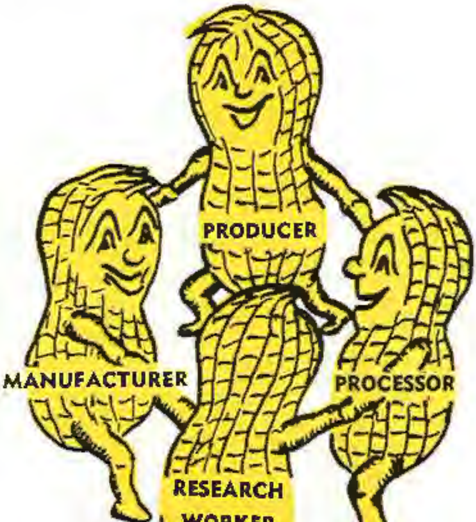
Proceedings

SECOND NATIONAL PEANUT RESEARCH CONFERENCE

Held At

NORTH CAROLINA STATE COLLEGE, RALEIGH, N. C.

AUGUST 13-15, 1962



Theme

"Peanut Progress Through Research"

Proceedings

PAPERS AND ADDRESSES

Second National Peanut Research Conference

North Carolina State College, Raleigh, N. C.

August 13-15, 1962

Sponsored by

National Peanut Council
American Potash Institute
Peanut Butter Manufacturers Association
Peanut and Nut Salters Association
Southwestern Peanut Shellers Association
Southeastern Peanut Shellers Association
Virginia-Carolina Peanut Association
Southwestern Peanut Growers Association
GFA Peanut Association
Peanut Growers Cooperative Marketing Association
Alabama Peanut Producers Association
Georgia Agriculture Commodity Commission for Peanuts
North Carolina Peanut Growers Association
Association of Virginia Peanut and Hog Growers
Southern Farm Equipment Manufacturers Association
Peanut Improvement Working Group

Co-Chairmen

Astor Perry, N. C. State College, Raleigh, N. C.
Joe S. Sugg, Chairman, Peanut Improvement Working Group,
Rocky Mount, N. C.

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PREFACE

The Second National Peanut Research Conference with the theme "Peanut Progress Through Research" was a sequel to the First National Peanut Research Conference held in 1957 and was inspired by the desire of members of all segments of the industry for another Research Conference on a national level.

The Peanut Improvement Working Group, representing all phases of the industry, including research and educational groups, accepted the task of coordinating this Conference. The Executive Committee of PIWG appointed a Program Committee who planned the program and solicited the cooperation of all organized associations and groups of the industry.

The Program Committee in carrying out the program accepted the invitation of North Carolina State College to hold the Conference on the campus of State College in Raleigh, North Carolina, and the facilities and personnel of the College added tremendously to the success of the Conference.

The objective of the Conference was to provide an opportunity for all research workers, educators, and people throughout the nation interested in the progress of the peanut industry to come together, exchange their views and share in the opportunities offered by such a Conference. Every segment of the industry was represented.

To those participating on the program, to those participating in the Conference, to those acting as sponsors of the banquets, to North Carolina State College, to others directly or indirectly concerned with the Conference, we offer our sincere expression of deep appreciation for a most successful Second National Peanut Research Conference. The presentations of all participants on the program have been reduced to writing and are compiled in these published proceedings which are available to anyone desiring a printed copy.

PROGRAM COMMITTEE

Extension Peannt Specialist North Carolina State College Raleigh, North Carolina	Astor Perry, Secretary, PIWG Co-Chairman
Execntive Secretary N. C. Peanut Growers Association Rocky Mount, North Carolina	Joe S. Sugg, Chairman, PIWG Co-Chairman
Best Foods Division Corn Products Corporation Bayonne, New Jersey	Edwin L. Sexton, Vice-Chairman, PIWG
Tidewater Research Station Holland, Virginia	Marshall Clark, Member, Executive Committee, PIWG

STATE OF NORTH CAROLINA

GOVERNOR'S OFFICE

RALEIGH

TERRY SANFORD
GOVERNOR

August 10, 1962

STATEMENT BY GOVERNOR TERRY SANFORD

On behalf of all the citizens of North Carolina, I am happy to welcome to North Carolina all the delegates attending the Second National Research Peanut Conference.

Peanuts long have been a mainstay in the agricultural economy of North Carolina. The processing of peanuts is an increasingly important element in the industrial economy of this State. I invite all processors to examine carefully the opportunities available for new plants in North Carolina near the fields where the tastiest peanuts in the world are grown.

I trust all of the delegates to this Conference will enjoy their stay here and will plan to return often to North Carolina.

With best wishes always,

Sincerely,

Terry Sanford

ADDRESS BY A. S. YOHALEM

Corn Products Corporation

New York City, N. Y.

Five years is not a very long time in the span of history. But five years can set or reverse a trend; they are a good round number in which to contain a plan or make a beginning; and they are just long enough, one after the other, to mount the pressure of impatience if all your hopes are not achieved within their number.

Five years ago you opened the first National Peanut Research Conference, prepared to solve all the problems of this industry. You've had some pretty solid results since—more than our industry could boast in any previous period of five, ten or more years. The decisions you made all stood the test of time. A round of compliments is in order. Today you have the same, the identical, and no other objectives than you have five years ago. But these were good objectives then, and they still are—to raise quality standards, and increase the consumption of peanuts. They don't get achieved just like that.

But let's not be satisfied with our results, either. I said they were good. And those who know me best will tell you that's quite a concession. I'm hard to please and make no apologies for it. When I am committed to something as deeply and fully as I am to the future of this industry, I can be mighty impatient for quick and complete results. And you should know that I reserve my severest criticisms for whatever has the strongest claim on my affections. My daughter understood this, thank goodness. Because when this young lady, one of the smartest in the world in my obviously objective opinion, would bring home her report card she'd never get complimented for a string of A's. But let me tell you, she caught the very dickens for an occasional B.

Is it just me, though? Are you satisfied that we are where we ought to be today?

Think of the enormous potential of the peanut. Bear in mind the preconditioned mouthwatering that the sight and smell of fresh roasted peanuts set off. Look at the enormous talent represented here in this room. Imagine the results if our Peanut Improvement Working Group, the End Users, the Universities, the Experiment Stations, State and Federal Laboratories, the Grower and the Sheller associations, all working together, would develop a peanut so perfect that the products made from it were downright irresistible.

The Peanut Improvement Working Group has spearheaded, coordinated, and guided research on peanuts since the Atlanta meeting. It has done an effective job of keeping the various segments of our industry—in each of the areas—informed of the latest research developments in peanut improvement. The End Users have, in addition to their regular research activity on finished products, expanded their programs on raw peanut improvement. For instance, over the last few years my own company has sponsored research activity on peanuts here at North Carolina State College, also at Oklahoma State University, and the Georgia Experiment Station.

