and 48 hr, respectively, after 11.5 months of storage in 100% RH, when compared to 10% RH at the same time. An important result was that after 21 months of storage in 10% RH, the seeds showed changing patterns of ethylene and CO_2 production that indicate physiological changes similar to those at 100% RH where the seeds deteriorated more rapidly. Early and high rates of ethylene production within 24 hr are associated with vigorous germination (emergence of hypocotyl-radicle and radicle) and growth of peanut seeds during initial stages of germination.

PAPER

It is essential that peanut seeds stored for future use as planting seed retain their initial germinability and vigor to the greatest extent possible. Unfortunately, under the standard low temperature (47°F) and humidity (55-70%) used to store shelled peanuts, some lots of seed rapidly decline in germinability and vigor. Causes of the deterioration during storage are not understood. This study was made to determine some physiological and biochemical changes in peanut seeds that occur under conditions known to reduce seed quality. It seems reasonable to expect that similar changes occur in standard peanut storage, but at slower rates.

Previous investigations have shown that the plant-growth regulator, ethylene, is important in the growth processes of peanut seeds (1-6). Ethylene breaks the dormancy of peanut seeds (1-3, 5). All of the evidence available indicates that the capacity to produce ethylene after imbibition changes, and the ethylene thus produced, whether during natural afterripening or after treatment, releases the

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seeds from dormancy. Its production must rise at a particular time (24 hr) to be effective in breaking dormancy (3). Also, ethylene-production maxima occur at critical stages in the germination of non-dormant seeds (1, 6). An ethylene-production maximum occurs at emergence of the hypocotyl-radicle and at emergence of the radicle from the hypocotyl (6). Storage conditions that cause physiological changes in the seeds and that alter the growth processes of the seeds, of which ethylene production is apparently an essential part, could affect germination and vigor. Previous tests of germination, vigor, and ethylene production and measurements of various organic and inorganic contents of two commercial lots of seed indicate that ethylene production is most closely correlated with germination and vigor of the seeds (4).

PROCEDURES

Seeds for this study were from Starr variety Spanish-type peanuts, grown at Holland, Virginia. They were shipped in the shell to College Station, Texas. Seeds were handshelled, placed in cloth bags, and stored at 3C and either 10 or 100% relative humidity (RH). Seed samples were removed from storage at intervals and tested for germination, vigor, and production of carbon dioxide and ethylene. The tests were made in two parts: Series 1 without fungicide, and Series 2 with fungicide (Captan 50 WP) applied to the seeds. At the same times, samples were frozen in liquid nitrogen, freeze-dried, and stored at -20C for protein and RNA analyses at a later date. At the beginning of the experimental series and after 21 months, a sample of seeds from 10% RH was analyzed for mineral content. Except for protein extraction, details concerning methods have been published (1-5). Proteins were extracted in 0.1 M tris buffer at pH 7.0 by grinding in a mortar. The slurry was centrifuged at 20,000 X G for 30 min to pellet the debris. Proteins were precipitated by making the supernatant 5% in trichloroacetic acid. The proteins were pelleted by centrifugation at 20,000 X G for 10 min. The supernatant was decanted, and the proteins were dried at 55-60 F for 24 hr and weighed.

RESULTS AND DISCUSSION

In Series 1 under 100% RH, germination declined from 100 to 63% at 8 months and from 63 to 31% at 9 months of storage (Table 1). The percentage of vigorous seeds declined from 95 to 43% at 8 months and from 13 to 0% at 9 months (Table 2). Vigorous seeds were defined as those attaining a hypocotyl-radicle length 20 mm by 72 hr. Seeds stored at 10% RH retained 100% germination and 90% vigorous seeds (Table 1 and 2).

Ethylene and CO_2 maximum production rates after 8 months of storage were, respectively, 45 and 15% less at 100% RH than at 10% RH (Fig. 1E). The time of maximum production had also changed from 24 to 48 hr for ethylene and from 48 to 72 hr for CO_2 at 100% RH when compared to seeds stored at 10% RH for the same length of time (Fig. 1E). After 9 months of storage at 100% RH ethylene and CO_2 production had been further reduced (Fig. 1F). Also beginning at 8 months of storage, a decrease in maximum ethylene and CO_2 production in 10% RH (Fig. 1E) was noted. The time of maximum ethylene production did not shift, while the CO_2 maximum changed from 48 to 72 hr after 9 months in 10% RH (Fig. 1F). Once the time change for maximum production occurred, it remained at that time for the remainder of the tests (Fig. 1 and 2).

The data show a correlation between reduced peak rates and changing patterns of ethylene and CO_2 production and reduced germinability and vigor. However, there appears to be a range (7 to 13 nl/g fresh wt/hr) within which ethylene can be produced at 24 hr and the seeds remain germinable and vigorous (Fig. 1A-F). The CO_2 maximum may also change to 72 hr without noticeable effect on germination and vigor at 10% RH (Fig. 1F). But these changes at 10% RH are the same ones that occurred more rapidly and to a greater extent at 100% RH and were associated with decreased germination and vigor of the seeds. Thus, it was possible to detect physiological changes that were correlated with decreased germination and vigor (100% RH) before changes in germination and vigor were noticeable (10% RH). That ethylene is the critical indicator in the growth processes, and not CO_2, has been indicated previously (1-6). Also, the data here suggest that a critical

Table 1. Effect of storage treatment on percent germination of peanut seeds at 72 hr.

Months of storage		Germination[5/]	
10% RH	100% RH	10% RH	100% RH
	Series 1[1/]		
0	0	100	100
1	1	99	100
2	2	100	100
4	4	99	100
8	8[2/]	100	63
9	9	100	31
	Series 2		
13	3.5[3/]	99	99
17	7.5[4/]	100	87
19	9.5	99	71
21	11.5	99	44

1/ Series 1 - no fungicide; Series 2 - fungicide was applied to the seeds.

2/ Seeds stored at 100% RH were contaminated with storage mold at this time. The least contaminated seeds were selected for this experiment, and all samples were surface-sterilized with 1% NaOCl for 2 min just before imbibition. The remainder of all seeds were treated with Captan 50 WP (N-[(trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide) at a rate of about 7 g per pound of seeds. One month later, at 9 months of storage, an additional experiment was run with the Captan-treated seeds. The seeds from 100% RH were then discarded. The seeds from 10% RH were divided equally, and one-half were placed at 100% RH. The first test after this division was at 13 months of continuous storage at 10% RH.

3/ Seeds from previous storage at 10% RH were stored 3.5 months at 100% RH to begin this second series of experiments.

4/ A few colonies of mold began to appear on some seeds at 100% RH, even in the presence of Captan. For this and the remaining two experiments, seeds were selected that were visibly free of mold growth.

5/ Each datum is the mean of 3 replicate samples of 100 seeds each per experiment.

Table 2. Effect of storage treatment on vigor (extent of growth of hypocotyl and radicle) of peanut seeds.

Months of storage		Extent of growth in mm of hypocotyl and radicle at 72 hr of germination.							
		10% RH				100% RH			
10% RH	100% RH	< 5	5-10	10-20	> 20 mm	< 5	5-10	10-20	> 20 mm
		%				%			
				Series 1					
0	0	1	0	3	96	1	0	3	96
1	1	4	1	2	92	0	0	1	99
2	2	4	1	1	94	0	0	0	100
4	4	6	2	9	82	1	0	4	95
8[1/]	8	6	1	3	90	22	9	19	13
9	9	5	1	2	92	20	8	3	0
				Series 2					
13	3.5	5	5	25	64	1	1	11	86
17	7.5	6	8	27	59	15	13	32	27
19	9.5	6	7	24	62	27	18	21	5
21	11.5	5	7	30	57	34	7	3	0

1/ See notes Table 1.

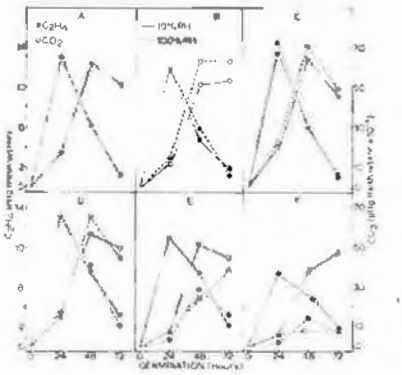

Figure 1. The effect of two storage relative humidities on ethylene and carbon dioxide production by peanut seeds. A, fresh seeds; B, 1; C, 2; D, 4; E, 8 and F, 9 months of storage, Series 1. Each point represents the mean of 3 replicate samples of 100 seeds each.

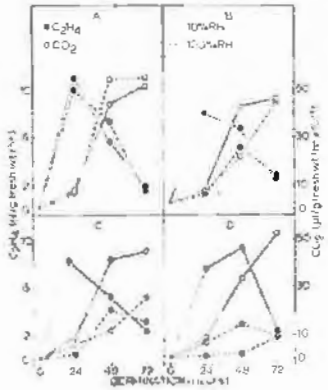

Figure 2. The effect of two storage relative humidities on ethylene and carbon dioxide production by peanut seeds. A, 13 and 3.5; B, 17 and 7.5; C, 19 and 9.5; D, 21 and 11.5 months of storage at 10 and 100% relative humidity, respectively. Each point represents the mean of 3 replicate samples of 100 seeds each.

minimum of ethylene production must occur, and ethylene production is more sensitive to poor storage conditions than is CO_2 production. It has also been demonstrated on individual peanut seeds that ethylene-production maxima occur at emergence of the hypocotyl-radicle and again at emergence of the radicle (Fig. 3 and ref. 6).

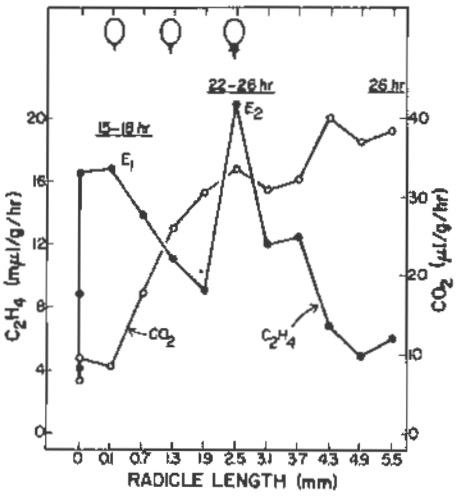

Figure 3. Ethylene and carbon dioxide production during early phases of peanut seed germination. E_1, emergence of the hypocotyl-radicle; E_2, emergence of the radicle. Hours indicated are hours of germination. Each point represents the mean C_2H_4 and CO_2 produced over a 0.5 mm increment of growth beginning at 0.1 mm; 0.1 to 0.6, 0.7 to 1.2 mm, and so on, for several individual seeds. Data calculated on fresh weight of seeds. (Adapted from reference 6).

Series 2 was begun with fungicide-treated seeds from 10% RH (Table 1, Note 3). Four months after fungicide application, the number of vigorous seeds decreased from about 90 to 60% at 10% RH (Table 2). They remained near this level for the remainder of the test. At the same time that the number of vigorous seeds decreased, there was a decrease in maximum ethylene production at 24 hr (Fig. 2B). Thus, either the fungicide had an effect on vigor and ethylene production that would not be noticeable in standard germination tests, or there was an abrupt decrease in vigor and ethylene production of the seeds caused by length of storage.

A more gradual reduction in germination occurred in Series 2 than in Series 1 beginning at 7.5 months of storage in 100% RH (Table 1, Series 2). Germination and percentage of vigorous seeds remained nearly constant at 99 and 60%, respectively, for seeds from 10% RH until termination of the tests at 21 months (Table 1 and 2, Series 2). In contrast, germination and vigorous seeds declined to 44 and 0%, respectively, by 11.5 months of storage in 100% RH (Tables 1 and 2). Under poor storage conditions (100% RH) the seeds show a continuous decline in vigor and growth (Table 2). Reductions in ethylene and CO_2 production and changes in their production patterns correlate with the reduced germination and vigor of the seeds in Series 2 and were similar to those in Series 1 (Figs. 1 and 2). Ethylene production decreased 29% and maximized at 48 hr while germination was reduced only 12% at 7.5 months of storage in 100% RH, but the percentage of vigorous seeds was reduced 59% at the same time (Table 1 and 2, and Fig. 2B). These data confirm the correlation between reduced ethylene production and decreased seed vigor that was shown in Series 1. Time of maximum carbon dioxide production at 100% RH after 7.5 months of storage had shifted to 72 hr (Fig. 2B). Further

reductions in ethylene and CO_2 production were similar to those in seeds from Series 1 (Fig. 1 and 2). However, an important result was that after 21 months of storage at 10% RH, the ethylene and CO_2 production maxima shifted to 48 and 72 hr, respectively, indicating a gradual slowing of germination processes at 10% RH. These results indicate that physiological changes similar to those at 100% RH also occurred at 10% RH, but at a slower rate. Measurements of germination and vigor did not reflect these changes at this time. The results of Series 2 extended and substantiated the information from Series 1, but were without the complication of mold interference with the tests (see notes Table 1).

In both Series 1 and 2, significant loss of soluble protein was not detectable until after deterioration of germination, vigor, and ethylene and CO_2 production. The reduction of soluble protein was greatest in seeds stored at 100% RH for 9 months (Series 1) and 11.5 months (Series 2)(Table 3).

Table 3. The effect of storage on soluble protein content of peanut seeds.

Months of storage			Soluble-protein-content Storage condition	
10% RH	100% RH		10% RH	100% RH
		Series 1	g/5 g of seeds[2/]	
1	1		0.34±0.05	0.32±0.05
2	2		0.32±0.02	0.33±0.03
4	4		0.31±0.07	0.34±0.01
8	8[1/]		0.36±0.02	0.33±0.03
9	9		0.46±0.02	0.20±0.05
		Series 2		
12	3.5		0.39±0.04	0.30±0.05
17	7.5		0.39±0.01	0.37±0.04
19	9.5		0.37±0.02	0.35±0.02
21	11.5		0.32±0.01	0.26±0.00

1/ See notes 1, 2, 3, and 4, Table 1.
2/ Each datum is the mean of duplicate extractions.

After 1 month of storage at 100% RH, less RNA was extracted from the seeds (Table 4). Whether there is an actual loss of RHA, or whether it is changed to some form that is not extractable, is unknown. However, the data agree with previous results that showed less extractable RNA in seeds stored 1 to 2 months under high relative humidity (4). Previous results also showed that low-quality seeds were affected more by poor storage conditions (high RH) than were high-quality seeds (4). The present data do not show any correlation between deterioration of the seeds and RNA content; however, there was a decreasing trend of extractable RNA with increasing time of storage at 100% RH (Table 4).

Table 5 shows no significant changes in mineral content of the seeds during 21 months of storage at 10% RH. The 100% RH samples were not tested. Previous results showed that low-quality seeds contained less Ca, K, and Zn; more P and Mn; and about the same amount of Mg and Cu as the high-quality seeds (4).

Table 4. The effect of storage on RNA content of Peanut Seeds

Months of storage			RNA content Storage condition		Ratio
10% RH	100% RH		10% RH	100% RH	100% RH / 10% RH
		Series 1	mg/g of seeds		
1	1		1.243[2/]	1.182	0.95
2	2		1.250	1.186	0.95
4	4		1.438	1.350	0.94
8	8[1/]		1.250	1.138	0.91
9	9		1.324	1.133	0.86
		Series 2			
13	3.5		1.429	1.059	0.74
17	7.5		1.325	0.997	0.75
19	9.5		1.438	1.223	0.85
21	11.5		1.320	1.147	0.87

1/ See notes 1, 2, 3, and 4, Table 1.

2/ Each treatment was extracted in duplicate and both treatments for a given time interval were extracted on the same day. Maximum deviation between duplicate extractions was ± 0.015 mg.

Table 5. Mineral content of peanut seeds.

Storage time	Ca	Mn	Zn	Fe	Cu	B	K	Mg	P
			ppm[1/]				%		
Initial analyses	592	25	39	35	15	-	0.63	0.22	0.37
21 months at 10% RH	410[2/]	18	36	55	14	3	0.48	0.29	0.38

1/ Based on initial dry weight of the seeds.

2/ Not significantly different.

Thus far, among the physiological and biochemical parameters that have been measured, the correlation is closest between germinability, vigor, and ethylene production by the seeds (Tables 1 and 2, Figs. 1 and 2). The available evidence (1-6) indicates that ethylene production by peanut seeds is important in the initial phases of germination. Ethylene is produced in large amounts just before hypocotyl-radicle emergence and at emergence of the radicle (6). In previous results, the ethylene maximum occurred at 48 hr, and the most vigorous seeds attained a hypocotyl-radicle length >10 mm at 96 hr. These amounted to only 17±7% of the population (4). In the results here, the ethylene maximum occurred

at 24 hr for the most vigorous seeds, which attained a hypocotyl-radicle length $>$20 mm at 72 hr. They amounted to 90 and 60% of the population in Series 1 and 2, respectively (Table 2, Figs. 1 and 2).

Thus early and high rates of ethylene production within 24 hr are associated with vigorous germination (emergence of hypocotyl-radicle and radicle) and growth of peanut seeds during initial stages of germination.

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FURTHER STUDIES ON CYLINDROCLADIUM BLACK ROT OF PEANUTS IN VIRGINIA

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ABSTRACT AND PAPER

ABSTRACT

Cylindrocladium black rot of peanuts (CBR) caused by Cylindrocladium crotalariae progressed from 1 severe development in 1970 to 2 severe developments in 1971 and 10 severe developments in 1972. A 3 year study of stored seed gave no evidence that infested seed should be blamed for the rapid spread of the disease in Virginia. A greenhouse study with two field soils suggest much more C. crotalariae or a much more potent strain in one field than in the other.

PAPER

In 1970 Cylindrocladium black rot of peanuts (CBR), caused by Cylindrocladium crotalariae (Loos) Bell & Sobers (Calonectria crotalariae (Loos) Bell & Sobers), was found to be severe in one field in Virginia. In 1971 it was found to be severe in two fields in two counties in Virginia. In 1972, without a concerted survey, it was found to be severe in 10 fields in 4 counties in Virginia.

SEED TRANSMISSION?

Fruit taken from a severely infested field in October, 1972 were stored in burlap bags in a seed storage building. These were tested by surface sterilizing with sodium hypochlorite a piece of shell and one sound appearing seed from each fruit that was selected for testing. These shell pieces and seed were plated on acidified PDA, incubated 4 days at 27C, and read after another 4 days at room temperature. At time of testing for the CBR pathogen fruit were separated into lots of discolored and clean pods. Platings were made every 7 days for the first 70 days, and then at 14 day intervals.

Virtually no C. crotalariae could be found in shells or seeds of the clean pods. In 70 days of storage the percentage of discolored shells and seeds in which viable C. crotalariae could be found decreased from a high of 60% to a high of 12%. As many seeds as shells were infested with the CBR pathogen. After 125 days the high for infestation was 4%. An occasional shell, but no seed, was found infested at planting time.

This was the third year of such a study. Thus, in 3 years of study of the longevity of the pathogen in peanut seed stored as seedsmen and growers store seed, we found no evidence that infested seed should be considered a factor in the rapid spread of this disease in Virginia.

THE PATHOGEN IN FIELD SOILS

Soil from the upper 4 inches of two severely infested fields was brought into the greenhouse December 28, 1972 and apparently sound seed were planted immediately. In one of these soils many peanut seedlings died from typical damping-off and C. crotalariae was isolated with ease from the seedlings. No such damping-off was observed in the other soil. (A similar damping-off type killing of seedlings by CBR was noted in 1973 in two fields now in peanuts for the third consecutive year.) In plants surviving the damping-off phase of CBR symptoms of CBR were not evident until mid-May at which time the pathogen was isolated from 30 of 40 tap roots of plants in the soil in which the damping-off developed and from only 10 of 40 tap roots in the other soil. Symptom development was much more evident in the former soil. There was no difference in symptom development or in pathogen

isolation between these two soils in some over-mature plants surviving to mid-June.

Thus results of a greenhouse study with soil from two infested fields suggests: (1) The pathogen remains highly viable until well into colder weather; (2) either a much higher inoculum density of the pathogen in one field than in the other or a more virulent strain of the pathogen in one field than in the other; (3) persistence of the pathogen may not be influenced by prolonged exposure to high temperatures (as in the greenhouse), but such treatment may affect difference in virulence between strains of the pathogen.

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INSECT PEST MANAGEMENT ON PEANUTS IN GEORGIA

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ABSTRACT AND PAPER

ABSTRACT

The overuse of insecticide in peanut production in Georgia has been emphasized since the mid 1960's. In 1972 four insect pest management demonstrations were conducted. Each demonstration was scouted weekly and each cooperating farmer was apprised of the insect situation. Only one of the four fields of peanuts developed an insect infestation that was considered to be of economic importance.

PAPER

Pest management is new terminology for what many of us have been practicing for a long time. In Georgia we have emphasized the overuse of insecticides on peanuts since the mid 1960's. Much of this overuse was due to formulators including either DDT, toxaphene or carbaryl in almost all fungicide dusts used to control leafspot diseases. Since the advent of chlorothalonil and benomyl in 1971, two superior fungicides for leafspot control, neither of which is formulated with an insecticide, we seem to be making more rapid progress in reducing unnecessary applications of insecticides.

In 1972 four insect pest management demonstrations were conducted in an effort to convince growers that insecticides should be applied only when certain levels of damaging pests were present. Each grower agreed to apply insecticides only when weekly insect counts were considered to be above economic levels. Most insecticide applications in the Southeastern peanut belt are made to control foliage feeding caterpillars. Based on limited artificial defoliation data, limited foliage consumption data of some species and largely on experience, a threshold level of four caterpillars per foot of row was used. This number appears to be completely reasonable and may be a little conservative if peanuts have a normal growth of foliage. As each field was checked observations were made for damaging species other than foliage feeding caterpillars and beneficial species. The following tables give a brief summary of insect counts in each demonstration each week and a brief summary of results.

Table I. Worth County Demonstration
1972
Peanut Insect Pest Management

Date	Observations
5/18	Thrips damage light.
5/25	Thrips damage light.
6/1	Thrips damage moderate.
6/8	Thrips damage light; foliage damage very light, no caterpillars.
6/15	Parasitized granulate cutworms (*Apanteles* sp.) very light. Thrips damage light.
6/29	Light foliage feeding, no caterpillars.
7/6	0.15 granulate cutworms/row foot.
7/11	No damaging sp.
7/20	Lesser cornstalk borer very light, branch feeding.
7/25	0.15 foliage feeding caterpillars/row foot.
8/1	0.10 foliage feeding caterpillars/row foot.
8/10	0.10 foliage feeding caterpillars/row foot.
8/15	0.05 foliage feeding caterpillars/row foot; Lesser cornstalk borer damage light (2 larvae).

Summary

No insecticide
Yield: 2325 - very light sandy soil, dry weather
Grade: 76

Table II. Tift County Demonstration
1972
Peanut Insect Pest Management

Date	Observations
5/22	Thrips damage heavy, stunting apparent.
5/29	Thrips damage heavy, stunting apparent.
6/5	Thrips damage heavy; light foliage damage, no caterpillars.
6/12	Thrips damage moderate; 0.05 foliage feeding caterpillars/row foot.
6/19	Thrips damage light; light foliage damage, no caterpillars.
6/26	0.50 foliage feeding caterpillars/row foot.
7/3	1.50 foliage feeding caterpillars/row foot.
7/10	2.00 foliage feeding caterpillars/row foot.
7/16	1.05 foliage feeding caterpillars/row foot.
7/25	0.55 foliage feeding caterpillars/row foot.
7/30	1.95 foliage feeding caterpillars/row foot.
8/7	1.70 foliage feeding caterpillars/row foot.
8/14	1.30 foliage feeding caterpillars/row foot.
8/21	1.75 foliage feeding caterpillars/row foot.
8/28	1.65 foliage feeding caterpillars/row foot.

Summary

No insecticide
Yield: 2950 lbs./A.
Grade: 75-76

Table III. Cook County Demonstration
1972
Peanut Insect Pest Management

Date	Observations
5/24	Thrips damage light.
5/30	Thrips damage light.
6/7	Very light foliage feeding.
6/14	Very light foliage feeding.
6/21	0.25 granulate cutworms/row foot.
6/28	0.40 foliage feeding caterpillars/row foot.
7/2	0.45 foliage feeding caterpillars/row foot; leafhoppers and hopperburn light.
7/5	Accidental toxaphene application.
7/12	0.10 granulate cutworms/row foot; hopperburn light.
7/21	Southern corn rootworm and *Sciara sp.* very light pod damage.
7/27	0.05 loopers/row foot.
8/2	0.10 foliage feeding caterpillars/row foot
8/9	Very light hopperburn.
8/14	0.15 foliage feeding caterpillar/row foot.

Summary

One accidental application of 2 lbs. toxaphene 7/5.
Yield: 3205 lbs./A.
Grade: 76-77

Table IV. Crisp County Demonstration
1972
Peanut Insect Pest Management

Date	Observations
6/17	0.75 granulate cutworms/row foot.
6/23	0.30 granulate cutworms/row foot.
7/2	0.75 granulate cutworms/row foot.
7/7	1.30 granulate cutworms/row foot.
7/14	0.50 foliage feeding caterpillars/row foot.
7/21	6.40 foliage feeding caterpillars/row foot; mites on east border of field.
7/24	Applied Dylox bait and Lannate each on one-half of field. Spot treatment with X for mites.
7/25	1.80 foliage feeding caterpillars/row foot.
8/3	1.11 foliage feeding caterpillars/row foot.
8/11	2.75 foliage feeding caterpillars/row foot.
8/18	2.05 foliage feeding caterpillars/row foot.

Summary

One insecticide (Dylox bait and Lannate) 7/24.
Yield: 3567 lbs./A.
Grade: 73-75

DISCUSSION

The two insects that were predominant in the foliage feeding caterpillar group were the granulate cutworm, Feltia subterranea (F.), and the corn earworm, Heliothis zea (Boddie). Next in importance were the beet armyworm, Spodopter exigua (Hubner) and fall armyworm, Spodoptera frugiperda (J. E. Smith). Others included in this group were the velvetbean caterpillar, Anticarsia gemmatalis (Hubner), soybean looper, Pseudoplusia includens (Walker), yellow striped armyworm, Prodenia ornithogalli (Guenee), and a few undetermined species.

It is interesting to note that in demonstration II and IV, though a continuous moderate infestation of foliage feeding caterpillars were present for most of the latter part of the growing season, neither farmer became overly concerned, even though they normally would have controlled similar infestations. It is also interesting to note that demonstrations II, III and IV made excellent yields of peanuts and only one application of insecticide was needed on demonstration IV.

Results from those demonstrations indicate that Georgia peanut growers can greatly reduce the present average of two applications of insecticides made each year to control foliage feeding caterpillars.

INVESTIGATIONS OF CAUSES AND PREVENTION OF FATTY ACID PEROXIDATION IN PEANUT BUTTER

by
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ABSTRACT AND PAPER

ABSTRACT

Our earlier report (J. APREA 4: 186, 1972) showed that heat-denatured metalloproteins in peanut butter were primary catalysts of fatty acid peroxidation (staling) during storage. In a continuation of these studies, acceptable methods for decreasing or preventing this oxidation were examined. Different amounts of water, inorganic salts, and chelating agents suspended in water or in inert solvents were added to peanut butters, which were then stored for several months. Results of periodic analyses showed that proper control of water concentration and use of metal chelating agents are the most effective means of decreasing the formation of peroxides. However, the quality of freshly prepared peanut butters used in these experiments varied considerably, which may be an important factor to consider when determining optimal concentrations of additives needed to extend shelf life.

PAPER

INTRODUCTION

In a previous report (1) on causes of lipid oxidation in peanut butter, we showed that metalloproteins as well as metal salts can catalyze the peroxidation of fatty acids in peanut butter. The degree of oxidation of the fatty acids depended upon their microenvironment--i.e., the aqueous or nonaqueous surroundings. The increase in peroxidation caused by the metalloprotein peroxidase was overcome by adding the chelating agent, ethylenediaminetetraacetic acid (EDTA). Water acted as an antioxidant, but peanut oil enhanced peroxidation. As part of a continuing study on causes of lipid oxidation, acceptable methods for decreasing or preventing oxidation were devised and are reported herein.

MATERIALS AND METHODS

The peanut butters used in these studies were commercial products, to which various materials, dissolved or suspended in either deionized water or mineral oil, were added. Peanut oil was also a commercial product. Mineral oil, or paraffin oil, was obtained from Fisher Scientific Company, New Jersey[2/]. Enzymes were purchased from Nutritional Biochemicals Corp., Ohio, and spectrophotometric grade hexane from Mallinckrodt Chemical Works, Missouri. Extracts of peanut butter were prepared and assayed according to procedures previously reported (1).

Briefly, each sterilized glass jar containing 20 g of peanut butter, to which various materials were added, was stored in the dark at ambient temperature until assayed. On predetermined days, about 1 g samples were withdrawn and accurately weighed into centrifuge tubes, then 30 ml of spectrophotometric grade hexane was added. After thorough stirring of each sample, the tubes were centrifuged. The supernatants containing the lipid were immediately analyzed for total conjugated diene hydroperoxide (CDHP) contents, reported as μmoles per gram of peanut butter. One CDHP unit is defined as 1 μmole per g of peanut butter. The Δ CDHP values represent the increase in CDHP units from the initial value taken on the first day that the sample was assayed.

1/ One of the facilities of the Southern Region, Agricultural Research Service, U. S. Department of Agriculture.

2/ Use of a company or product name by the Department does not imply approval or recommendation of the product to the exclusion of others which might also be suitable.

RESULTS AND DISCUSSION

Several methods are commonly used to determine the degree of rancidity, staling, or formation of lipid peroxides in oil-containing food products. These methods include the determination of peroxide value, the thiobarbiturate determination of malonaldehyde formation, and the determination of increase in absorption at 234 nm due to increasing diene conjugation (2). In our previous communication (1), we showed that the diene conjugation (CDHP) method parallels the peroxide value (PV) method and was faster and more convenient for following the development of rancidity in peanut butter.

Heme proteins and metal salts were previously shown to catalyze the oxidation of unsaturated fatty acids in peanut butter over a 4-week period (1). Figure 1 illustrates the effects of these additives over a 3-month storage period. Curve A

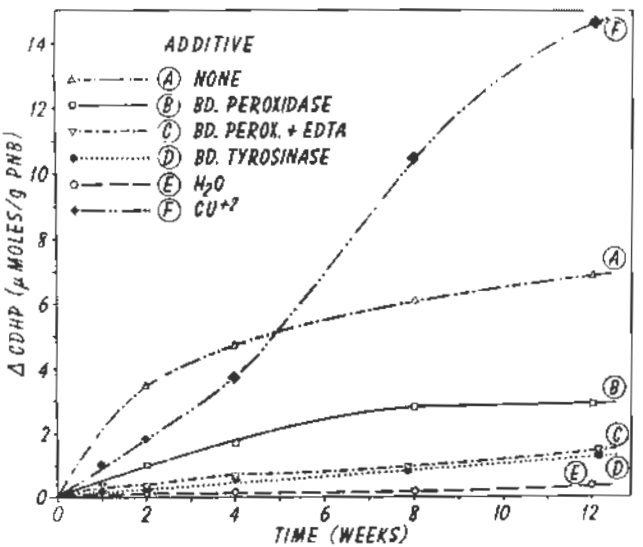

Figure 1. Effect of additives on peroxidation of fatty acids. Each series (A-F) contained 20 g of peanut butter. All additives were dissolved in 1 ml of deionized water; concentrations were: peroxidase and tyrosinase, 20 mg each; EDTA, 0.1 mMole; cupric acetate, 0.02 mMole.

represents the control sample (commercial peanut butter to which nothing was added). Curve E, for a sample to which was added 1 ml of deionized water, shows that water can reduce peroxide formation. After 84 days of storage, the control increased in CDHP content to 6.8, whereas the sample containing water increased only 0.4 units. Therefore, for a proper comparison of substances dissolved in water and added to peanut butter, curve E should be considered the control. It is noteworthy that no mold formed on any of the samples whose jars were initially sterilized by autoclaving.

A sample of peanut butter containing boiled peroxidase (20 mg) as an additive showed an increase to 2.9 μmoles CDHP per g, a net increase of 2.5 units over the water control (compare curves B and E). When EDTA was added to this sample, curve C, there was a significant decrease in the amount of oxidation from 2.9 to 1.4. The copper-containing enzyme, tyrosinase, (curve D), also catalyzed peroxidation of fatty acids over this 3-month period (curve D), but to a lesser degree than the iron-containing enzyme, peroxidase (curve B). Cupric acetate, however, had a pronounced effect on fatty acid peroxidation. After 84 days, CDHP values

increased to 14.6 (curve F), which represents an increase of 14.2 over the control. Comparing the effects of free copper to bound copper as found in tyrosinase, the ratio was 14.6 to 1.3, an elevenfold increase in lipid peroxidation.

Peanuts contain many proteins that contain metals; tyrosinase and peroxidase are only two of these. Although roasting the nuts causes heat-denatured enzymes to lose their specific activities, their ability to catalyze the peroxidation of fatty acids is not destroyed. Ory and Cherry (3) examined approximately 400 seeds from cultivars of Runner, Spanish, and Virginia peanuts grown in different areas and found that they all contained five common peroxidase isozymes, in addition to several others in lesser amounts.

Catalase, another iron-containing enzyme found in peanuts (3), was not tested for its catalytic ability in peanut butter, but this enzyme has been shown to catalyze nonenzymic peroxidation in linoleic acid (4). The peanut catalase showed the same two isozymes in all 400 seeds examined (3).

The 1 ml of water mixed into peanut butter amounted to a final water concentration of 4.8%, which showed an apparent antioxidant effect. As shown in Figure 2, three

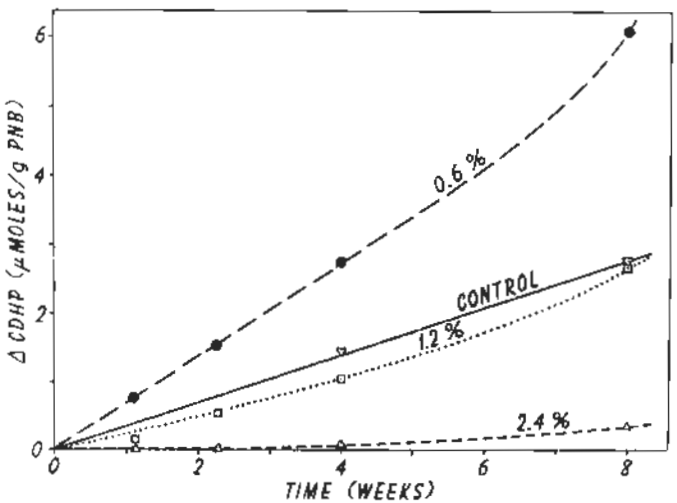

Figure 2. Effect of water concentration on lipid peroxidation. Each sample contained 20 g of peanut butter.

other concentrations of water were compared for their effects on peroxidation in peanut butter over a period of two months. When 1.2% added water was added, the rate of peroxidation did not differ from that of the control sample. Doubling the amount of water did not increase peroxide formation for the first 28 days and increased it only 0.4 CDHP units after two months; these results suggested inhibition of peroxide formation in this sample. However, when only 0.6% water was added, it behaved as a prooxidant. In this case, the CDHP value rose 2.8 units in 28 days and increased to 6.1 units after 56 days, much higher than the peanut butter control values of 1.4 and 2.7, respectively.

Investigating the effects of water on stability of foods, Lebuza et al. (5) have shown that water can act both as a prooxidant and as an antioxidant, depending upon the "water activity". At high and low water activities, it behaved as a prooxidant, whereas at water activities in the medium range, it acted as an antioxidant. Our results on peanut butter, presented in Figure 2, seem to conform to the theories of Lebuza and his coworkers.