The grower and sheller groups have raised funds in support of research projects such as those now being conducted at Texas A & M and the University of Georgia. Research Committees of the grower and sheller groups have worked closely with universities and Agricultural Experiment

Stations to develop new programs to improve peanut qnality. They have sponsored area meetings to discuss local problems with experiment station personnel in order that there might be wider application of recent research results.

The research scientists at the State and Federal Laboratories have not only furnished the facilities, the programs, and the investigators to carry forward programs, but they have been able to do the vital job of translating the polysyllables of research reports into plain and practical "how to" English. The Extension personnel and County Agents, too, have played a key role.

In fact, everyone has played his position jnst fine but still the team isn't winning the way it shonld. I am reminded of the strange situation in South Africa, a land from which I retnrned a little more than a week ago. There, despite what seems to them insurmountable cultural, ethnic, and similar problems, they are managing to build a strong and healthy economy that may one day achieve real greatness. How? Well, for one thing, they have not permitted their differences to intrnde on their economic decisions. They recognize an identity of interest strong enough to wrap themselves together in a figurative cape of good hope.

This industry has, or should have, one unifying objective and that is *quality*. I may give people reason to believe that I am slightly obsessed with the quality objective, bnt let me tell yon I come by it honestly. In my youth my study of law taught me that there is no snch thing as being a little negligent, a little liable, a little pregnant, or a little snbstandard. Something's either substandard or it isn't. The state of substandardness, like pregnancy, is an absolnte condition. My more recent experiences in marketing is that yon don't compromise quality—not if you want to protect the reputation of the prodnct—and when all else is said and done what does your product have *but* a repntation?

No, Sir. It's one thing to be "realistic" and say you can't achieve perfection. It's another to rationalize this fact into an apology, an excuse, a jnstification for snbstandard results. I say perfection is a perfectly proper goal, and if goals are intended to stretch performance, then a lesser goal is all too likely to compromise excellence.

Yet in spite of considerable progress, and notwithstanding the sharply increased level of research activity, onr indnstry mnst face the sobering fact that in some respects we are losing ground. Economic conditions have forced changes in the growing and harvesting of agricultural crops. The result has been a gradual deterioration in the quality and flavor of the peanut. Some of these changes have given us immature peanuts which, when roasted for peanut butter, or cooked for salting, develop bitter flavors and have contributed to shorter shelf life. Another change which has affected us adversely is the abusive use of artificial drying with resulting flavor impairment.

Until recently, new strains were developed primarily with a view to increasing yield per acre, ignoring the effect on quality and flavor. Of conrse, End Users must assume a major responsibility for failing to provide the plant breeder with guidance in the selection of varieties. No single quality factor influences the consumers' decision to buy our product as much as flavor. Improvement in flavor must be the overriding factor in the selection by the breeder of new varieties. The members of the Peanut Improvement Working Group have recognized the need to supply the breeders with better tools for measuring flavor. As yet, however, the breeders do not have a facility whereby these factors can be evaluated.

Strong evidence of the decline in peanut quality has been the relaxation in grade tolerances. In 1956 the grade tolerance on U. S. #1 Spanish Peanuts permitted only ¾ of 1% of damaged peanuts. Today peanuts containing 2% damage may be sold as U. S. Grade #1. In 1956 the grade tolerance on U. S. #1 Virginia Shelled Peannts was 1.25%. Today it is 2%.

The net effect of these deteriorating infinences are products offered to our customers of lower quality and flavor. Experts with long years of experience in this field have convinced me that today's peanut products are more bland with less real honest-to-goodness peannt flavor than there used to be jnst a few years ago.

Unfortunately peanut processors cannot change the basic character of the raw peanut. The quality of onr finished prodncts reflects directly the quality of the peanuts made available to us. If our raw materials are less than they should be, so are the prodncts we offer onr consumers.

Perhaps you caught the joker in that last sentence: I said *our* consnmers. Nothing makes them *ours* by right of inheritance. Nothing ensures that they will remain *ours* any longer than it is their pleasure to do so. If you gain any comfort from the thought that the changes in quality are difficnlt to detect because there is no basis of comparison with a more perfect prodnct, forget it. A good part of the consumer's memory is located right on her palate. And she knows only too well she's under no compulsion to eat peanuts.

The End Users in this industry are every bit as competitive with other spreads, snacks, and what-have-you, as they are with each other. No consumer you know ever made allowances for damage, conceded an average amount of dirt, or accepted a tolerance for mold in the product. No shopper ever will excuse poor flavor on the grouuds that the peanuts were immature or improperly dried. Indeed not. They expect, and are entitled to, perfection.

If yonr product has the best reputation in the world, the first unhappy experience on the part of the consumer may draw a surprised reaction, maybe a letter, the second a lasting rebnff iu the grocery store.

It is this same reasoning—the precariousness of any marketers' standing with cousumers and the absolute necessity for presenting her with the best possible product—that leads to my opposition to a Federal Food and Drug order which would establish a Standard of Identity for Peanut Butter. This order, if it becomes law, would specify the exact composition of Peanut Butter. It wonld list each ingredient which will be permitted. It would prohibit the nse of any iugredient not specified in the order. In its origiual form, the order would have banned the sale of many brands on the market today.

At a time when agricultnral practices are undergoiug drastic chauge—at a time when peanut research programs are growing by leaps and bounds—at a time when our entire peanut industry collectively seeks to adapt to the changes and to improve quality and flavor, this standard would declare a moratorinm on progress.

Peanut Butter is still in its infancy. Not too many years ago, peanut butter consisted only of grouud roasted peanuts with a little salt added for seasoning. Recall if you will that stabilized peanut butter, which ended oil separation and early rancidity, has only been available to the consumer nationally for about a quarter of a century. Peanut Butter was a relatively insignificant product until this improvement carried it to a position of prominence on the grocery shelves. The growth potential for Peanut Butter still staggers the imagination. The realizatiou of this potential would have a tremeudous impact on the entire peanut industry.

But how can we innovate, how can we modify and improve, how can we stimulate growth, when our formulae are frozen? Those of us who have lived with standards on other food products realize all too clearly that we can find ourselves in a virtual straight jacket.

We are all fully aware, of course, that there is no such thing as peanut uniformity, either chemical or physical, from type to type, crop to crop. The peanut is justifiably nicknamed "The Unpredictable Legume".

Ironically—because standards are designed to protect the consumer—it is the consumer in this instance who will be the primary loser. She is denied the fruits of progress, the constant increment of improvement that she has come to expect, and require, on all the products she buys. We in this room, of course, are also losers, because the removal of our incentive to experiment and improve amounts to disarmament and defenselessness in our fight for unrestricted growth.