Since water can act either to promote or to retard lipid oxidation, peanut oil was tested as the carrier solvent for several metalloproteins and salts added to peanut butter. Because peanut oil normally contains about 83% unsaturated fatty acids (including about 22% linoleic acid, the primary substrate for lipid oxidation in peanut products), one would expect the sample with added peanut oil to show an increase in oxidation over that of the control. This was confirmed by the results shown in Figure 3. The control sample had a change of 2.5 CDHP units over the

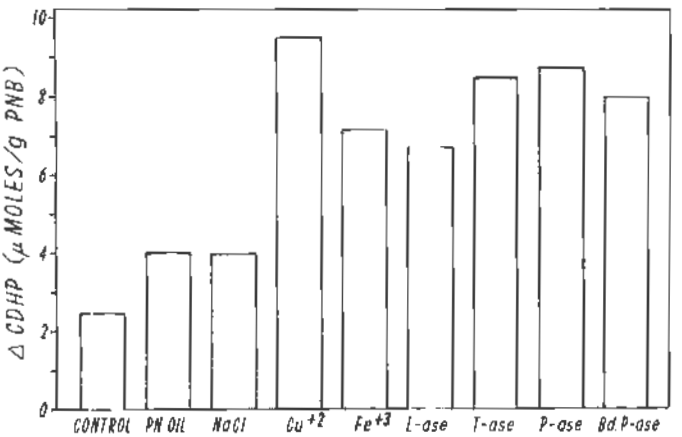

Figure 3. Effect of various additives suspended in peanut oil on lipid peroxidation. Each sample contained 20 g of peanut butter. Each additive was suspended in 1 ml of peanut oil; concentrations were sodium chloride, cupric acetate, and ferric chloride, 0.02 mMole; lipoxygenase, tyrosinase, and peroxidase, 20 mg. Duration of experiment was three months.

3-month storage period, whereas the one containing added peanut oil increased to 4.0. Sodium chloride, which is normally added to peanut butter, had no effect at all when added in peanut oil; however, the two metal salts, cupric acetate and ferric chloride, showed increases up to 9.5 and 7.2, respectively. Addition of the copper-containing tyrosinase and the iron-containing peroxidase again resulted in increases in rates of oxidation, but, as was shown in Figure 1, neither enzyme was as effective a catalyst as the free copper. Lipoxygenase, the primary catalyst for enzymic oxidation of unsaturated fatty acids, also gave an increase in the rate of peroxidation, as expected, but the effect was less than that caused by metal-containing proteins.

Since peanut oil promoted oxidation, an inert mineral oil was the next solvent tested. Mineral oil is a long-chain hydrocarbon containing very little, if any, unsaturated compounds, and should not have any pro- or antioxidant influence on the additives. The additives were suspended in the oil by sonification and tested in peanut butter as previously described. The results are shown in Table I. Added mineral oil caused an increase in CDHP value from 2.8 to 3.8 after 56 days of storage. Peroxidase had no effect when suspended in mineral oil (3.6 CDHP units after 56 days), but Fe^{+3} (ferric chloride salt) had a significant effect. In 28 days, the CDHP value increased from 2.5 to 4.2; after 56 days, the value was 7.4, twice that of the mineral oil control. EDTA added with the iron salt caused only a slight decrease (down to 6.3 units) after 56 days of storage. Because of this lowering effect of EDTA in mineral oil, it was decided to examine several concentrations of EDTA without added metals to study its effect on fatty acid oxidation.

EDTA suspended in mineral oil caused a slight increase in CDHP values of peanut butters after 56 days (see bottom of Table I), not a decrease as might be expected

Table I. Effect of Additives in Mineral Oil on CDHP Formation in Peanut Butter

Additive	Days Storage (28)	(56)
	CDHP (μMoles/g peanut butter)	
None	1.4	2.8
Mineral Oil (1 ml)	2.5	3.8
" + Peroxidase (20 Mg)	2.9	3.6
" + Fe^{+3} (0.05 mMole)	4.2	7.4
" + " + EDTA (0.1 mMole)	2.9	6.3
	(21)	(56)
Mineral oil (1 ml)	4.5	7.6
" + EDTA (0.1 mMole)	5.2	8.0
" + " (0.2 ")	5.4	8.7
" + " (0.3 ")	5.7	8.3

When trace metals were added to catalyze peroxidation. Increasing the amount of EDTA caused no difference in the amount of CDHP formed, which suggests that the main prooxidants in peanut butter are probably the endogenous metalloproteins and not the free metals. However, if free metals are present in significant amounts in the peanut butter, EDTA should retard their catalytic effect more readily than it does with peroxidase.

After analyzing many different samples of commercial peanut butters over the past year, we observed that no two samples had the same initial peroxide content. This observation suggested that the quality of the peanuts before roasting and processing varied considerably and that they were already in different stages of peroxidation. Figure 4 presents the initial CDHP contents of nine of these peanut butters. The

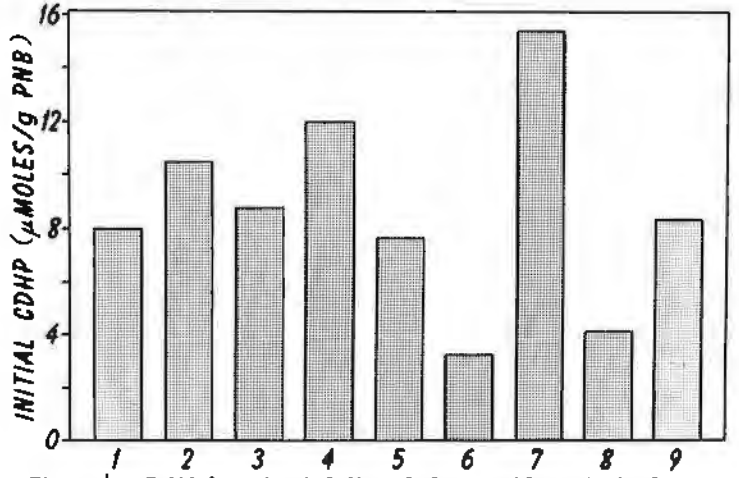

Figure 4. Initial conjugated diene hydroperoxide content of nine different peanut butters.

values vary from 3.2 to as high as 15.5, which indicates that the history of the peanuts prior to processing is just as important as the conditions present after processing. This finding stresses the importance of performing a quality check for peroxide content of the peanuts before processing.

Since both free and protein-bound iron and copper catalyze peroxidation of fatty acids in peanut butter, we determined total iron and copper contents of peanut butter by atomic absorption spectroscopy. The results (Table II)

Table II. Iron and Copper Contents of Different Peanut Butters

Sample	%Iron	%Copper
A	0.001	0.01
B	0.006	0.01
C	0.003	0.04
D	0.002	0.01

show that all four samples differed in iron content, where only one differed from the other three in copper content. The percentages vary from 0.001 to 0.006 (10 ppm to 60 ppm) for iron and 0.01 to 0.04 (100 ppm to 400 ppm) for copper. Although List et al. (6) have reported that free copper is present in oil extracted from soybeans and that concentrations as low as 30 ppb were active catalysts of autoxidation in the oil, we suspect that most of these metals in peanuts are present in bound form as metalloproteins.

SUMMARY

Water in peanut butter influenced peroxidation of fatty acids. Depending upon its concentration the water either promoted or retarded oxidation. As little as 2.4% acted as an antioxidant. Salts and metalloproteins containing iron or copper were major catalysts of peroxide formation in peanut butter. Citric acid and EDTA, which are effective chelating agents, reduced the peroxidizing effects of these metal-catalysts, being more effective when added in aqueous solution than in either peanut oil or a mineral oil.

ACKNOWLEDGMENT

The authors thank Mr. Biagio Piccolo for the atomic absorption analyses of iron and copper in the peanut butters, and to Mr. John Conkerton for the photographs.

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NATURAL OUTCROSSING OF PEANUTS, *ARACHIS HYPOGAEA* L., IN PUERTO RICO

by

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ABSTRACT

Natural crossing of peanuts, *Arachis hypogaea* L., in Puerto Rico was measured by alternate hill planting of seven varieties with the dominant marker line Krinkle and counting the hybrids in the progeny from the varietal plants on an individual plant basis. In the 2-year study 1969 and 1970 at Isabela, Puerto Rico, natural outcrossing averaged 0.27 and 0.09%, respectively. Varietal and seasonal differences were noted. Natural outcrossing in peanuts was less at Isabela than that reported for other areas. The amount was similar to Holland, Virginia for the varieties tested in both areas. Tennessee Red had the highest mean natural outcrossing with 0.29% (range = 0.09 to 0.49%) and Virginia Bunch 67 had the lowest mean with 0.08% (range = 0.05 to 0.10%). Argentine was lowest in 1970 with 0.02%, but not the lowest mean over two years. The level of natural outcrossing in peanuts at Isabela would give in the next generation 20 to 484 natural hybrid plants/ha (8-196/acre) at the present commercial planting rates and 3 to 81 plants/ha (1-33/acre) space planted to 0.6m (2 ft) for breeding work. This has implications in maintaining purity in peanut breeding lines grown in Puerto Rico.

INTRODUCTION

Peanuts were once throught to be totally self-pollinated and that natural hybridization was almost non-existent. Stokes and Hull (1930) stated, "It is generally believed that cross fertilization occurs very infrequently in common peanuts." Recent studies have shown that natural hybridization does occur and sometimes at alarming rates. Kushman and Beattie (1946) found 17 hybrid plants among the 200 grown from "off type" seed in Virginia. Natural outcrossing has been reported in Java (Bolhius, 1951), India (Srinwasalu and Chandrasekaran, 1958), and Rhodesia (Smartt, 1960). Natural outcrossing frequencies were 0.73-2.56% in nine varieties studied at Tifton, Georgia in 1959 (Hammons, 1964). In peanut breeding nurseries at Tifton the levels of natural crossing range from 0.25 to 6.16% (Leuck and Hammons, 1969). Hammons has found in some cases as much as 10% natural outcrossing (USDA, 1963). A recent study at Holland, Virginia, showed outcrossing frequencies of 0.01 to 0.55% over the 3-year period 1963 to 1965 (Culp. et.al,1968).

The vectors of natural outcrossing have been extensively studied (Hammons, 1963; Hammons, et. al., 1963; 1966; and Leuck and Hammons, 1965a, 1965b). The principal insects observed visiting the peanut flowers in the early morning are solitary bees of the Halictidae and Magachilidae families. Several species of the Apoidae family are effective flower trippers, but they usually visit the flowers later in the day after most self-pollination has occurred.

Seed increase of peanut introductions and breeding lines during the winter months have been very successful in the past four seasons in Puerto Rico, but information was not available on how much natural outcrossing could be expected. The objective of the experiments reported here was to determine the amount of natural outcrossing in this geographical area.

PROCEDURE

Varieties included in the study were Argentine and Starr (*Arachis hypogaea* ss. *fastigiata* var. *vulgaris*); Tennessee Red (ss. *fastigiata* var. *fastigiata*); Virginia Bunch 67, Early Runner, Florunner, and Florigiant (ss. *hypogaea* var. *hypogaea*). Seeds of these varieties were planted in alternate hills with the dominant genetic marker line (Culp et. al., 1968, Hammons, 1964) with hills 0.6m

(24 in) apart and rows 1 m (40 in) apart. The planting was a randomized complete block design with six replications for five of the varieties.

Individual variety replicates consisted of 11 hills of the tester variety alternating with 12 hills of Krinkle. The planting consisted of two tiers of plots with three replications in each tier. The two outside rows on both sides of the two tiers were planted with the varieties Starr and Florunner in alternate hills with Krinkle. This arrangement provided only four replications of these two entries with randomness restricted.

Thiram-treated seeds were hand planted with two seeds per hill on December 5, 1969 and November 18, 1970. Following emergence the plants were thinned to one per hill. Plants were dug at approximately 130 days after planting. Ten plants of each test variety were harvested from each replication.

The pods were picked, fried, and shelled with the identity of the seed of individual plants being maintained together with the location of each plant in the field. The seeds from the 1969 planting were planted in benches of sand in the greenhouse. After 14 days the plantings were checked for Krinkle progeny and the number of Krinkles and normals were recorded. The seeds from the 1970 planting were planted directly into the field and data recorded as in the greenhouse planting.

The percentage of plants with outcrossed seed was determined by calculating the number of plants with crosses in each variety as a percentage of the total plants in each variety. The randomness of the outcrossing was determined by dividing the test area into eight equal parts and using the X^2 test for randomness.

RESULTS

The plants developed normally under good field conditions with irrigation and periodic insecticide spraying. No major field problems occurred except heavy infection of rust late in the season of both years. The extent of plant growth was moderate with some overlapping of branches of adjacent plants within the row, but no overlapping between rows. Flowering began approximately four weeks after planting and continued throughout most of the growing season. Nearly all flowering ceased after the heavy infection of rust.

In 1969, the percentage of plants that outcrossed at least once with Krinkle was highest in the case of Early Runner 36.7% and Tennessee Red 37.9% (Table 1). Virginia Bunch 67 and Florigiant had the least number of outcrossed plants with 3.3 and 10.0%, respectively. In 1970 Early Runner and Florunner had the most outcrosses with 16.7 and 15.0%, respectively; Argentine had the least number of outcrosses with 1.7%. All of the varieties except Starr and Virginia Bunch 67 had considerably less plants with crosses in 1970 than in 1969. With the average for all varieties combined in 1969 more than twice that for 1970 (19.8 vs 9.0). When data for both years were combined, 14.4% of the plants produced at least one outcrossed seed.

The minimum percentage of natural outcrossing in the seven varieties, determined by the Krinkle seedlings observed among the progeny from individually harvested plants, is shown in Table 2. In 1969, the percent of outcrossing with Krinkle ranged from 0.05 to 0.49% for Virginia Bunch 67 and Tennessee Red, respectively. The percent of outcrossing in 1970 was considerably less with a range from 0.02 to 0.13% for Argentine and Early Runner, respectively. The mean for the two years ranged from 0.08 to 0.29% for Virginia Bunch 67 and Tennessee Red, respectively. The amount of reduction of crossing in the second year varied for the respective varieties. Tennessee Red had the highest outcrossing in 1969 when the mean level was 0.27%, but was equaled or exceeded by several varieties in 1970. When the mean level was less than 0.10 percent. The plants with demonstrated outcrosses showed only a small number of crosses per plant in most cases. Most showed only one or two outcrosses per plant, or occasionally three outcrosses. One plant of Tennessee Red showed four outcrosses and one plant of Argentine showed seven in 1969.

The numbers of seeds produced on the test plants as shown by the number of progeny (Table 2) were quite similar for the 2 years. On the other hand, varieties differed in seed production.

The Chi-square values in the tests for randomness of crossing in the test area were not significant for number of plants with crosses (1969 X^2 = 8.367, 1970 = 6.470, df = 7) or for number of crosses (1969 X^2 = 12.945, 1970 = 7.540, df = 7). The location within the test area with respect to the prevailing wind or proximity to the same or other crops apparently did not significantly affect the extent of natural crossing.

DISCUSSION

A striking aspect of the results of this study is the low level of natural crossing that was recorded. The level of natural crossing recorded is by no means a valid estimate of the total outcrossing that occurred in our test plantings. No information is available on the extent of the outcrossing of the test varieties on Krinkle, outcrossing of the test varieties with one another, or outcrossing among different plants of the same variety or among flowers on the same plant. However, we feel that our results are a reasonably reliable estimate of the degree of contamination that might result from natural outcrossing when plants of two peanut genotypes are grown in close proximity to one another at or near Isabela, Puerto Rico, during the winter months.

The potential for natural crossing in peanuts is determined by the presence of functional flowers that have not been self-pollinated and visitation of such flowers by bees that carry peanut pollen. The generally low level of natural crossing reported for peanuts suggests that most flowers are self-pollinated before they are visited by pollen-carrying bees.

Leuck and Hammons (1969), have reported the presence on plants of two varieties of morphologically atypical but otherwise functional flowers with open keels, and anthers and stigma separated sufficiently to make natural self pollination unlikely. The varieties differed significantly in the proportion of these atypical flowers. In areas such as Tifton, Georgia, and Beltsville, Maryland, where individual peanut flowers are visited repeatedly by bees, the level of natural crossing doubtless is determined largely by the extent to which the flowers have not been self pollinated prior to visits of pollen-carrying bees. The extent to which environmental conditions might influence the occurrence of such flowers is unknown.

However, it seems unlikely that morphological differences in flowers could be responsible for the three-fold difference in natural crossing at Isabela between the two seasons. The winter climate at Isabela is an equable one, with rain infrequent. The average daily temperature for the 1969-1970 and 1970-1971 seasons was 64°F. minimum and 88°F. maximum. The temperature did not fluctuate greatly from day to day or from year to year, which is typical of the area. Sunshine was abundant and the temperature rose quickly after sunrise so that bee activity was not hampered by cool daytime temperatures.

Comparatively few bees were observed visiting peanut flowers in our plantings. We suspect that infrequency of bee visits probably was responsible for the unusually low level of outcrossing during the 1970-1971 season. With the exception of Argentine, differences in outcrossing to Krinkle probably were not statistically significant. We have no logical explanation for the very low frequency of outcrossing of Argentine. Avoidance of Argentine flowers by bees seems improbable. A possible explanation might be a disproportionate loss of natural crosses among the seed of Argentine that split on shelling, that were lost because of decay during maturation on the plant, or that failed to germinate when planted. However, we have no evidence that any of these factors were operative.

Differences in outcrossing among varieties in 1969, when the average level was three times that for 1970, probably reflect largely differences in frequency of flowers that were not self-pollinated by the time the bees reached them. Under situations where bee visitation of flowers is not extensive, possible insect preference for flowers of certain genotypes might be a factor in the extent of natural crossing.

Our results in 1969 probably are a more realistic indication of the level of unidirectional natural crossing that might be anticipated at Isabela than are results in 1970.

The general level of natural crossing at Isabela roughly approximated that of the same varieties tested at Holland, Virginia. At Holland, Tennessee Red was the most promiscuous, Virginia Bunch 67 the least, and Argentine was intermediate. A similar ranking of these varieties was obtained in our study. Of varieties tested for the first time, Early Runner and Florunner approached Tennessee Red, Starr was similar to Argentine, and Florigiant was about as low as Virginia Bunch 67 in extent of natural crossing at Isabela.

The range of natural crossing of 0.02 to 0.49% encountered in our study at Isabela would pose no problem for a peanut breeder who is interested in advancing breeding lines one generation by growing them in Puerto Rico during the winter months. However, natural crossing levels within this range could be important in the production of breeders seed or in genetic studies where maintenance of genetic integrity is essential.

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Table 1. Number and percentage of plants with one or more crosses in 1969 and 1970

Variety	Year	Number of test plants Observed	With crosses	Percentage with crosses
Argentine	1969	60	8	13.3
	1970	59	1	1.7
Starr	1969	40	5	12.5
	1970	40	5	12.5
Virginia Bunch 67	1969	60	2	3.3
	1970	60	3	5.0
Early Runner	1969	60	22	36.7
	1970	60	10	16.7
Florunner	1969	40	10	25.0
	1970	40	6	15.0
Florigiant	1969	60	6	10.0
	1970	60	3	5.0
Tennessee Red	1969	58	22	37.9
	1970	60	6	10.0
Total	1969	378	75	19.8
	1970	379	34	9.0
	Mean			14.4

Table 2. Total seedlings, Krinkle seedlings, and percentage outcrossing to Krinkle for seven peanut varieties grown at Isabela, Puerto Rico in 1969 and 1970

Variety	Total seedlings: 1969	1970	Krinkle: 1969	1970	Outcrossing percentage: 1969	1970	Mean
Argentine	6,046	6,112	19	1	0.31	0.02	0.16
Starr	4,272	4,144	8	5	0,19	0,12	0,16
Virginia Bunch 67	5,583	5,923	3	6	0.05	0.10	0.08
Early Runner	8,164	7,633	28	10	0.34	0.13	0.24
Florunner	4,809	4,827	14	6	0.29	0.12	0.20
Florigiant	4,862	5,408	6	3	0.12	0.06	0.09
Tennessee Red	6,531	6,604	32	6	0.49	0.09	0.29
Total	40,267	40,651	110	37	0.27	0.09	0.18

Table 3. Number of Krinkle progeny per plant and field location 1969

Variety	Plant number										Variety	Plant number									
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
Starr											Starr		1								
Florunner	1					2				1	Florunner	1			1	1	2				
Argentine				1	7	3	3				Early Runner	1		1				1			1
Tennessee Red		1		1	4	1					Virginia Bunch 67		2								
Early Runner	1	1	1				1		1		Argentine										
Virginia Bunch 67											Florigiant	1									
Florigiant									1		Tennessee Red		1				2				
Florigiant			1	1							Tennessee Red		1		1	1	1	2		2	1
Early Runner						3	1				Early Runner	1	1		1		1				
Argentine		2									Florigiant			1							
Virginia Bunch 67											Argentine							1			
Tennessee Red		2									Virginia Bunch 67										
Early Runner	1	2									Florigiant								1		
Tennessee Red	1		1				1	1			Early Runner	1	1				1	2	3		
Argentine										1	Argentine	1									
Florigiant											Virginia Bunch 67										
Virginia Bunch 67								1			Tennessee Red			1	3			1	1		1
Starr			3							1	Starr							2	1	2	
Florunner						2				1	Florunner										

Table 4. Number of Krinkle progeny per plant and field location 1970

Variety	Plant number									
	1	2	3	4	5	6	7	8	9	10
Starr							1			
Florunner							1			
Early Runner			1			1				
Florigiant		1								
Argentine										
Virginia Bunch 67										
Tennessee Red										
Florigiant										
Virginia Bunch 67					2		3	1		
Tennessee Red			1	1				1		
Argentine					1					
Early Runner										
Tennessee Red				1			1		1	
Florigiant										
Early Runner					1			1		
Virginia Bunch 67										
Argentine										
Starr			1						1	
Florunner										

Variety	Plant number									
	1	2	3	4	5	6	7	8	9	10
Starr						1				
Florunner			1			1	1	1	1	
Tennessee Red										
Argentine										
Virginia Bunch 67										
Florigiant										
Early Runner						1			1	
Argentine										
Virginia Bunch 67										
Tennessee Red										
Early Runner						1			1	
Florigiant						1				1
Argentine										
Florigiant										
Virginia Bunch 67										
Early Runner	1		1							
Tennessee Red										
Starr										1
Florunner										

PEANUT YIELDS FOLLOWING DEFOLIATION TO ASSIMILATE INSECT DAMAGE

by
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ABSTRACT

Foliage was removed from Florunner peanuts with a mowing machine during 1970, 1971, and 1972. Yields were decreased when 33% of the leaf area was lost at several growth stages. Yield was reduced more the later leaf loss occurred and was significant 90 days after planting, ranging from 441 to 899 lbs/A reduction. Plots with removal of 10-15% of the leaf area yielded 4270 lbs/A, while 50% leaf loss averaged 2504 lbs/A compared to 4443 lbs/A in the untreated plots. Yields of the plots mowed late in the season and the 50% leaf loss plots were reduced less by late harvest than was the check.

Even though yield reductions were not significant following 33% leaf loss 50 to 80 days after planting, average yields were lowered more than would be commercially acceptable. When check plots yielded over 5000 lbs/A, yield losses were greater in the mowed plots than when check plot yields were below 5000 lbs/A.

PAPER

Peanut foliage is eaten by several insects in Florida including armyworms, corn earworms, velvetbean caterpillars, green clover worms, cutworms, and the red necked peanut worm. Therefore, we felt the first step in establishing an action threshhold for foliage feeding insect control would be to learn what effect foliage loss would have on yield.

MATERIALS AND METHODS

Field experiments were conducted at the Agricultural Research Center at Marianna, Florida, during the growing seasons of 1970, 1971, and 1972. The primary soil types on which these studies were conducted were sandy loams and loamy sands. Conventional land preparation, fertilization, insect and disease control, and other cultural practices were followed. During 1970 copper sulfate was applied for control of Cercospora Leafspot, while during 1971 and 1972 Ben late was utilized. Insecticides were applied to all plots and leaf feeding was never apparent.

The 'Florunner' variety was planted in 36 inch rows at a seeding rate of 85 pounds per acre on April 28, 1970; May 10, 1971; and May 22, 1972. Each plot consisted of two 20 foot rows replicated 4 times. The 1970 and 1971 studies were irrigated, while the 1972 test was not irrigated and experienced moisture stress in early June, August, and September. Leaves were removed from the tops of the plants with a rotary mower mounted on a 3-point hitch with an adjustable rear wheel. The wheel height was set to remove approximately 33% of the leaf area. During one mowing each year the wheel setting was changed to remove 10-15, 20, 33 and 50% of the leaf area. At the 50% setting 50% or more of the leaf area was removed as well as some of the branched or potential pegging area of the plants.

RESULTS AND DISCUSSION

Removal of 33% of the leaf area lowered yields, though not significantly in all tests (Table 1). The closer to harvest time that mowing occurred, the greater yields were reduced with significant reductions after 91 days of plant growth. The higher yield levels during 1970 and 1971 showed more significant reduction than was obtained from 1972, when yields were lower. The average yield reductions for the three years show a decrease in yield the later in plant maturity that leaf area was removed.

Table 1 Florunner peanut yields following removal of 33% of the leaf area.

Year	Days after planting mowing occurred						
	0	51-60	61-70	71-80	81-90	91-100	101-110
1970	4427[a]	-	-	4228[ab]	4527[a]	2751[bcd]	2471[cd]
1971	5582[a]	5101[ab]	4967[b]	4992[b]	4299[c]	4337[c]	-
1972	3320[a]	2889[ab]	2809[ab]	2786[abc]	2657[abc]	-	-
Ave.	4443	3995	3888	4002	3828	3544	

Yield reductions were greater during 1970 than during 1971 or 1972, when leaves were removed after 91 days of plant growth, yet at 81-90 days the yield was reduced less during 1970. An average yield reduction of almost 500 lbs/A following leaf removal at 51-60 days after planting was not statistically significant but could be very important to the producer.

When different levels of leaf area were removed, greater yield reduction resulted as the percent leaf loss increased (Table 2).

Table 2 Yield of Florunner peanuts following removal of varying percentages of leaf area.

Year	Days after planting	% Leaf removal				
		0	10-15	20	33	50+
1970	108	4427[a]	4257[ab]	3986[abc]	2471[cd]	1651[d]
1971	65	5582[a]	5482[ab]	5372[ab]	5101[ab]	4163[c]
1972	58	3320[a]	3072[a]	2257[bcd]	2889[ab]	1698[d]
3 Yr. Ave.	77	4443	4270	3872	3487	2504

The magnitude of loss was less during 1971 when yields were higher. Yield reductions following 20 or 33% leaf removal was not always significant, but loss of over 100 lbs of peanuts per acre would be important to the grower. The 10-15% leaf removal was close to an acceptable level, since the reduction was less than 200 lbs/A. Loss of 20% or more of the foliage would certainly be too severe. The greater reduction in yield during 1970 than 71 or 72 probably was due to mowing at 108 days compared to 65 and 58 days respectively. (Table 2).

Each year two diggings were made from each plot approximately 7 days apart. The later diggings were much lower yielding than the first except for plots mowed after 90 days of age. Those plots had greener leaves later in the season and delayed digging was beneficial. From these yield results delayed digging might be warranted if leaf area is lost from a peanut field after 90 days of growth.

PROTEINS FROM PEANUT CULTIVARS (ARACHIS HYPOGAEA) GROWN IN DIFFERENT AREAS. VIII. AMINO ACID COMPOSITIONS OF SPANISH PEANUT FLOURS AND PROTEIN ISOLATES[1/]

by

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ABSTRACT AND PAPER

ABSTRACT

Seeds from Argentine, Starr, and Comet varieties representing the 1970 crops in Georgia, Oklahoma, and Texas were selected for this study. By solvent extracting the seeds on a laboratory scale, peanut flours having nitrogen contents of approximately 10% were obtained.

Protein isolates were prepared from each of the flours by extraction with mild salt solutions buffered to pH 7.0. The amino acid compositions, including available lysine contents, of all the flours and isolates were determined. The results were compared with respect to varietal differences and geographical areas where the peanuts were grown.

PAPER

INTRODUCTION

In 1971, an in depth study of proteins from peanut cultivars grown in different areas was begun at this laboratory. Data reported earlier showed qualitative and quantitative variations in the electrophoretic and immunochemical properties of proteins isolated from these samples (1,4,5). As a result of these studies interest was concentrated on cultivars of Spanish type peanuts grown in Georgia, Oklahoma, and Texas. Recent research has been directed toward the potential use of peanut proteins as flours and/or isolates for incorporation into food products for human consumption. For such a use, knowledge of the amount and quality of any protein is essential. Therefore, flours and soluble isolates were prepared from Argentine, Comet, and Starr variety peanuts from the different growing areas. Nitrogen and amino acid contents of all fractions were determined, and these data were examined for varietal and/or geographical area differences. Results of this survey are reported in this paper.

PREPARATION OF SAMPLES

a) Flours:

Twenty dehulled intact peanuts were homogenized in 40 ml acetone in a Sorvall Omnimixer[3/] for 5 min. at 5° C. The homogenate was filtered, then rehomogenized with a second 40 ml portion of acetone. The filtrates were combined and made up to 100 ml. A 5 ml aliquot was withdrawn from each for estimation of oil contents. The oil-free meal (flour) was air-dried, weighed, and divided into two portions. One was analyzed for nitrogen and amino acid contents; the second was used to prepare a soluble protein isolate.

1/ Presented at A.P.R.E.A. Meeting in Oklahoma City, Oklahoma, July 15-18, 1973.

2/ One of the facilities of the Southern Region, Agricultural Research Service, U. S. Department of Agriculture.

3. It is not the policy of the Department to recommend the products of one company over those of any others engaged in the same business.

b) Isolates:

A weighed amount of flour was suspended in 10% NaCl buffered to pH 7.0 with $NaHCO_3$ at a w/v ratio of 1:10. The slurries were equilibrated for 10-15 min., then stirred for one hr. at room temperature, 22° C. After being centrifuged at 22° C for 25 min. at 39,100 x g, the supernatants were decanted. Salts were removed from both fractions, supernatant and insoluble residue, by dialysis against four portions of deionized water at a 1:100, v/v ratio. After dialysis both fractions were freeze-dried, then stored at 0° C until used. Total nitrogens of both of these fractions and amino acid contents of the soluble isolates were determined.

A second series of meals and isolates were prepared as described above, except that, for comparison, skins were removed before the peanuts were decoiled.

A schematic illustration of the preparation of the sample is shown in Figure 1.

ANALYTICAL METHODS

Total nitrogen contents were determined by the Kjeldahl procedure. Amino acids were determined by gas chromatography as described by Conkerton (2). Available lysine contents were determined by the dinitrofluorobenzene derivatization technique (6).

RESULTS AND DISCUSSION

Since these experiments were carried out on a laboratory scale, results are compatible with -- but not necessarily convertible to -- those obtained by large-scale commercial production methods. All seeds yielded a light cream colored flour from which a white protein isolate was obtained. Removal of skins before decoiling had very little effect on the colors of the flours and no apparent effect on their chemical compositions as measured in these experiments. Since the skin pigments were not soluble in the buffered salt solution used to extract the protein, they were separated easily from the isolates. Data for oil contents of the seeds and nitrogen contents of the flours, isolates, and residues were almost identical, as indicated by the average values for each variety in the three growing areas (Table 1).

Table 1. Varietal Comparison of Spanish Peanut Cultivars

	Oil Content	Nitrogen Content		
		Flour	Isolate	Residue
	%	%	%	%
Argentine	46	9.7	16.7	3.2
Comet	45	9.6	16.9	3.3
Starr	45	9.7	17.1	2.8

Geographical comparison of the cultivars also indicated similarities in these values (Table 2).

Table 2. Geographical Comparison of Spanish Peanut Cultivars

	Oil Content	Nitrogen Content		
		Flour	Isolate	Residue
	%	%	%	%
Georgia	46	10.1	16.7	3.1
Oklahoma	45	9.6	17.1	3.0
Texas	46	10.1	17.2	3.1

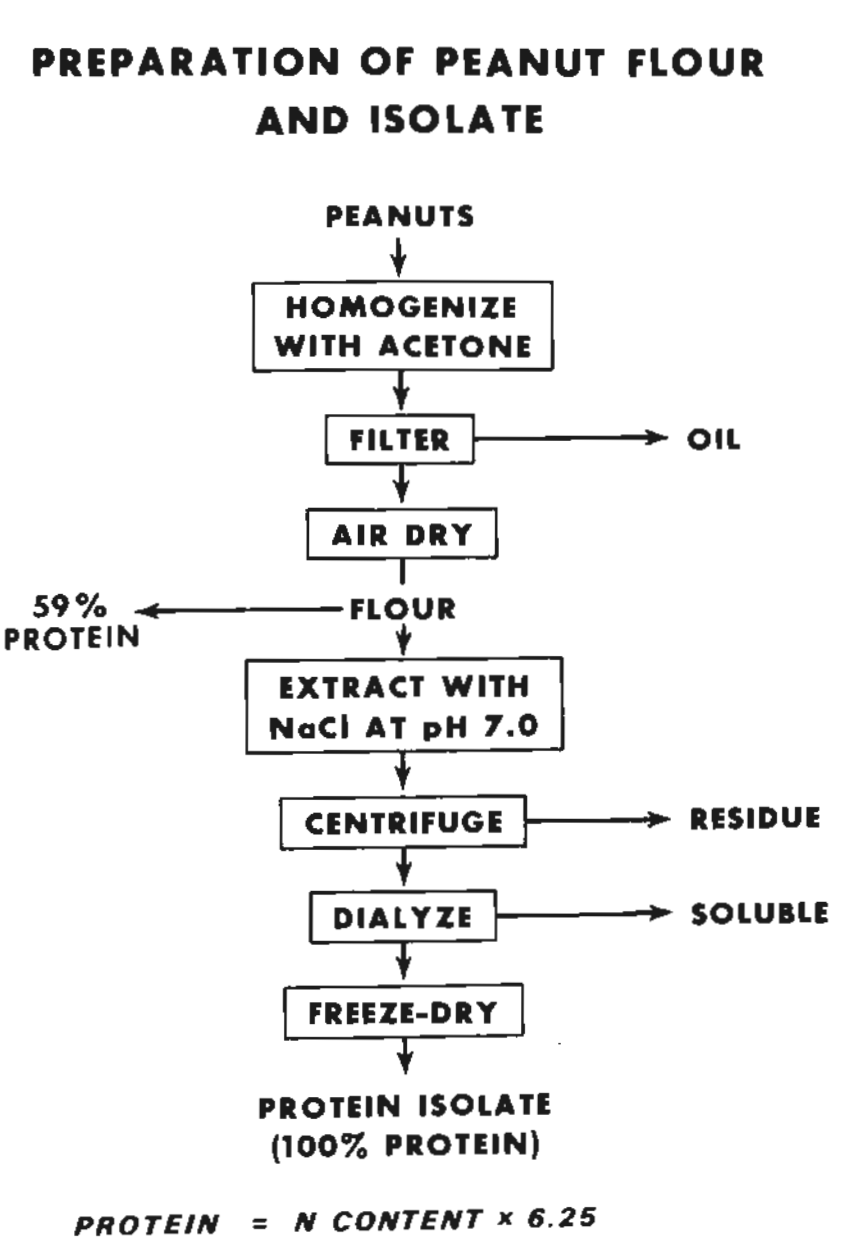

Figure 1. Preparation of Peanut Flours and Protein Isolates.

The analogy between these peanut extended to their amino acid patterns. Therefore, values were averaged to allow varietal and geographical comparisons.

In Figure 2, the geographical and varietal comparison of some of the essential

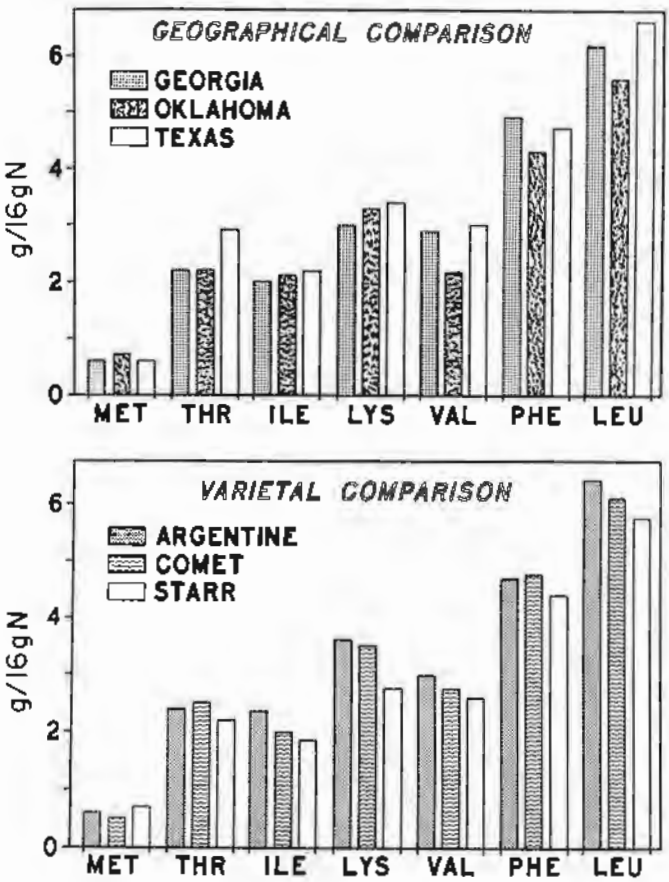

Figure 2. Spanish Peanut Flours - Comparison of Some Essential Amino Acids.

amino acids of these flours are illustrated. There did not seem to be any consistency in differences in amino acid contents with respect to the growing area. Except for methionine, Starr peanuts were slightly lower in each of these essential amino acids than either Argentine or Comet peanuts. However, the differences were not significant.