Research has been directly responsible for the growth of our industry in recent years. Such action as is proposed is regressive for *all* peanut research. Surely, the peanut industry, dependent as it is upon peanut butter, has a tremendous stake in the outcome of this order. Those of us who are closest to this situation are greatly alarmed over the long range detrimental effects of this measure.

It is apparent that our destinies are closely linked together—and that we must jointly meet the many challenges facing us. I have outlined some of these challenges, which include overcoming existing deficiencies in our raw materials and creating new, different, exciting, flavorful peanut products which will capture the imagination of consumers.

I am immensely encouraged by the manner in which we are joining forces in an effort to meet these challenges successfully and by the real progress being made on many fronts. As you gentlemen are well aware, there are projects underway at a number of locations which will, when completed, prove beneficial to all of us.

Truly, the challenges are not area-wide but industry-wide. Fortunately, we have the talents of devoted, unselfish, and dedicated people, such as yourselves, responsible for the conduct of the research. Without these research efforts, we most assuredly would be a dying industry.

Five years may not be a very long time, but it has been time enough for you to make an excellent beginning. The reports reaching me are filled with the evidences of activity, work that is about to mature and pay off handsomely on your investment.

In my opinion, this industry has the promise of a great future. But I'd be willing to trade all the promises you can find in an election year for just three things: a unified integrated program of research that will raise the standards of quality for peanuts—closer cooperation and communications—and the strong conviction to get the job done.

I believe this conference is directing us toward the fulfillment of these goals.

I believe we are going places.

Plant Breeding

PROGRAM COMMITTEE

B. C. LANGLEY, *Stephenville, Texas, Chairman*
W. C. GREGORY, *N. C. State College*
WALLACE K. BAILEY, *U.S.D.A., Beltsville, Md.*

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PEANUT BREEDING RESOURCES

WALTON C. GREGORY
North Carolina State College
Raleigh, N. C.

Because of the relatively large number of paired combinations which may be obtained with a small number of factor pairs there has become extant among scientists and laymen alike some misconception of the vastness of breeding resources available to plant breeders. It should be remembered that even in those species with a large number of factor differences many of those differences are of minor or negative consequence in the economy of the commodity under improvement. Larger changes introduced by wider cross hybridization usually result in the transfer of large quantities of undesirable change interwoven into the complex of the hereditary mechanism of the hybrid. Therefore, any plant breeder is confronted with the problem of introducing change in some aspect of his plant material without carrying over undesirable changes in other aspects. Whatever resolution the individual breeder may bring to his particular problem and material, his resources are finite and exhaustible. They are not infinite and inexhaustible as some may have been led to suppose from the truly noteworthy accomplishments of plant breeding science. There are in fact, only three basic sources upon which a plant breeder may draw for genetic material in the breeding of peanuts. These are: 1) the hereditary differences among varieties of cultivated peanuts; 2) the differeuces that may be created artificially by the use of mutagens; and 3) differences which occur among the wild relatives of the cultivated species. Preliminary investigations at this laboratory and the brilliant work done by Sears and Elliott in the transfer of genic material from wild species to the cultivated form suggest that the combined use of the resources in numbers 1, 2, and 3 may yield even more significant results than the use of any of them alone.

In the cultivated peanut there are only four or five basic varietal groups upon which the breeder may draw even though there may be several thousand strains scattered throughout the four or five basic groups. Through hybridization and individual plant selection under the conditions of the different countries of the world to which the cultivated peanut has been distributed new hereditary constellations of proven value have been developed. It has been a major objective of the N. C. Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture Research Service, New Crops Branch, to make available to peanut breeders the total genetic resources of the genus. To this end the N. C. Agricultural Experiment Station in cooperation with the U. S. Atomic Energy Commission has explored the possibility of the creation of new and worthwhile forms of peanuts through radiation-induced mutation. Since 1936 the Plant Introduction Section of what is now the New Crops Branch of the Agricultural Research Service, U. S. Department of Agriculture, has introduced cultivated peanuts from every peanut growing country of the world and has sent four exploration expeditions into South America for the collection of wild and cultivated peanuts in their native home, one in 1936, one in 1948, another in 1959, and the fourth in 1961. In the latter two explorations through the cooperation of the Argentine government the number of known and undescribed wild species of peanuts introduced to the United States now exceeds the botanically described species by several hnndred percent. The difficult task of propagation and distribntion of these species to interested workers in the field of peannt breeding is still in progress. We have yet to learn how to grow them, whether they have characteristics of value to the plant breeder, to the peanut industry, and if so by what techniques these characteristics can be transferred to the cultivated form. The basic problems of giving the collections appropriate names, describing their chromosome cytology, and learning how to hybridize them among themselves and with cultivated peanuts all remain to be done.

In contrast to more thoroughly investigated crop plants the breeders of peanuts have before them an almost unplowed field. There are various reasons for this circumstance but one of them I suspect is that the field is difficult of travel. This being true we shall need to develop to its fullest the fourth and last resource available to the genetic improvement of peanuts and that is those persons engaged in this work. It is our task while exploiting to the maximum the individuality and resourcefulness of the imagination of each breeder so to collaborate among ourselves and with those members of society interested in the economic aspects of this crop that a maximum result is obtained. This is a challenge I think not only to the scientific ingenuity of each worker in his laboratory or at his station but especially to those engaged in the administrative organization of the breeding programs in the several agricultural experiment stations and in the federal department of agriculture. We face the real test in seeing to it that this fourth and human resource for the breeding of peanuts is so brought to bear on the other three resonrces as to maximize individual accomplishment, scientific significance, and economic yield.

(This talk was followed by a showing of kodachrome slides illustrating radiation-induced mutants, wild species of peanuts and South American landscape where the wild peanuts were collected.)

EVALUATION OF NEW PEANUT INTRODUCTIONS

WALLACE K. BAILEY[1]

My comments will be confined largely to the evaluation of new peanut introductions within our own cooperative peanut-improvement program. Our work involves breeding and genetic studies, variety evaluation, cultural practices, and disease investigations. We stretch our resources by working closely with the State Agricultural experiment stations, with formal working arrangements with State stations in Georgia, Alabama, and Virginia. In Georgia our geneticist furnishes leadership in cooperative breeding, variety evaluation and genetic studies. In Alabama our research agronomist has primary responsibility for cooperative variety and advanced breeding lines investigations and for certain cooperative studies relating to cultural practices and diseases. At the Tidewater Research Station, Holland, Virginia, our pathologist conducts intensive cooperative studies of peanut diseases.

In addition from Beltsville we provide leadership, seed aud other services for 20 to 25 cooperative regioual peanut variety tests each year, in which new varieties and advanced breediug lines are evaluated from the agronomic and other staudpoints in 9 States on what might be termed a national basis.

[1]Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland.

In onr cooperative peannt breeding and evaluation program we are seeking improvement in all major types of peanuts. One phase of this program involves the seeking from all parts of the world wherever they are available new lines of cultivated and wild peanuts. Peanut introductions from foreign countries come to us through the Plant Introduction Investigations unit of the New Crops Research Branch of our Crops Research Division, which along with North Carolina State College cosponsored the two recent peanut collection trips of W. C. Gregory in South America.

Seed of peanut introductions turned over to us by the New Crops Research Branch are planted first at Beltsville, Maryland, well away from the commercial peannt producing areas, where they are carefnlly screened for possible seed-borne diseases which might be uew to this country. Seed are planted 12 to 15 inches apart in the row so that each plant can be observed individually. The planting at Beltsville is checked carefully several times during the growing season by K. H. Garren, our peanut pathologist, and me and questionable looking plants are eliminated. Notes are taken on botanical type, plant growth habit, plant vigor, profuseness of branching, comparative earliness, pod and seed characteristics, and any differential prevalence of insects and diseases.

At digging several well-developed pods are pulled from each plant, and these pods together with all descriptive information recorded therefor are turned over to the Regional Primary Plant Introduction Station at Experiment, Georgia, for distribution to interested breeders, for storage for fntnre use, or for seed increase for snbsequent distribution and storage. We anticipate that after fnll characterization and evaluation, seed of all of these introductions together with information recorded for each of them will be deposited in the National Seed Storage Laboratory at Fort Collins, Colorado, where viable seed will be maintained indefinitely as insurance against possible loss at Experiment, Georgia, and elsewhere.

Peanuts are brought in from foreign countries primarily for use in breeding programs as possible sources of snperior genes for yield and other desirable agronomic featnres, resistance to diseases and insects, improved market qnality attributes, and enhanced nutritional properties, or for use in genetic studies designed to increase the efficiency of future breeding programs. Such use is a long-range aspect of peanut variety improvement.

However, beginning with the 1960 growing season, we have been making a special effort to exploit what might be termed a short-range aspect of peannt introdnctions by intensively screening them for suitability for use in the United States in their present form. Fnlly 85 percent of these new introductions appear to be pure lines or mixtures of genetically stable lines. Following the collection of pods at Beltsville to perpetuate the accessions, seed are saved from the most promising plants of each accession for use in onr evaluation program or in special emergency screening programs such as the one in Virginia for possible resistance to the sonthern corn rootworm for which we provided seed of more than 1,000 new accessions during the past 2 years through the Regional Primary Plant Introduction Station.

Altogether more than 2,000 new introdnctions or special selections from them have been involved in our stepped-np introduction evaluation program since its inception in 1960. At present more than 1750 new accessions or selections therefrom are in various stages of evaluation under the program. Among these are 130 new introductions which are being screened at Beltsville for possible seed-borne diseases new to this conntry; 303 lines growing at the Tidewater Research Station at Holland, Virginia, for seed increase for future agronomic evalnation; 479 Spanish in replicated yield trials in Georgia for first time; 467 Virginias, including small-seeded runners, in replicated yield trials in Alabama for first time; and some 200 Valencias seed of which are in storage because we could not find a suitable place to test them this season. In addition 30 Spanish, which ontyielded Argentine in replicated variety tests at Holland, Virginia, in 1961, are in replicated variety tests in both Texas and Oklahoma this season, and 12 new high-yielding Valencies of the Tennessee Red type are under test in New Mexico.

Finding introductions superior in yield to varieties now grown in this country and suitable for our purposes otherwise in their present form would be a rapid comparatively inexpensive method of peanut variety improvement. We have no way of knowing what the prospects are that such improvement might be forthcoming from our present program.

However, in preliminary yield trials involving more than 400 entries at Holland, Virginia, in 1961, 20 to 35 percent of the new accessions or selections therefrom outyielded standard commercial check varieties. Fnrther, the two more productive Spanish peanuts that are widely grown in the Southeast and in Oklahoma today, Argentine and Dixie Spanish, were brought in from foreign countries, and stocks now grown are essentially unchanged from those brought in. Dixie Spanish was in this country more than 20 years and Argentine more than 15 years before they were fully evalnated and seed of them began to be available to growers in appreciable volume.

We hope and are determined that snfficient resources can and will be brought to bear on our cooperative introduction evaluation program so that superior new peanuts among the new introductions can be identified and evaluated and seed of them will begin to be available to growers within 5 or 6 years after they reach this country. We are endeavoring to accomplish this without a major disruption of our cooperative long-range breeding program and genetic studies at Tifton, Georgia.

I wish to publicly acknowledge and express appreciation to the Georgia Agricultural Commodity Commission for Peannts and the Georgia-Florida-Alabama Association for their financial support of our cooperative peanut evaluation program in Georgia through the Georgia Coastal Plain Experiment Station. This support is helping ns to evaluate these new peanut iutroductions promptly without serious disruption of our long-range cooperative peanut improvement program in Georgia and the Southeast.

A recent development in the long-range aspect of our peannt improvement program might be mentioned appropriately here. For some 40 years peanut rust has appeared sporadically in portions of the Southeast and Southwest. The disease has usually showu up late in the season and its effect on yield and quality has not beeu determined. A few times in restricted areas the rust has approached epidemic status in its severity. During the past 10 or 12 years the disease has seemed to occur with increasing frequency. In 1961 rust was observed for the first time in North Carolina and Virginia.

Peanut rust is widespread throughout the islands of the West Iudies and in Central America and portions of South America. In some countries (Veuezuela and the Dominican Republic among others) rust is cousidered a major limiting factor in peanut production.

Little is known of either the disease or the organism which causes it. We have no way of knowing why rust is not a more serious problem in peanut production in the United States and no way of predicting when a new form of the rust that would persist and thrive under environmental conditions here might evolve.

In conntries where peanut rust is a serious problem, fungicides have not given acceptable economic control of the disease. Use of resistant varieties would seem to be the only feasible control. Of some 1200 to 1500 varieties, advanced breeding lines, and introductions of both cultivated and wild peanuts which have been exposed to rust from time to time in the United States, none has shown any measurable resistance to the disease.

Arrangements have been made with the Venezuelan Agricultural Experiment Station at Maracay to screen onr extensive collection of peanut germ plasm for possible resistance to rust. A shipment of 166 lots of seed of recent introductions from Northern Rhodesia has been made for the first planting in Venezuela. Negotiations are under way with the Federal Experiment Station at Mayaguez, Puerto Rico, for a similar rust screening program in Puerto Rico. We hope that both screening programs can proceed simultaneonsly and that eventually we can determine whether the form of peanut rust present iu these countries is the same as that which occurs in the southern United States. These efforts to screen our peanut germ plasm for possible resistance to rust are a modest beginning to forearm ourselves in the event that peanut rust becomes a major problem in the United States in the future.