These values are similar to Rosen's data (7), except for isoleucine and valine, which were significantly lower than published literature values of 3.3 and 3.7 g/16 gN, respectively. Although these lower values may be attributed to varietal differences, there is a possibility that earlier data may be misleading. A gas chromatographic analysis of standard soybean and peanut meals yielded highly reproducible results for isoleucine and valine, but the values were lower than data obtained on the same meals by the classical ion-exchange procedure(2). In addition, other investigators have reported unexpectedly low isoleucine values in peanut meals (8).

For the isolates, the geographical and varietal comparisons of these essential amino acids, excluding methionine, are illustrated in Figure 3. Similarities in

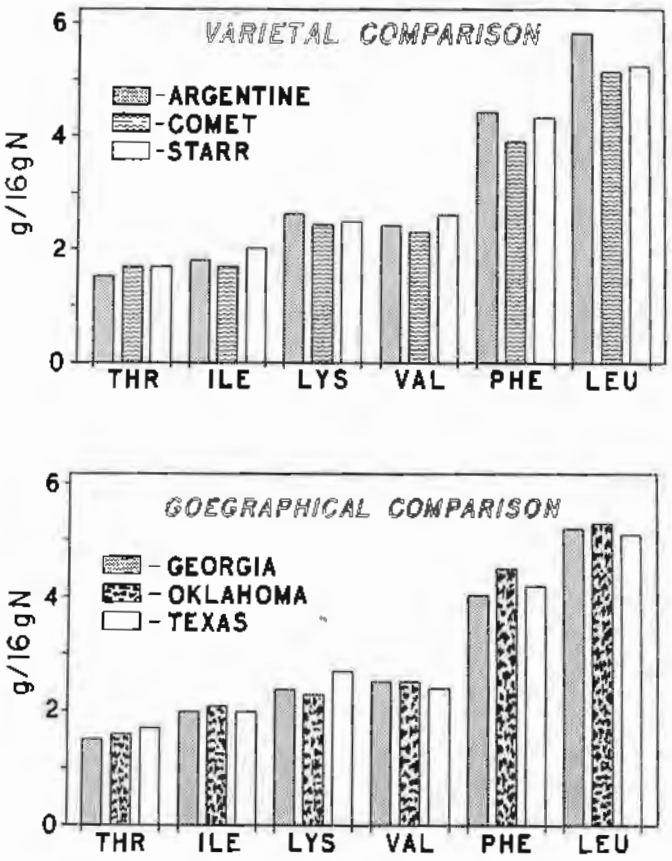

Figure 3. Spanish Peanut Protein Isolates - Comparison of Some Essential Amino Acids

these samples on both a geographical and a varietal basis were more obvious than those found for the flours. Several of the isolates, including all obtained from Comet variety peanuts, did not contain measurable amounts of methionine. Although research is underway, it has not been determined whether the absence of methionine represents a selective fractionation of the proteins or a loss of methionine during either preparation of the isolate or hydrolysis before amino acid analysis.

In addition to total lysine determinations, chemically available lysine (AVL) was determined for all flours and isolates. The AVL of all isolates represented 90% or more of their total lysine contents. Fom Table 3, it is apparent that, whereas the Starr variety has lower total lysine contents than the Argentine or Comet varieties, the AVL of all samples are similar. Therefore, the average available lysine content of Starr peanuts was approximately 12% higher than that available in Argentine and Comet peanuts. Since Starr peanuts were grown in each area,

Table 3. Varietal Comparison of Available Lysine in Spanish Peanut Flours

	Lysine g/16 gN	AVL g/16 gN	% Available
Argentine	3.7	2.6	70
	3.3	2.5	76
	3.8	2.2	58
Comet	3.7	2.4	65
	3.4	2.3	68
Starr	2.6	2.2	85
	2.8	2.0	71
	2.9	2.2	83

there was no apparent correlation on a geographical basis (Table 4).

Table 4. Geographical Comparison of Available Lysine in Spanish Peanut Flours

	Lysine %	AVL %	% Available
Georgia	3.7	2.6	70
	2.6	2.2	85
Oklahoma	3.3	2.5	76
	3.7	2.4	65
	2.8	2.0	71
Texas	3.8	2.2	58
	3.4	2.3	68
	2.9	2.4	83

It must be emphasized, however, that these data represent only one crop year; therefore, evidence such as variations in amino acid content would have to be substantiated by additional samples from different plantings over several years.

Potential uses of peanut flours and isolates such as those prepared in this study include supplementation of breads, dairy-type products, beverages, and comminuted meat products. General use of oilseed proteins for such products in the United States has been limited primarily to soybeans. In a comparison of the amino acid profiles of soy flours and isolates (3) with similar profiles of Spanish peanut flours and isolates, the most obvious advantage of the soy products is their high lysine contents. However, the bland flavor of peanut protein products offers a number of advantages for food formulations, especially in combinations with other vegetable proteins.

CONCLUSIONS

Data reported here on Spanish peanuts from one crop year in Georgia, Oklahoma, and Texas suggest that:

1) Geographical area of growth does not affect the chemical composition of flours or soluble protein isolates of Argentine, Comet, and Starr peanut cultivars.

2) Slight differences are evident in essential amino acid profiles of flours from Starr peanuts as compared with flours from Argentine and Comet peanuts.

3) Varietal differences are not evident in soluble protein isolates from these

three cultivars.

However, until analogous data are obtained on additional samples from several crop years, the varietal differences in the flours cannot be considered significant.

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RONSTAR™, A SELECTIVE HERBICIDE FOR PEANUTS

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ABSTRACT

Ronstar™ under evaluation as a preemergence herbicide in peanuts and other crops since 1967 offers a broad spectrum of activity on a wide range of soils. Many problem weeds such as signalgrass (Brachiaria sp.), crabgrass (Digitaria sp.), pigweed (Amaranthus sp.), and lambsquarters (Chenopodium sp.) are controlled with 1.0 pound active per acre of Ronstar while peanuts have shown tolerance to 3.0 pounds active per acre. Crop tolerance and activity on weeds combine to make Ronstar a potentially promising new herbicide for the peanut industry.

PAPER

Under the environmental conditions experienced in peanut production, it is often desirable to employ a residual preemergence herbicide. With this in mind, the Chipman Division of Rhodia Inc. in 1968 began development of Ronstar™. In the past five years of evaluation, Ronstar™ has proven selective on peanuts, effective in controlling a wide spectrum of weeds, and to be in harmony with the environment.

Ronstar™, 2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one, was discovered by research laboratories of the Societe des Usines Chimiques Rhone-Poulenc, Paris, France. Ronstar™ is of a low order of oral acute toxicity, LD_{50} in rats and mice >3.5 g/kg ; dermal acute toxicity, $LD_{50} > 2.5$ g/kg, is also low. Inhalation studies have shown little hazard on LD_{50}'s of >34 mg/L. Ronstar™ has proven non-irritating and non-sensitizing to normal intact skin of man at field use rates. Toxicity to wildlife and fish is also of a low order - LD_{50}'s in mallards $>1,000$ mg/kg and quail approximately 6,000 mg/kg; the LC_{50} in fresh water fish is >9 ppm for all species tested.

The persistence of Ronstar™ in soils is little affected by seasonal changes; the normal half-life varies from 4 to 6 months under limited cultivation. Ronstar™ is strongly absorbed by soil colloids (and humus) and very little migration or leaching occurs; however, persistence does not vary with soil type. Useful doses for control of annual weeds lie between 1.0 and 3.0 lbai/A when applied to bare soil, and some correlation exists between dose rate and duration of weed control.

Ronstar™ is a contact herbicide effective preemergence. Plants are affected by absorption of the chemical through the young shoot as it grows upwards through the treated zone. Ronstar™ can be taken up by the roots of certain species, but this is not normally so. Better herbicidal action is obtained when the soil is moist, and in very dry conditions, the activity may be greatly reduced. The herbicidal action of Ronstar™ is decreased by soil incorporation.

During our field testing, all peanut varieties tested have demonstrated tolerance to 3.0 lbai/A of Ronstar™; they are:

Argentine Spanish
Comet
Early Runner
Florigiant
NC-2
Spanhoma
Spantex
Starr Spanish
Virginia 61-R

The broad spectrum of activity of Ronstar™ includes many weeds commonly problems in U.S. peanut production.

Susceptibility of Weeds to Ronstar™

Applied Preemergence

Weeds	Rates: lbai/A* 1	1-2	≥2
Broadleaf signalgrass (Brachiaria platyphylla)		MS	
Yellow nutsedge (Cyperus esculentus)	R	R	MS
Large crabgrass (Digitaria sanguinalis)	MS	S	S
Barnyardgrass (Echinochloa crus-galli)	MS	S	S
Goosegrass (Eleusine indica)	S	S	S
Southwestern cupgrass (Eriochloa gracilis)	-	S	S
Texas panicum (Panicum texanum)	MS	S	S
Yellow foxtail (Setaria glauca)	-	S	S
Green foxtail (Setaria viridis)	R	S	S
Johnsongrass (Sorghum halepense)(seedling)	-	MS	S
Velvetleaf (Abutilon theophrasti)	-	S	S
Hophornbeam copperleaf (Acalypha ostryaefolia)	-	S	S
Tumble pigweed (Amaranthus albus)	-	S	S
Prostrate pigweed (Amaranthus blitoides)	S	S	S
Smooth pigweed (Amaranthus hybridus)	-	S	S
Palmer amaranthus (Amaranthus palmeri)	-	S	S
Redroot pigweed (Amaranthus retroflexus)	S	S	S
Spiny amaranthus (Amaranthus spinosus)	S	S	S
Slender amaranthus (Amaranthus viridis)	S	S	S
Common ragweed (Ambrosia artemisiifolia)	S	S	S
Sicklepod (Cassia obtusifolia)	R	MS	MS
Common lambsquarters (Chenopodium album)	S	S	S
Nettleleaf goosefoot (Chenopodium murale)	S	S	S
Lindheimer croton (Croton lindheimeri)	-	S	S
Jimsonweed (Datura stramonium)	MS	S	S
Florida beggarweed (Desmodium tortuosum)	MR	S	S
Ivyleaf morningglory (Ipomoea hederacea)	-	S	S
Tall morningglory (Ipomoea purpurea)	-	MR	MR
Smallflower morningglory (Jacquemontia tamnifolia)	-	MR	S
Carpetweed (Mollugo verticillata)	S	S	S
Pennsylvania smartweed (Polygonum pensylvanicum)	S	S	S
Common purslane (Portulaca pensylvanicum)	S	S	S
Florida pusley (Richardia scabra)	MR	S	S
Prickly sida (Sida spinosa)	MS	S	S

*S = Susceptible
MS = Moderately susceptible
MR = Moderately resistant
R = Resistant

Field performance of Ronstar™ has been comparable to commercially available pre-emergence herbicides. Generally, rates of 1 to 1.5 lbai/A are required for commercially acceptable weed control in the southwest while 1.5 to 2.0 lbai/A of Ronstar™ may be required in the southeast.

SOIL FERTILITY RELATIONSHIPS IN POD BREAKDOWN DISEASE OF PEANUTS

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ABSTRACT

In experiments during 1967-72, higher than normal rates of landplaster (LP) (2000 lb per acre) applied during early flower stage increased average peanut crop values $55 per acre and decreased peanut pod breakdown (PBD) from 8% to 4%. High rates of K_2SO_4 (2000 lb per acre) applied during early flowering increased PBD from 8% to 11% and reduced crop value by $195 per acre. Landplaster counteracted the adverse effects of high K_2SO_4 rates and increased crop values by $65 per acre. Pod breakdown averaged 4% when both materials were applied at the rate and stage of growth mentioned above.

Effects of K_2SO_4 or KCl on PBD enhancement were similar during 1971-72. However, crop values were lower when KCl rather than K_2SO_4 was applied with LP. During 1971-72, PBD in 60 plots which received a normal (600 lb per acre) rate of LP and which were randomized among many tests was about one-half that in untreated plots. Crop values averaged $38 per acre higher where LP was applied at that rate.

Available soil Ca and K levels before treatment in these experiments ranged from 300 to 2000 and 60 to 300 lb per acre, respectively.

No PBD was found in fruit samples from plots on which 2000 lb per acre of both LP and triple superphosphate (CSP) were applied at early flowering stage. Thus, LP and CSP may be more effective against PBD than LP alone but results are preliminary and need further corroboration.

INTRODUCTION

In recent years, pod-breakdown disease (PBD), has caused very significant losses in peanut production (6). In this paper PBD refers to a rotting of the pods with no apparent symptoms in the tops. Investigations by Garren (7) pointed to Pythium myriotylum Dreshl., particularly, and Rhizoctonia solani Kuehn as the principal PBD pathogens. He further demonstrated that either pathogen can cause the disease with symptoms indistinguishable from that caused by the other (8).

Considerable reduction of PBD was obtained by Garren (6) and by Hallock and Garren (11) from the application of relatively large amounts of landplaster (LP). On the other hand, in the latter investigation, application of relatively high rates of $MgSO_4$ and K_2SO_4, particularly, stimulated PBD considerably. Also, evidence was obtained that fruit shells which contained 0.20% Ca or more appeared less vulnerable to injury by the rot causing pathogens. These results were evidence of a probable relationship between PBD and Ca nutrition of the peanut fruit.

This paper presents information obtained in recent experiments to elucidate further soil fertility relationships in PBD.

EXPERIMENTAL PROCEDURE

Most of the experiments were located on the Tidewater Research and Continuing Education Center, Holland, Va. Other experiments in which PBD observations were taken were located on farm fields in the major peanut growing area of southeastern Virginia. The soil types were loamy fine sands to fine sands generally high in available P, medium to low in available Ca, Mg and K, and contained less than 2% organic matter according to Virginia State Soils Laboratory Tests (13).

The production practices employed in all experiments were as recommended by the Virginia Cooperative Extension Service except for the experimental treatments.

Virginia B46-2, primarily, or NC 17 or Virginia 61R was planted in the PBD experiments. However, PBD was measured in other experiments in which Florigiant was planted. The peanuts were machine planted and harvested.

Treatments in all experiments were arranged in randomized complete blocks with four replications. Landplaster and/or K and/or P fertilizers were broadcast on peanut foliage in the early flowering stage or as otherwise given in legends of the figures. The plots were 4 rows wide (12 feet) by 40 or 50 feet long. Data were obtained from the two middle rows of each plot.

Pod breakdown readings were made 1 to 2 weeks prior to normal digging time. Four plants randomly selected from each plot were carefully dug and lifted from the soil. Following washing, the fruits were removed by hand and PBD per plant was determined by visual inspection of each pod. Samples of pods exhibiting typical rot symptoms were examined and the causal agent identified.*

Fruit samples were obtained during combining and dried with heated air after partial drying and curing in the windrow. The samples were graded according to Official Federal-State Inspection Service specifications for grading Farmer's Stock large seeded Virginia type peanuts. Gross crop values per acre (CV/A) were calculated according to the support price schedule based on yield and grade data for each plot. The data were subjected to an analysis of variance and significant differences were determined by Duncan's Multiple Range Test.

RESULTS

The effect of high rates of LP or K_2SO_4 on the incidence of PBD in several experiments during 1967 to 1971 are summarized in Figure 1. In these studies, LP reduced PBD by one-half (8% to 4%). On the other hand, high rates of K_2SO_4 increased the percentage of PBD (8% to 11%). These treatments had drastic effects

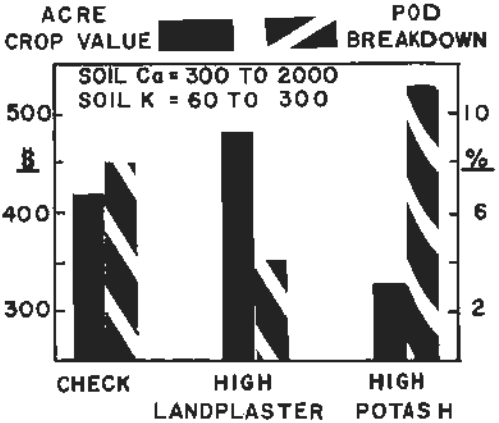

Fig. 1. Effect of high rates (1500-2000 lb/a) of landplaster or K_2SO_4 on average peanut pod breakdown disease incidence and gross crop value, Holland, Va., 1967-1971.

on CV/A. Landplaster increased CV/A over the check plots approximately $55 per acre, whereas the K_2SO_4 rates decreased returns $95 per acre below the check or $150 less than for LP. Available soil Ca or K levels, before treatments were applied, ranged from 300 to 2000 and 60 to 300 lb per acre, respectively, in these experiments. However, the relationship of nutrient levels in plots, prior to treatment, to disease incidence could not be determined in these studies.

*/ Courtesy of laboratory of K. H. Garren and D. M. Porter, USDA, ARS, Holland, Va.

Potassium sulfate was utilized as the source of K in most experiments to reduce possible associated anion effects. Sulfate also is the anion in the LP. Since KCl is the predominate K supplying fertilizer used by farmers, experiments were conducted during 1971 and 1972 to compare effects of KCl and K_2SO_4 on PBD (Fig. 2).

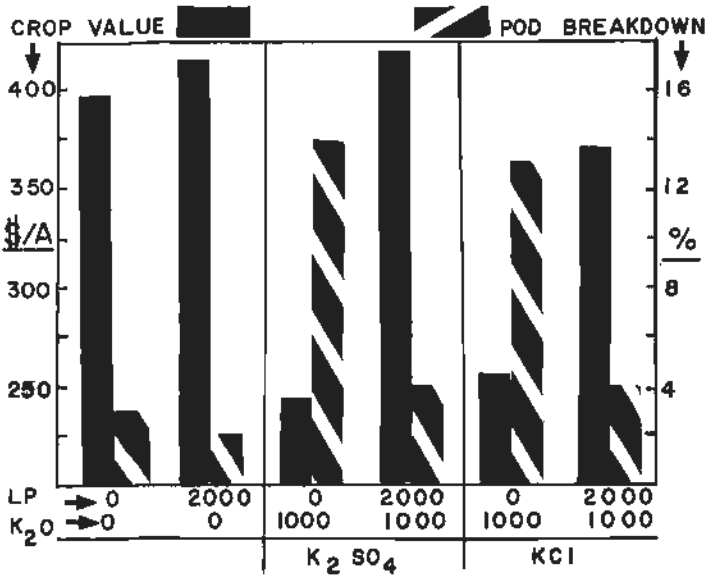

Fig. 2. Comparative effects of K_2SO_4 and KCl alone and in combination with landplaster (LP) on average peanut pod breakdown disease incidence and gross crop value, Holland, Va., 1971-72.

Either K source increased average PBD over the check similarly (from 3% to 13 or 14%). Average CV/A was depressed slightly more by application of K_2SO_4 only than KCl only. Available soil K levels prior to treatment were approximately 100 lb per acre.

The counteractive effect of LP against the apparent enhancement effect of K on the severity of PBD was investigated during the period 1968 to 1972. Average results for this period are given in Figure 3.

In these experiments, average PBD was reduced from 9% in the check plots to 3% by application of 2000 lb per acre of LP. Application of 1000 lb per acre of K_2O as K_2SO_4 increased PBD from 9% to 16%. However, when both LP and K_2SO_4 were applied, average PBD was only 4%. Thus, the LP appeared to effectively counteract the detrimental effects of the high K treatments on the percentage of pods infected with PBD. Gross crop value, however, averaged $30 less per acre when both K_2SO_4 and landplaster were applied than for the LP only treatment. The data in Figure 2 indicate that 2000 lb per acre of LP counteracts to a similar extent the effect of either K_2SO_4 or KCl on the percentage of PBD (4%). However, average CV/A for the LP only and the LP plus K_2SO_4 treatments were similar ($413 & $419) but that for the LP plus KCl treatment was $45 less than for the LP only treatment and $30 less than for the check plot. The principal factor causing reduced CV/A of the LP plus KCl treatment was reduced yield (2810 vs. 3115 lb per acre). Thus, the severity of the rot may not have been counteracted as effectively by LP in the case of KCl, although only the number of pods infected and not the proportion of surface area

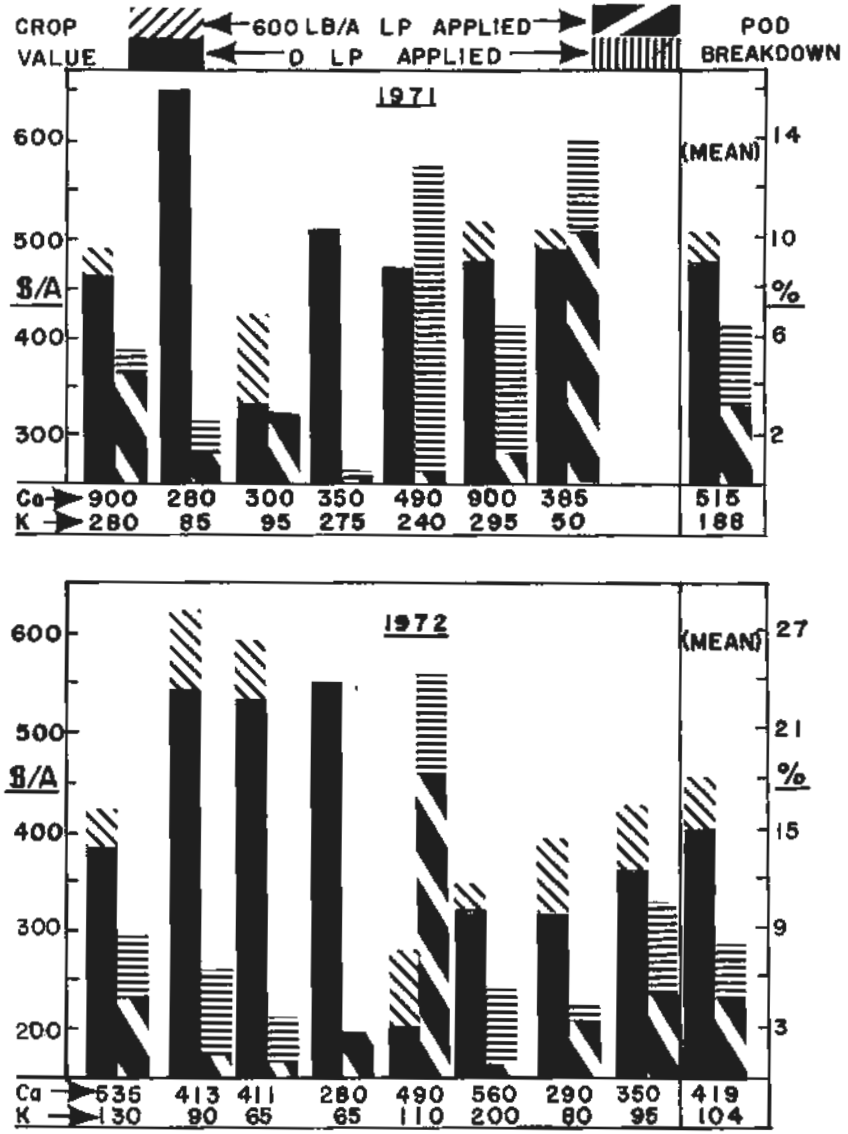

Fig. 4. Effect of the minimum recommended rate of landplaster (LP) for peanuts on pod breakdown disease incidence and gross crop value in 15 different tests, Holland, Va. (Columns with similar crosshatching throughout indicate results with and without LP were similar). Available soil Ca and K levels in the fruiting zone of check plots are given for each test.

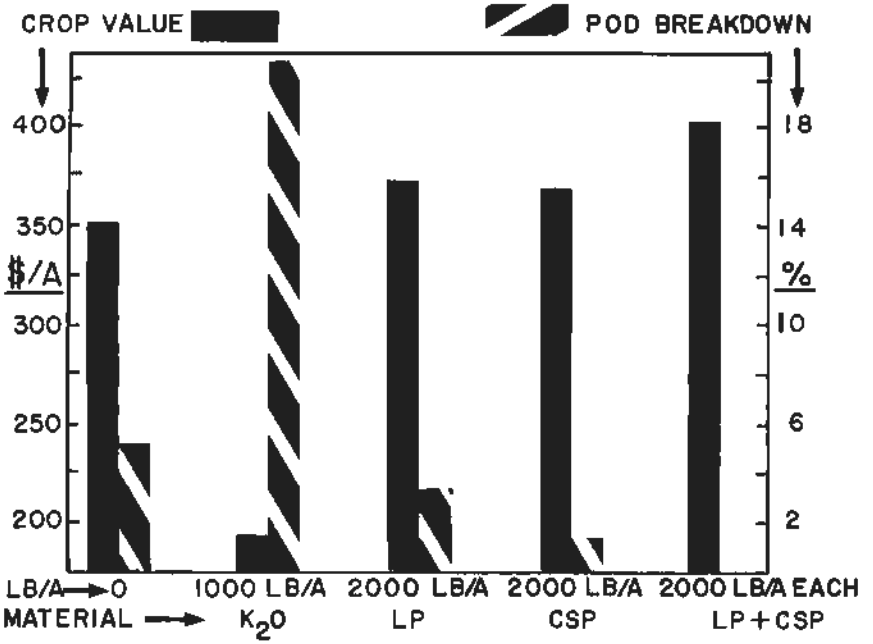

Fig. 5. Effect of landplaster (LP) or K_2SO_4 or triple superphosphate (CSP) on peanut pod breakdown incidence and gross crop value per acre, Holland, Va., 1972.

DISCUSSION

Some possible roles of Ca and K in PBD were reviewed in a previous paper (11). It was noted that tissue maceration by polyglacturonase in Rhizoctonia - infected bean hypocotyls was greatly reduced in Ca or Ba solutions, whereas it occurred readily in K and Na solutions (6). Other work (1,3) also indicated that Ca seemed to render the tissue more resistant to R. solani than controls. Monovalent cations, such as K, greatly increased susceptibility and tissue degradation. There is evidence that the vulnerability of tissue to Pythium (12) may be affected likewise by Ca.

Hale and Shay reported (10) that peanut fruit exuded similar sugars with one or two exceptions as roots. External medium composition may effect these exudation processes and composition of the mycofloral community.

Another type of effect possibly associated with the Ca in LP is the promotion of more dormant and less pathogenic stages of Pythium as opposed to an opposite effect by K (15). Excessive P in the fruiting zone also may interfere with Ca nutrition of fruit since the fruit must absorb their own supply of Ca (4), whereas K may be absorbed by the fruit directly or by translocation from the main plant.

The effect of CSP alone as well as in combination with LP on PBD may have been a Ca response. Application of both materials greatly increased the amount of Ca applied relative to the other treatments. However, Vanterpool (14) found that a combination of gypsum (both gypsum and LP are predominately $CaSO_4$) and CSP decreased browning rot of wheat, caused by Pythium spp., more than either material alone. Elzam and Hodges (5) reported that P was essential for large accumulations of Ca. Hence, there is evidence that a combination treatment of Ca and P may be particularly beneficial in PBD control. Further investigation of this relationship is planned.

Previous reports have dealt with the effect of relatively high rates of LP on PBD, primarily. However, recent investigations where normal rates of LP were used indicated frequent decreases in PBD and that such decreases in PBD could account for the increased yields and CV/A obtained. These results suggest that the responses generally attributed to normal rates of LP (600-800 lb/a) may be one of PBD suppression to an appreciable extent.

In 1972, R. solani was isolated from rotted pods in most cases rather than P. myriotylum. The suppressive effect of Ca on PBD in Virginia has been attributed mainly to an effect on Pythium rather than Rhizoctonia (9). Therefore, the 1972 results with rates of LP of 600 or 2000 lb per acre indicate that LP also may be effective on Rhizoctonia caused PBD.

It seems reasonable to conclude that low soil Ca and high soil K in the fruiting zone do not cause PBD but only appear to enhance the probability of greater damage when the disease occurs. It is evident that poor correlation exists between PBD and the soil analyses prior to treatment given in this paper. Certainly, the natural existence of PBD fungi inoculum and/or their pathogenicity can vary among soils without close relationship to the level of residual available soil nutrients. However, the evidence is considerable that in PBD problem fields high soil K increases and high soil Ca decreases the probable occurrence of PBD. Farmers alerted to this concept have reported decreased losses from PBD by application of all K fertilizer for the rotation to other crops, thus reducing soil K levels in the peanut fruiting zone. Should further investigation show that higher P applications than normally applied to one crop reduce PBD incidence and/or severity, application of most of the fertilizer P for the rotation on peanuts likewise would be feasible.

ACKNOWLEDGEMENT

The author expresses appreciation to K. H. Garren and D. M. Porter, Plant Pathologists, Southern Region, USDA, ARS, Holland, Va. for isolation of the principal organism in rotted peanut pods taken from experiments reviewed in this paper.

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SOME RESULTS CONCERNING THE OCCURRENCE OF AFLATOXIN IN SELECTED SIZES OF PEANUT KERNELS

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ABSTRACT

A group of 60 samples from contaminated peanuts was provided by the Federal-State Inspection Service from six widely separated grading points in Southwest Georgia. Another group of 28 samples was collected from various warehouses in Georgia, Alabama, and Florida. Each sample of peanuts was shelled and the kernels divided into four subsamples of different sizes. Standard slotted-hole grading screens having either 20/64-, 18/64-, or 16/64-inch width slots were used to make the size separations. Analysis of the subsamples for aflatoxin showed that 85 percent of the subsamples in the group of 60 samples contained measurable amounts of aflatoxin and the kernels that fell through the 18/64-inch screen and rode the 16/64-inch screen had a significantly higher average concentration of aflatoxin than the other kernels. Aflatoxin at $\geq$ 20 ppb was detected in 65 percent of the subsamples in the 28-sample set. The smaller size kernels contained higher levels and more frequent occurrence of aflatoxin than the larger size kernels.

INTRODUCTION

The occurrence of aflatoxin in various separations of peanuts has been studied by several researchers. According to Banes (1), the levels of aflatoxins in peanuts correlate with the number of shrivelled, rancid, and discolored kernels. Also, it has been reported that aflatoxin levels are higher in damaged kernels than in sound, mature kernels, but that sound mature kernels may contain aflatoxin (2) (4). Cucullu, et al. (3) found that dark, wrinkled kernels of Spanish peanuts were higher in aflatoxin content than four other separations including (a) well-shaped, sound kernels, (b) kernels having red dappled skins, (c) green-veined kernels, and (d) splits.

Most of the separations studied thus far have been collected from samples by visual selections based on physical appearance.

The purpose of this study was to determine whether different sizes of shelled peanut kernels varied in the occurrence and concentration of aflatoxin contamination.

MATERIALS AND METHODS

Two series of samples were analyzed during the tests. One group of 60 shelled samples was provided by the Federal-State Inspection Service from six widely separated grading points in Southwest Georgia. The samples were taken from peanuts that had been stored in warehouses as the peanuts were being shelled in commercial shelling plants. The other group of 28 unshelled samples was taken from various warehouses in Georgia, Alabama, and Florida. The peanuts from which both groups of samples were collected had been graded as Segregation One peanuts when stored in the warehouse, but were subsequently found to contain aflatoxin. Nearly all of the peanuts in both groups of samples were Runner-type peanuts. After shelling, the peanuts were separated according to size by vibrating the kernels over official Federal-State Inspection Service screens.

Peanuts in the set of 60, 10-pound samples were received shelled and prescreened over 16/64-inch slotted screens, the loose shelled kernels (LSK) having been removed prior to the tests. Each sample of peanuts then was screened over three slotted hole screens--20/64-, 18/64-, and 16/64-inch. These screens were stacked in order with the largest screen on top. All of the kernels riding each screen

and those falling through the 16/64 formed a total of four subsamples from each sample. The 16/64 fall through subsamples weighed an average of 245 gm; subsamples > 16/64, < 18/64, 1150 gm; subsamples > 18/64 < 20/64, 2254 gm; and subsamples > 20/64, 1047 gm. Each subsample was ground and assayed quantitatively for aflatoxin (5).

Peanuts in the group of 28, 2-pound warehouse samples were shelled and screened, but the LSK's for each sample were collected prior to shelling. With the LSK's, this group had five subsamples for each sample. These subsamples were not weighed. Data collected from the aflatoxin assay of the subsamples from this sample group only showed if the kernels in each subsample had aflatoxin at $\geq$ 20 ppb (5).

RESULTS

The average aflatoxin concentration for the subsamples of each size category of kernels in the group of 60 samples are shown in Figure 1. Analysis of variance

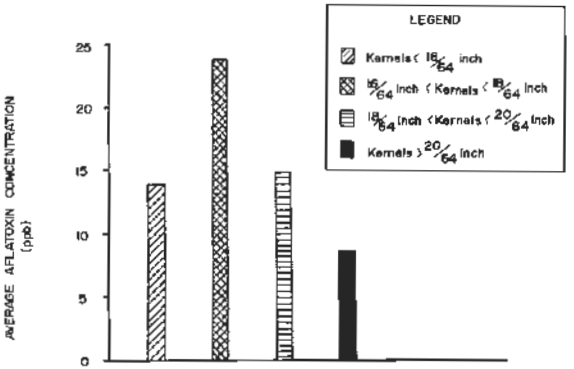

Figure 1 Comparison of the averages of aflatoxin concentration for the kernel sizes of the 60 sample set.

showed that the subsamples of peanuts that rode the 16/64 screen had a significantly (1 percent level) higher average concentration of aflatoxin than the other subsample groups. The other subsample groups were not significantly different in aflatoxin concentration. Kernels that rode the 20/64 screen had the lowest average concentration of aflatoxin.

Even though the average concentration of aflatoxin for the kernels riding the 16/64 screen was significantly higher than for the averages of each of the other size groups, the 16/64's were actually higher in only 23 out of the 60 samples. Kernels that fell through the 16/64 screen were higher in 14 samples; 18/64 in 10 samples; and the 20/64 in 7 of the samples. In 6 of the samples more than one size category had the same high value.

Of the total 240 subsamples of this group, 204 had detectable amounts of aflatoxin. The 16/64 fall through's contained detectable concentrations of aflatoxin in 53 out of 60 samples; 16/64, 57; 18/64, 56; 20/64, 38.

Figure 2 shows the percent of the subsamples for each size category that had aflatoxin at concentrations of 20 ppb or greater. The kernels that rode the 16/64 screen had the highest percentage of subsamples at $\geq$ 20 ppb. The subsamples of kernels that rode the 20/64 screen had the lowest occurrence of aflatoxin at $\geq$ 20 ppb.

Figure 3 shows the percent of the subsamples for each size category for the 28-sample set that contained aflatoxin at 20 ppb or greater. In this set of samples, LSK's and the kernels that fell through the 16/64 screen had the highest occurrence of aflatoxin at 20 ppb or greater, and the samples of kernels that rode the 20/64 screen were lowest, as before.

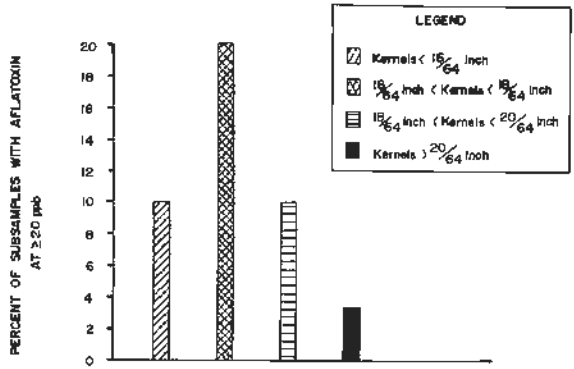

Figure 2. Comparison of the percent of the subsamples with aflatoxin at ≥ 20 ppb for the kernel sizes of the 60 sample set.