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Soils and Fertility

PROGRAM COMMITTEE

D. L. HALLOCK, *Holland, Va., Chairman*
B. B. TUCKER, *Oklahoma State University*
H. T. ROGERS, *Auburn University*
FRED COX, *N. C. State College*

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PEANUT FERTILIZATION RESEARCH IN THE SOUTHWEST

B. B. TUCKER

Oklahoma State University
Stillwater, Oklahoma

All of the fertilizer research work of which I am aware in the Southwest Peannt area has been conducted with varieties of the Spanish peanut type. More than 95 per cent of the peanut acreage in the Southwest area is devoted to the production of Spanish Peanuts. The majority of the peanuts in the Southwest are grown in Oklahoma and Texas.

Peanut soils are usually lower in the essential plant-food elements than soils commonly devoted to most other crops. Because of their sandy nature they are almost always low in O. M. We think of our peanut soils as being low in all the essential nutrients—and they are low compared to our other soils—but they are higher iu some nntrieuts if compared to some of the Coastal Plains soils.

Average analysis of a soil on which many acres of irrigated peanuts are growu in Oklahoma is as follows: (Cobb saudy loam)

	Surface	Subsoil B-Horizon
pH	7.3	6.6
O.M.	0.5%	1.0%
P_2O_5	Very low	Very low
K	200 lbs/A	256 lbs/A
Mg	200 lbs/A	680 lbs/A
Ca	800 lbs/A	1840 lbs/A
C. E. C.	3.5 Meq/100 gms.	9.2 Meq/100 gms

The subsoil is markedly higher in available nntrients than the snrface and little or no fertilizer has been applied until recent years.

Our field fertilization results on peanuts are quite erratic, but certain geueralizations can be made:

1. Residual fertility seems to give better response than direct fertilization.
2. Apparently the potassium levels in our soils are usually high euough for optimum yields.
3. Phosphorus seems to be the first limiting factor in peanut prodnction on our soils.
4. Nitrogen fertilization will iucrease yields on some soils and in some years, providing high yields are obtained (above 3,000 lbs/acre).

What Are Peanut Farmers Using?

Farmers are using higher rates of fertilizer on peanuts than ou any other commonly grown field crop. The grades of fertilizer vary from 10-20-10 to 16-48-0 with 5-20-20 beiug the most common, especially in the irrigated areas. It is also a common practice to add from 200 to 800 ponuds of agricultural gypsum per acre even though large quantities are often present in the irrigatiou water. We are in au embarrassing position because we have not been able experimentally to substantiate the ueed for the commonly used fertilizer ratios on peanuts. We do know that peanuts remove considerable qnantities of the essential chemical elements from the soil and these elements must be returned if peanut yields are to be maintained.

We think that it is necessary to take a new look at our research program in peanut fertilization. There is no reason to assnme that continued field experiments similar to the ones we have been conducting will give different results in the future than have been obtained in the past.

I think we need to take some basic approaches to the problem of peanut nutrition. We need to study the physiological effects of fertilizer elements on the peanut plant. Also, shouldn't investigators study more thoroughly the influence of added nntrients on the morphological development of the peannt plant?

There are also some general questions that might be raised in connection with soil fertility-peanut type interactions. The most important of which might be: Can plant breeders select plants exhibiting a more favorable response to fertilizer elements? To answer this qnestion, perhaps, we need to consider the following:

1. Are there differences in rooting patterns of peanut types?
2. Do all kinds of peanuts possess abont the same amonnt of roots?
3. Is there a relation between peanut yield and quantity of root growth?
4. What relation is there between varieties and root energy reserves (i.e., do varieties differ in nutrient uptake capacity)?
5. Why do some varieties outyield other varieties (i.e., what yield components are responsible for increased yields)?

We mnst know whether or not differences in responses to fertilization are genetically controlled and if so, how?

A question that many breeders would apparently like to resolve immediately is: At what level of soil fertility should variety tests be conducted?

To answer many of the questions raised will require close cooperation and team effort between the plant breeder and investigators in soil fertility.

STATUS OF SOIL FERTILITY FINDINGS AND PROBLEMS NEEDING RESEARCH ON PEANUTS IN THE ALABAMA-FLORIDA-GEORGIA AREA

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Dr. W. K. Robertson of Florida Agricultural Experiment Station reported that their fertility research findings could be summarized as follows:

1. Peannts need lime.
2. This crop responds to residnal P & K—as good if not better than to direct fertilization.
3. K in row may injure stand.
4. Rotations are better than coutinuous planting and will reduce nematodes.

Mr. Bob Carter of the Georgia Experiment Station summarized the Georgia work as follows:

1. Response to PK and trace elements has been erratic.
2. Molybdennm has been observed to produce green foliage but no effect on nut yields.

3. There is less disease on peanuts after grass sods.
4. More research is needed on the place for the peannt crop in the rotation and methods of application of P & K.

The early data in Alabama on response to plant nntrients were snmmarized in bulletin 302 issued in December, 1956. A more recent experiment which was concluded in 1961 was designed to determine whether peanut yields conld be maintained on continuously cropped land by any fertilizer or organic matter treatment. Results from this 12-year experiment can be summarized as follows:

1. The soil (Norfolk sandy loam) on which the experiment was conducted tested medinm in Ca, P, and K at the outset. The experiment was conducted six years with Dixie Runner and six years with Ga. 119-20 varieties. Twelve year average yield increases were as follows:

Treatment	Yield Increase
PK	656
Lime	1377
Gypsum (after lime)	56
Basic slag (after lime)	119
Corn stalks	225
W. legumes	35
Yield of best treatment	2657

2. There was no response the first three years to any of the fertilizer or lime treatments.
3. There was no response to trace elements or to application of nitrogen in this test.
4. Broadcast applications of P and K were equal to row placement.
5. There did not appear to be any interaction of varieties on fertility treatments.

General Conclusions (from all data reviewed):

1. Nitrogen—frequently there is a vegetative response but no response in nut yields (earlier tests showed a response on Spanish).
2. Phosphorus—usually there is no response to direct application of phosphorus fertilizers unless the soil tests extremely low for most crops.
3. Potassium—there is seldom a response to potassium unless the soil level of this element is qnite low and the fertilizer is properly applied; too much potassinm will lower the quality of the nuts and improperly placed potassium will injnre the stand of this crop.
4. The peanut crop is extremely sensitive to soil calcium level in the pegging zone.
5. It is usually more economical to fertilize other crops and grow peanuts in the rotation.
6. The peanut crop is not as unpredictable as once believed if adequate soil data and treatment practices are recorded.