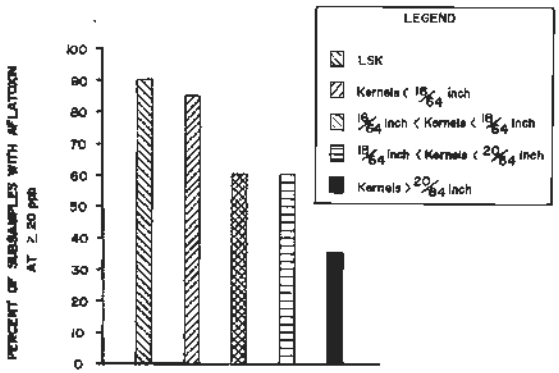

Figure 3. Comparison of the percent of the subsamples with aflatoxin at ≥ 20 ppb for the kernel sizes of the 26 sample set.

DISCUSSION

Even though all of the kernel sizes were susceptible to aflatoxin contamination, the largest size kernels (> 20/64) from both sets of samples contained fewer instances of contamination than the others. The average concentration of aflatoxin also was lower in the largest size.

The results of these tests suggest that the level of aflatoxin contamination could be reduced in contaminated peanuts by culling the small kernels. However, there are several factors that limit this method for reducing aflatoxin levels.

In these tests, size separation did not isolate the aflatoxin to any one kernel size in any of the samples analyzed. At least two kernel sizes contained aflatoxin in every sample. Also, different kernel sizes contained the highest level of aflatoxin from sample to sample. To obtain any benefit for reducing aflatoxin levels by size separation, a representative sample of the contaminated peanuts under consideration would have to be collected and analyzed to determine which sizes of kernels must be eliminated.

It has been reported that aflatoxin contamination of peanuts within a lot occurs in only a small percentage of the peanuts (3) (6). Because the aflatoxin is highly

concentrated in a small percentage of peanuts within a contaminated lot, variation in sample means is large and the average aflatoxin concentration cannot be determined exactly from the samples (7). Other research has shown that aflatoxin is not evenly distributed among various visual separations of suspect kernels and that sampling errors can cause wide variations in the results of aflatoxin analyses from the same lot of peanuts (3). Therefore, extreme care would have to be taken to obtain a representative sample or samples from a lot of peanuts in determining which size should be discarded.

Even with the disadvantages discussed above, reducing aflatoxin levels by size separation might hold some promise because apparently different sizes of kernels contain different concentrations and levels of occurrence of aflatoxin. So, at least some of the peanut kernels from contaminated peanuts might be salvaged by size separation using equipment that is commonly found in the industry.

Before separation of aflatoxin-contaminated peanuts on the basis of kernel size could be considered for commercial trials, however, experimental separations should be made on samples of a size that would estimate aflatoxin concentration within some defined limits of accuracy.

ACKNOWLEDGEMENTS

The authors wish to thank the Federal-State Inspection Service for providing samples for this study.

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THE EFFECTS OF HARVESTING, HANDLING AND DRYING PROCEDURES ON THE PERCENT OF SOUND SPLITS IN SPANISH PEANUTS

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ABSTRACT AND PAPER

ABSTRACT

Tests were conducted in Texas during the 1971 harvest season to determine the effects of different harvesting, handling and drying procedures on the percent of sound splits. Results showed that the average sound splits throughout Texas increased from 2.1 percent prior to combining to 3.9 percent after this operation. This increase was approximately three times higher in the high temperature areas of South Texas than the colder areas of North Texas. The average sound splits in South Texas increased from 2.9 percent before combining to 5.6 percent after combining, while in North Texas the increase was from 1.2 to 2.0 percent. The higher splits in South Texas can be attributed to the moisture content at the time of combining, since combine damage was approximately two times greater when peanuts were completely field dried compared to partially field dried. The average sound split damage for the farms sampled before and after the mechanical drying operation was 3.1 and 6.1 percent, respectively. There was no difference in the increase in splits due to the mechanical drying operation for North and South Texas.

Based on the average data from farms where both the combine and dryer damage studies were conducted, there were no price deductions due to sound splits prior to the combining operation. However, the combining operation increased the average sound split deduction to $1.00 per ton in South Texas, while there were no deductions in North Texas. The mechanical drying operation increased the average sound split deduction to $3.20 per ton in South Texas and $1.00 per ton in North Texas.

INTRODUCTION

Research was conducted during the 1971 peanut harvest season to determine the effects of the harvesting, handling and drying procedures on the percent of sound splits in Spanish peanuts. These studies were performed in the two major geographical areas of Texas where peanuts are grown; namely, South Texas and North Texas.

The South Texas tests were conducted at 24 farms selected at random and 9 commercial drying facilities located in one of the following counties: Atascosa, Bexar, Frio, Medina and Wilson. Samples were collected from five different combine models manufactured by four companies. The North Texas studies involved 20 farms and 9 commercial dryers located in one of the following counties: Callahan, Comanche, Eastland and Erath. These samples were collected from six models of combines manufactured by three companies.

Climatic conditions during these tests ranged from extremely poor to good. Some samples were collected in South Texas which were dug 15 days earlier and received a total of seven inches of rain during a seven-day period. Other samples from this area were dug and dried under typical weather conditions. Unseasonable weather was also encountered in North Texas where many samples received approximately five inches of rain after digging. Peanuts on one farm were collected from a field which had been flooded. Many farms were sampled in this area, however, which were harvested and dried under normal conditions.

PROCEDURES

The procedures under which this research was conducted were divided into two categories; one for studying the mechanical damage due to combining and one for determing damage caused by the artificial drying operations. Each farm was selected at random with the commercial drying installation being predetermined by the grower. There was no connection between the farms or dryers other than location within an

area.

The actual field sampling technique consisted of collecting samples of peanuts from fields where harvesting was in progress. This was done by hand picking duplicate samples of peanuts from windrowed vines within the area from which only one combine was operating. Comparative replicated samples were then collected from the same combine after the hand sampled area of the field was harvested. These data were used to determine the split damage content due to the combining operation.

The truck into which the field samples were loaded was then followed to the dryer where a representative sample was obtained as the truck was unloaded. This sample was used to determine the condition of the peanuts received by the dryer installation and was compared to the inspection certificate to determine the actual damage associated with the drying operation.

All samples of wet peanuts were collected in cloth bags suitable for sack drying procedures. At the end of each day, the samples were placed in several small-scale dryers and dried under procedures which consisted of using heated air several degrees above the ambient temperature. These samples remained on the dryers 24 to 48 hours and were then placed in the shade where the drying was completed under natural conditions.

Standard grading tests were conducted on each sample in accordance with the 1971 inspection instructions for farmers' stock peanuts of the USDA Consumer and Marketing Service.

RESULTS AND DISCUSSION

The effect of the combining operation on sound splits in Texas during the 1971 harvest season is shown in Table 1. Results showed that the average sound splits for the 44 farms sampled throughout Texas increased from 2.1 percent prior to harvesting to 3.9 percent after the combining operation. This resulted in a net increase of 1.8 percentage points. It was found that the split damage due to combining was approximately three times higher in South Texas than North Texas. The average sound split damage due to this operation increased from 2.9 to 5.6 percent in South Texas and from 1.2 to 2.0 percent in North Texas.

It appears that the higher sound split damage in South Texas may be due to the lower moisture content at the time of combining. The average pod moisture contents during harvesting were 13.5 and 23.8 percent for South and North Texas, respectively. The effects of pod moisture content and field exposure time on combine damage in South Texas are given in Table 2. When the test data were arranged according to whether the peanuts were completely dried in the field or only partially dried, the sound split damage due to combining was approximately two times higher under the low moisture conditions of peanuts which were completely field dried. The average increase in splits during the combining operation was 4.2 and 2.0 percentage points for completely field dried peanuts and partially field dried peanuts, respectively. Not only were low moisture peanuts more subject to combine damage, but the field drying process in South Texas also resulted in much higher splits. Peanuts completely dried in the field had 4.9 percent sound splits prior to combining compared to only 2.1 percent for peanuts which were partially dried in the field.

This study also included peanuts which were dried in inverted windrows as well as conventional windrows. Results indicate that peanuts dried in inverted windrows had slightly higher split damage due to combining than those dried in conventional windrows, Table 3. Under nearly equal moisture contents, peanuts combined from inverted windrows had an increase of 3.3 percentage points in sound splits compared to 2.0 for peanuts combined from conventional windrows. It should also be pointed out that peanuts dried in inverted windrows had slightly higher splits before combining. It appears, however, that any sound split problem associated with inverted windrows may be corrected by combining peanuts at a moisture content slightly higher than is now being practiced. Table 4 shows that peanuts combined from inverted windrows which were partially field dried, 17.1 percent moisture, had a smaller split damage due to combining than those completely field dried. Partially dried peanuts from inverted windrows also had three times less sound splits due to field drying than those which were dried completely in the field. The sound splits before combining were 1.8 and 5.5 percent, respectively, for peanuts only partially field dried as opposed to

those which were completely field dried.

A total of 12 of the 24 South Texas farms sampled during 1971 would have received a price deduction due to excessive sound splits after the combining operation. This deduction could have resulted from the field drying conditions and/or combine damage. Five of these farms had excessive splits prior to combining with the other seven occurring after combining. It is interesting to note that of the five farms having high splits before combining, each one dried their peanuts to low moisture contents in inverted windrows. Only one farm sampled in North Texas had excessive sound splits after the combining operation. This farm had calcium applied to the field, but it is not known at the present time if this would affect the ability of peanuts to withstand mechanical damage due to combining. No farm was found to have excessive splits in North Texas prior to the combining operation. Percent sound splits before combining ranged from 1.0 to 2.0 and 1.0 to 5.0 percent after combining.

Research to determine the effect of the mechanical drying operation on sound splits was conducted on 14 farms and 9 commercial drying facilities in South Texas and 18 farms and 9 commercial dryers in North Texas. Since it was not possible to sample all combines which were operating in any one field during the combine damage study, one truck was used to determine the initial condition of the peanuts at the dryer facility.. Therefore, there is no direct relationship between the combine damage results presented in Table 1 and those presented in this discussion on mechanical drying.

The average sound split damage due to the mechanical drying operation for the 32 farms sampled in this test throughout Texas increased from 3.1 to 6.1 percent, Table 5. This resulted in a 3.0 percentage point increase in splits due to the mechanical drying operation. The same net increase in splits due to this operation was observed for both North and South Texas. The average sound splits in South Texas increased from 4.7 to 7.7 percent, while in North Texas they increased from 1.8 to 4.8 percent. These increases resulted in an 83 percent increase in the number of farms receiving price deductions in South Texas, six prior to drying and eleven after. The number of farms in North Texas receiving price deductions because of excessive splits increased from one to eight due to mechanical drying. This was a 700 percent increase in the number of farms with excessive sound splits.

Even though the percent increase in the number of farms receiving sound split price deductions due to mechanical drying was much higher in North Texas than South Texas, the monetary loss to the grower was much higher in South Texas. The average monetary losses from sound split price deductions due to the combining and mechanical drying operations are presented in Table 6. The loss to South Texas growers increased from 0 to $1.00 per ton of farmers' stock peanuts because of combine damage and from $1.00 to $3.20 per ton due to the mechanical drying operation. In North Texas there was no average loss due to combine damage and the average price deductions due to mechanical drying increased from 0 to $1.00 per ton.

Analysis of the data indicates that the dollars lost by South Texas growers due to split damage deductions could be significantly reduced by further cooperation between the grower and dryer operator. It was found that the split damage in peanuts received at the drying installations could be substantially reduced by combining at higher moisture contents than now being practiced. This would give the dryer operators some latitude in their operations. However, at the same time, growers should insist that the dryers handling their peanuts be operated in accordance with proven recommended procedures.

SUMMARY

The average sound split damage for 44 farms sampled throughout Texas was 2.1 percent prior to combining and 3.9 percent after this operation. This damage was approximately three times higher in South Texas than North Texas. The average sound splits in South Texas increased from 2.9 percent before combining to 5.6 percent after combining, while in North Texas the increase was from 1.2 to 2.0 percent. The high splits in South Texas can be attributed to the low moisture content at the time of combining, since combine damage was approximately two times greater when peanuts were completely field dried compared to partially field dried. The average sound split damage for the farms sampled before and after the mechanical drying operation was 3.1 and 6.1 percent, respectively. There was no difference in the increase in

splits due to the mechanical drying operation for North and South Texas.

Based on the average data from farms where both the combine and dryer damage studies were conducted, there were no price deductions due to sound splits prior to the combining operation. However, the combining operation increased the average sound split deduction to $1.00 per ton in South Texas, while there was no deduction in North Texas. The mechanical drying operation increased the average sound split deduction to $3.20 per ton in South Texas and $1.00 per ton in North Texas.

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Sincere appreciation is expressed to the Texas Peanut Producers Board for the financial assistance which made this research possible and to the peanut growers and commercial dryer managements for their cooperation in the collection of these data.

TABLE 1. EFFECT OF THE COMBINING OPERATION ON SOUND SPLITS

	Sound Splits, %		Net Increase	Pod Moisture Content, %
	Before Combining	After Combining		
Texas	2.1	3.9	1.8	18.4
South Texas	2.9	5.6	2.7	13.5
North Texas	1.2	2.0	0.8	23.8

TABLE 2. EFFECT OF POD MOISTURE CONTENT AND FIELD EXPOSURE TIME ON COMBINE DAMAGE IN SOUTH TEXAS

	Sound Splits, %		Net Increase	Pod Moisture Content, %
	Before Combining	After Combining		
Field Dried	4.9	9.1	4.2	6.8
Partially Field Dried	2.1	4.1	2.0	16.6

TABLE 3. EFFECT OF TYPE OF WINDROW ON SOUND SPLITS IN SOUTH TEXAS

	Sound Splits, %		Net Increase	Pod Moisture Content, %
	Before Combining	After Combining		
Conventional Windrow	2.5	4.5	2.0	14.5
Inverted Windrow	3.5	6.8	3.3	12.5

TABLE 4. EFFECT OF FIELD EXPOSURE ON SOUND SPLITS FOR PEANUTS DRIED IN INVERTED WINDROWS IN SOUTH TEXAS

	Sound Splits, %		Net Increase	Pod Moisture Content, %
	Before Combining	After Combining		
Field Dried	5.5	9.5	4.0	6.9
Partially Field Dried	1.8	4.6	2.8	17.1

TABLE 5. EFFECT OF THE MECHANICAL DRYING OPERATION ON SOUND SPLITS

	Sound Splits, %		Net Increase	Pod Moisture Content, %
	Before Drying	After Drying		
Texas	3.1	6.1	3.0	20.9
South Texas	4.7	7.7	3.0	15.9
North Texas	1.8	4.8	3.0	24.2

TABLE 6. AVERAGE PRICE DEDUCTIONS DUE TO EXCESSIVE SOUND SPLITS

	Combining Operation, dollars per ton		Mechanical Drying Operation, dollars per ton	
	Before	After	Before	After
South Texas	0	1.00	1.00	3.20
North Texas	0	0	0	1.00

THE RELATIONSHIP OF PEANUT MILLING QUALITY TO KERNEL TENSILE STRENGTH

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ABSTRACT

Samples of peanuts dried at four temperatures were hand shelled and mechanically shelled. The tensile force required to separate the cotyledons was determined for the kernels of the hand-shelled samples. The separation force showed a high degree of correlation with the milling quality of the peanuts shelled mechanically. The kernel tensile strength was attributed almost entirely to the skin and was independent of kernel size.

INTRODUCTION

Split kernels (kernels broken into two pieces) are a major concern of the peanut industry. They have less value than whole kernels primarily because they are easily contaminated. Also, separation of the skin, germ, and other pieces results in either a direct loss through aspiration, or a value loss if they are recovered and used for oil stock. Previous research at National Peanut Research Laboratory (1)1/ showed that the cotyledons of bald kernels (kernels with skins removed) separated at the end opposite the germ when the bald kernels were dried from the green state. The amount of separation was dependent on the rate of drying. From this work, the theory was developed that the forces which cause the separation weaken the bonds between the cotyledons. This weakening of the bonds between the cotyledons subsequently results in increased splitting. The purpose of the research reported here was to investigate the type and magnitude of the bond between cotyledons and its relationship to split kernel outturn.

MATERIALS AND METHODS

Tests were conducted on Starr Spanish, Florunner, and Florigiant peanuts. The peanuts were harvested green and dried in bins with forced air (10 cfm/ft^3) at four conditions--natural ambient air, and ambient air heated to 90°, 110°, and 130° F. Samples were taken from each lot and hand shelled for the tensile strength tests. The remaining peanuts were subdivided into four subsamples for mechanical shelling. All peanuts were stored at 65 percent relative humidity until completely processed.

A test facility, designed and fabricated especially for the tensile strength tests, consisted of a frame, variable speed motor, worm-gear jack, and a load cell of the variable transformer type. Force values were recorded on a strip-chart. A photograph of the apparatus is shown in Figure 1.

Pins, made from 0.021-in. sewing needles, were inserted in the kernels for gripping (Figure 2). A jig was made to facilitate precise placement of the pins; however, the jig was considered unnecessary after some proficiency at placement was acquired by the operator. Fifty kernels were tested from each lot. The pulls were made at a rate of 0.060 in./min. The diameter, both across and parallel to the intercotyledon plane, and the length were determined for each kernel.

The mechancial shelling was performed on an experimental sheller which has been shown to duplicate the outturn of commercial-type shellers (2). The percentage of split kernels and bald kernels was determined for each test, based on the farmers stock weight. Bald kernels are generally considered as undesirable as split kernels in small scale research work, since they easily split from normal commercial handling and processing. Thus, the sum of the bald and split kernels was used as the index of milling quality.

1/ Numbers in parentheses refer to appended references.

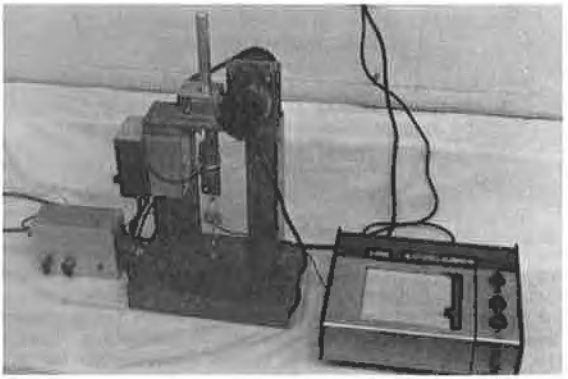

Figure 1.--Tensile strength test apparatus.

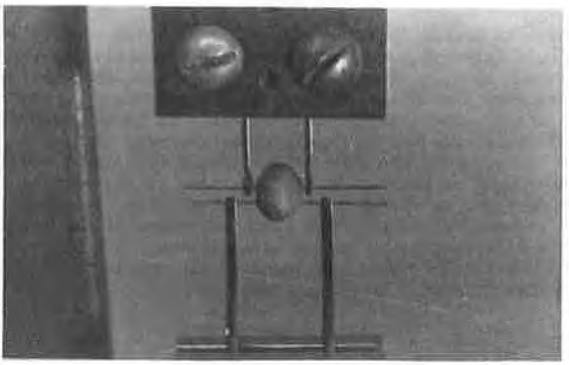

Figure 2.--Pins inserted in kernel.

RESULTS AND DISCUSSION

Tensile strength tests were conducted to determine which component, skin or internal bond, offered the most resistance to splitting. Kernels with skins carefully separated at the interface of the two cotyledons offered less than one-tenth the resistance to separation as similar kernels with skins intact, which indicated that skins offered almost all resistance to splitting.

Investigation of the effect of pin location along the kernel axis revealed, somewhat surprisingly, higher strength values for the center location than for pins near the germ or near the end opposite the germ. Since the skin was the major resistance to splitting, the application of force in the center (center loading) of the kernel apparently allowed a more uniform stress distribution throughout the skin. Center loading was employed for the remainder of the tensile strength tests.

Tests of pin location on broken-skin kernels showed the strength of the peanut was greater the closer to the germ the point of loading. The cotyledons showed almost no bond strength anywhere except at the germ.

As planned, the drying conditions provided a wide range in milling quality. The effect of temperature on split and bald kernels is shown in Figure 3 for a typical group of peanuts. In all tests, split and bald kernels increased steadily with increased drying temperatures.

The average values of separation force are plotted versus percent split and bald kernels in Figures 4, 5, and 6, for Spanish, Florunner, and Florigiant peanuts.

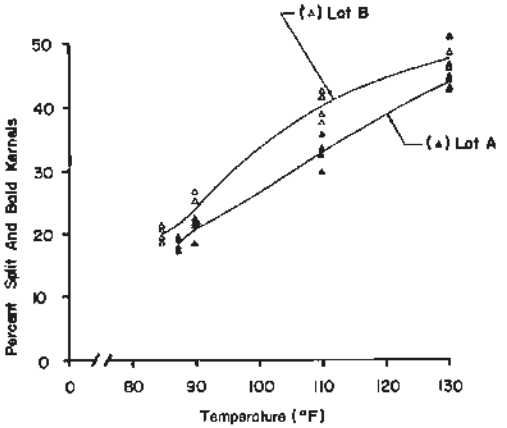

Figure 3. Percent split and bald kernels versus temperature for Spanish peanuts.

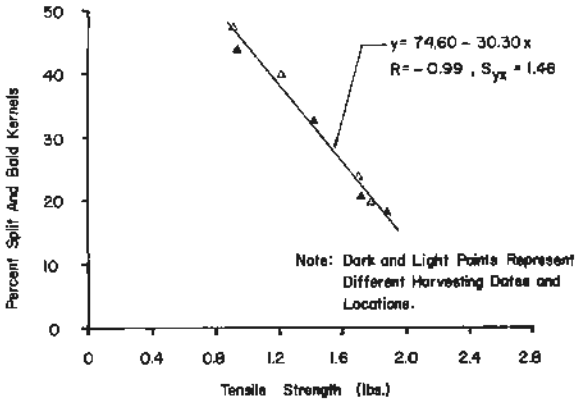

Figure 4. Percent split and bald kernels versus kernel tensile strength for Spanish peanuts.

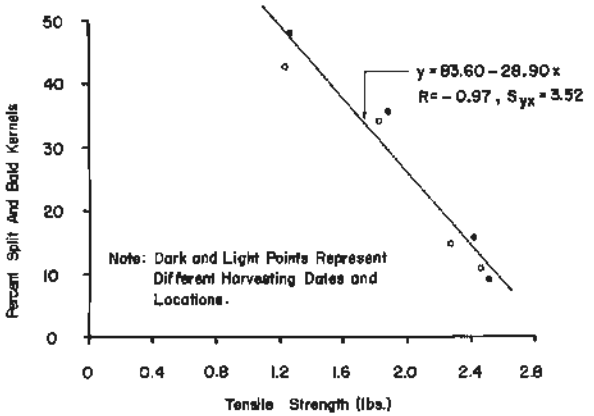

Figure 5. Percent split and bald kernels versus kernel tensile strength for Florunner peanuts.

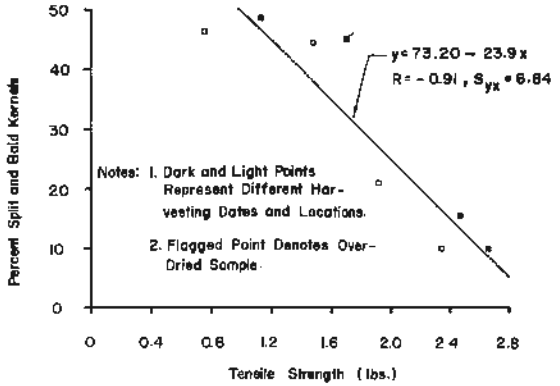

Figure 6. Percent split and bold kernels versus kernel tensile strength for Florigiant Peanuts.

Each point represents the average of four shelling tests and 50 tensile strength tests. Dark and light points represent different harvesting dates and locations. Generally, within-lot results were more consistent; however, good correlation resulted when all data points were plotted together. The linear correlation coefficient was greater than 0.91 for each type of peanut.

Data for all varieties are shown in Figure 7. Note that the values for Florunner

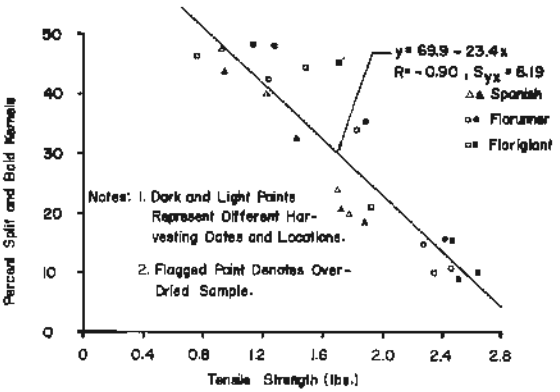

Figure 7. Percent split and bold kernels versus kernel tensile strength for Spanish, Florunner, and Florigiant peanuts.

and Florigiant peanuts fell approximately together, while the values for Spanish peanuts were slightly displaced. Nevertheless, all points considered together showed a correlation coefficient of 0.9. Although a very wide selection of peanuts were not tested, there is an indication that the values of separation force for most peanuts would fall within a fairly narrow range.

Seemingly, since the separation force was dependent primarily on the skin, the larger kernels should be stronger because they have more skin area. However, an analysis of the data, based on the approximate circumference of the kernels near the intercotyledon plane, showed no correlation between circumference and strength. Also, no correlation was apparent for diameter or slenderness ratio (length/diamter). The stress was apparently distributed about a fairly small area of skin near the loading points.

Individual values from tensile strength test and shelling evaluations appear in Tables 1 and 2 for a typical test lot. Although the average values for the

Table 1.--Tensile strength data from Florunner peanuts dried at 90° F.

	Length	Diameter1/		Separation force
		A	B	
	Inches	Inches	Inches	Pounds
	0.665	0.370	0.288	2.31
	.543	.408	.298	2.01
	.618	.438	.325	2.41
	.591	.392	.357	1.89
	.630	.366	.308	2.38
	.556	.382	.321	2.97
	.575	.391	.289	2.76
	.612	.436	.345	2.56
	.587	.374	.298	1.70
	.586	.341	.310	1.44
	.601	.397	.347	2.38
	.451	.352	.298	2.31
	.589	.318	.283	1.65
	.551	.387	.344	2.30
	.573	.336	.280	2.06
	.584	.407	.307	2.33
	.632	.390	.314	2.06
	.558	.416	.311	2.96
	.584	.342	.334	2.68
	.612	.382	.310	1.70
	.568	.413	.288	2.12
	.569	.410	.331	2.40
	.598	.392	.281	2.23
	.520	.333	.302	1.93
	.533	.341	.302	2.42
	.534	.356	.304	2.162/
	.501	.319	.285	2.23
	.451	.268	.259	1.49
	.535	.434	.282	2.73
	.595	.383	.319	2.59
	.534	.373	.320	2.81
	.597	.403	.329	2.84
	.580	.407	.322	2.56
	.495	.345	.296	1.51
	.624	.434	.303	2.68
	.656	.412	.328	3.01
	.570	.408	.352	2.80
	.567	.372	.340	2.76
	.567	.387	.350	2.30
	.560	.370	.318	2.00
	.643	.303	.297	1.44
	.462	.345	.312	.20
	.600	.369	.308	2.14
	.609	.386	.302	2.93
	.578	.351	.271	2.30
	.594	.360	.296	2.14
	.594	.342	.291	1.30
	.693	.379	.297	2.69
	.438	.416	.316	2.67
	.600	.436	.290	3.46
Average	.573	.377	.309	2.27
Std. dev.	.053	.037	.022	0.55

1/ "A" is perpendicular and "B" is parallel to intercotyledon plane.

2/ Pin pulled through peanut--cotyledons did not separate.

Table 2.--Shelling data from Florunner peanuts dried at 90° F.

	Split kernels	Bald kernels	Split and bald kernels
	Percent	Percent	Percent
	10.2	3.4	13.6
	10.3	2.7	13.0
	9.7	3.9	13.6
	13.0	5.5	18.6
Average	10.8	3.9	14.7
Std. dev.	1.29	1.03	2.26

tensile strength tests showed good correlation, less scatter of the individual values probably would have resulted if the peanuts could have been dried more uniformly. Bin drying, a practical requirement because of the number of peanuts required, inherently causes nonuniformity in peanut quality since the lower layers dry more rapidly and usually overdry, while the upper layers dry more slowly. Since each lot of peanuts was blended before shelling, average values of shelling and tensile strength evaluations were generally very consistent. Another problem encountered in the testing, generally for the stronger kernels, was rupture at the pin location rather than between cotyledons. This resulted in a somewhat less than ultimate value; however, this occurrence was not frequent enough to affect results significantly.

CONCLUSIONS

Rapid drying of peanuts apparently weakens the skin of the kernel. Whether skin weakening is caused by the internal separation forces of the cotyledons, as previously theorized (1), has not been proven. However, skin weakening could occur from being stretched as cotyledons tend to separate.

The kernel tensile strength test provides a method of determining milling quality of peanuts by evaluating individual kernels. The test may be used to evaluate milling quality without performing bulk shelling tests. Also, further research is possible to correlate milling quality with other parameters on the basis of individual kernels. For example, kernels with high or low milling quality may be selected individually for other types of quality evaluations.

The tests indicate that split kernels can be reduced if procedures which maintain the integrity of the skin are followed in processing.

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ACKNOWLEDGMENT

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EVALUATION OF METHODS OF APPLYING SOIL FUNGICIDES FOR CONTROL OF SOIL FUNGI ON SPANISH PEANUTS

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ABSTRACT AND PAPER

ABSTRACT

Sclerotium rolfsii, the cause of Southern Blight, and other parasitic soil-inhabiting fungi can be a serious problem in many Oklahoma peanut fields and usually become most prevalent during middle and late season when the peanut plants have lapped the rows. A single application of Pentachloronitrobenzene (Terraclor) at planting or during the season has not given adequate protection, even at excessive rates. Increased yields and less plant damage have been demonstrated with split applications of PCNB applied at planting and at various times during the season. Late-season applications of granular PCNB have proven effective in maintaining a more full-season control; however, driving the tractor through the field can cause plant damage and encourage the development of S. rolfsii. This problem has encouraged the search for more acceptable methods for applying a soil fungicide during the later part of the season. Tests carried out during 1970, 1971, and 1972 show that liquid PCNB applied through the sprinkler irrigation system is as effective as granular PCNB applied over the row by ground-rig. Although dividing the 10 lbs. active ingredient of PCNB into several applications during the season has improved disease control and increased yields, the desired level of disease control has not yet been reached.

PAPER

INTRODUCTION: Oklahoma growers usually face cool, wet periods after peanuts are planted which encourage seedling blight and produce unfavorable soil conditions for plant growth. Rhizoctonia solani, Fusarium sp., and Pythium sp. are among the fungi most commonly found in the seedling disease complex. Standard seed treatments provide only a protective zone around the seed. Tests carried out during 1970, 1971, and 1972 have shown that PCNB (Terraclor) applied in the seed furrow at planting will improve stands and insure healthier plants to start the season. However, a single application of PCNB at planting has not given adequate protection to the plants throughout the season, even at excessive rates. Increased yields with less root, peg, and pod rot have been attained by dividing 10 lbs. active PCNB per acre into two or three applications during the season. The program consists of applying granular PCNB 2 to 3 lbs. ai per acre infurrow-band at planting, and 3 lbs. ai per acre in a 14-inch band over the row in mid-July and August in fields known to have a history of or showing heavy infestations of S. rolfsii, R. solani, Fusarium sp., and Pythiaceous fungi.

S. rolfsii (Southern Blight) is a serious problem in many Oklahoma growers' fields and usually becomes most prevalent during August and early September. The split applications of PCNB were found to be needed in many fields infested with S. rolfsii and the other parasitic soil-inhabiting fungi. Peanut plants under irrigation have lapped the rows by this time, and driving a tractor through the field can cause plant damage and encourage the development of S. rolfsii. This problem has encouraged the search for more acceptable methods of applying a soil fungicide during late July, August, and early September. To fulfill this need, broadcast applications of granular and liquid PCNB were made by airplane and a study was designed to determine the practicality and effect of applying a soil fungicide, PCNB, through a sprinkler irrigation system.

METHODS AND MATERIALS: During 1972 a field having a high yield potential and history of severe root and pod-rot problems on the Grover Skaggs farm near Ft. Cobb in Caddo County was selected for the study. The field was planted May 21 with Foundation Argentine seed, and all plots except the non-treated received

PCNB (Terraclor 10G) at 2 lbs. ai per acre applied infurrow-band at planting using a Gandy 901 Jr. applicator-planter attachment. The effectiveness of 8 soil fungicide treatments was compared to a non-treatment for control of S. rolfsii and the other parasitic soil-inhabiting fungi. The fungicide-treated plots were approximately two acres conforming to one irrigation set across the field, and the non-treated plot was one acre in size. The "More-Crop" fertilizer applicator, portable model 35, was used to dispense the liquid PCNB (Terraclor 2EC) and 5-Ethoxy-3-trichloromethyl-1,2,4-thiadiazole (Terrazole 4EC) into the Farmland wheel-move sprinkler irrigation system. The system consisted of five-inch mainline and 1,280 ft. of five-inch lateral, equipped with 33 Rainbird heads--3/16-tips on 40-ft. centers. The liquid fungicides were dispensed slowly into the irrigation system during the first 30 minutes of the irrigation set. Granular fungicide applications during July and August were applied in 14-inch bands over the rows with Gandy 901 Jr. applicators mounted on a Lilliston cultivator during July and mounted on a 3-point tool bar for the August applications. Only enough soil was moved during the cultivation application to insure some incorporation and not enough to cover plant parts; thus, the soil fungicides were held in the pegging zone, and S. rolfsii was not encouraged. Disease observations and isolates from diseased plants were made throughout the season and peanuts were dug October 6. Plots were harvested and sacked separately, and data were taken from total yield of each plot. One-gallon samples were taken at random as peanuts were sacked to make up the composite from which grade and the disease determination samples were taken. Grades were determined by Oklahoma Federal-State Inspection Service, and three one-gallon samples were taken and counted for discolored-damaged pods.

RESULTS AND DISCUSSION: Seedling disease was noted in the study; however, due to good growing conditions, stands were not appreciably reduced. R. solani, Fusarium sp., S. rolfsii, and Pythiaceous fungi were identified from diseased plant samples taken from plots during the season, and isolates of Aspergillus, Penicillium, and Rhizopus were commonly found. S. rolfsii was first observed in the field about mid-July and became more severe during August and early September.

The fungicide-treated plots produced 378 to 774 lbs. per acre more peanuts than the untreated plot (Table 1). The greatest yield (4411 lbs./acre) was obtained from the plot receiving the higher rate of Terraclor 2EC (8 lbs. ai/acre all in July); yet, the highest grade (71) and the highest increase in dollar value per acre ($103.60) were obtained from the Terraclor-Terrazole 2-0.5EC combination applied at 2 lbs. ai/acre July 7, 28, and August 11. This would indicate a heavy fungicide application is needed in July to maintain the best level of protection and that the addition of Terrazole to control certain Pythiaceous fungi is needed later in the season for the best peanut grade. Yield differences between the various fungicide treatments (granular and liquid) were small for the most part; however, less pod damage was found in plots receiving the liquid fungicide through the irrigation system. Terrazole 4EC applied at 2 lbs. ai/acre August 3 produced 142 lbs. more peanuts per acre than same amount applied July 8. This would indicate the Pythiaceous fungi are perhaps more prevalent and are causing greater damage when the peanut foliage becomes heavier and forms a canopy over the row.

CONCLUSION: The small difference between yields obtained from granular and liquid Terraclor treatments indicates that liquid Terraclor can be applied by the overhead irrigation system as effectively as granular Terraclor applied in a banded application over the row by ground-rig. Aerial application of Terraclor 10G at 4 to 5 lbs. ai per acre, applied by airplane, and Terraclor 2EC 2 to 3 lbs. ai per acre applied through the overhead irrigation system have both been successful in reducing damage from Southern Blight and other soil fungi found in peanuts. The fact that the control obtained by the lower rate applied through the overhead irrigation system was essentially equal to the higher rate applied as granules may be due to use of water as a carrier. Residue analysis of soil samples taken at 2-inch intervals to a depth of 6 inches, show that PCNB penetrated to a greater depth when applied as liquid through the irrigation system than with granular applications. Realizing that many irrigation systems do not apply water uniformly, and wind has a definite influence on water distribution, still there are several advantages that may be found when fungicides are applied in the irrigation water: 1) placement of the fungicide where it is needed; 2) applying the fungicide at the beginning of the irrigation set allows the water to move the fungicide into the soil; 3) although water often encourages disease development, higher levels of

the fungicide are placed in those areas receiving more water. The distribution of the soil fungicide is only as uniform as the water, which may be an advantage since the most fungicide is placed where the most water falls.