Recommendations for new research:

1. In the field—experiments to calibrate soil test chemical methods against residual levels of P & K in the soil.
2. Under controlled environment (growth chambers)
   - A. Study root development patterns as affected by:
     - a. Soil compaction
     - b. Al and/or Ca concentrations
     - c. Nutrient placement
   - B. Study moisture stress effects on root development, disease, pegging and interactions with mineral nutrients.

SOME MANAGEMENT AND SOIL FERTILITY FACTORS AFFECTING THE YIELD AND GRADE OF PEANUTS GROWN IN NORTH CAROLINA AND VIRGINIA

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Many factors are known or suspected to affect the yield and grade of peanuts. In soil fertility studies, as in other forms of research, all aspects of production mnst be evaluated. Management factors in particular may be closely interrelated with the fertility of soil and are factors which can be controlled and tested. Examples of these are plant population and time of harvesting. These factors are being tested in this area, in some cases by several departments. I would like to present a partial summary of results on such management factors first and then present some recent information from soil fertility studies.

Plant Population

Low plant population dne to poor stands or very wide rows is undoubtedly one of the major management factors limiting peannt yields. Decreasing the width of rows and the spacing of plants in the row often have been noted to increase yields. Nelson and Welch (1948) found yield increases more common from reduced row width than from spacing plants closer in the row with Virginia Bunch peanuts. Neither factor, however, appeared to affect the grade of the variety nsed. Recent plant population experiments with NC2 and NC4x, both semi-bunch peannts, (Cox, 1961), indicate that the increased yield was fnrther accompanied by an improvement in grade. This was expressed by a higher percentage of ELK (Extra Large Kernels). In Virginia, however, Shear and Miller (1960) used Jumbo Runner peannts and noted that the percentage ELK decreased with increasing plant population in one of the three years of their stndy.

The lack of agreement in the effect of increasing plant population on the grade of peanuts among the three series of experiments jnst cited is probably due to variety differences. The varieties tested differ considerably in growth habit. Althongh increasing the plant population increased the yield of all varieties, the grade was generally improved only from the semi-bnnch and not from the trne bunch or runner.

Time of Harvest

Another management factor presently receiving considerable research attention is the time or date of harvest. One of the most arbitrary decisions a prodncer must make is when to dig his crop. This decision, however, can be one of the most critical in determining maximum retnrn per acre. Several studies have been condncted trying to develop a method of prediction which would help the producer in deciding when to dig. Length of growing season, effective heat nnits, and shell discoloration have been applied. Thus far predictions from these factors have not been sufficiently accurate to be completely reliable. Experiments on this snbject, however, have shown some interesting relationships between the date of harvest and the yield and grade of the crop. The results of one snch experiment are shown in Fignre 1. The maximum yield was obtained when the crop was harvested October 2. At that time the grade factors were still increasing. The maximum percentage SMK (Sound Mature Kernels) occurred 11 days later, on October 13. The percentage ELK reached a maximum on October 18, which was 16 days after yield and 5 days after SMK had been at an optimum. According to the data of this test, a producer should harvest two days after the optimum yield for maximum return. This date is considerably before the grade optimum, and the observation, if substantiated, creates an interesting research problem as to how the time lag in grade optimum may be minimized or how the crop may be harvested in its entirety at the grade optimum.

Soil Fertility

Now let us consider some soil fertility factors affecting the yield and grade of peanuts in this area. Peanuts appear to benefit more from a good fertility level of the soil than from direct application of fertilizers. Normally the phosphorus content of cultivated soils in the Coastal Plain is adequate for peanut production due to their long history of fertilization. In addition, applications of nitrogen have not increased yields as long as the plants are well nodulated. The macronutrient most likely to be critical for peanut production is potassium. If no potassium is applied for several years yields may be drastically reduced. Yield reductions of 700 lb./A. have been noted due to allowing the soil K level to become depleted. (Reid, 1960; Cox and Reid, 1961) It is very important, therefore, to maintain the soil potassium level.

In this area it is recommended that soil potassium be maintained by applying more than normal to the previous crop in the rotation. Peanuts utilize the residual K and produce as well or better if the potassium is applied in this manner than if it is applied directly. Brady and Colwell (1945) noted that direct application of K combined with inadequate gypsum reduced the percentage SMK. Recently it has been demonstrated that direct application of K may reduce the percentage ELK (Hallock, 1962). A reduction of up to 4% ELK was noted when a portion of the fertilizer was applied to peanuts rather than all to corn in a corn-peanuts rotation.

Another grade factor which is associated partly with soil fertility is concealed damage of non-pathological origin. Two forms of damage have previously been noted in other areas (Wilson, 1947; Harris and Gilman, 1957). One type is exemplified by an enlarged cavity between the cotyledons, often with a severely depressed area near the center of the face, which may be discolored. This type has been termed "hollow heart". The other form of damage is a darkening of the "germ" of the seed and has been termed "black heart".

These two forms of damage were noted in three soil fertility experiments in North Carolina in 1960 (Cox, 1961). Of the many nutrient oral treatments applied in this series of tests, calcium and boron were found to be beneficial. Calcium, from lime or increased rates of gypsum, decreased black heart considerably and hollow heart moderately. On the other hand, boron applied either before planting or as a late-season spray decreased hollow heart considerably and black heart moderately. Neither of these nutrients, applied singly or in combination, completely eliminated concealed damage, but they were applied at reasonably low rates.

Preliminary investigations on concealed damage in North Carolina and Virginia point out that it occurs sporadically. That is, it is not present every year in peanuts grown on the same field. Since management and fertility have been held constant on these fields, environmental factors must contribute to its occurrence. At the present time it appears that rainfall distribution, notably low rainfall during the fruit-filling period, is important. The effect of such factors and their interaction with the fertility of the soil on the occnrrence of concealed damage mnst be critically assessed. With this information and a knowledge of the metabolic processes involved in the kernel, concealed damage may be eliminated in the near future.

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Questions

1. Q: It is known that lime and other materials often contain trace amounts of boron. Is it possible that the effect of lime and gypsnm in your experiments are really dne to calcium or could it be due to an impurity of boron?

   A. The calcitic materials were not analyzed for boron but the peanuts prodnced were. Lime or gypsnm had no effect on the boron concentration in the kernel whereas applying ½ lb. B/A. nearly doubled it.

2. Q. Were the effects of a calcium source and boron additive?

   A. Yes. There was no interaction between the effect of calcium sonrce and boron source; that is, the materials acted independently in decreasing the amount of concealed damage.