SUMMARY: The application of Terraclor 2EC through the sprinkler irrigation system has proven effective. This practice is not intended to replace the banded application in early July, but to provide another effective, economical method of applying a soil fungicide after the plants have lapped the rows. Previous tests have shown that the banded application in early July is needed to place a concentration of fungicide in the pegging zone, providing initial protection. The later application, by airplane or irrigation, supplements the banded application as another step in a full-season soil fungicide program.

Table 1. Soil Fungicides Applied by Irrigation - Skaggs Farm, Ft. Cobb, Oklahoma, 1972.

Variety: Argentine Planted: May 23 Harvested: October 2

Treatment Fungicide, Rate ai/a and Time of Application	Yield lbs/a	Yield Diff-Ck lbs/a	Grade	Val./ Ton	Inc. Val./a Over Ck.	% Damage Pod
1. Ter 2EC 8 lbs July 10	4411	774	67	$ 275	$ 98	6%
2. Ter 30G 3 lbs July 10 & Aug. 4	4290	653	70	286	101	10%
3. TSx 2-0.5EC 2 lbs July 7 & 28 & Aug. 11	4252	615	71	290	104	7%
4. Ter 2EC 1 lb (ea. irr.) July 10 & 25, Aug. 5, 15 & 25, & Sept. 5 & 15	4169	532	67	276	64	3%
5. Terz 4EC 2 lbs Aug. 3	4147	510	69	282	72	4%
6. Ter 2EC 2 lbs July 9, Aug. 4 & 24	4131	494	67	275	56	7%
7. Ter 2EC 8 lbs Aug. 4	4109	472	69	283	69	6.5%
8. Terz 4EC 2 lbs July 8	4015	378	68	279	48	5%
9. No Treatment	3637	---	69	282	---	12%

EFFECT OF NEMATICIDES UPON ROOT LESION NEMATODE POPULATIONS

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ABSTRACT AND PAPER

ABSTRACT

Root lesion nematode (Pratylenchus brachyurus) is commonly found in peanut fields throughout Oklahoma. Nematicide trials carried out in fields having heavy infestations of lesion nematodes during recent years show increased yields from pegging-time applications. Results from the 1969, 1970, and 1971 tests indicated that a reduction in pod damage and an increase in yields resulted from mid-season nematicide applications. However, since only soil samples were processed, the root lesion nematode population counts were erratic and no correlation could be made with yield, pod damage, and time of application. By processing both soil and root samples during the 1972 test, more accurate population data were obtained. Results from this study showed increased yields can be correlated with a decrease in lesion nematode population and reduced pod damage. Pegging-time nematicide applications with fumigants and non-fumigants produced yield responses similar to past tests; however, 45-50% of the yield increases were in excess of 1000 lbs./ acre. These were obtained in plots receiving a nematicide application at planting followed by two or three applications during the season. Monthly soil and root samples processed by the modified Christie-Perry method and by root incubation show that late-season nematicide applications reduced pod damage and P. brachyurus population recovered.

PAPER

Many Oklahoma peanut growers have found damaging populations of the root lesion nematode (Pratylenchus brachyurus) in their fields. The heaviest infestations have been more commonly found in the deep sands of Southern Oklahoma; however, moderate to heavy infestations have been recovered from other peanut areas in the State. Limited acreage allotments and available irrigation facilities have forced growers to plant peanuts on the same land in successive years, increasing nematode populations. When infestations of P. brachyurus become severe, growers have been forced to dig peanuts early and suffer severe reductions in yield. The lesion nematode feeds on the peanut root, peg, and pod, allowing fungi and bacteria to enter the damaged cells, causing a peg and pod rot. The peg, weakened by infection or rotted away, allows the mature pod to be shed and lost at harvest.

P. brachyurus has a wide host range so that crop rotation, in most cases, is not a practical method of control. Nematicide applications made during the growing season have been effective in controlling P. brachyurus, resulting in reduced pod damage and increased yields.

Sturgeon, Russell, and Shackelford (1), in 1970, found that nematicides applied at pegging time appeared to increase peanut yields over non-treated plots and at-plant applications. In 1971, Sturgeon and Russell (2) studied this problem in more detail and found that pegging applications increased yields from 230-900 lbs. over non-treated peanuts and 170-600 lbs. over at-plant applications.

In 1972, a study was designed to further evaluate certain nematicides and fumigants at various rates applied at different times during the season for control of P. brachyurus.

METHODS AND MATERIALS: The study was located on the Dee Keeton farm near Willis, Marshall County, Oklahoma. This irrigated farm was found to have a heavy infestation of P. brachyurus and a moderate to heavy infestation of the ring nematode (Criconemoides sp.).

Nine treatments, consisting of Dasanit 15G (O,O-Diethyl-O-[p-(methylsulfinyl-phenyl]-phosphorothioate), Fumazone 86E (1,2-dibromo-3-chloropropane and related halogenated C_3 aliphatics), and Furadan 10G (2,3-dihydro-2,3-dimethyl-7-benzo-furanyl methylcarbamate) were applied at various rates, using various methods, and at different times. Argentine seed was planted June 15, a pegging application was made August 1, a mid-late season application was made September 8, and a late-season application was made October 4. The plots were harvested November 28. The plots consisted of two rows, 36 inches apart, and 1250 ft. long. Each treatment was replicated three times. Soil and root samples were taken at selected times during the season for nematode analysis. 100 Milliliters of soil was processed by a modified Christie-Perry extraction technique, and the roots were incubated in water for four days. The yield from each plot was determined by taking combine bin measurements. Nut samples for evaluation of damage and grades were collected as each bin was dumped. The damaged pod ratings were determined from a 5-lb. sample taken from each replication. Each sample was rated on the basis of degree of pod damage (0 = none, 5 = 80-100% damage). Nematicides were applied at planting with a Gandy 901 Jr. applicator mounted on a planter and incorporated with a ro-wheel. Band widths of 7, 12, and 14 inches were used depending upon the treatment. The soil fumigant was injected at an 8-inch depth with one stubble coulter per row at planting. For the August application, two stubble coulters per row about 8 inches on either side of the plants were used to inject the soil fumigant. The granular nematicides were applied with a Gandy 901 Jr. applicator in 12-inch and 14-inch bands over the row and irrigated into the soil.

RESULTS AND DISCUSSION: Plots receiving nematicide treatments showed an increase in peanut yields of 261-1292 lbs. per acre. The largest increase in yield, 1292 lbs. per acre, was obtained from the plot receiving Furadan 10G, 4 lbs. ai/acre at plant, followed with three applications of Furadan 10G, 2 lbs. ai/acre applied over the row in a 12-inch band in August, September, and October (Table 1). The plots receiving Furadan 10G or Fumazone 86E applications at plant, followed with an application in August, produced greater yields than those receiving only one application of Fumazone 86E, Dasanit 15G, and Furadan 10G in August (Table 1). Single applications of Fumazone 86E at plant or in August were similar in yield. However, an increase of approximately 200 lbs. per acre was obtained when Fumazone 86E was applied at plant followed by another application in August. These results indicate that at least two nematicide applications per season may be necessary to obtain effective control of P. brachyurus. However, the cost of the second application may be greater than the value of the increased yields.

Table 1. 1972 Nematicide Trials - Lesion Nematode - Keeton Farm, Willis, Oklahoma.

Treatments Chemical & Rate/acre Type of Application	Yield[1] lbs/a	Diff-Ck lbs/a		Pod[2] Damage Rating	Nema/gm Root Wt. (avg.)
1. Furadan 10G 4 lbs plt + 2 lbs 3 app. Aug., Sept., Oct.	3749	1292	a	0.9	0.2
2. Furadan 10G 2 lbs plt + 2 lbs 2 app. Aug., Sept.	3567	1110	ab	1.1	0.4
3. Fumazone 86E 4 qts plt + 3 qts Aug.	3276	819	abc	2.5	1.0
4. Furadan 10G 4 lbs plt + 2 lbs Aug.	3167	710	abcd	1.3	0.1
5. Dasanit 15G 3 lbs Aug.	3131	674	abcd	1.3	1.6
6. Fumazone 86E 3 qts Aug.	3094	637	abcd	2.3	2.6
7. Fumazone 86E 4 qts Aug.	3057	600	abcde	2.9	1.4
8. Fumazone 86E 4 qts plt	3033	576	bcde	3.2	2.2
9. Furadan 10G 2 lbs Aug.	2718	261	cdefg	1.2	1.5
10. No treatment	2457	---	defg	4.8	7.8

[1]Difference in yield is increase or decrease comparing to non-treated plots (checks). Those values not followed by the same letter are significantly different at the 0.05 level by Duncan test.

[2]Pod rating nematode damage: 0 = No necrosis; 5 = 80-100%.

Root and soil samples taken from the check plots showed that the P. brachyurus infestations increased from a trace at planting time (June 15) to a very heavy infestation by the end of the season (October 1).(Table 2). The root-soil samples taken from the plots receiving the at-plant treatment followed by other applications during the season showed that the infestation remained constantly low throughout the season. This would account for the low pod damage index reading and low average of nematodes recovered per gram root weight.

Table 2. 1972 Peanut Nematicide Trials - Nematode Population Counts - Keeton Farm, Willis, Oklahoma

Treatments Chemical & Rate/a Type of App.	P. brachyurus[1] June	July[2]	Aug.[3]	Sept.	Oct.
1. Furadan 10G 4 lbs ai plt + 2 lbs ai 3 app. (Aug., Sept., Oct.)	T	2.7	4	0	12
2. Furadan 10G 2 lbs ai plt + 2 lbs ai Aug.	T	2.7	20	0	0
3. Fumazone 86E 4 qts plt + 3 qts Aug.	T	13.3	24	24	0
4. Furadan 10G 4 lbs ai plt + 2 lbs ai Aug.	T	5.3	0	0	0
5. Dasanit 15G 3 lbs ai Aug.	T	34	40	12	4
6. Fumazone 86E 3 qts Aug.	T	16	80	0	4
7. Fumazone 86E 4 qts Aug.	T	23.5	52	0	0
8. Fumazone 86E 4 qts plt	T	26	12	36	28
9. Furadan 10G 2 lbs ai Aug.	T	16	44	20	4
10. No treatment	T	32.1	28	40	104

[1]Indicates number of P. brachyurus recovered by root incubation. T = trace.

[2]Average of 3 replications.

[3]First replication only.

Root-soil samples taken from the plots treated with Dasanit 15G, Furadan 10G, and Fumazone 86E in August showed a moderate to heavy infestation of P. brachyurus prior to the August application. The population had decreased 50-100% when sampled one month later, and did not show any increase at the October sampling (Table 2). The heavy infestation prior to the August application was responsible for the high number of nematodes per gram weight and is credited for the increase in the damaged pod ratings when compared to the full-season treatments. It would appear that the damage to these pods may have occurred before the August treatment since very few nematodes were recovered from the September and October samplings. This is further demonstrated with the two Fumazone 86E treatments applied at plant and in August. The Fumazone 86E treatment applied at plant had a nematode/gram root weight average of 2.2 and a pod damage rating of 3.2, while the Fumazone 86E treatment applied at pegging had a nematode/gram root weight average of 2.6 and a pod damage rating of 2.2 (Table 2). The moderate to heavy infestation of P. brachyurus prior to the August application may also account for the reduction in yield observed in these plots compared to those receiving several treatments during the season.

High levels of pod damage were highly correlated to low peanut yields ($r = -.76874$). Similarly, high numbers of P. brachyurus per gram root weight were correlated with low peanut yields ($r = -.37747$). A positive correlation ($r = .58633$) between pod damage and nematodes/gram root weight indicates a direct relationship between pod damage and the nematode population. Pod damage ratings may then be another diagnostic tool for determining effectiveness of nematicide treatments and estimating populations of P. brachyurus.

In summary, it appears that two or more applications of nematicides during the season may be needed for effective control of P. brachyurus. The results also show that P. brachyurus has a definite detrimental effect upon peanut yields in Oklahoma.

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EVALUATION OF VIRGINIA TYPE PEANUTS FOR MATURITY USING THE FREE ARGININE CONTENT (AMI METHOD)[1]

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ABSTRACT

Several varieties of peanuts grown at four locations in the North Carolina-Virginia area were sampled over a ten-week period. They were analyzed by the arginine maturity index (AMI) method. The tabulated and statistical results show that most of the variation was due to harvest dates and secondly variety. Location was also significant but to a lesser degree. Overall mean AMI values for both locations and varieties ranked the rate of maturing of peanuts (early to later) in agreement with previous subjective evaluations. These findings are compared with those presently being reported on peanuts grown in Georgia. Also, seasonal conditions and sampling methods are discussed with relation to results obtained.

INTRODUCTION

The degree of maturity of peanuts is closely correlated with maximum yield and quality. Harvesting of immature peanuts results in low yields, due to undeveloped seeds, and inferior product quality. The present methods for determining the degree of maturity are based largely on subjective evaluations; therefore, a good reliable objective method of maturity determination has been desired by the peanut industry for some time.

Newell (1) and Mason et al. (2) observed a distinct decrease in the amino acid, arginine, with increasing maturity of the Spanish-type peanuts. Young and Mason (3) carefully examined this relationship and found that the free arginine content of peanuts was a useful measure of maturity under field conditions. More recently Young (4) has developed a continuous flow automated analytical method for analyzing large numbers of samples. The use of this method has been shown to have great potential for measuring maturity in peanuts grown in Oklahoma and Georgia (5). Young et al. (5) has reviewed this technique and its potential use.

The present study was designed to test the potential usefulness of the method on peanut varieties grown in the North Carolina and Virginia peanut producing area.

EXPERIMENTAL

Green peanut samples in duplicate were hand collected over a ten week period at four locations in North Carolina and Virginia. Virginia 56R, Florigiant and NC-Fla 14 varieties were obtained at Nansemond and Southampton Counties in Virginia and Chowan and Halifax Counties in North Carolina along with seven additional varieties at the Southampton County location. The samples were taken from the border rows of peanuts in the Virginia-North Carolina Peanut Variety and Quality Evaluation Program (5,6) in all locations but the Southampton County where the samples were immediately adjacent to the evaluation program plot. Cultural practices were identical at all locations and in accord with recommendations for high yields of acceptable quality.

[1]Arginine Maturity Index (4)

All developed pods on each plant sample were removed, washed thoroughly and frozen until ready for chemical analysis.

The arginine maturity index (AMI) method of Young (4) was used to determine maturity of the samples. The method involved grinding 30 grams of inshell peanuts in 200 ml. of trichloroacetic acid for 30 seconds, filtering and analyzing the filtrate for free arginine using an automated continuous flow system. The optical density of the filtrate measured at 520 nm multiplied by 100 gave the arginine maturity index. Moisture content was determined by drying duplicate 20 grams samples for 5 hours at 100°C. All AMI values reported have been corrected to dry weight basis.

RESULTS AND DISCUSSION

Table 1 lists the AMI values for 3 varieties of peanuts that were sampled weekly for 10 weeks at four locations. In all cases the AMI value decreased with increasing age (maturity) of the peanuts sampled. Some week to week fluctuations were observed and were probably due to sampling error and climatic conditions. Figure 1 shows graphically the trend of all values in Table 1 averaged and plotted against sampling date. The curve obtained is similar to those previously published (1, 2). The sampling dates shown in Table 1 will be referred to as weeks 1 through 10.

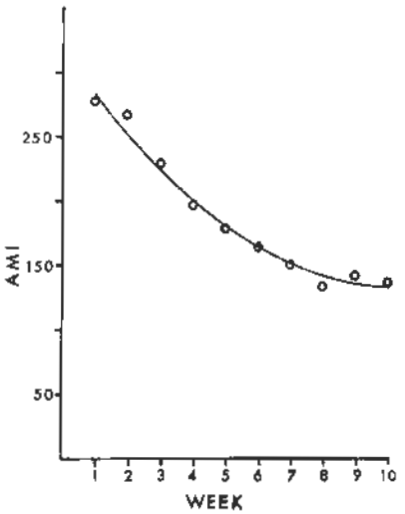

Figure 1. Effect of sampling date on average AMI values of 3 varieties at 4 locations.

Statistical evaluation (Table 2) shows location, variety and digging dates were highly significant factors, while sampling replicates and all location, variety and digging date interactions were not significant.

An average of all AMI values for 3 varieties for each location is shown in parentheses alongside the respective county (Table 1). If AMI values are indicative of maturity, then these averages should reflect the relative maturing rates at each location. The averages ranked the counties from earlier to later maturing peanuts, Halifax, Chowan, Southampton, Nansemond. The ranking is as would be expected based on previous experience. Also an average of all AMI values at all locations for each variety successfully ranked the 3 varieties in the order

Table 1. Effect of location, variety and sampling date on the arginine maturity index (AMI) values of peanuts grown in the NC-Va area in 1972

Variety	Sampling Date 8/21	8/28	9/4	9/11	9/18	9/25	10/2	10/9	10/16	10/23	Average*
					Nansemond Co., Va. (Average 214a)						
Va 56R	275	284	226	285	185	178	206	183	134	114	
Florigiant	331	307	236	270	250	213	147	157	130	139	
NC-Fla 14	331	321	272	269	195	190	130	131	193	140	
					Southampton Co., Va. (Average 212a)						
Va 56R	409	221	258	197	203	242	233	173	171	214	
Florigiant	240	340	291	200	184	187	190	166	163	160	
NC-Fla 14	317	259	238	193	181	125	147	152	145	168	
					Chowan Co., N. C. (Average 169b)						
Va 56R	297	244	202	115	169	183	170	150	193	192	
Florigiant	253	230	191	162	152	147	117	106	127	113	
NC-Fla 14	297	201	189	203	146	123	115	83	85	109	
					Halifax Co., N. C. (Average 155b)						
Va 56R	211	341	226	139	151	140	141	115	164	105	
Florigiant	151	242	262	169	186	134	116	104	102	102	
NC-Fla 14	216	221	158	155	134	102	91	87	98	95	
					All Locations						
Va 56R	298	272	228	184	177	185	187	155	165	156	200.8a
Florigiant	243	279	245	200	193	170	142	133	130	128	186.5b
NC-Fla 14	290	250	214	205	164	135	121	113	130	128	174.9b
Average	277a	267a	229b	196c	178cd	163de	150ef	134f	142ef	137ef	

*Duncan's new multiple range test at the .05 level. Means sharing the same subscript are not statistically different.

Table 2. Summary of the analysis of variance on AMI values on three varieties of peanuts grown at four locations in the NC-Va area in 1972

Source	Degrees Freedom	F
Total	239	--
Location (L)	3	26.967**
Variety (V)	2	6.685**
Digging (D)	9	34.285**
Reps	1	2.331NS
L X V	6	1.680NS
L X D	27	1.523NS
V X D	18	1.309NS
L X V X D	54	.931NS
Error	119	--

** Significant at the .01 level.
NS Not Significant.

of observed maturing rates. NC-Fla 14, Florigiant and Va 56R ranked in order of earlier maturing to later maturing.

The AMI values of 10 commercial varieties for 10 sampling dates at Southampton County, Virginia are shown in Table 3. Again the AMI values decrease considerably with increasing age (maturity) of the peanuts. The varieties are listed according to their average AMI values with Avoco 11 being the highest and NC-17 the lowest. Ranking of these average AMI values agrees with the observed rates of maturity based on a familiarity with the growing characteristics of these varieties and subjective observations. Figure 2 shows the curves obtained from a plot of Avoco 11, NC-17 and overall average AMI values.

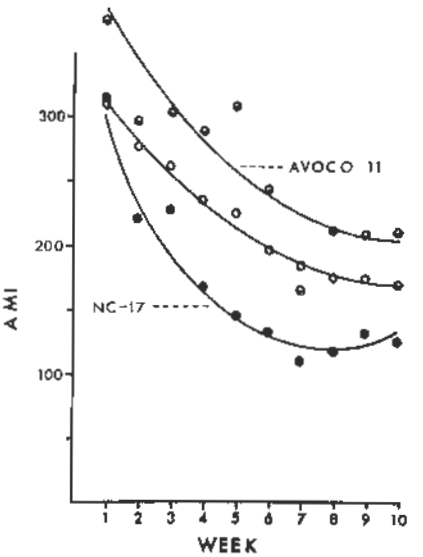

Figure 2. Effect of sampling date on high, low and average AMI values of ten peanut varieties at Southampton County, Va.

Statistical evaluation (Table 4) of these values shows both variety and digging date significant at the .01 level with variety-digging date interaction significant at the .05 level.

Table 4. Summary of the analysis of variance on the arginine maturity index (AMI) values on peanuts grown at Southampton, Va. in 1972

Source	Degrees Freedom	F
Total	199	
Variety (V)	9	10.904**
Digging (D)	9	25.460**
Rep.	1	0.530NS
V X D	81	1.442*
Error	99	

* Significant at the .05 level.
** Significant at the .01 level.
NS Not significant.

Table 5 lists AMI values of NC-17 variety sampled over a 10 week period at 3 locations. The data in this table would fit into Table 1 except that NC-17 samples were not available at Halifax County and all values are an average of duplicate chemical analyses. The definite trend of decreasing values with increasing age of peanut is observed. As above both location and digging dates were significant factors at .01 level (Table 6). Although chemical analyses were not significant, the error for these large seeded peanuts was large enough to suggest that a modification of the sampling technique is needed in future studies. The method was developed with smaller-seeded peanuts, hence the 30 gm. sample may need to be increased to 50 gm to reduce sampling error in Virginia-type peanuts.

Table 6. Summary of analysis of variance on AMI values on the NC 17 variety grown at 3 locations in the NC-Va peanut growing area in 1972

Source	Degrees Freedom	F
Total	119	--
Location (L)	2	18.471**
Digging (D)	9	43.402**
Reps	1	1.824NS
Lab anal (A)	1	2.161NS
L X D	18	1.034NS
Error	88	--

** Significant at the .01 level.
NS Not significant.

An average of all values in Table 5 gives an average for NC-17 (169) at 3 of the 4 locations in Table 1. A direct comparison of this average with those of the other 3 varieties in Table 1 places NC-17 as more mature (earlier maturing) than the other 3 varieties. This agreed with rankings in Table 3 and with predicted rates of maturing. If values from Halifax County (the earliest maturing county in Table 1) had been obtained the average for NC-17 would be expected to be significantly lower than NC-Fla 14 as shown in Table 3.

Comparison of data obtained in these experiments with those from similar experiments on 1971 Georgia peanuts (6) showed a much lower AMI value during normal harvest times for the Georgia peanuts. The range of AMI values for Florunner and Florigiant varieties were of 69 to 89 and 60 to 95, respectively for 1971 Georgia grown peanuts. This compares to values of 91 to 136 and 128 to 133 for the same two varieties grown in NC-Va area where the range of values represent

Table 3. Effect of variety and sampling date on the arginine maturity index (AMI) values on ten varieties of peanuts grown at Southampton, Va. in 1972

Variety	Sampling Date										
	8/21	8/28	9/4	9/11	9/18	9/25	10/2	10/9	10/16	10/23	Average*
Avoca 11	375	296	303	289	308	244	165	212	209	210	260.9a
Va 72R	293	302	343	265	265	253	182	260	207	161	253.0ab
NC2	350	300	299	325	290	198	184	160	198	182	248.5ab
Va 61R	359	241	273	277	220	193	214	191	190	207	236.4abc
Va 56R	409	221	258	197	203	242	233	173	171	214	231.8abc
NC5	175	300	212	276	290	246	251	188	187	161	228.4 bc
Florigiant	240	340	291	200	184	187	190	166	163	160	211.9 cd
NC-Fla 14	317	259	238	193	181	125	148	152	145	168	192.4 d
Florunner	264	278	223	163	166	136	157	136	138	91	175.0 e
NC17	313	220	227	166	144	132	110	117	132	125	168.6 e
Average	309a	276b	267b	235c	225c	195d	183d	175d	174d	168d	

*Duncan's new multiple range test at the .05 level. Means sharing the same subscript are not statistical different.

Table 5. Effect of location and sampling date on the arginine maturity index (AMI) Values[1] on the NC 17 variety grown in the NC-Va Peanut area in 1972

Location		Sampling date									
		8/21	8/28	9/4	9/11	9/18	9/25	10/2	10/9	10/16	10/23
Nansemond Co., Va.	a*	297	260	262	182	137	149	143	154	111	132
Southampton Co., Va.	a	356	251	216	177	150	144	122	138	134	132
Chowan Co., N.C.	b	274	194	165	153	113	116	100	115	96	100
Average		309a	235b	214b	171c	133d	137d	122d	135d	114d	121d

*Duncan's new Multiple Range Test at the .05 level. Means sharing the same subscript are not statistically different.
[1]Average of duplicate chemical determinations.

those obtained over a 3-week normal harvest period. Both Spanish and Runner types gave values of 50 to 100 for mature peanuts while NC-Va values seldom dropped below 100. These differences may be due to environmental differences and may be normal for the locations. However, the 1972 season was very late in NC-Va area with digging hastened by an early frost, so most peanuts dug were somewhat immature.

The results from these experiments show that AMI values are negatively correlated with maturity in peanuts grown in NC-Va area. Also, average AMI values objectively ranked both varieties and locations in order of early to late maturity in agreement with subjectively observed rankings. This method shows some definite potential for evaluating new varieties for rate of maturing. Additional studies are needed to determine the real potential for using the AMI method for predicting optimum digging date for peanut growers.

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PEANUT POD ROT DISEASE CONTROL

by
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ABSTRACT & PAPER

ABSTRACT

This paper summarizes the results of field research where forty-five different chemicals or chemical combinations were evaluated on 28 treated plots to determine their effectiveness against the peanut pod rot disease. There were four replications per treatment placed in a complete randomized block design. Data were collected on fungi associated with rotted pods, percent pod rot disease, peanut quality, yield and value per acre.

Species of Pythium, Rhizoctonia, and Fusarium were isolated from rotted pods; however, the predominant pathogen was Sclerotium rolfsii. The best chemical treatment on this farm was the application of Terraclor + Terrazole[1] which curtailed pod rot from 30.3% to 11.4% and increased peanut value by $205.41 per acre.

PAPER

INTRODUCTION

The peanut pod rot disease occurs throughout the peanut producing area in Virginia and causes over 15% annual loss in peanut yield and quality. Four major soil borne fungi, Pythium spp., Rhizoctonia solani, Sclerotium rolfsii and Fusarium spp. are the primary causal agents of the peanut pod rot disease in Virginia.

Research reported here was conducted on the Bob Edwards farm in Southampton County, Virginia. This site was selected because it possessed a well drained sandy loam soil. Also, peanuts planted in this area the previous year showed approximately 30 per cent pod rot damage and low populations of northern root-knot, ring, and sting nematodes. The fungus Sclerotium rolfsii was prevalent in this field.

METHODS AND MATERIALS

Forty-five different chemicals or chemical combinations were applied in 28 treated plots. There were four replications per treatment arranged in a complete randomized block design.

Treatments were evaluated for: fungi associated with rotted pods; percent pod rot disease; peanut quality; yield and value per acre.

Different times and methods of chemical application were:

Preplant Chemical Application: Chemicals were applied two weeks prior to planting peanuts. Granular materials were applied on a 12 inch wide band over the row and incorporated 5 inches deep. Liquid materials were injected 8 inches deep in the center of the row and sealed with a press wheel.

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1 The use of trade names in this publication does not imply endorsement by the Virginia Agricultural Experiment Station of the products named nor criticism of similar ones not mentioned.

At Planting Chemical Application: Peanuts were planted on May 18 which was the same day that chemicals were applied to the plots. Chemicals were applied in the same manner described in preplant chemical application.

Early Pegging Chemical Application: Chemicals were applied on a 12 inch wide band centered over the row on June 29.

Post Pegging Chemical Application: Chemicals were applied on July 29, four weeks after the early pegging chemical application using the same procedures described for that treatment.

The percent of peanut pod rot disease was determined by digging a plant from each of 4 locations per treated row, per replication, per treatment. Soil in the fruiting area of each plant was searched for healthy and rotted peanut pods which were placed in a paper bag with the plant from that location. Individual plants were washed and all pods were removed by hand. The healthy and diseased pods per plant were separated and counted. Data presented on the "Percent Pod Rot Disease" represents the averages of peanut pods with pod rot symptoms from 16 plants per treatment per farm.

Damaged peanut pods from selected field treatments were cultured on artificial media to ascertain the identity of fungi associated with pod rot.

Peanut yield and quality were obtained as the primary criteria of the effectiveness of various treatments: Peanuts were dug on October 6 and combined on October 13. Immediately after peanuts were combined, they were dried in the shell to 12% moisture, weighed, and stored for two months prior to collecting a sample from each replicate for grading.

RESULTS AND DISCUSSION

Table 1. presents data on treated plots which produced $90.00 or more per acre above the untreated plots. These treatments are also presented graphically in Figure 1.

On this research location, the fungus Sclerotium rolfsii caused pods to rot from mid-season until harvest time. Terraclor is effective against Sclerotium rolfsii and provided a high degree of control of the Sclerotium rolfsii phase of the peanut pod rot disease.

The compounds Terr-o-cide 15, D-D/PIC, and Telone C contain a nematicide plus the fungicide chloropicrin. These compounds show promise as pod rot control agents.

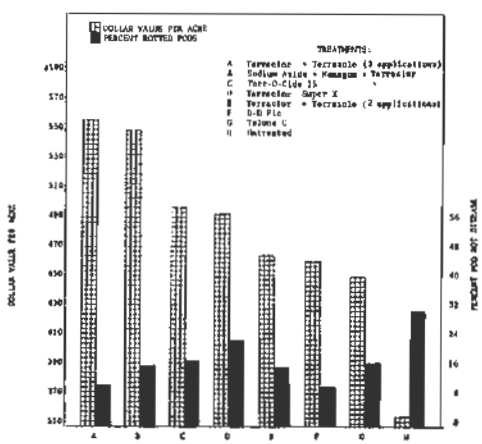

Fig 1 Comparison of peanut value per acre and pod rot disease control. The seven treatments shown produced the highest value per acre of 28 treatments used in this study. Data is the average of four replications.

Table 1. Summary of Results on Peanut Pod Rot Disease Control-(Southampton County, 1971)

	TREATMENTS[1]								RATINGS			
Treatment	2 weeks Preplant Chemical & Formulation	Row Rate/A	At Planting Chemical & Formulation	Row Rate/A	Early Pegging Chemical & Formulation	Row Rate/A	Post Pegging Chemical & Formulation	Row Rate/A	% Pod Rot Disease[2] (Sept. 13)	Support Price $ Per CWT	Yield Pounds Per acre	Value $ Per acre
A			Terraclor 8%G + Terrazole 4%G	20lbs	Terraclor 8%G + Terrazole 4%G	40lbs	Terraclor 8%G + Terrazole 4%G	40lbs	11.4	14.93 e[3]	3755d	560.62e
B	Sodium Azide 8%G	66lbs	Nemagon 12.1	.75gal	Terraclor10%G	100lbs			16.1	14.34a-e	3852d	552.37a-e
C	Terr-o-cide 15	3gal							17.9	14.35a-e	3485c-d	500.10c-e
D			Terraclor Super X	33lbs					23.6	14.83d-e	3341b-d	495.47a-c
E			Terraclor 8%G Terrazole 4%G	20lbs	Terraclor 8%G Terrazole 4%G	30lbs			16.1	14.91 e	3125b-d	465.94b-e
F	D-D/PIC	3gal							11.1	14.34a-e	3215b-d	461.03b-e
G	Telone C	3gal							17.5	14.55b-e	3114b-d	453.08a-c
H	Untreated Plot		Untreated Plot		Untreated Plot				30.3	13.80a-d	2574a-c	355.21a-e

1 Preplant and at planting applications-Granular materials (G) were applied on a 12" wide band and incorporated 5" deep; Liquid fumigants were injected 8" deep in center of the row. Early pegging and post pegging applications-all compounds were applied on a 12" wide band over the row.

2 Percent pod rot disease were taken by digging 4 plants per treatment per replicate and counting healthy and rotting peanut pods.

3 Values having a common letter, within columns, do not differ significantly at the .05 level according to Duncan's Multiple Range Test. Data are averages of 4 replications.

EARLY GENERATION YIELD TRIALS AS A BREEDING METHOD FOR PEANUTS

by

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ABSTRACT

In 1969, a large number of F_2 lines was available for use in the breeding program at Tifton, Georgia. These lines were developed from reciprocal infraspecific crosses between the peanut (Arachis hypogaea L.) varieties Argentine and Early Runner. Evaluation of these lines by use of the pedigree method of plant breeding was considered uneconomical; therefore, early generation yield trials were proposed as a possible breeding method. The highest yielding F_2 lines were selected and placed in a replicated F_3 yield trial. Lines yielding more than the parental lines were advanced to replicated F_4 yield trials. F_4 lines outyielding the parents were placed in replicated F_5 Spanish and Runner yield trials on the basis of seed weight/100 seeds. The five highest yielding F_4 lines were winter increased in Puerto Rico for use in F_6 yield trials. Yield and shelling data from the F_5 and F_6 yield trials were evaluated by analysis of variance and Duncan's multiple range test. Results from these tests indicate that acceptable breeding lines can be developed using early generation yield trials. Commercial checks used in these yield trials were Argentine, Spancross, Tifspan, Comet, Early Runner, Florunner, Florigiant, and Virginia Bunch 67. Of the 12 breeding lines in the F_5 yield trials, nine outyielded the parents, and seven outyielded the highest yielding commercial check. The three breeding lines in the F_6 Spanish yield trial were significantly outyielded by the highest yielding commercial check, but not by Argentine. No significant differences were observed in the F_6 Runner yield trial. Results from the F_5 and F_6 yield trials show that desirable characters in each parent were transferred to breeding lines of different commercial type, although selection was on the basis of yield only. From our results, we concluded that early generation yield trials were an acceptable breeding method for peanuts.

Film Documentation of Plant Introduction Peanuts

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ABSTRACT

Approximately 2100 Plant Introduction peanuts, grown at Tifton, Georgia in 1972 for evaluation for insect resistance, were harvested and evaluated for stage of maturity, and for protein and oil content. Genetic and other visable differences were documented on movie film. The pictures included field plots, pods on the harvested plants, harvested pods, and shelled kernels. These are being processed on microfiche for reference purposes. Chemical composition data on the samples will be published in the USDA Plant Introduction seed catalogue for peanuts. Details of the methodology and equipment are described.

BREEDING PEANUTS (*Arachis hypogaea* L.) FOR RESISTANCE TO VERTICILLIUM WILT

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ABSTRACT

The objectives of this study were to evaluate germplasm of peanuts, *Arachis hypogaea* L., for possible sources of resistance to Verticillium wilt and to study the inheritance pattern of this resistance to facilitate the incorporation of resistance into improved commercial varieties. Preliminary screening of 152 accessions was made in a field infested with *Verticillium*. Promising accessions were selected and further examined under controlled environments of a greenhouse and a growth chamber with artificial inoculation procedures. Genetic studies were conducted using crosses among two of the most tolerant and two of the most susceptible accessions.

Out of 89 accessions screened under field conditions for resistance to Verticillium wilt in the first year of the study, 21 accessions were selected having less than 40% wilt prevalence. After critical evaluation under greenhouse and growth chamber conditions, these accessions were grouped into three arbitrary Verticillium wilt reaction classes of tolerant, intermediate, and susceptible. The Argentine variety and 9 other lines, P-338 (P.I. 259671), P-425 (P.I. 268759), P-431 (P.I. 268778), P-436 (P.I. 268795), P-442 (P.I. 268818), P-446 (P.I. 268825), P-555 (P.I. 248768), P-559 (P.I. 240555) and P-628 (P.I. 268707), ranked in the tolerant group. Georgia Bunch 182-28, previously reported to be highly resistant, ranked in the intermediate group. P-361 (P.I. 268616), P-362 (P.I. 268626), P-860 (P.I. 268680) and P-870 (P.I. 268706) were highly susceptible. From studies on the inheritance of Verticillium wilt reaction using P-362 and P-870 as susceptible parents and P-431 and P-446 as tolerant parents, susceptibility appeared to be controlled by a single dominant gene. However, tolerance was somewhat intensified in a hybrid of the two tolerant parents. Broad sense heritability estimates for tolerance to Verticillium wilt varied from zero to 0.44 from F_2 generations of tolerant by susceptible crosses.

THE NECROTIC-ETCH LEAF DISEASE IN PEANUTS. I. GENETIC MODELS [1/]

by

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ABSTRACT

Cultivated peanuts (*Arachis hypogaea* L.) are devoid of qualitative genetic resistance to most of the diseases affecting the crop. A necrotic-etch leaf disease, first observed in 1962, lacks distinctiveness or uniformity of affected areas, but can be easily distinguished from the leafspots, peanut ringspot, and other described diseases. It is not transmitted mechanically. The incitant of this disease is unknown. Attempts to isolate a causal agent have been unsuccessful.

Necrotic-etch leaf, investigated by our "multicross" testing procedure, inherits as a qualitatively-controlled recessive characteristic, but F_2 progenies from different matings segregated for monogenic, digenic and apparently also for trigenic phenotypic assortments.

F_2 data for 44 progenies (totalling 3197 normal : 183 necrotic etch) in 9 cross combinations gave good fits to the digenic 15:1 model, indicating duplicate loci.

Two F_2 progenies, in a cross of a necrotic-etch leaf plant with the line from which it was isolated, segregated for the monogenic 3:1 ratio. Another cross of 2 progenies (301 plants) appears to fit the trigenic 63:1 ratio.

This behavior adds further support to our hypothesis that a "wide variety of cross combinations constitutes a more critical test of locus character" in peanuts than single cross procedures.

1/ For presentation at the American Peanut Research and Education Association annual meeting, Oklahoma City, Oklahoma, July 15-18, 1973. Cooperative Research of the Agricultural Research Service, U. S. Department Agriculture and the University of Georgia College of Agriculture, Coastal Plain Experiment Station, Tifton, Georgia 31794.

PHOTOSYNTHESIS IN PEANUT GENOTYPES

by
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ABSTRACT

Photosynthesis rates of attached leaves of thirty-one peanut genotypes, consisting of seven wild species and twenty-four cultivated types were measured by using gas exchange techniques. Plants were grown in pots during 1971 and both in pots and field during 1972. Statistically significant differences were observed in the rates of photosynthesis among the various genotypes studied, the range of photosynthesis being from 15 mg $CO_2/dm^2/hr$ for Arachis pintoi, a wild species, to 37 mg $CO_2/dm^2/hr$ for florunner, a US variety. Florunner had the highest photosynthetic rates in each experiment although not significantly higher than several other genotypes. A. pusila and A. monticola gave almost as high photosynthetic rates (27.6 and 27.8 mg CO_2/dm^2hr, respectively) as most of the cultivated species.

The average chlorophyll content of the leaves of various genotypes varied from 6.13 mg/g of dry matter for a cultivated genotype from Volta to 4.04 mg/g for both A. pintoi and A. glabrata. Most of the genotypes had significantly higher chlorophyll content for the 1971 pot experiment and 1972 field experiment than A. pintoi and A. glabrata. Florunner and florigiant, both US varieties, had significantly higher % nitrogen in the leaves as compared with all other genotypes for the 1971 experiment. The stomatal intensity per unit leaf area (upper and lower surfaces combined) varied from 297 mm^{-2} for florunner to 809 mm^{-2} for A. villosulicarpus. The average number of stomates for the cultivated types and the wild species were 345 and 420 mm^{-2}, respectively. Specific leaf area ranged from 1.27 to 2.52 dm^2/g. Wild genotypes had comparatively higher specific leaf area than the cultivated types except A. glabrata which had the lowest specific leaf area of 1.27 dm^2/g.

Photosynthetic rates were positively correlated with the chlorophyll content of the leaves in the 1971 pot experiment ($r=+0.42$) and 1972 field experiment ($r=+0.43$) but no statistically significant correlation was found for 1972 pot experiment. A significant positive correlation was observed between % nitrogen content of leaves and rate of photosynthesis for the pot experiments only. Stomatal intensity and photosynthesis were negatively correlated in 1972. Specific leaf area was negatively correlated with photosynthesis in 1971 but not in 1972.

PREVALENCE OF ASPERGILLUS FLAVUS IN PEANUT SOILS

by

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ABSTRACT

Studies designed to measure the survival of Aspergillus flavus propagules in peanut soils have revealed that cropping practices, tillage practices, and climatic conditions influence the incidence of viable units. The incidence of A. flavus was highest in the upper soil levels and infrequently detected below the tillage depth. Soils with higher levels of organic matter contained a higher incidence of total fungi and generally a lower percentage of A. flavus. Soil pH appeared to exert little influence on the isolation frequency of A. flavus. The highest levels of A. flavus propagules occurred following peanut crop harvest and again in late winter. These isolates produced more aflatoxin B_1 than did isolates taken at other times of the year. New land with soil previously free of A. flavus became contaminated during the latter part of the second year peanuts were grown. Aspergillus flavus incidence remained high in soil from fields on which peanuts had been grown continuously. Continuous cropping of peanuts did not select for high aflatoxin producing isolates. Corn or peanut residues left undisturbed on the soil resulted in a buildup of A. flavus populations. Soils from fields with a winter cover crop planted in the crop residues or in rotation with grasses or sorghum contained fewer A. flavus propagules; however, some of these isolates were high aflatoxin producers.

This investigation was supported by Agricultural Research Service, U.S. Department of Agriculture, Grant No. 12-14-100 9943(34), Texas Agricultural Experiment Station and Market Quality Research Group, Southern Region, U.S. Department of Agriculture.

CONDITIONS RELATED TO AFLATOXIN CONTAMINATION IN THE FIELD

by

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ABSTRACT

Samples of peanuts were collected in the field prior to harvest, immediately after harvest and from farmers stock storage warehouses at widely separated points in Southwest Georgia, Alabama and North Florida. These were analyzed for aflatoxin contamination. Some peanuts showing no visible hull damage (mechanical or

insect) were analyzed just as they came from the ground, and the kernels were found to contain high levels of aflatoxin, though no mold was apparent, even when examined by microscope. Extremely dry weather during the latter part of the growing season allowed the peanuts to dry to the moisture level which has been shown to be conducive to aflatoxin production in the field. Some peanuts were dug, inverted and sprayed immediately with fungicides. Low levels of aflatoxin were present at digging and these increased with exposure in the windrow even though they were sprayed with fungicides.

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EFFECTIVENESS OF PROPIONIC ACID AND "MOLDSTAT" AS FUNGICIDES DURING PEANUT STORAGE

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ABSTRACT

The molding of farmers stock peanuts in storage is a problem in certain locations because of inadequate storage facilities. An experiment was designed to test the effectiveness of propionic acid and "Moldstat" in preventing molding of farmers stock peanuts stored in facilities that do not provide adequate protection from rainy weather. Only the highest concentration of the propionic acid prevented aflatoxin build-up. "Moldstat" provided little or no protection from aflatoxin contamination at any concentration. Results of flavor evaluations on samples from the treatments showed that the peanuts treated with propionic acid were poor in flavor while those treated with "Moldstat" had about the same flavor as the controls. The free fatty acids were significantly lower on the treated samples than on the controls.

MACHINE FOR DIRECT HARVESTING OF VIRGINIA-TYPE PEANUTS

by
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Abstract

Field studies were begun in 1970 on an experimental machine to lift the peanut plants from the soil and remove the fruit from the plants in a once-over operation. The picking principle employed by the "direct harvesting" machine requires that the naturally growing fruit-plant orientation be maintained.

The direct harvesting machine consists of digging, picking, and cleaning sections. The digger components lift the plants from the soil and elevate them to the picking section. An overhead conveyor moves the plants over a vibrating rack. The fruit hang below the rack and are removed by notched metal strips attached to rotating drums. The fruit fall onto conveying components which transport and elevate the fruit through the cleaning components and into a container. The cleaning com-

ponents include a paddle section to remove long plant branches, a suction fan to remove leaflets, fine roots, etc., and a stemming saw section to remove the pegs from pods.

Operating at a ground speed of approximately 1.5 mph the picking efficiency for the machine ranged from 90 to 96 percent. The percentage of loose shelled kernels was nil. Pod damage was approximately 5 percent as compared to about 25 percent for conventional combines. Other potential advantages of a direct harvesting system are discussed.

OBJECTIVE DETERMINATION OF OPTIMUM HARVEST MATURITY

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ABSTRACT

In this paper two quick methods for measuring maturity are evaluated in relation to yield and quality of peanuts. Light transmittance (at 450 or 460 mμ) is determined for a methanol extract of fresh, green whole peanuts in one method. The other measures the electrical impedance ratio (5/500,000 Hertz) of fresh, green whole peanuts. Using Spanish and Virginia peanuts from several weekly harvests, maturity measurements by these new methods are compared with such other parameters as flavor, optical density of oil, and yield of sound mature kernels.

STUDIES ON THE BIOLOGY AND CONTROL OF CYLINDROCLADIUM BLACK ROT (CBR) OF PEANUT

by

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ABSTRACT

Cylindrocladium black rot of peanut (CBR) caused by C. crotalariae (Loos) Bell & Sobers was identified in all 12 major peanut growing counties in eastern North Carolina during the 1972 season. Red perithecia were found on intact stems, pegs and pods on and under the soil surface beginning in early September. In mid-September an ca. four-acre soybean field was found with 15-20% of the plants bearing red perithecia on their stems near the soil surface. Cultures of C. crotalariae isolated from peanut or soybean were tested and found to be pathogenic on both hosts and formed perithecia profusely on necrotic tissues kept under moist conditions. Forty-two single spore isolates (originating from fourteen infested fields in widely scattered areas of N. C.) tested for pathogenecity on the cultivar Florigiant showed significant variability in aggressiveness between isolates.

Studies on the role of various propagules in spread and survival of the fungus indicate that both conidia and ascospores are capable of causing infection but have limited viability due to a high susceptibility to dessication (< 5 min at 80% R. H.). Mature microsclerotia, however, will withstand long periods of drying in the soil or dessication in culture. Plant debris larger in size than microsclerotia have been trapped long distances downwind from peanut combines. The fungus can also spread from plant to plant in field soils.

All legumes tested were susceptible to the fungus. CBR was found to cause a severe root rot on McNair 12 tobacco and to maintain a moderate disease potential in soils planted to tobacco. Cotton was less severely damaged by CBR but the fungus could be isolated from tap roots and persisted at high levels in soil planted to cotton. Corn was not found to be susceptible and did not increase the disease potential in soil. A preliminary evaluation of 50 peanut cultivars or introductions indicated that although all were susceptible, plants varied considerably in resistance to CBR.

No effective fungicides have been identified in extensive screening in CBR infested soil in greenhouse tests. Sodium azide has been effective in disease control in these tests when used at 40 lb Ai per acre.

PEANUT POD ROT DISEASE CONTROL

by
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ABSTRACT

Forty-five different chemicals or chemical combinations were evaluated on 28 treated plots on each of two farms to determine their effectiveness against the peanut pod rot disease. Certain chemical treatments were applied two weeks pre-plant, at time of planting, and at early pegging. Data was collected on plant growth response, fungi associated with rotted pods, percent pod rot disease, peanut quality, yield and value per acre. The best treatment on Farm A, Terraclor + Terrazole, curtailed pod rot from 30.0% to 8.3% and the value per acre increased by $108.00 over the untreated control. On Farm B the best treatment, Sodium Azide + Furadan, curtailed pod rot from 20.6% to 0.5% and value per acre increased by $111.00 over the untreated control. The fungus flora differed on each farm. Several chemical treatments reduced the frequency of isolation of certain pathogenic fungi.

TOMATO SPOTTED WILT VIRUS DISEASE OF PEANUTS

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In 1971, a virus-like disease of Spanish peanut was observed in one Texas county. The affected plants were severely stunted, the leaves chlorotic and frequently displayed mosaic and ring spot patterns. Peanut stunt and peanut mottle virus diseases were systematically ruled out. The virus has been mechanically transmitted to tobacco, pepper, petunia, nasturium, periwinkle, tomato, Datura, and peanut. Virus-like particles contained within a membrane have been observed in electron micrographs of diseased peanut and tobacco tissue. The membrane enveloped virus-like particles and the symptoms on the above mentioned hosts were similar to and compared favorably with tomato spotted wilt virus (TSWV). TSWV, which is thrip transmitted, has been reported previously causing substantial damage to peanuts in Australia, Brazil, and South Africa.

PEANUT BLIGHT CAUSED BY A SCLEROTINIA SPECIES

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ABSTRACT

A Sclerotinia sp. similar to that described as causing a peanut foliage disease in Japan, China, Australia and Argentina has been found and isolated from diseased peanut plants in Virginia and North Carolina. We called this peanut disease, apparently new to the United States, "Sclerotinia blight." It was widespread in both states in 1971 and 1972. Disease incidence ranged from less than 1% in some fields to more than 50% in others. Some plants exhibited single or multiple branch infections while on other plants all branches were infected. Infected branches wilt, leaves become chlorotic, turn brown and the branch generally dies. Sclerotinia blight symptoms resemble those normally associated with Botrytis blight (Botrytis cinerea), however, conidia and conidiophores typical of Botrytis infections were not observed on diseased tissue. Sclerotinia blight is characterized by profuse sclerotia production on all infected plant parts including branches, roots, pegs and pods. The sclerotia are smaller than those produced by B. cinerea. Under severe disease conditions peanut yields are greatly reduced. Yield reductions are enhanced by the rotting of pegs and pods due to colonization by the Sclerotinia sp. In greenhouse pathogenicity tests, typical field symptoms resulted when peanut plants were inoculated with cultures of Sclerotinia, presumably S. sclerotiorum, isolated from field infection sites. Six months following harvest Sclerotinia was isolated at a frequency of 0.2% and 2.4% from seed from sound and discolored pods, respectively. Sclerotinia was not isolated from shells of sound or discolored pods. The fungal populations were much greater in discolored pods than in sound pods. In fact, only 1% of the seed from sound pods were colonized but 21% of seed from discolored pods were infested.

DETERMINATION OF LINEAR REGRESSION EQUATIONS TO ESTIMATE YIELD LOSSES TO WHITE MOLD IN PEANUT FIELDS

by
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ABSTRACT

Evaluations of peanut yield losses to white mold (Sclerotium rolfsii) were conducted with Florunner variety during the 1971 and 1972 seasons at the Wiregrass Substation, Headland, Ala. The study was superimposed on 4-row plots 30 feet long, which were part of other experiments. Peanut plants killed by S. rolfsii were counted in the two center rows of each plot in September just prior to harvest. Only dead plants on which white mycelial mats or sclerotia were evident were included in the counts. Such plants were considered directly or indirectly affected by S. rolfsii, and their ultimate cause of death was assumed to be from this organism. Yields were taken from the two center rows of each plot and were expressed in pounds of dry peanuts per acre. Results from 1971 using data from 28 plots revealed that a statistically significant ($p<0.01$) linear correlation coefficient ($r=-0.81$) existed between yield and the number of plants killed by S. rolfsii. The linear regression equation relating the two variables indicated a yield loss of approximately 35 lbs/acre for every peanut plant killed by the pathogen in 100 feet of row. More extensive studies performed in 1972 with 208 plots also revealed a statistically significant correlation coefficient ($r=-0.69$) existing between yield and plants killed by white mold. The linear regression equation for the 1972 data indicated a yield loss of approximately 36 lbs/acre for every plant killed by the pathogen in 100 feet of row. Our results indicate

that under Alabama conditions S. rolfsii causes serious losses in yield even in fields with relatively low (1 plant killed/100 feet row) densities of the pathogen. This conclusion assumes that the distribution and population density of this pathogen in larger fields is equivalent to that in the small plots of this study.

CHOICE OF LEAFSPOT SPRAY EQUIPMENT CAN SIGNIFICANTLY AFFECT PEANUT LOSSES FROM WHITE MOLD

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ABSTRACT

During 1972 Florunner peanut plants that received fungicide applications by air, span and conventional ground sprayers were examined for white mold (Sclerotium rolfsii) infestation, Cercospora leafspot and yield. The study was conducted using the fungicides Benlate, Bravo and Topsin M sprayed at biweekly intervals through the last 100 days of the season. Each treatment was represented by five plots, each 150 feet long. All plots were evaluated for diseased plants just prior to harvest (157 days after planting). Statistical evaluation of results showed that method of application did not significantly affect Cercospora infection or yield. Span-sprayed plots showed significantly higher ($p<0.05$) white mold (64%) than conventionally-sprayed plots. Air-sprayed plots contained 37% more white mold-infected plants than conventionally-sprayed plots; this difference was not significant. Differences between span-sprayed and air-sprayed plots were not significant. A possible explanation for the results on white mold incidence may be that degree of penetration of active materials through the foliage to the soil surface differs between spray systems.

NEW NATURALLY OCCURRING COMPOUNDS FROM PEANUTS

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ABSTRACT

Three compounds (I, II and III), which gave Dragendorff positive reactions, were isolated from the basic extracts of peanut plants. Analysis of the extracts by combined gas liquid chromatography-mass spectrometry revealed that Compounds I, II and III had molecular weights of 206, 390 and 355 respectively. Compounds II and III are present in both raw peanuts and peanut vines whereas Compound I was found only in the vine. Further analysis of partially purified preparations of Compound I showed it to have an empirical formula of $C_8H_{18}N_2O_4$. Analysis of the steam distillate of peanut vines by combined gas liquid chromatography-mass spectrometry revealed the presence of 1-pentene-3-ol, 1-hexanol, linalool, α-terpineol, and geraniol. None have been previously identified in peanut plants. Linalool, α-terpineol, and geraniol are terpene alcohols that are common to a wide variety of plants. Preliminary evidence suggested that one of the unidentified steam volatile compounds isolated was a nitrogen containing alcohol.

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Partial Hydrolysis of Proteins in Peanut Meals by Endogenous Proteolytic Systems

by

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ABSTRACT

An increasing world population with greater awareness of nutritional needs is creating a greater demand for cheap sources of protein for staple and supplement foods. In certain products, defatted peanut meals can be added directly to existing formulae. However, in other products, such as beverages, peanut protein isolates having desirable solubility properties must be prepared.

When defatted peanut meals were homogenized with water or dilute buffer and the resulting suspension refrigerated for several hours and then centrifuged, the milky extract contained a substantial amount of protein, which may be spray-dried or added directly to naturally opaque beverages. However, this extract is unsuitable as a soft drink additive since such products are traditionally clear. Evidence was found for a neutral proteolytic enzyme system in defatted peanut meals that catalyzes the hydrolysis of casein (milk protein) and peanut proteins. Autolysates were prepared by incubating buffer extracts of the meals at different temperatures and pHs for varying times. Extracts incubated at 37° C., pH 7.2, for approximately 12 hours became much clearer and remained so when refrigerated. Such hydrolysates may be suitable as soft drink additives or other types of food applications. This paper will describe the preparation of peanut protein isolates and hydrolysates for such uses.

COMPARISON OF OIL STORAGE STABILITY OF PEANUT OILS PREPARED BY EXTRACTION WITH VARIOUS SOLVENTS AND COLD PRESSING

by
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ABSTRACT

Storage stability (oven stability, 60°C), oleate/linoleate (O/L) ratios, initial peroxide values and free fatty acid and iodine numbers were determined for 1971 and 1972 crop peanuts. Peanuts used had O/L ratios from 1.1 to 1.9. They represented 10 varieties and were grown at 3 Southeastern and 7 Texas locations, but the main emphasis was on 5 varieties grown at 2 Texas locations. Cold-pressing within polyethylene bags rather than pressing with direct contact between the metallic ram and nuts resulted in extended storage stability which approached the solvent extracted values. Based on the averages for varieties tested, relative storage stabilities were chloroform-methanol (3:1) $\gg$ cyclohexane $\cong$ acetone $\cong$ bag-pressed $>$ ether $>$ cold pressed oil for 1971. For 1972 crops, the order was chloroform-methanol $>$ cyclohexane $\cong$ ether $>$ acetone $>$ bag-pressed $>$ cold-pressed, although bag-pressed ranked ahead of acetone at the second location. In 1971 the correlation between the storage stability of cold pressed oils and O/L ratios was 0.60. Use of peroxide free ether and testing within a short time after sample preparation gave best results (ether: 0.91 and 0.82; cyclohexane: 0.86 and 0.74). Generally poor correlations were found between storage stability, peroxide values, free fatty acid and iodine numbers and the O/L ratios of solvent-extracted oils. The O/L ratios of the solvent-extracted and cold-pressed oil samples were quite similar, but the observed differences in oil stabilities may result from differences in degree of extraction of one or more minor lipid components. Interaction with residual traces of solvent or solvent impurities also may be significant.

COMPARISON OF OIL STORAGE STABILITY OF PEANUT OILS PREPARED BY EXTRACTION WITH VARIOUS SOLVENTS AND COLD PRESSING

by
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ABSTRACT AND PAPER

ABSTRACT

Storage stability (oven stability, 60°C), oleate/linoleate (O/L) ratios, initial peroxide values, free fatty acid and iodine numbers were determined for 1971 and 1972 crop peanuts. Peanuts used had O/L ratios from 1.1 to 2.2. They represented 10 standard varieties which were grown at several Southeastern and Southwestern locations. Cold pressing within polyethylene bags rather than pressing with direct contact between the metallic ram and nuts resulted in extended storage stability which approximated the solvent extracted values. Based on the averages for all varieties tested, relative storage stabilities were chloroform-methanol (3:1)$\gg$cyclohexane~ether~bag pressed$>$acetone$>$cold pressed oil for 1971. For 1972 crops, the order was chloroform-methanol$>$cyclohexane~ether$>$acetone$>$bag pressed$>$cold pressed. In 1971 the correlation between the storage stability of cyclohexane extracted oils and O/L ratios was 0.34, whereas the corresponding value for cold pressed oils was 0.67. Generally low correlations were found between storage stability, peroxide values, free fatty acid and iodine numbers and the O/L ratios of oils extracted with other solvents. The O/L ratios found between solvent extracted and cold pressed oil samples were similar, but the differences in oil stabilities may indicate differences in the extent to which one or more minor lipid components are extracted.

QUALITY OF PEANUTS FROM LEAFSPOT CONTROL FIELD TESTS

by
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ABSTRACT

Varietal and seasonal variations in the processing characteristics of shelled edible peanuts are a recognized problem in quality control of peanut products at consumer levels. To determine whether field applications of agricultural chemicals may influence such variations, processing and sensory quality tests of salted peanuts were conducted over three seasons using four varieties of peanuts which had been variously treated for control of Cercospora leafspot and southern blight (Sclerotium rolfsii) diseases of vines and stems. Standard applications of herbicides and insecticides, as well as various chemical or carrier adjuncts for the fungicides, a chemical growth regulator, and spaced intervals of harvest were also included in the tests. Significant though frequently minor variations in processing and sensory quality were associated with certain of the chemical agents and cultural practices, but all such relationships were influenced by seasonal and varietal effects.

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SUPPRESSION OF THE TWO-SPOTTED SPIDER MITE ON PEANUTS

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ABSTRACT

The two-spotted spider mite Tetranychus urticae Koch is a major pest of peanuts in North Carolina. Mite populations increase during hot, dry weather and are especially destructive in August and September. Currently there are no miticides registered for use on peanuts. The potential losses to peanuts in the absence of a miticide prompted an investigation of the miticidal and ovicidal properties of fungicides and insecticides currently registered for peanuts as well as the evaluation of experimental chemicals for control of the two-spotted spider mite.

Plictran, Galecron, Trithion, Azodrin, Carzol, and Omite provided good suppression of the spider mite in field tests.

Laboratory studies, using a five second dip technique, indicated Plictran, Galecron, and Trithion had good ovicidal properties. The fungicides Du-Ter and Benlate exhibited a low level of ovicidal action. Du-Ter recommended for leaf spot control gave good control of mites in the laboratory tests and suppressed mite buildup in greenhouse experiments.

There was no evidence of high resistance of commercial varieties of peanuts to the two-spotted spider mite; however, mite damage increased at a higher rate on some peanut varieties.

A Method for Screening Peanut Cultivars for Resistance to the Lesser Cornstalk Borer

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A greenhouse screening technique was developed which permited the rapid, objective screening of a large number of peanut cultivars for resistance to the lesser cornstalk borer while allowing for a normal growth rate of both plant and insect.

Using a survival rating, the best indicator of insect response, 41 cultivars were found to be very susceptable to the lesser cornstalk borer. Thirty-six cultivars were selected as "resistant" and 45 as "promising candidates".

Effects of Foliage Loss on Yield and Grade in Starr Peanuts in Texas

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ABSTRACT

Starr peanuts were subjected to defoliation rates of 0, 25, 75 and 100% on a weekly basis beginning at 35 days old until 10 days prior to harvest. This was done in an attempt to simulate defoliation by foliage feeding lepidopterons insects. Results indicate that Starr peanuts can withstand varying amounts of defoliation without yield or quality loss depending upon their age. Regression analysis reveals definite susceptibility curves and significant prediction equations.

PEST MANAGEMENT FOR PEANUT INSECTS IN TEXAS

by

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ABSTRACT

The Texas Agricultural Extension Service will initiate a pilot peanut pest management program in Comanche County, Texas, during the 1973 crop season. The program is a grower program which has received Federal funds. Field scouts will assess the development of pest populations on a weekly basis. Insect, plant disease, nematode and weed pest data will be collected for the development of a management system. A computer program has been developed to handle the data for systems analysis. A county entomologist located in the County Extension office will be responsible for grower consultation and field operations. Producers will keep a detail record of production practices, rainfall and yields for economic analysis of the program. The Texas Peanut Producers Board is collecting special producer funds which will partially pay for scouting costs.

PEST MANAGEMENT SYSTEMS FOR INSECTS OF PEANUTS IN VIRGINIA

by

J. C. Smith
Tidewater Research and Continuing Education Center
Virginia Polytechnic Institute and State University
Holland, Va.

ABSTRACT

Preplant applications of carbofuran as both in-furrow treatments and incorporated band treatments have been generally successful in control of tobacco thrips, potato leafhoppers, and southern corn rootworms in Virginia. Pegging-time applications of several soil insecticides show promise of control of both leafhoppers and rootworms from a single application, thus reducing the need for multiple foliar applications. Reduced insecticide usage should allow maximum utilization of beneficial arthropods and prevent premature incidence of insecticide resistance.

BREEDING PEANUTS FOR RESISTANCE TO ASPERGILLUS FLAVUS (L)

by
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Plant Science Research Division
Southern Region
Agricultural Research Service
U.S. Department of Agriculture
in cooperation with the Alabama Agricultural
Experiment Station, Auburn University,
Auburn, Alabama 36830

ABSTRACT

Two peanut accessions averaged less than 5% seed infection to toxin-producing strains of Aspergillus flavus L. following laboratory inoculation of samples at optimum seed maturity and incubating under conditions highly conducive to fungal development. Comparable checks of two susceptible accessions averaged 89% and 91% seed infection, and Florunner, Goldin I and Argentine varieties averaged 22%, 23% and 38%, respectively. Three maturity separations of the resistant accessions indicated that sound mature seed were less susceptible to A. flavus than immature and overmature seed. Seed from the two resistant accessions and a susceptible check harvested at four 2-week intervals beginning near optimum maturity revealed that delayed harvest increased the incidence of infection, but the resistant selections were considerably more tolerant to delayed harvest than the susceptible check.

SCREENING FOR TOXIN-PRODUCING FUNGI

by
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USDA, ARS, Dawson, Georgia

ABSTRACT

A practical method of screening fungi for toxin-producing potential uses day-old cockerels dosed orally with extracts of mold cultures and rations mixed with extracted culture residues fed ad libitum. Advantages of the method are worker safety, simplicity, and economy. The method detected mycotoxin-producing fungi from several genera commonly found contaminating peanuts.

COMPARISON OF ASPERGILLUS FLAVUS TOLERANT AND SUCEPTIBLE PEANUT LINES I. LIGHT MICROSCOPE INVESTIGATION

by

Ruth Ann Taber, R. E. Pettit, C. R. Benedict, J. W. Dieckert and D. L. Ketring
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ABSTRACT

Peanut seeds representing peanut lines selected by Dr. Aubrey Mixon for varying degrees of tolerance to Aspergillus flavus Link were compared in an effort to determine why some varieties exhibited more resistance than others. The seed coats, in particular, were sectioned and examined under light microscopy to determine whether there were any morphological differences between varieties that might account for such differences. The seed coat of peanut differs from that of other legumes including a difference in the definition of the light line, presence of osteosclereids and Malpighian cells. Peanut plant introductions differed from each other in several respects including the size and shape of the hila, amount of cuticular wax secretion, thickness of the palisade-like layers and size and

arrangement of cells within these layers. The hila of the most tolerant line were small and closed. The seeds of susceptible lines had longer, more open hila. A. flavus has a definite affinity for the open hilar area as opposed to other parts of the seed coat. Breaks in the seed coats of both tolerant and susceptible lines allow the fungus to establish colonies at such points. Cotyledonary material of both tolerant and susceptible lines served as an excellent nutrient source for A. flavus. It appears that a number of factors may influence varietal resistance in the peanut. This investigation was supported by U.S. Department of Agriculture Co-operative Agreement No. PSDR 11,220 and the Texas Agricultural Experiment Station.

COMPARISON OF ASPERGILLUS FLAVUS TOLERANT AND SUSCEPTIBLE LINES II. ELECTRONMICROSCOPY.

by
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College Station, Texas
Darold L. Ketring
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Texas A&M University
College Station, Texas

ABSTRACT

The work of Aubrey C. Mixon indicates that certain varieties of peanuts are more resistant than other varieties to invasion by aflatoxin producing strains of Aspergillus flavus. His results gave some indication that the resistance might be related to the seed coat. One possibility is that the seed coat serves as a structural barrier to the hyphae of the fungus. Therefore, the resistance of the various varieties of peanuts might be related to genetically determined variations in the structure of the seed coat. As a first step in testing this hypothesis we are studying the ultrastructure of the seed coat of mature peanut seeds from a resistant strain, P.I.337394 and a susceptible strain, P.I.343326. The observations were made on thin section of epoxy embedded samples by transmission electron microscopy. The ultrastructure of the seed coats of the resistant and susceptible strains will be described and the possible relationship of that ultrastructure to resistance to infection by A. flavus will be discussed.

*This work is supported by the Texas Agricultural Experiment Station and U.S.D.A. Contract #P.S.R.D.-11,220.

COMPARISON OF ASPERGILLUS FLAVUS TOLERANT AND SUSCEPTIBLE PEANUT LINES. III. PHYSIOLOGICAL INVESTIGATIONS

by

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College Station, Texas 77843

ABSTRACT

Experiments were designed to investigate physiological processes in seeds of peanut lines which are tolerant or susceptible to Aspergillus flavus invasion. The rate of H_2O uptake by intact peanut seeds during the imbibition phase of germination is one of the most striking differences in these seeds. The rate of H_2O uptake (mg H_2O/g dry wt/3 hrs) for PI 337409, Florunner, and PI 343360 is 318, 370, and 535, respectively. The order for the imbibitional H_2O uptake by these seeds is the same order established by Dr. Aubrey Mixon for tolerance or susceptibility to invasion by A. flavus. The susceptible seeds exhibit a greater rate of H_2O uptake while a smaller rate of H_2O uptake is characteristic of the resistant seeds. When seedcoats were removed, the water uptake by all PI's was more rapid but differences similar to intact seeds were noted. However, removal of the seedcoats resulted in all PI seeds being equally susceptible to invasion by A. parasiticus, a species closely related to A. flavus. Thus, an inherent difference in internal seed structures or contents apparently did not determine tolerance to the fungus although it did affect water uptake. The hilum has been indicated as a site of water uptake in some hardcoated leguminous seeds. When water uptake comparisons were made between susceptible and tolerant PI's that had the hilum open or sealed, water uptake was similar between susceptible and tolerant PI's. However, final water uptake was still greater for the susceptible PI. This indicates the hilum may function as a region or valve which regulates the rate of H_2O uptake and that rapidly reaches moisture levels (when open) more conducive to mold growth in susceptible than in tolerant PI's. The inherent cotyledon structures and contents of the susceptible PI's that cause more rapid imbibitional H_2O uptake would tend to enhance water uptake through the hilum. Also, differences in seedcoat structure indicated in reports I and II may contribute to increased water uptake by susceptible PI's.

SEARCH FOR A PRACTICAL PROCEDURE FOR BREAKING DORMANCY OF SEED OF PEANUTS, ARACHIS HYPOGAEA L.

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U.S. Department of Agriculture, Beltsville, Maryland 20705

ABSTRACT

Treatment of peanut seed by coating them with a slurry consisting of the seed protectant thiram (bis [dimethylthiocarbamoyl] disulfide) and ethrel (2-chloroethylphosponic acid) was highly effective in inducing dormant seed of Virginia type peanuts to germinate promptly when applied to 1971 crop seed, when the seed were planted immediately after treatment or when they were dried after treatment and stored for as long as 2 months before planting. When a different formulation of ethrel was used in the slurry applied to 1972 crop seed, release of the seed from dormancy was less consistent. Ethrel at a concentration of 1×10^{-3} M in these mixtures had no apparent adverse effect on foliar or root development of 10-day old seedlings, on dry weight of above-ground parts of 24-day or 45-day-old seedlings, or on pod yield and market grade of two Virginia varieties grown under field conditions.

FLORUNNER SEED SIZING STUDIES

BY
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University of Florida, Institute of Food and Agricultural Sciences
Marianna, Florida

ABSTRACT

Seed sizing studies were conducted during the growing seasons of 1971, 1972, and 1973 at the Marianna Agricultural Research Center using Foundation Florunner seed. Data were collected on seed size distribution, germination, plant vigor, yield, and various grading factors.

In general the larger size seed produced the more favorable results. No significant differences were obtained in 1971 for any of the factors analyzed, but the largest size seed (riding a 21.5/64 x 3/4 - inch slotted screen) did yield 435 pounds per acre more than the smallest size (riding a 16/64 x 3/4 - inch slotted screen).

Seed for the 1972 study were sized on 3/4 - inch slotted grading screens into the following incremental classes: A) 21.5/64, B) 19/64, C) 17/64, D) 15/64, E) 13/64, F) check (all above a 15/64 - inch screen). Rate of plant emergence, final plant count, and plant size increased with increasing seed size. The 21.5/64 - inch seed size produced the greatest yield for two of the four harvest dates, and the smallest seed size gave the lowest yield at all harvests. The grading factors also favored the larger seed sizes. The size of seed planted in 1972 did not statistically (P=.05) influence the distribution of seed sizes obtained at harvest. The general trend was for the larger seed sizes to produce more large seed.

Available results for the 1973 study will also be present.

FIELD EVALUATIONS OF ALACHLOR/DINOSEB IN PEANUTS

by
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Monsanto Company, St. Louis, Missouri

ABSTRACT

Alachlor, 2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide, (Lasso®), as a surface applied preemergence residual herbicide, controls a broad spectrum of grass and broadleafed weeds, selectively in peanuts. Dinoseb, 2-sec-butyl-4, 6-dinitrophenol, (Premerge®), as a cracking or early postemergence contact herbicide, controls emerged seedling broadleafed weeds in peanuts. To determine the influence of combined alachlor/dinoseb application systems, field experiments were conducted in 1968 through 1972 by Monsanto technical personnel in eight peanut producing states. The objectives were to evaluate postemergence and piggyback applications of alachlor/dinoseb for improved and/or additive control of broadleafed and grass weeds. Secondly, to evaluate various rates of application timings of alachlor/dinoseb for crop injury symptoms, alone, or preceded by various preemergence or preplant incorporated herbicides.

Alachlor/dinoseb (1.5-4.0/1.0-3.0 lb./A.) applied at cracking to early postemergence gave fair to excellent control of crabgrass, fall panicum, goosegrass, johnsongrass, yellow nutsedge, pigweed, purslane, carpetweed, Florida pusley, morningglory, cocklebur, prickly sida, hophornbeam copperleaf, Florida beggarweed and sicklepod. Moreover, an improved top-kill of emerged weed species and an extended control period, as compared to dinoseb. Degree of weed control was influenced by (a) alachlor rate, (b) dinoseb rate with

associated air temperature response, (c) stage of emerged weeds at application date, (d) inherent tolerance of weed species and (e) rainfall prior to and following postemergence application.