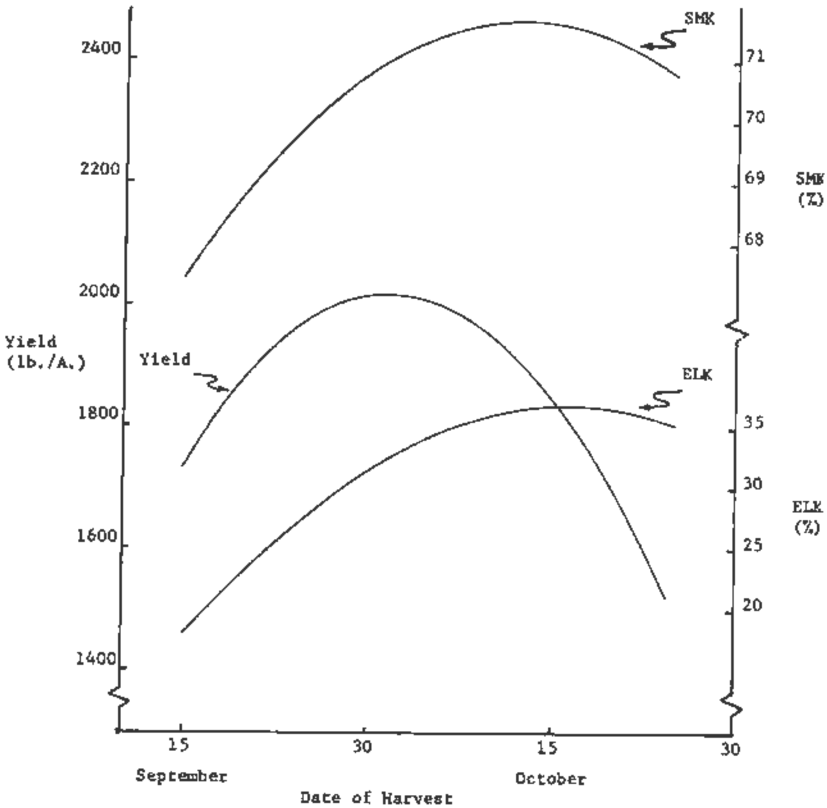

Figure 1. Effect of date of harvest on the yield and grade of NC2 peanuts (N. C. Border Belt Tobacco Research Station, 1961)

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Plant Pathology

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REACTION OF MARKET-GRADE FACTORS TO DISEASE CONTROL PRACTICES

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in cooperation with

Tidewater Research Station of Virginia Agricultural Experiment Station, Holland, Va.

Introduction

In 1957 I combed the scientific literature seeking data to determine what relations, if any, there are between diseases and disease control measures and peanut quality. I reported my findings at the first of these research conferences. The literature on this phase of peanut quality has not been enriched since 1957. Therefore, "market grade" is substituted for "quality" in the title of this discussion; and the discussion is based on the only pertinent data I found, which are data from my own research, still largely unpublished.

Six years ago I began determining the percentages of (1) fancy pods, (2) extra-large kernels, (3) sound mature kernels, and (4) damaged kernels in the crop of peanuts harvested from my Holland, Va. studies of the peanut diseases stem rot and pod rot. All of us know that the market grade factor "damage" measures a condition which can greatly influence quality of end product. The other factors, if they are related to quality, are related in more complex and poorly defined ways. Certainly there must be some relation between percentage of mature kernels in a lot of peanuts and the flavor of those peanuts after roasting. There must be some relation between size and shape of kernels and the flavor, texture, appearance, etc., of these kernels after blanching and roasting. So far as I know, no one has yet developed methods of accurately measuring and expressing these relations.

But, since support or loan price is based on market grade, procedures for determining market-grade factors are highly standardized. My discussion will perhaps have more meaning if we agree on two premises: (1) Potential price per ton is a graphic means of measuring and expressing the sum total of influences on market-grade factors. (2) Market grade is, at present, the only approach to a sound basis for predicting quality of end product.

Stem-Rot-Control Practices and Market Grade

Peanut stem rot caused by a soil fungus can be a very destructive disease. The fungus involved has two peculiarities: (1) Its growth is greatly stimulated by trash trapped among the emerging peanut stems. (2) The fungus develops rapidly in wounded and weakened plant tissue. Much peanut tissue is bruised and smothered when soil is piled into the row to control weeds.

A combination of two practices for controlling stem rot has evolved from the Virginia stem rot study and other studies. These practices, now widely recommended in the southeastern and Virginia-Carolina peanut belts, are (1) complete and irreversible burial of trash in land preparation, (2) control of weeds without throwing soil into the peanut row.

Descriptive names "deep covering" and "non-dirting" were assigned to these practices. They are the two "do's" of figure 1. In the Virginia study deep covering was compared with surface mnlching, which gave almost no covering of trash; and non-dirting was compared with cultivation involving enough dirting of plants to control weeds.

Use of both "do's" gives high yield and low level of disease (fignre 1). Failnre to bury trash increases diseases slightly but lowers yield a good bit. Dirting cultivation increases disease greatly and lowers yield considerably. Combining the two "don'ts" gives the greatest increase in disease and the greatest decrease in yield.

Now let us see whether this slacking-off on the disease control practices has any effect on market grade.

When average potential price per ton, calculated from market grade of these same crops, is superimposed on the yield trend, one sees that as yield goes down so also does market grade (figure 2). But, obviously, the effect of stem rot control practices on market grade are slightly more complex than their effects on yield. The distinct plateau in the market-grade trend indicates that the two "don't's" of snrface mulching and dirting, when acting independently, have about eqnally depressing effects on grade.

If 6-year trends for market-grade factors are presented on one chart, the chart becomes complicated but, actually, only the trends are important (figure 3). Every trend except the slight downward trend for fancies was classified "significant" by statisticians. Thus, there is a significant upward trend for extra-large and sonnd-mature kernels. The trend for damage is interrupted at mid-point, but the net effect is a desirable downward trend. The plateau in the trend for price is explained by the lack of any effect of cultivation on damage. Within each type of cultivation (dirting or non-dirting) the trend for damage is downward. Thns, the deep covering of trash must in itself be responsible for the decrease in damage.

The dashed lines in the extra-large section of figure 3 show the trends for each year. In 1957 July and August rainfall was very low in this test field. Possibly the reversal of the general trend in 1957 was dne to low rainfall. Certainly the reversal is a typical example of "an exception which proves a rule." The upward climb of the general trend for extra-large kernels would be steeper if the 1957 data were not used in determining the general trend.

Six years' statistically sound data show that in comparison with almost no covering of trash and conventional weed control by dirting cultivation the stem rot control measures of deep covering and non-dirting had distinct and measnrable effects on market-grade factors. Probably these effects may be summarized most succinctly in terms of increases in potential price per ton (figure 4).