The degree of peanut vigor reduction associated with postemergence treatments of alachlor/dinoseb was influenced by (a) increasing rates of alachlor/dinoseb, (b) increasing maturity of vegetative stage or peanuts at treatment and (c) presence of the preplant incorporated herebicide, particularly vernolate.

EFFECT OF SOIL CALCIUM ON PEANUT YIELDS AND GRADES

by
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Agronomy and Soils Department
Auburn University
Auburn, Alabama

ABSTRACT

The objective of this study was to determine by soil test calibration the level of calcium in the soil at which peanuts would not respond to any additional calcium. Fifty two calcium experiments were conducted on farmer's fields in the peanut growing area of Alabama. The critical level of soil calcium was determined to be 200 pounds per acre. Gypsum was used as a standard in making comparisions as to the availability of calcium from basic slag, Fairfield slag, Magi-Cal, and lime. Basic slag and Fairfield slag are unsatisfactory sources of calcium for peanuts when applied at blooming time. Magi-Cal is not a suitable source of calcium for peanuts. Lime applied after the land is turned and disked thoroughly into the soil surface and allowed to remain in the pegging zone is a suitable source of calcium.

YIELD AND COMPOSITION OF PEANUTS AS AFFECTED BY CALCIUM SOURCES

BY
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University of Florida, Institute of Food and Agricultural Sciences.
Quincy, Florida

ABSTRACT

Labor requirements for application of gypsum to peanuts has created an interest in use of foliar-applied calcium materials. Experiments were conducted for three years, 1970-72, to evaluate foliar-applied calcium compared to gypsum as well as a control. Rates and time of application were in accordance with manufacturers' recommendations. Peanut yields were not different among the treatments, including the control, in any of the three years. The failure to obtain a yield response to any calcium source in 1970 and 1971 was probably due to the level of soil calcium in the experimental soil being above minimum requirements for a response. In 1972, dry weather is believed to be the reason for a lack of yield differences. However, in 1972, gypsum was more effective than other calcium sources in increasing calcium levels of certain plant parts. Gypsum rates of 2000 pounds per acre resulted in higher calcium levels in the plants than rates of 500 pounds per acre.

THE EFFECT OF TIME OF KYLAR APPLICATION ON YIELD AND ASSOCIATED CHARACTERISTICS OF PEANUTS

by
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College of Agriculture
Athens, Georgia 30602

ABSTRACT

Peanuts were treated with 1 lb/AC of Kylar (succinic acid-2, 2-dimethyl-hydrazide) at various times during the growing season. In 1970, applications were made on "Starr" peanuts at 6, 8, 10, 12, and 14 weeks after planting. In 1971 and 1972 the same treatments, with the exception of the 14-week application were applied to "Tifspan" and "Florunner" varieties. In 1970 and 1972, an additional treatment was used; Kylar was applied as needed to keep plants shorter than 12-14 inches. Pod yields were not affected by Kylar, except that yields of "Tifspan" were increased by Kylar in 1971. Time of Kylar application had no significant effects on yield. There was a trend, however, toward higher yields for the application at 8 weeks after planting. When Kylar was applied at 8 weeks or less after planting, there were decreases in weight per pod and/or pod length. The decrease in weight per pod by early Kylar application appears to be associated with increases in pod number per plant. In the Spanish varieties, there appeared to be an increase in weight per pod caused by applying Kylar later than 8 weeks. Although there were no significant influences on SMK, changes in the kernel size distribution were noted. Early applications increased the percentage of small kernels, while the late applications increased the percentage of large kernels. Kylar residue carry-over greater than 5 ppm was found in seeds from the 12 week and the "as needed" treatments of 1972. The residue carry-over tended to reduce embryo weight and radicle length. Time of Kylar application, seed size, and position of the seed in the pod appeared to have little effect on percent germination and/or rate of respiration.

RESPONSE OF PEANUTS TO INOCULATION WITH NITROGEN-FIXING BACTERIA

by
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University of Florida Institute of Food and Agricultural Sciences
Bronson, Florida
E. B. Whitty
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University of Florida Institute of Food and Agricultural Sciences
Gainesville, Florida

ABSTRACT

Chlorotic plants and reduced yields have resulted from peanuts planted on recently-cleared sandy soils in Florida. Applications of minor elements did not correct the condition. Peanuts with chlorosis had abundant nodules, but generally the nodules were inactive as evidenced by dry or green interiors. Healthy plants often had fewer nodules, but the interiors were usually moist and had a red or pink color.

After greenhouse trials showed that either inoculation with Rhizobium bacteria or applying nitrogen fertilizer would prevent the chlorosis, field tests with an inoculant were established on one of the affected farms. Granular peanut inoculant was applied with a granular applicator in the planter furrow at the rate of five pounds per acre. Untreated checks were left in the field for comparison. A fumigant nematicide was used with and without the inoculant to determine if the nitrogen-fixing bacteria would be affected by the fumigant.

About eight weeks after planting, the vines in the inoculated area were green, while those in the uninoculated rows were yellow except for patches of healthy plants that were evidently due to previous growth of native legumes maintaining an adequate level of Rhizobium bacteria in the soil. Also poor distribution of the inoculant accounted for some chlorotic plants in the inoculated area. Fumigation had no visible effect on nodulation. This difference was maintained until harvest, when plants in the inoculated area yielded 3400 pounds of nuts per acre compared to 2729 pounds per acre on the entire uninoculated area. Since the uninoculated area contained patches of green peanut vines, samples containing only yellow plants were harvested by hand and yields were about 1700 pounds of nuts per acre. Analyses of the vines showed that the healthy green plants contained more nitrogen than the chlorotic plants.

Trials were also conducted on soils that had grown peanuts in the preceding three years. There were no visible effects on the vines and yields were almost identical from inoculated and noninoculated plots.

DIFFERENT METHODS OF APPLYING SOIL FUMIGANTS ON PEANUT FOR NEMATODE CONTROL

D. W. Dickson and R. A. Kinloch

ABSTRACT

The peanut root-knot nematode, Meloidogyne arenaria, is one of the major pests of of peanut in Florida. One chisel per row applications of DBCP (1,2-Dibromo-3-chloropropane) have been used as the standard method of control. We compared one chisel per row with 2 chisels per row applications of DBCP. The same amounts of DBCP per row was applied whether using one chisel or two. Average yield data from 2 tests conducted the past 2 years showed an increase of 412 lb/Acre when DBCP was applied with two chisels per row as compared with applications made with one chisel.

Department of Entomology and Nematology
University of Florida, Gainesville, Florida 32601

RESULTS OF A LABORATORY METHOD FOR MEASURING FUNGICIDAL TOXICITY TO SOIL PATHOGENS

by
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L. O. Roth, Professor
Department of Agricultural Engineering
Oklahoma State University
Stillwater, Oklahoma 74074

ABSTRACT

A laboratory method using nutrient-ammended field soil as a growth medium was developed to aid in measuring the effectiveness of soil fungicides against certain soil pathogens. The soil medium was treated with wettable and granular fungicides for determining preventive and eradicative effectiveness. In the former, fungicides were applied 48 hrs prior to fungal infestation, while in the latter, the soil medium was infested with the fungus and allowed to develop for 48 hrs before fungicidal treatment. Growth measurements were recorded 72 hrs later. Terraclor Super X (10-2.5G) and Terraclor 75W at the rates of 3.75 lbs ai per acre were evaluated against Sclerotium rolfsii and species of Rhizoctonia, Fusarium, and Sclerotinia. Granular treatments were applied with a hand shaker. Spray treatments were applied in water at 30 psi, at the rate of approximately 40 gallons per acre utilizing a variable speed conveyer system.

In the preventive method, Terraclor Super X was completely effective against the four fungi whereas Terraclor 75W was 100, 95.1, 100, and 37.7% effective against S. rolfsii, and species of Rhizoctonia, Sclerotinia and Fusarium, respectively.

In the eradicative method, Terraclor Super X was 100, 98.3, 100, and 90.9% effective in stopping growth of S. rolfsii, and species of Rhizoctonia, Sclerotinia and Fusarium, respectively. Terraclor 75W was 94.8, 49.9, 100, and 25.6% effective in stopping growth of the fungi as previously listed. In general, Terraclor Super X was more effective against the four fungi than Terraclor 75W. Combining the preventive and eradicative performance against the four organisms, Terraclor Super X and Terraclor 75W were 98.7 and 75.4% effective, respectively.

The preliminary data presented were obtained in approximately 2 weeks that might otherwise have required a growing season in the field. Ineffective materials and rates can be quickly eliminated from further testing. As a result, more time and space can be devoted to research with promising fungicides.

Marketing Procedures & Economics Discussion Group

by
Astor Perry, Discussion Leader
Extension Peanut Specialist
North Carolina State University
Raleigh, North Carolina 27607

The main topic of this discussion group was the three administrative proposals as introduced by Secretary of Agriculture Butz and their effect on peanut marketing this fall. It was the general feeling of the panel that the three proposals would: 1- be very costly to producers in that the $15 grading charge would lower the support price by this much on every ton marketed and that the $50/ton deduction on all segregation 3 peanuts would unduly penalize producers as there is no easy way for producers to prevent segregation 3 peanuts from occurring; 2- lower the quality of peanuts used in manufacturing products as the number 2 "bail-out" provision would force shellers to sell low grade peanuts which heretofore had been sold to CCC for crushing or export; 3- cause chaotic marketing conditions especially in the Virginia-Carolina area since the already acute shortage of storage would of necessity become worse since the No. 2 program would no longer be effective and shellers would no longer offer storage for CCC peanuts.

There was also a brief discussion on new legislation for peanuts. Many proposals had been made to USDA, and while the grower and manufacturing interests had agreed upon certain principles, the USDA did not necessarily agree with any of them. At the present time USDA is studying several proposals. Major changes may be some time away.

The following members of the discussion panel gave brief statements and answered questions from the audience on the following subjects:

1- Effect of the three administrative proposals on the marketing of the 1973 crop - J. E. Mobly, President, Alabama Peanut Producers.
2- National Peanut Council Promotional Program for 1973-1974. Wayne Eaves, Chairman, National Peanut Council Board.
3- National Export Promotional Programs for Peanuts - Bill Birdsong, Birdsong Storage Company.
4- Peanut Administrative Committee Program for 1973. Bob Pender, Chairman, Peanut Administrative Committee.
5- Legislative Proposals - Russell Schools, Executive Secretary, Virginia Peanut Growers Association.
6- The role of peanut grower Co-op's in making price support effective. Joe S. Sugg, Executive Secretary, North Carolina Peanut Growers Association.
7- Marketing seed peanuts - Bob Pender, Chairman, Peanut Administrative Committee.

NATIONAL PEANUT PROMOTION DISCUSSION GROUP

John L. Currier, Leader

President, National Peanut Council
McLean, Virginia

The discussion on national peanut promotion was opened with the objectives of the national peanut promotion outlined by Leader John Currier.

Mr. Currier then presented William Flanagan, Executive Secretary of the Oklahoma Peanut Commission, who is currently serving as Chairman of the National Peanut Council's Promotion Committee, who went into the overall national promotion program for 1973 and a review of the proposed plans for 1974.

John Currier and Bill Flanagan followed the general discussion with a more detailed color slide presentation and a film report on the program, as carried out by Smith Bucklin in 1973.

Following this presentation the discussion from the floor centered around:

1. The need to measure the effectiveness of the national promotion program.
2. The need for and how to increase the availability of funds for an overall national promotion program.

1973 APREA Meeting

Discussion Session 2, Wednesday, July 18, Subject,

PRODUCTION TECHNOLOGY

This session, chaired by K. H. Garren, addressed itself to two topics:

1. What is the future of pesticides and other chemicals in peanut production?

The chairman introduced the topic by noting some great changes along these lines occurring since World War II. Briefly these were: The advent of organic fungicides and insecticides. The development of systemic fungicides and insecticides. The widespread recognition of the need for nematode control. The introudction of and burgeoning use of herbicides. The increased awareness of the potentiality represented in the terms "biological control."

The chairman then introduced three men who spoke briefly on specific types of pesticides; their role in peanut production; and the sometimes delicate balance between the need for their use and the need to contribute to the decrease in environmental pollution. It was their unanimous opinion that regulations for approval of pesticides are

so stringent that a peanut producer need fear neither damage to himself nor undesirable alteration of the environment from using pesticides if they are used strictly in accordance with the instructions on the label. However, noone, either scheduled or extemporaneous speaker, expressed the viewpoint that clearance regulations are too stringent to live with.

Specifically: Dr. W. W. Osborne of Virginia Tech discussed fungicides and nematocides. He noted the great need to control the complex of pod rotting diseases through the use of pesticides applied to the soil. Dr. W. V. Campbell of N. C. State discussed insecticides primarily from the viewpoints of their relation to some fairly recently recognized pests of peanuts and the variety of experimental insecticides. He expressed an optomistic viewpoint on the future of insect control and the role that chemicals will play, along side biological control, etc. in this control program. Dr. H. A. L. Greer of Oklahoma State discussed herbicides. He noted the absolute necessity for using herbicides in peanut production and reported progress in research on application of a combination of a herbicide with one or more other pesticide.

2. How much of a production problem is the peanut mycotoxin problem?

This topic was discussed by plant pathologist Dr. R. E. Pettit of Texas A&M and Dr. D. M. Porter of Tidewater Center, Virginia. They spoke for the southernmost and northernmost extensions of U. S. peanut production. The geographic middle was represented by agricultural engineer Dr. J. L. Butler of the Tifton, Ga. station.

The consensus viewpoint of these three speakers was that under ordinary growing conditions there is some infection of peanuts by molds (including mycotoxin producers such as Aspergillus flavus) in the soil. To this must be added the infection which can take place in the windrow, particularly when there is injury to the pods in the digging or windrowing procedures. Then there are the instances of extraordinary growing conditions (drought, soil, insect attacks, etc.) under which peanuts become contaminated with molds and/or mycotoxins before digging. Thus production research shares the responsibility with marketing research for attacking the peanut mycotoxin problem.

MANUFACTURING AND PROCESSING TECHNOLOGY DISCUSSION GROUP

C. B. Smith, Leader

Director of Sales
Seabrook Blanching Corporation
Edenton, North Carolina

Approximately fifty-five people attended the discussion groups on manufacturing and processing technology. There was a formal ten to twelve minute statement including some slide films relating to recent developments. The following participated:

Carter Day Company
655 - 19th Avenue, N. E.
Minneapolis, Minn. 55418

Mr. Tom Hartman
Field Sales Operations

Discussed the cleaning and separation of peanuts by the use of several machines as well as destoners.

Forsebergs, Inc.
Thief River Falls
Minnesota 56701

Mr. David Stone
Sales Manager

Discussed gravity and vacuum separators and destoners, several other cleaning machines.

Bauer Bros. Company
P. O. Box 968
Springfield, Ohio

Mr. Al Bubb
Industrial Sales Mgr.

Discussed the several types of peanut butter grinding mills and oil roasting peanuts for salting industry.

Proctor & Schwartz, Inc.
7th St. & Tabor Road
Philadelphia, Pa.

Mr. Ted Wentz
Sales Manager

Disccused the design and structure of a roaster. Their units are used for other areas of the agriculture industry as well as all facets of peanuts.

Electric Sorting Machines
6909 Southwest Freeway
Houston, Texas 77036

Mr. Jerry Williams
Regional Marketing Mgr.

Discussed the new method of Electric Sorting as being faster and less expensive to maintain.

This period was open for discussion by the complete group with many questions being asked. I felt very sorry that we had to close the session as time was out. All members of the group appreciated the opportunity to participate.

Minutes of the Regular Business Meeting of the
AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION
Lincoln Plaza Motel, Oklahoma City, Okla., July 17, 1973

President Olin Smith called the meeting to order at 8:30 A.M.
Coyt Wilson moved that the minutes of last year's meeting be approved as they appeared in the 1972 Journal. Seconded by Joe Sugg. Passed.
President Smith recognized the assistance of Ruth Sturgeon, Thelma Smith, and Bernie Tripp for their part in helping with the registration.
President Smith then asked for committee reports.
Finance - Lawton Samples - See Appendix I
Lawton Samples moved that the report be accepted. Seconded by John French. Passed.
Peanuts - Culture And Uses - Astor Perry - See Appendix II
Publication and Editorial - Joe Sugg - See Appendix III
Program - Ed Sexton - See Appendix IV
Peanut Quality - James Butler - See Appendix V
Public Relations - Robert Ory - See Appendix VI
Nominating - Bill Mills - See Appendix VII
Julius Heinis moved that we elect the group by acclamation. Seconded by Ray Hammons. Passed.
Necrology and Recognition - Robert Ory - See Appendix VIII
Robert Ory moved that these be accepted. Seconded by Astor Perry. Passed.
An announcement was made that the 1974 meeting of the Association would be at the Williamsburg Hilton Hotel in Williamsburg, Virginia, July 14-17.
The meeting was adjourned at 9:30 A.M.

APPENDIX I

REPORT OF FINANCE COMMITTEE

L. E. Samples, Chairman

The Finance Committee functions primarily in an advisory capacity. It has, in addition, a responsibility of making a limited audit of the Association's financial records. This audit was conducted on Sunday afternoon, July 15, 1973, by members of the Finance Committee and Finance Chairman. Records were found to be in agreement with financial statements from the First National Bank and Trust Company of Stillwater, Oklahoma, and disbursements and deposits were found to be in agreement with checks and receipts furnished by the General Secretary and Treasurer.

By vote of the Board of Directors and members, APREA has elected to invest existing reserves in inventory of printed copies of the book Peanuts - Culture and Uses. At this accounting, 1,065 copies have been sold at prepublication price or the current $20 per copy rate. Current inventory of 935 copies at a cost price of $11.33 per copy are on hand.

It is the recommendation of the Finance Committee that all reasonable efforts be expended to sell additional copies as soon as possible, thereby replenishing cash on hand for operation of the Association.

The following financial report is prepared and includes a review of the 1972 budget and financial reports which seem to be appropriate at this time. In addition, a budget and financial report for the first half of 1973 has been prepared according to the request of the Board of Directors.

AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION

1973 First Half Budget Report

Assets and Income	Budget	Transacted
Bank Balance-Stillwater First National Bank	$10,959.47	$10,959.47
Membership Dues & Registration Ann. Meeting	3,222.00	3,914.00
Proceedings and Reprint Sales	156.00	198.25
Special Contributions		
The Peanut Book	13,071.00	10,776.16
TOTAL	$27,408.47	$25,847.88
Liabilities and Expenditures		
Printing - Proceedings	$22,701.20	$22,701.20
Annual Meeting (Printing, Catering, Misc)	150.00	151.58
Secretarial Services	160.00	
Office Supplies	40.00	
Position Bond for $5,000	33.00	33.00
Travel President	300.00	
Travel Executive Secretary & Treasurer	300.00	
Postage and book mailing	639.00	268.58
Registration State of Georgia		
Bank Charges		1.76
Miscellaneous	275.00	48.00
Sub Total	$24,598.20	$23,204.12
Reserve - June 30,1973	2,810.27	2,643.76
TOTAL	$27,408.47	$25,847.88

June 30, 1973
LES:sgr

AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION

July 1, 1973 - June 30, 1974

Item	Budget
Assets and Income	
Balance - Stillwater First National Bank	$ 2,643.76
Sales - Peanuts, C & U 400 Copies	8,000.00
Membership and Registration Annual Meeting	6,800.00
Proceedings and Reprint Sales	2,650.00
Special Contributions	
Inv. - Peanuts, C & U 535 Copies @ $11.33	6,061.55
TOTAL	$26,155.31
Liabilities and Expenditures	
Printing - Proceedings	$ 4,200.00
Annual Meeting (Printing and Catering)	450.00
Secretarial Services	550.00
News Peanut Research	175.00
Postage	800.00
Book Mailing	420.00
Office Supplies	200.00
Travel - President	300.00
Travel - Executive Secretary	300.00
Position Bond (Exec. Secretary and Treasurer)	40.00
Registration - State of Georgia	5.00
Brochure	500.00
Miscellaneous	500.00
TOTAL	$ 8,440.00
RESERVE	17,715.31
TOTAL	$26,155.31

June 30, 1973
LES:sgr

APPENDIX II

Report of "The Peanut" Committee
Astor Perry, Chairman

"The Peanut" Committee consists of 36 members scattered throughout the world. Our task is simple and straightforward --- sell the "The Peanut" book. Many things have occurred since our last meeting. The title of the book was changed from "The Peanut" to "Peanuts - Culture & Uses". The size and cost of the book went up considerably. We had anticipated a book length of 416 pages but because of editorial changes ended up with one with 684 pages. Initially, we had hoped to have 3000 of the books printed for $15,600 but because of the increase in size we obtained 2000 copies for a cost of $22,600. Our pre-publication price of $12.50/copy will barely pay for the printing, advertising, and shipping costs. We had hoped to receive the book from the printers in November, 1972, but because of several factors did not get delivery until March, 1973.

Total sales thus far amount to $14,256.00 for the 1105 books sold. Most of these sold for the $12.50 price. At the present rate of sales we can expect to sell between 300-400 more during the coming year.

I would like to thank every member of the Committee for the wonderful job they have done in stimulating sales and would welcome any suggestions on how we might sell additional copies.

APPENDIX III

REPORT OF THE PUBLICATION AND EDITORIAL COMMITTEE

Joe S. Sugg, Chairman
Coyt Wilson
Astor Perry
Wallace Bailey
Grady Pearman

Preston H. Reid (appointed to fill Bailey's unexpired term)

As Chairman of the Publication and Editorial Committee, I wish to take this opportunity to express my sincere appreciation to the members of my committee for their exceptionally fine assistance during the year in carrying out the functions of this committee. As a matter of fact, the SubCommittees functioned so well that I was not even aware that they were a part of the Publication and Editorial Committee, and special commendation should be given to these SubCommittee Chairmen for their work:

... To Coyt Wilson whose activities in publishing "PEANUTS - CULTURE AND USES" were above and beyond the call of duty and will bring great recognition to APREA in this accomplishment. In recognition of Coyt's work, I would like to suggest that we give Coyt at this time a rising vote of thanks.

... To Preston Reid as Chairman of the Ad Hoc Committee special recognition should be given for the work which he and his committee have done toward planning the refereed journal which will be reported more in detail at this time.

... To Ray Hammonds and Emery Cheek as editors of PEANUT RESEARCH. Their activities were super during the year and were attested to by each issue of the publication. This will be reported shortly more in detail.

I. The Publication and Editorial Committee is happy to report that the experiment using blue lined paper for the publication by the many authors was highly successful in publishing the Journal of Proceedings of last year's meeting, which permitted us to publish the Proceedings within thirty days of the annual meeting and at approximately one-half the cost. To all the authors we express thanks for following instructions on this procedure.

II. Your Committee proposed and the Board has authorized a brochure on APREA, which gives the history, purposes, goals, membership requirements, and an application blank to be used by the present membership in soliciting new members. These brochures should be ready for distribution this summer.

III. The Ad Hoc Committee, chaired by Preston Reid and consisting of Matlock, Jackson, Goldblatt, Tiemstra, Smith, Butler, Bass, Emery, Norden, Hammons and Ketring, presented to the Publication and Editorial Committee a sixteen point proposal for the publication of a refereed journal, titled "PEANUT SCIENCE", The Journal of the APREA, Inc., wherein the scientists can publish original reports of research or educational methods not previously or simultaneously reported in any other scientific or technical journal. The proposal was approved by the committee and recommended to your Board of Directors. The

Board unanimously approved the Committee's recommendation and appointed Preston Reid as Editor for a three-year term. The plan calls for two issues of the journal per year initially, the first being published March, 1974. Editor Reid will begin immediately working out details and will inform the membership as early as possible on procedures for publishing papers in the journal. We know this is something many of you have been wanting a long time and I am sure you all will give Editor Reid your full support and cooperation.

The proposal of the Ad Hoc Committee in its entirety follows:

1. Name. The name of the publication shall be PEANUT SCIENCE, the Journal of the American Peanut Research and Education Association, Inc.

2. General requirements. Voluntary articles will be accepted which are original reports of research or education methods not previously or simultaneously published in any other scientific or technical journal. Membership in APREA is not a requisite to publication in the Journal.

Upon submission to the Journal, papers become the property of the Journal and shall not be published elsewhere until released to the author by the Editor. The paper must be published within a period of one year or be released to the author.

3. The Editor shall be appointed by the Board of Directors for a period of three years. The position may be renewed for as many subsequent terms as the Directors desire except that reappointment must be made each three years.

4. The Editor may nominate for appointment by the Board of Directors as many Associate Editors as necessary. The following disciplines are offered as suggestion of disciplines which should have representation among the Associate Editors. This list is in no way intended to be all-inclusive or to limit the number of Associate Editors:- Agricultural Engineering, Biometry, Entomology, Extension Education, Food Science and Nutrition, Marketing, New Products, Plant Pathology, Plant Physiology and Biochemistry, Plant Breeding and Genetics, Processing, Soils, Soil Fertility and Plant Nutrition, Water Requirement and Irrigation, Weed Science.

5. Authors will submit three copies of the paper to the Editor who will assign the paper to the appropriate Associate Editor. The Associate Editor will have the paper reviewed by two anonymous reviewers, of which he may be one, and based on such review make recommendation to the Editor of the disposition of the article. One of the three following recommendations shall be made:

(1) Publish the article as submitted.
(2) Return the article to the author(s) for change and incorporation of reviewers suggestions.
(3) Release the paper to the author(s).

6. Abstracts of papers for presentation at the annual meeting must be in the hands of the Editor at least six (6) weeks ahead of the annual meeting. These may be printed and distributed to the membership at the annual meeting. Submission of the abstract does not obligate the author beyond presenting the paper at the meeting.

7. Invitational papers may be published, without review, in the first issue of the Journal following the annual meeting. Copy of the invitational papers, including those of symposia speakers, should be available at the annual meeting.

8. At least two issues per year of the Journal will be published to appear in March and September. The Editor may publish additional issues up to four per year as the paper volume warrants. Publication of more than four issues per year or of special publications must be approved by the Board of Directors. The abstracts will be printed separately and will not be considered an issue of the Journal.

9. Subscriptions to the Journal will be included in the membership dues. The Board of Directors will set the cost of subscription in accordance with the cost of the publication. It is recommended that the dues be increased by $2.00 per year the first year to cover the cost of the subscription. (This will cover mailing and correspondence cost). This would entitle the member to a copy of the abstracts and one year's issues of the Journal. Non-member subscriptions are recommended at $4.00 for the first year.

10. The Journal shall be 8½ x 11 inches in size and printed on slick paper of a quality to provide good reproduction of photographs. The titles will be 12-point bold type, print will be 10-point type except the materials and methods, literature reviews and literature cited will be set in 8-point type to conserve space. A summary of not more than 200 words will precede the text of the article. The USDA-ARS guidelines or the AIBS Style Manual for Biological Journals should be used for style of literature citations, etc. The journal issue will be printed on 11 x 17 inch paper folded to 8½ x 11 inch and saddle-stitched. (This is the general format of Agronomy Journal prior to 1967).

11. The cover of the Journal will be slick stock. In addition to an appropriate heading, the cover will carry the Table of Contents on the outside and inside front cover. A cover format similar to the attached sketch is suggested.

12. Articles, upon recommendation of the appropriate Associate Editor and approval by the Editor, will be published for a cost of $35.00 per page for the first 4 pages and $35.00 per 1/2-page for all over 4 pages. The senior author will receive, without further charge, 100 reprints of the article. Additional reprints may be obtained for a cost of $12.00 for the first 200 copies with additional raprints at cost to printer.

NOTE: The above recommendation is based on prices quoted by Mr. Terry Reel, Editor of the Peanut Journal and Nut World. Final costs should be adjusted by the Board of Directors after consideration of the printing contract.

13. Manuscripts. The manuscript must be typed double-spaced on 8½ x 11 inch paper with each line numbered. Submit three copies to the Editor. Type footnotes at the bottom of the page. Use footnotes sparingly. Type each table immediately after the page containing the first reference and number the pages as 1a, 2a, etc. Type legends for figures on one or more sheets and place at the end of the manuscripts. Figures should be black ink line drawings or 5 x 7 inch glossy print photographs.

14. The first issue following the annual meeting will carry such items of business as the Directors' request, summaries of work groups, and such other items as the Board of Directors shall request.

15. Printing will be contracted by the Board of Directors with a reputable printing firm.

16. Policy with respect to accepting advertising for the Journal shall be determined by the Board of Directors except that no advertising shall appear on any page which is a part of any article.

IV. We shall continue to publish PEANUT RESEARCH, improving it to better serve APREA and the industry. To this end, I call on Ray Hammons, Co-Editor, for comments on how you can help make PEANUT RESEARCH better.

Mr. Hammons' report follows:

Issues of Volume 10 Nos. 2-5 were mailed to approximately 877 people in the U. S. and 70 in foreign countries.

With the mailing of Volume 10 No. 6, the mailing list had been revised and only 373 were mailed in the U. S. with 73 to foreign countries.

Mailing list revisions were carried out using the guidelines published in the January 1973 (Vol. 10, No. 4) issue of PEANUT RESEARCH.

In the first five issues, reference was given to 29 theses and dissertations. Two hundred sixty-eight additional peanut literature references were listed in the selected reference section.

All APREA news items forwarded to us by officers and members were published.

Response from people seeking copies of references listed indicates that PEANUT RESEARCH is widely read. While the library at Tifton does not have all references listed, it is a good list to work from in obtaining articles in some of the more obscure journals.

V. The Publication and Editorial Committee was charged by the Board to provide ways and means of publishing worthy papers and proceedings of APREA for the advantage of our members and the benefit of the industry and the public. To comply with this mandate by the Board, the Publication and Editorial Committee has decided that APREA will publish:

(1) A refereed journal for the publication of qualified papers.

(2) Continue to publish the Journal of Proceedings of the annual Conferences as has been done in the past.

(3) Continue to publish PEANUT RESEARCH six times a year, expanding its coverage in the opinion of the editors to better serve the membership of APREA in specific and general communications.

PEANUT SCIENCE

THE JOURNAL OF THE

AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION, INC.

VOLUME DATE NUMBER

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APREA

Editor's Address

APPENDIX IV

PROGRAM
for the
Fifth Annual Meeting
of the
American Peanut Research and Education
Association, Inc.

Sunday Afternoon, July 15

1 - 5 Registration - Foyer - Governor's Club

3 - 5 Committee Meetings:

Finance	- Arcade Room
Peanut Quality	- Room 107
Publications and Editorial	- Room 108
Public Relations	- Choctaw Room
"The Peanut" Committee	
(4:00-5:00p.m.)-Room 109	

7 - 10 Board of Directors Meeting - Choctaw Room

Monday, July 16

8 - 5 Registration - Foyer - Governor's Club

General Session
O. D. Smith, Presiding - Senate Room

8:30 President's Welcome - O. D. Smith

8:45 Peanuts - Queensland (Australia) Style - O. I. Higgins

9:30 National Peanut Council's Programs and Projections for Peanut Research - George F. Hartnett

10:00 Coffee Break

10:30 - 12:00 - Two Concurrent Sessions

Session 1 D. J. Banks, Presiding - Cherokee Room

10:30 Early Generation Yield Trials as a Breeding Method for Peanuts - T. A. Coffelt and R. O. Hammons

10:45 Natural Outcrossing of Peanuts, Arachis Hypogaea L., in Puerto Rico - E. G. Stone and W. K. Bailey

11:00 Film Documentation of Plant Introduction Peanuts - C. T. Young, L. Morgan, and Yai-Po Tai

11:15 Breeding Peanuts (Arachis Hypogaea L.) for Resistance to Verticillium Wilt - B. M. Khan, J. S. Kirby, and D. F. Wadsworth

11:30 The Necrotic-Etch Leaf Disease in Peanuts. 1. Genetic Models - R. O. Hammons

11:45 Photosynthesis in Peanut Genotypes - A. S. Bhagsari and R. H. Brown

Session 2 C. M. Cater, Presiding - Senate Room

10:30 Prevalence of Aspergillus Flavus in Peanut Soils - R. E. Pettit, R. A. Taber, and H. W. Schroeder

10:45 Conditions Related to Aflatoxin Contamination in the Field - J. L. Butler, R. J. Cole, C. E. Holaday, E. J. Williams, L. E. Samples, J. F. McGill, P. D. Blankenship, and L. M. Redlinger

11:00 Aflatoxin - Contaminated Peanuts Produced on North Carolina Farms in 1968 - J. W. Dickens, J. B. Satterwhite, and R. E. Sneed

11:15 Some Results Concerning the Occurrence of Aflatoxin in Selected Sizes of Peanut Kernels - P. D. Blankenship, C. E. Holaday, and J. L. Butler

11:30 Evaluation of Applying Soil Fungicids Through a Sprinkler Irrigation System for Control of Soil Fungi on Spanish Peanuts - R. V. Sturgeon, Jr.

11:45 Effectiveness of Propionic Acid and "Moldstat" as Fungicides During Peanut Storage - C. E. Holaday, E. J. Williams, and J. L. Pearson

12:00 Lunch

1:15 Discussion Session - Senate Room
Marketing Procedures and Economics - Astor Perry, Presiding

2:45 Coffee Break

3:10 - 5:10 - Two Concurrent Sessions

Session 1 J. H. Young, Presiding - Cherokee Room

3:10 The Effects of Harvesting, Handling and Drying Procedures on the Percent of Sound Splits in Spanish Peanuts - N. K. Person, Jr. and J. W. Sorenson, Jr.

3:25 Development of a Small Laboratory Sheller for Determining Peanut Milling Quality - J. I. Davidson, Jr. and F. P. McIntosh

3:40 The Relationship of Peanut Milling Quality and Kernel Tensile Strength - J. D. Woodward

3:55 Aerodynamic Characteristics of Peanut Components - E. J. Williams and J. L. Butler

4:10 Machine for Direct Harvesting of Virginia-Type Peanuts - F. S. Wright

4:25 Objective Determination of Optimum Harvest Maturity - J. L. Pearson, C. E. Holaday, J. L. Butler, E. J. Williams, J. M. Troeger

4:40 Quality Analysis Using the 1972 Federal-State Inspection Peanut Sample Data from One Receiving Station in Georgia - Yai-Po Tai and C. T. Young

4:55 Changes in Grade Factors of Virginia and North Carolina Farmers' Stock Peanuts During Storage - L. W. Brown and J. L. Steele

Session 2 R. E. Pettit, Presiding - Senate Room

3:10 Further Studies on Cylindrocladium Black Rot of Peanuts in Virginia - K. H. Garren

3:25 Studies on the Biology and Control of Cylindrocladium Black Rot (CBR) of Peanut - M. K. Beute and R. C. Rowe

3:40 Soil Fertility Relationships in Pod Breakdown Disease of Peanuts - D. L. Hallock

3:55 Peanut Pod Rot Disease Control - W. W. Osborne, W. H. Wills, L. D. Moore, K. M. Hameed, R. Pristou, R. C. Lambe, J. A. Fox, and L. Sill

4:10 Tomato Spotted Wilt Virus Disease of Peanuts - G. Philley, R. S. Halliwell and C. W. Horne

4:25 Peanut Blight Caused by a Sclerotinia Species - D. M. Porter and M. K. Beute

4:40 Determination of Linear Regression Equations to Estimate Yield Losses to White Mold in Peanut Fields - R. Rodriquez - Kabana and P. A. Backman

4:55 Choice of Leafspot Spray Equipment Can Significantly Affect Peanut Losses from White Mold - P. A. Backman and R. Rodriquez - Kabana

Tuesday, July 17

8 - 12 Registration - Foyer - Governor's Club

8:30 Business Meeting:
Committee Reports
Election of Officers

9:40 Coffee Break

10:00 - 11:45 - Two Concurrent Sessions

Session 1 C. E. Holaday, Presiding - Cherokee Room

10:00 New Naturally Occurring Compounds from Peanuts - G. R. Waller and S. E. Young

10:15 Proteins from Peanut Cultivars (Arachis Hypogaea) Grown in Different Areas. VIII. Amino Acid Compositions of Spanish Peanut Flours and Protein Isolates - E. J. Conkerton, R. L. Ory, and J. M. Dechary

10:30 Partial Hydrolysis of Proteins in Peanut Meals by Endogenous Proteolytic Systems - M. H. Moseley and R. L. Ory

10:45 Comparison of Oil Storage Stability of Peanut Oils Prepared by Extraction with Various Solvents and Cold Pressing - D. F. Brown, C. M. Cater and K. F. Mattil

11:00 Investigations of Causes and Prevention of Fatty Acid Peroxidation in Peanut Butter - A. J. St. Angelo and R. L. Ory

11:15 A Simplified Technique for the Analysis of Volatiles in Peanut Butter by Direct Gas Chromatography - S. P. Fore, H. P. Dupuy, J. I. Wadsworth and L. A. Goldblatt

11:30 Quality of Peanuts from Leafspot Control Field Tests - S. R. Cecil, C. T. Young and D. H. Smith

Session 2 R. L. Robertson, Presiding - Senate Room

10:00 Suppression of the Two-Spotted Spider Mite on Peanuts - W. V. Campbell, R. W. Batts, R. L. Robertson and D. A. Emery

10:15 A Method for Screening Peanut Cultivars for Resistance to the Lesser Cornstalk Borer - L. Posada, R. L. Holloway, and J. W. Smith, Jr.

10:30 Effects of Foliage Loss on Yield and Grade in Starr Peanuts in Texas - J. W. Smith, Jr., P. W. Jackson and F. R. Huffman

10:45 Peanut Yields Following Defoliation to Assimilate Insect Damage - G. L. Greene and D. W. Gorbet

11:00 Pest Management for Peanut Insects in Texas - C. E. Hoelscher, J. W. Smith, Jr. and P. W. Jackson

11:15 Insect Pest Management on Peanuts in Georgia - J. C. French

11:30 Pest Management for Insects of Peanuts in Virginia - J. C. Smith

11:45 Lunch

1:15 - 2:45 - Two Concurrent Sessions

Session 1 Discussion Session - Senate Room
National Peanut Promotion - J. L. Currier, Presiding

Session 2 P. W. Santelmann, Presiding - Cherokee Room

1:15 Breeding Peanuts for Resistance to Aspergillus Flavus (L) - A. C. Mixon and K. M. Rogers

1:30 Correlation of Peanut Seed-coat Surface Wax Accumulation with Tolerance to Colonization by Aspergillus Flavus - J. C. LaPrade, J. A. Bartz, A. J. Norden, and T. Demuynk

1:45 Screening for Toxin-Producing Fungi - J. W. Kirksey and R. J. Cole

2:00 Comparison of Aspergillus Flavus Tolerant and Susceptible Peanut Lines - I. Light Microscope Investigation - R. A. Taber, T. E. Pettit, C. R. Benedict, J. W. Dieckert and D. L. Ketring

2:15 Comparison of Aspergillus Flavus Tolerant and Susceptible Peanut Lines. II. Electronmicroscopy - J. W. Dieckert, M. C. Dieckert, R. E. Pettit, C. R. Benedict and D. L. Ketring

2:30 Comparison of Aspergillus Flavus Tolerant and Susceptible Peanut Lines. III. Physiological Investigations - C. R. Benedict, D. L. Ketring, R. E. Pettit and J. W. Dieckert

2:45 Coffee Break

3:10 - 5:10 - Two Concurrent Sessions

Session 1 A. H. Allison, Presiding - Cherokee Room

3:10 The Effect of High Humidity Storage Conditions on Ethylene Production, Germination and Vigor of Starr Variety Spanish Type Peanut Seeds - D. L. Ketring

3:25 The Effect of Curing and Storage Environment on Dormancy of Seed of Different Genotypes of Peanuts, Arachis Hypogaea L. - J. E. Bear and W. K. Bailey

3:40 Search for a Practical Procedure for Breaking Dormancy of Seed of Peanuts, Arachia Hypogaea L. - W. K. Bailey and J. E. Bear

3:55 Florunner Seed Sizing Studies - D. W. Gorbet

4:10 Evaluation of Virginia Type Peanuts for Maturity Using the Free Arginine Content (AMI * Method) - B. R. Johnson, R. W. Mozingo and C. T. Young

4:25 Full Season Weed Control Systems in Peanuts - H. A. L. Greer and P. W. Santelmann

4:40 Field Evaluations of Alachlor/Dinoseb in Peanuts - R. G. Duncan, O. A. Andrews and F. D. Timmons

4:55 Ronstar, A Selective Herbicide for Peanuts - J. R. Bone, R. D. Wilson and G. R. Crowley

Session 2 M. K. Beute, Presiding - Senate Room

3:10 Effect of Soil Calcium on Peanut Yields and Grades - D. L. Hartzog and F. Adams

3:25 Yield and Composition of Peanuts as Affected by Calcium Sources - E. B. Whitty, D. W. Gorbet and F. M. Rhoads

3:40 The Effect of Time of Kylar Application on Yield and Associated Characteristics of Peanuts - C. S. Daughtry, W. J. Ethredge, and R. H. Brown

3:55 Response of Peanuts to Inoculation with Nitrogen-Fixing Bacteria - L. C. Cobb and E. B. Whitty

4:10 Different Methods of Applying Soil Fumigants on Peanuts for Nematode Control - D. W. Dickson and R. A. Kinloch

4:25 Effect of Nematicides Upon the Root Lesion Namatode Population Under Field Conditions - K. E. Jackson and R. V. Sturgeon, Jr.

4:40 Results of a Laboratory Method for Measuring Fungicidal Toxicity to Soil Pathogens - D. F. Wadsworth, A. M. Pedrosa, Jr., and L. O. Roth

Wednesday, July 18

8:15 - 9:30 - Two Concurrent Sessions

Session 1 Discussion Session - Cherokee Room
Manufacturing and Processing Technology - C. B. Smith, Presiding

Session 2 Discussion Session - Senate Room
Production Technology - K. H. Garren, Presiding

9:30 - 9:45 General Session
O. D. Smith, Presiding

Tour Information - L. D. Tripp
Committee Appointments and Concluding Remarks - E. L. Sexton

10:00 Tours Begin

3:00 Return to Will Rogers International Airport

PROGRAM COMMITTEE

E. L. Sexton, Chairman

Local Arrangements

L. D. Tripp, Chairman
Donald Banks
Richard Berberet
Peter Bloome
Bob Clary
William Flanagan
Ed Granstaff
Howard Greer
Floyd King
James Kirby
R. V. Sturgeon
D. F. Wadsworth

Technical Program

H. E. Pattee, Chairman
W. V. Campbell
G. B. Duke
D. A. Emery
D. L. Hallock
A. Perry
D. M. Porter
F. S. Wright
J. H. Young

Appendix V

REPORT OF QUALITY COMMITTEE
J.L. Butler, Chairman

The wide variation in the results obtained using the Water-Insoluble Inorganic Residue (WIIR) procedure was brought to the attention of the committee. One member felt that involved heavily in the variation was the presence of rodent excreta and hair and insect parts and excreta and other contaminants. The importance of having a reliable method or standard is emphasized by the fact that the peanut better may be either Grade A or Grade C on the results of this test.
After much discussion, Dr. Clyde Young said that he would contact at least five labs, which have a direct interest in this problem, to see whether they would evaluate samples. For those who will, duplicate samples of each of three levels of known contamination will be sent. The results of these evaluations will then be used as guidelines to develop procedures which will be more reproducible.
It is recognized that as the industry moves to containerization, the potential for contamination from used containers is a possibility. The quality committee will keep abreast of these developments to see that points of possible contamination do not develop.
It was stated by Dr. Jim Young that many different methods of moisture determination are now being used. The AOCS method gives very good results at the lower moisture levels. The results at the higher moisture contents, however, are not as reproducible. Dr. Young agreed to investigate this situation and recommend methods to be evaluated.
It was agreed that, even though newer methods of predicting shelf life are being developed, the iodine number is still important and should be retained. The role of trace elements in product stability was questioned. After discussion, it was agreed that little was known about this and that this would be a fruitful area of research.
The Sampling Procedures Sub-committee is as follows:

Subcommittee activities have been consistent with goals outlined in last year's report which was published in the 1972 Journal of APREA. Since no specific charge was given to the subcommittee by the Quality Committee, members were free to investigate sampling problems in areas previously designated.

Dr. Whitaker and Mr. Dickens have worked with the Peanut Administrative Committee in reviewing the present aflatoxin sampling program and evaluating various new sampling plans for shelled goods. Evaluations considered both cost and outgoing quality.

Mr. Dickens has been investigating the aflatoxin sampling program used on farmer stock peanuts in an effort to determine what would be the effect of using chemical assay methods to divert lots into Segregation III instead of the visual technique presently used. This question takes on added importance inlight of the new price support program.

Dr. Whitaker has been working on a computer simulation method to evaluate aflatoxin sampling plans. The method will determine the effects of not only sample size but subsample size and number of analyses on the accuracy of estimating aflatoxin concentrations.

The Quality Committee chairman pointed out, in closing, that as we develop standards and methods, we should consider that we are writing federal law. This is especially true in all those which affect the consumer. Since we are a professional society, we will be considered to have the expertise in the realm of peanuts.

Appendix VI

REPORT OF THE PUBLIC RELATIONS COMMITTEE
Robert Ory, Chairman

One of the major objectives of this committee is the securing and maintenance of membership. During the past year the Committee undertook the following activities:

1. Previous Chairman, Astor Perry, had compiled a list of 493 shellers, processors and manufacturers, and wrote to about 200 of these who were not members of APREA, inviting them to become members and to attend the 1972 meeting in Albany. Of these 200, 54 addresses were apparently incomplete; so these companies were not contacted. A revised list of these 54 companies was sent to each member of the 1972-73 Committee with a request for aid in correcting the addresses.

Results: 46 addresses were obtained; 2 companies were no longer in business. A one-page letter outlining the history of the APREA, with an invitation to become a member and to attend the 1973 meeting in Oklahoma City was sent to these 46 companies. Six letters were returned for the reasons: "Moved, No Forwarding Address; Out of Business (The Guidarelli Nut Co., Chicago)".

2. A similar letter was sent to Joe Sugg for reproduction and insertion of a copy into each issue of the 1972 APREA Journal, vol. 4. The goal here was to encourage non-member recipients to become members and for present members to use the application form and try to solicit one new member.

3. A brief version of this letter and membership application form was also sent to Ray Hammons and Emory Cheek of Peanut Research for inclusion in the December, 1972 issue.

4. The Committee received 25 copies of vol. 4 of the 1972 APREA Journal. Each member was sent 3 copies to present to "hot prospects" as inducements to become members, with emphasis on recruiting sustaining or organizational members.

5. In December, 1972, P. R. Committee member, James R. Bone (also a member of the Southern Weed Conference) suggested trying to contact peanut growers attending the January, 1973, S. W. C. meeting in New Orleans; placing APREA literature in their meeting area and try to get some new members. With Pres. Olin Smith's approval, the S. W. C. President in Delaware was contacted for his approval to place literature and application forms in their registration area. After obtaining his permission, Emory Cheek sent several copies of vol 10 (2) and (3) of Peanut Research for display. A number of APREA application forms and several copies of the 1972 APREA Journal were added to this and given to James Bone to display at the S. W. C. meeting. Jim also made several personal contacts with people there in behalf of APREA.

6. In April, 1973, Leland Tripp was contacted to ascertain the effectiveness of these various letters. He estimated that about 5 new members joined using the blank at the bottom of the letter; plus some other new memberships that could have been motivated by the letters (but we really do not know.).

7. Conclusions: The best way to get new members is still by personal contact with prospects. Letters with application forms might still be inserted into the Journal each year for present members to use in soliciting new members, but the extra cost and time involved in writing to individual companies, etc., does not seem to be too fruitful. Also, a recommendation of last year's Chairman, Astor Perry, (which this Committee failed to do) to send brief monthly articles on APREA activities for printing in the Peanut Journal and Nut World (or other suitable media), should be resumed. This would bring APREA highlights to the attention of a broader group and could stimulate interest in nonmembers.

Appendix VII

REPORT OF THE NOMINATING COMMITTEE
Bill Mills, Chairman

The Nominating Committee of APREA has selected the following slate of nominees:

President Elect - Kenneth Garren
State Employee's Representative - Nat K. Person, Jr.
Industry Representative (Production) - James E. Mobley
Executive Secretary-Treasurer - Leland Tripp

Appendix VIII

RESOLUTION

WHEREAS, during the past 5-6 years Dr. Coyt T. Wilson has been contacting prospective authors editing and organizing the various chapters into the APREA sponsored book, The Peanut-Culture and Uses, and

WHEREAS, the many last minute changes, writing and printing problems required much of his own time, in addition to his normal duties in the Research Division at Virginia Polytechnic Institute and State University, to finalize this comprehensive book of information on all aspects of peanut research

THEREFORE, be it resolved that we the members of APREA WISH TO EXPRESS OUR SINCERE THANKS AND APPRECIATION TO COYT T. WILSON FOR THE EXCELLENT JOB HE HAS DONE IN EDITING AND ASSEMBLING THE BOOK, THE PEANUT-CULTURE AND USES, which will benefit all segments of the peanut industry and those engaged in research on peanuts.

RESOLUTION

WHEREAS, Wallace K. Bailey has served all segments of the peanut industry for over 32 years since he began research on peanuts in the U.S.D.A. laboratory in Experiment, Georgia, in 1942, and since his transfer to Beltsville, Maryland in 1955 as Leader of Peanut Investigation and

WHEREAS, in addition to his responsibilities for national leadership in the program for peanut production research until his retirement from the U.S.D.A. in June, 1973, he devoted a considerable amount of his time towards furthering and increasing interest in APREA and its goals;

THEREFORE, be it resolved that we the members of APREA do hereby recognize and thank Wallace K. Bailey for his many years of unselfish devotion and dedication to the peanut industry, to peanut research and to APREA, and wish him good luck for the future.

RESOLUTION

Be it resolved that the American Peanut Research and Education Association (APREA) does hereby recognize that the death of Dr. Litton W. Boyle will be keenly felt by all segments of the peanut industry. Dr. Boyle, who spent most of his professional life as Plant Pathologist in the Georgia Experiment Station at Experiment, Georgia had retired in 1966. He died in February, 1973. His contributions in the field of peanut pathology, peanut diseases and control particularly leafspot disease and his "weather forecasts for peanut farmers" span many many years.

We therefore recommend that the resolution be included in the official minutes of the 1973 Annual Meeting of the APREA and that a copy of it be forwarded to his widow.

BY-LAWS
of
AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION, INC.

Article I. Name

Section 1. The name of this organization shall be "AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION, INC."

Article II. Purpose

Section 1. The purpose of the Association shall be to provide a continuing means for the exchange of information, cooperative planning, and periodic review of all phases of peanut research and extension being carried on by State Research Divisions, Cooperative State Extension Services, the United States Department of Agriculture, the Commercial Peanut Industry and supporting service businesses, and to conduct said Association in such manner as to comply with Section 501 (c)(3) of the United States Internal Revenue Code of 1954 and Acts amendatory thereto. Upon the dissolution of the Association, all of the assets of the Association shall be transferred to an organization whose purposes are similar to those of this Association or to such other charitable or educational organization exempt from Federal income tax under the provisions of Section 501 (c)(3) of the United States Internal Revenue Code of 1954 and Acts amendatory thereto as the directors may appoint provided that no director, officer or member of this organization may in any way benefit from the proceedes of dissolution.

Article III. Membership

Section 1. The several classes of membership which shall be recognized are as follows:

a. Individual memberships: Individuals who pay dues at the full rate as fixed by the Board of Directors.

b. Organizational memberships: Industrial or educational groups that pay dues as fixed by the Board of Directors. Organizational members may designate one representative who shall have individual member rights.

c. Sustaining memberships: Industrial organizations and others that pay dues as fixed by the Board of Directors. Sustaining members are those who wish to support this Association financially to an extent beyond minimum requirements as set forth in Section 1b, Article III. Sustaining members may designate one representative who shall have individual member rights. Also, any organization may hold sustaining memberships for any or all of its divisions or sections with individual member rights accorded each sustaining membership.

d. Student memberships: Full-time students that pay dues at a special rate as fixed by the Board of Directors. Persons presently enrolled as full-time students at any recognized college, university or technical school are eligible for student membership. Post doctoral students, employed persons taking refresher courses or special employee training programs are not eligible for student membership.

Section 2. Any member, participant, or representative duly serving on the Board of Directors or a Committee of this Association and who is unable to attend any meeting of the Board of such Committee may be temporarily replaced by an alternate selected by the agency or party served by such member, participant, or representative upon appropriate written notice filed with the president or Committee chairman evidencing such designation or selection.

Section 3. All classes of membership may attend all meetings and participate in discussions. Only individual members or those with individual membership rights may vote and hold office. Members of all classes shall receive notification and purposes of meetings, and shall receive minutes of all Proceedings of the American Peanut Research and Education Association.

Article IV. Dues and Fees

Section 1. The annual dues shall be determined by the Board of Directors with the advice of the Finance Committee subject to approval by the members at the annual meeting. Minimum annual dues for the four classes of membership shall be:

a. Individual memberships: $5.00
b. Organizational memberships: $25.00
c. Sustaining memberships: $100.00
d. Student memberships: $2.00

Section 2. Dues are receivable on or before January 1 of the year for which the membership is held. Members in arrears on April 1 for dues for the current year shall be dropped from the rolls of this Association provided prior notification of such delinquency was given. Membership shall be reinstated for the current year upon payment of dues.

Section 3. A $5.00 registration fee will be assessed at all regular meetings of this Association. The amount of this fee may be changed upon recommendation of the Finance Committee subject to approval by the Board of Directors.

Article V. Meetings

Section 1. Annual meetings of the Association shall be held for the presentation of papers and/or discussions, and for the transaction of business. At least one general business session will be held during regular annual meetings at which reports from the executive secretary-treasurer and all standing Committees will be given, and at which attention will be given to such other matters as the Board of Directors may designate. Also, opportunity shall be provided for discussion of these and other matters that members may wish to have brought before the Board of Directors and/or general memberships.

Section 2. Additional meetings may be called by the Board of Directors either on its own motion or upon request of one-fourth of the members. In either event, the time and place shall be fixed by the Board of Directors.

Section 3. Any member may submit only one paper as senior author for consideration by the program chairman of each annual meeting of the Association. Except for certain papers specifically invited by the Association president or program chairman with the approval of the president, at least one author of any paper presented shall be a member of this Association.

Section 4. Special meetings or projects by a portion of the Association membership, either alone or jointly with other groups, must be approved by the Board of Directors. Any request for the Association to underwrite obligations in connection with a proposed special meeting or project shall be submitted to the Board of Directors, who may obligate the Association to the extent they deem desirable.

Section 5. The executive secretary-treasurer shall give all members written notice of all meetings not less than 60 days in advance of annual meetings and 30 days in advance of all other special project meetings.

Article VI. Quorum

Section 1. Until such time as the membership association reaches 200 voting members, 20% of the voting members of this Association shall constitute a quorum for the transaction of business. When the membership exceeds 200, a quorum shall consist of 40 voting members.

Section 2. For meetings of the Board of Directors and all Committees, a majority of the members duly assigned to such Board or Committee shall constitute a quorum for the transaction of business.

Article VII. Officers

Section 1. The officers of this organization shall be:

a. President
b. President-elect
c. Executive Secretary-Treasurer

Section 2. The president and president-elect shall serve from the close of the annual general meeting of this Association to the close of the next annual general meeting. The president-elect shall automatically succeed to the presidency at the close of the annual general meeting. If the president-elect should succeed to the presidency to complete an unexpired term, he shall then also serve as president for the following full term. In the event the president or president-elect or both should resign or become unable or unavailable to serve during their terms of office, the Board of Directors shall appoint a president or both president-elect and president to complete the unexpired terms until the next annual general meeting when one or both offices, if necessary, will be filled by normal elective procedure. The most recent available past president (previously PIWG chairman) shall serve as president until the Board of Directors can make such appointment. The president shall serve without monetary compensation.

Section 3. The officers and directors shall be elected by the members in attendance at the annual general meeting from nominees selected by the Nominating Committee or members nominated for this office from the floor. The president-elect shall serve without monetary compensation.

Section 4. The executive secretary-treasurer may serve consecutive yearly terms subject to re-election by the membership at the annual meeting. The tenure of the executive secretary may be discontinued by a two-thirds majority vote of the Board of Directors who then shall appoint a temporary executive secretary to fill the unexpired term.

Section 5. The president shall arrange and preside at all general meetings of the Board of Directors and with the advice, counsel, and assistance of the president-elect and secretary-treasurer, and subject to consultation with the Board of Directors, shall carry on, transact and supervise the interim affairs of the Association and provide leadership in the promotion of the objectives of this Association.

Section 6. The president-elect shall be program chairman responsible for development and coordination of the overall program of the educational phase of the annual meetings.

Section 7. (a) The executive secretary-treasurer shall countersign all deeds, leases and conveyances executed by the Association and affix the seal of the Association thereto and to such other papers as shall be required or directed to be sealed. (b) The executive secretary-treasurer shall keep a record of the deliberations of the Board of Directors, and keep safely and systematically all books, papers, records, and documents belonging to the Association, or in any wise pertaining to the business thereof. (c) The executive secretary-treasurer shall keep account for all monies, credits, debts, and property, of any and every nature, of this Association, which shall come into his hands or be disbursed and shall render such accounts, statements, and inventories of monies, debts, and property, as shall be required by the Board of Directors. (d) The executive secretary-treasurer shall prepare and distribute all notices and reports as directed in these By-laws, and other information deemed necessary by the Board of Directors to keep the membership well informed of the Association activities.

Article VIII. Board of Directors

Section 1. The Board of Directors shall consist of the following:

a. The president
b. The most immediate past president able to serve
c. The president-elect (elected annually)

d. State employees' representative - This director is one whose employment is state sponsored and whose relation to peanuts principally concerns research, and/or educational, and/or regulatory pursuits.

e. United States Department of Agriculture representative - This director is one whose employment is directly sponsored by the USDA or one of its agencies and whose relation to peanuts principally concerns research, and/or educational, and/or regulatory pursuits.

f. Three Private Peanut Industry representatives - These directors are those whose employment is privately sponsored and whose principal activity with peanuts concerns: (1) the production of farmers' stock peanuts; (2) the shelling, marketing, and storage of raw peanuts; (3) the production or preparation of consumer food-stuffs or manufactured products containing whole or parts of peanuts.

g. A person oriented toward research - to be named by the chairman of the Board of Directors of the National Peanut Council.

h. The executive secretary-treasurer - non-voting member of the Board of Directors who may be compensated for his services on a part or full-time salary stipulated by the Board of Directors in consultation with Finance Committee.

i. The president of the National Peanut Council - a non-voting member.

Section 2. The Board of Directors shall determine the time and place of regular and special meetings and may authorize or direct the president to call special meetings whenever the functions, programs, and operations of the Association shall require special attention. All members of the Board of Directors shall be given at least 10 days advance notice of all meetings; except that in emergency cases, three days advance notice shall be sufficient.

Section 3. The Board of Directors will act as the legal representative of the Association when necessary and, as such, shall administer Association properties and affairs. The Board of Directors shall be the final authority on these affairs in conformity with the By-laws.

Section 4. The Board of Directors shall make and submit to this Association such recommendations, suggestions, functions, operations and programs as may appear necessary, advisable, or worthwhile.

Section 5. Contingencies not provided for elsewhere in these By-laws shall be handled by the Board of Directors in a manner they deem desirable.

Article IX. Committees

Section 1. Members of the Committees of the Association shall be appointed by the president and shall serve 2-year terms unless otherwise stipulated. The president shall appoint a chairman of each Committee from among the incumbent committeemen. The Board of Directors may, by a two-thirds vote, reject Committee appointments. Appointments made to fill unexpected vacancies by incapacity of any Committee member shall be only for the unexpired term of the incapacitated committeeman. Unless otherwise specified in these By-laws, any Committee member may be reappointed to succeed himself, and may serve on two or more Committees concurrently but shall not hold concurrent chairmanships. Initially, one-half of the members, or the nearest (smaller) part thereto, of each Committee will serve one-year terms as designated by the president.

a. Finance Committee: This Committee shall include at least four members, one each representing State-, and USDA-, and two from Private Business - segments of the peanut industry. This Committee shall be responsible for preparation of the financial budget of the Association and for promoting sound fiscal policies within the Association. They shall direct the audit of all financial records of the Association annually, and make such recommendations as they deem necessary or as requested or directed by the Board of Directors. The term of the Chairman shall close with preparation of the budget for the following year, or with the close of the annual meeting at which a report is given on the work of the Finance Committee

under his Chairmanship, whichever is later.

b. Nominating Committee: This Committee shall consist of at least three members appointed to one-year terms, one each representing State-, USDA-, and Private Business - segments of the peanut industry. This Committee shall nominate individual members to fill the positions as described and in the manner set forth in Articles VII and VIII of these By-laws and shall convey their nominations to the president of this Association on or before the date of the Annual Meeting. The Committee shall, insofar as possible, make nominations for the president-elect that will provide a balance among the various segments of the Industry and a rotation among Federal, State, and Industry members. The willingness of any nominee to accept the responsibility of the position shall be ascertained by the Committee (or members making nominations at general meetings) prior to the election. No person may succeed himself as a member of this Committee.

c. Publications and Editorial Committee: This Committee shall consist of at least three members appointed for indeterminate terms, one each representing State-, USDA-, and Private Business - segments of the peanut industry. This Committee shall be responsible for the publication of the proceedings of all general meetings and such other Association sponsored publications as directed by the Board of Directors in consultation with the Finance Committee. This Committee shall formulate and enforce the editorial policies for all publications of the Association, subject to the directives from the Board of Directors.

d. Peanut Quality Committee: This Committee shall include at least seven members; one each actively involved in research in peanut - (1) varietal development-, (2) production and marketing practices related to quality-, and (3) physical and chemical properties related to quality-, and one each representing the Grower-, Sheller-, Manufacturer-, and Services- (Pesticides and Harvesting Machinery, in particular) segments of the Peanut industry. This Committee shall actively seek improvement in the quality of raw and processed peanuts and peanut products through promotion of mechanisms for the elucidation and solution of major problems and deficiencies.

e. Public Relations Committee; This Committee shall include at least six members, one each representing the State-, USDA-, Grower-, Sheller-, Manufacturer-, and Services-, segments of the peanut industry. This Committee shall provide leadership and direction for the Association in the following areas:

(1) Membership: Development and implementation of mechanisms to create interest in the Association and increase its membership.

(2) Cooperation: Advise the Board of Directors relative to the extent and type of cooperation and/or affiliation this Association should pursue and/or support with other organizations.

(3) Necrology: Proper recognition of deceased members.

(4) Resolutions: Proper recognition of special services provided by members and friends of the Association.

Article X. Divisions

Section 1. A Division within the Association may be created upon recommendation of the Board of Directors, or members may petition the Board of Directors for such status, by a two-thirds vote of the general membership. Likewise, in a similar manner a Division may be dissolved.

Section 2. Divisions may establish or dissolve Subdivisions upon the approval of the Board of Directors.

Section 3. Divisions may make By-laws for their own government, provided they are consistent with the rules and regulations of the Association, but no dues may be assessed. Divisions and Subdivisions may elect officers (chairman, vice-chairman to succeed to the chairmanship, and a secretary) and appoint committees, provided that the efforts therof do not overlap or conflict with those of the officers and Committees of the main body of the Association.

Article XI. Amendments

Section 1. Proposed amendments to these By-laws must be submitted to the Board of Directors whose recommendation will then be considered at the next regular annual meeting of the Association except as provided in Section 2.

Section 2. Amendments shall be adopted only when a majority of those holding individual membership rights vote and then only by the vote of two-thirds of those voting. If a majority of the individual members are not in attendance at the first regular annual meeting following announcement of proposed amendments, the executive secretary-treasurer shall mail to all such members of the Association ballots concerning such amendments. Members shall be allowed thirty days to return mailed ballots after which the vote of those returning such ballots shall be binding subject to the regulations above. Failure of a majority of the members to return their ballots within the allotted time denotes rejection of the proposed amendment.

Section 3. Proposed amendments slated for adoption or rejection must be brought to the attention of members either by letter or through Association publications at least thirty days prior to consideration for final adoption.

Adopted at the Annual Business Meeting of the American Peanut Research and Education Association, Inc., July 18, 1972, Albany, Georgia.

MEMBERSHIP LIST
AMERICAN PEANUT RESEARCH AND EDUCATION ASSOCIATION

July, 1973

SUSTAINING MEMBERSHIPS

Anderson's Peanuts
P. O. Box 619
Opp, Al. 36467
Attn: James B. Anderson

A. H. Carmichael Company
Brokers & Manufacturer's Agents
Shelled Peanuts
2353 Christophers Walk, N.W.
Atlanta, Ga. 30327
Attn: Broadus Carmichael

CPC International
Best Foods Research Center
1120 Commerce Avenue
P. O. Box 1534
Union, N.J. 07083
Attn: Daniel Melnick, Vice Pres.
Production Research and
Quality Control

Denison Peanut Company
Denison, Tx. 74020
Attn: George Morrow

Derby Foods, Inc.
3327 West 48th Place
Chicago, Ill. 60632
Attn: S. E. Tierney

Dothan Oil Mill Company
P. O. Box 458
Dothan, Al. 36301
Attn: J. H. Bryson, Jr.

Gold Kist Peanuts, Inc.
3348 Peachtree Road, N.E.
P. O. Box 2210
Atlanta, Ga. 30301
Attn: H. E. Anderson

Hershey Foods Corporation
Hershey, Pa. 17033
Attn: E. W. Meyers
Director of Research

Keel Peanut Company, Inc.
P. O. Box 878
Greenville, N.C. 27834
Attn: James T. Keel

Lilliston Corporation
P. O. Box 407
Albany, Ga. 31702
Attn: William T. Mills

M & M/Mars - Albany Plant
P. O. Box 3289
Albany, Ga. 31706
Attn: Gayle N. Manley

Oklahoma Peanut Commission
P. O. Box D
Madill, Ok. 73446
Attn: William Flanagan, Exec. Secretary

Paul Hattaway Company
P. O. Box 669
Cordele, Ga. 31015
Attn: R. F. Hudgins, Secretary-Treasurer

Peanut Butter Manufacturers and Nut
Salters Association
807 Jefferson Building
1225 19th Street, N.W.
Washington, D. C. 20036
Attn: James E. Mack

Pender Peanut Corporation
P. O. Box 38
Greenwood, Fl. 32443
Attn: Robert Pender

H. B. Reese Candy Company, Inc.
Hershey, Pa. 17033
Attn: George D. McClees, Vice President

Stevens Industries
Dawson, Ga. 31742
Attn: C. M. Cruikshank

Turner Sales and Supply, Inc.
P. O. Box 847
Tifton, Ga. 31794
Attn: Luther Turner

United States Gypsum Company
101 South Wacker Drive
Chicago, Ill. 60606
Attn: W. T. McEwen
Department 140-6

Virginia Peanut Growers Association
Capron, Va. 23839
Attn: Russell C. Schools
Executive Secretary

ORGANIZATIONAL MEMBERSHIPS

Alabama Peanut Producers Association
P. O. Box 1282
Dothan, Al. 36301
Attn: James Earl Mobley, President

Alford Refrigeration Warehouse
P. O. Box 5088
Dallas, Tx. 75222
Attn: Bryant Shumpert, Sales

All American Nut Company
16901 Valley View
Cerritos, California 90701
Attn: William V. Ritchie
President

Birdsong Storage Company
Lock Drawer 1400
Suffolk, Va. 23434
Attn: W. J. Spain, Jr.

Jack Cockey Brokerage Co., Inc.
P. O. Box 1075
Suffolk, Va. 23434
Attn: John Cockey, Jr.

Fisher Nut Company
2327 Wycliff Street
St. Paul, Mn. 55114
Attn: Louis R. Smerling

General Foods Corporation
250 North Street
White Plains, New York 10602
Attn: J. J. Sheehan

Georgia Agricultural Commodity
Commission for Peanuts
110 East Fourth Street
Tifton, Ga. 31794
Attn: George P. Donaldson
Executive Secretary

Gorman Peanuts
P. O. Box 698
Gorman, Tx. 76545
Attn: T. H. Birdsong, III

Harrington Manufacturing Company, Inc.
Lewiston, N. C. 27849
Attn: J. J. Harrington

George F. Hartnett and Company, Inc.
540 Frontage Road
Northfield, Ill. 60093
Attn: George F. Hartnett

Hobbs-Adams Engineering Company
P. O. Box 1306
Suffolk, Va. 23434
Attn: James C. Adams, II

Institut De Recherches
Pour Les Huiles et Oleagineaux II
11 Square Petrarque
75016 Paris, France
Attn: Pierre Gillier
Director of Peanut Department

J. R. James Brokerage Company
P. O. Box 214
Suffolk, Va. 23434
Attn: Ruth J. Moore

Law and Company
Consulting and Analytical Chemists
P. O. Box 1558
Atlanta, Ga. 30301
Attn: William W. McBee

The Leavitt Corporation
P. O. Box 31
100 Santilli Highway
Everett, Massachusetts 02149
Attn: James T. Hintlian, President

Charles Matthews Company
P. O. Box 4059
Dallas, Tx. 75208
Attn: Charles S. Matthews

National Peanut Corporation
Planters Peanuts
200 Johnson Avenue
Suffolk, Va. 23434
Attn: D. M. Carter

National Peanut Council
7900 Westpark Drive, Suite 713
McLean, Va. 22101
Attn: John L. Currier, President

North Carolina Crop Improvement Association
State College Station
P. O. Box 5155
Raleigh, N. C. 27607
Attn: Foil W. McLaughlin
Director in Charge

North Carolina Peanut Growers Association, Inc.
P. O. Box 1709
Rocky Mount, N. C. 27801
Attn: Joe S. Sugg

Oklahoma Crop Improvement Assn.
Oklahoma State University
Stillwater, Ok. 74074
Attn: Ed Granstaff, Sec.-Mgr.

Olin
Agriculture Division
P. O. Box 991
Little Rock, Ark. 72203
Attn: L. Reid Faulkner

Peanut Growers Cooperative Marketing Association
Franklin, Va. 23851
Attn: S. Womack Lee, Manager

Peanut Processors, Inc.
P. O. Box 158
Dublin, N. C. 28332

Pearson Candy Company
2140 West Seventh Street
St. Paul, Mn. 55116
Attn: George Pearson

Pert Lab, Inc.
P. O. Box 267
1108 North Broad Street
Edenton, N. C. 27932
Attn: J. R. Baxley
Director of Research

Pond Brothers Peanut Company, Inc.
P. O. Box 1370
Suffolk, Va. 23434
Attn: Richard Pond

Preferred Products, Inc.
101 Jefferson Avenue, South
Hopkins, Mn. 55343

Reeves Peanut Company
Eufaula, Alabama 36027
Attn: M. M. Reeves

Seabrook Blanching Corporation
Tyrone, Pa. 16686
Attn: C. B. Smith

Shell Development Company
P. O. Box 4248
Modesto, Calif. 95352
Attn: Dr. H. Blondrau
Pesticide Development Dept.

Southeastern Peanut Association
P. O. Box 1746
Albany, Ga. 31702
Attn: John W. Greene, Exec. Director

Southwestern Peanut Growers Association
Gorman, Texas 76454
Attn: Ross Wilson, Manager

Southwestern Peanut Shellers Association
6815 Prestonshire
Dallas, Texas 75225
Attn: Sydney C. Reagan

Texas Peanut Producers Board
P. O. Box 398
Gorman, Texas 76454
Attn: Wayne Eaves

Tom's Foods, Ltd.
P. O. Box 60
Columbus, Ga. 31902
Attn: George Jenkins
Peanut Purchasing & Selling

Virginia-Carolina Peanut Association
Lock Drawer 499
Suffolk, Va. 23434
Attn: W. Randolph Carter
Executive Secretary

Wilco Peanut Company
P. O. Box 291
San Antonio, Tx. 78206
Attn: W. G. Conway

INDIVIDUAL MEMBERSHIPS

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Australia

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P. O. Box 1185
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Stillwater, Ok. 74074

Barnes, George L.
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Stillwater, Ok. 74074

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Plant Pathology Department
University of Florida
Gainesville, Fl. 32601

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1228 Magnolia Avenue
Norfolk, Va. 23508

Beach, Minton, Jr.
North Carolina Peanut Growers Assn.
Oak City, N. C. 27857

Bear, John E.
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