The Virginia study tested these stem rot control measures on 11 different peanut varieties and all varieties responded similarly to progressive change from the two "do's" of stem rot control to the two "don't's". When the decrease in yield for five of the varieties is plotted against the increase in stem rot (figure 5), the curves come close to being parallel, which is evidence of a strong similarity in response among these varieties. The 4 years' market-grade response of Virginia 56R (rnnner) (figure 6) is remarkably similar to the response of Virginia Bnnch 46-2 (figure 3). When 3 years' data for the three other varieties of fignre 4 are charted, the same distinct trends are evident.

The practices of deep covering and non-dirting, which were originally developed and tested as disease control practices, may also be classified as cultural practices; and, as such, variants were given prominent play in recently publicized "package-plans" for improving peanut production.

Pesticides and Other Soil Additives Vary In Their Effects on Market Grade

I have 1 year's data bearing on the relation between chemical disease control measures and market grade. I prefer to avoid use of preliminary data in a discussion of this type, but we desperately need to know the effects the various pesticides have on the edible parts of our food crops.
Some help may come from even a feeble beginning in the form of an attempt to relate market-grade variations to the use of different chemicals.

In 1961, while studying pod rot of peanuts, I developed 16 different treatments by incorporating, singly or in mixture, 1 herbicide, 3 nematocides, 7 fungicides, 2 insecticides, and very high rates of landplaster and dried cow manure into the soil of a field with a history of severe peanut pod rot.

In figure 7 the treatments are lined-up in order of effectiveness in reducing pod rot, and yield and market grade results for the same treatments in the same order are presented beneath the pod rot results.

Percentages of sound pods at digging varied from 96 to 70. But, even with the extremes somewhat out of line, no treatment departed markedly from a visually determined straight line of best fit. Yields varied from 2100 lbs./acre to 1100 lbs./acre. Market grades, as expressed by potential price per ton, varied from $210/ton to $150/ton. The lines for trends in yield and grade were drawn as parallels to the line for trend in pod rot reduction. By-and-large as pod rot reduction dropped-off, so also did yield and market grade. However, some sharp departures from the trends are bases for interesting speculations.

I hope to pursue the subject of relation of soil additives to market grade of peanuts further. I am sure that some of my colleagues entertain the same hope. Meanwhile, perhaps means of obtaining a scientific measure of flavor, taste, texture, etc., of peanut and products will be evolved. Even preliminary data such as these (figure 7) need evaluating. A fourth line in figure 7 showing a basis for predicting "consumer acceptance" would be a great help in such evaluations.

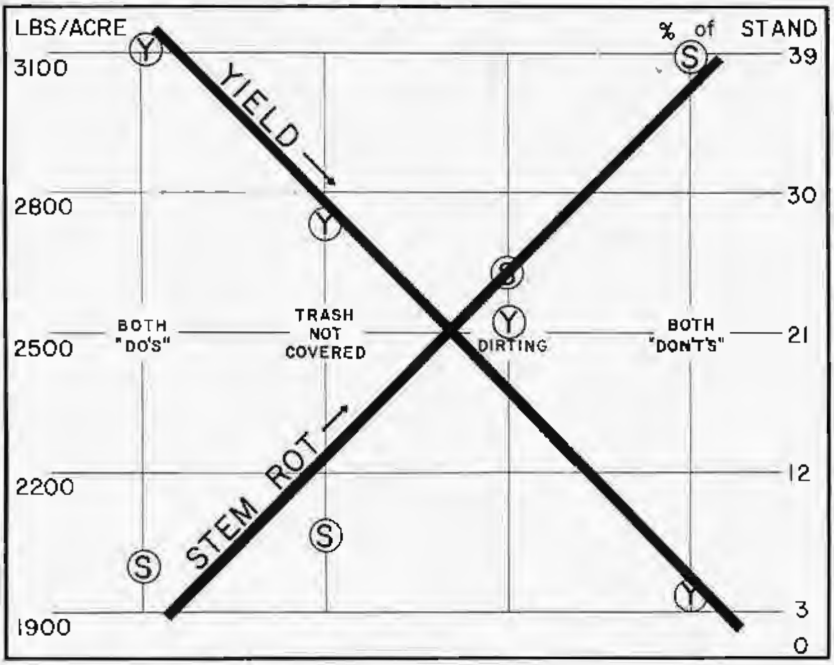

Figure 1. Effects of change from recommended procedures for stem rot control (the "do's" of deep covering of trash and non-dirting cultivation) to contrasting procedures (the "don't's" of surface mulching of trash and dirting cultivation) on yield of Virginia Bunch 46-2 peanuts and percentage of stand developing stem rot over a 6-year period at Holland, Va. "Y's" and "S's" locate 6-year averages for yield and stem rot.

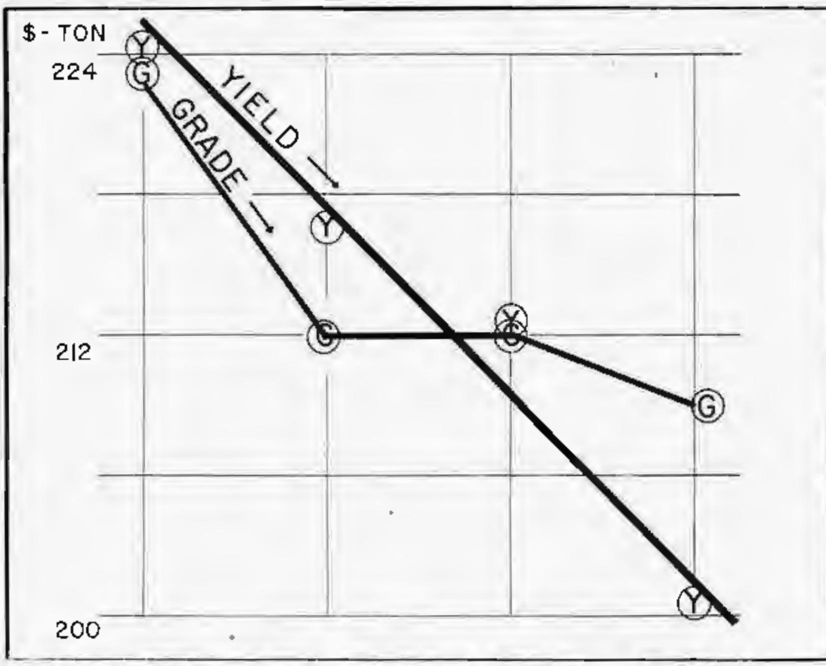

Figure 2. Effects of change from recommended procedures for stem rot control (the "do's" of deep covering of trash and non-dirting cultivation- to contrasting procedures (the "don't's" of surface mulching of trash and dirting cultivation) on yield of Virginia Bunch 46-2 peanuts and market grade as expressed in potential price per ton over a 6-year period at Holland, Va. "Y's" and "G's" locate 6-year averages for yield and potential price per ton. (For legend for yield portion of chart, see figure 1.)

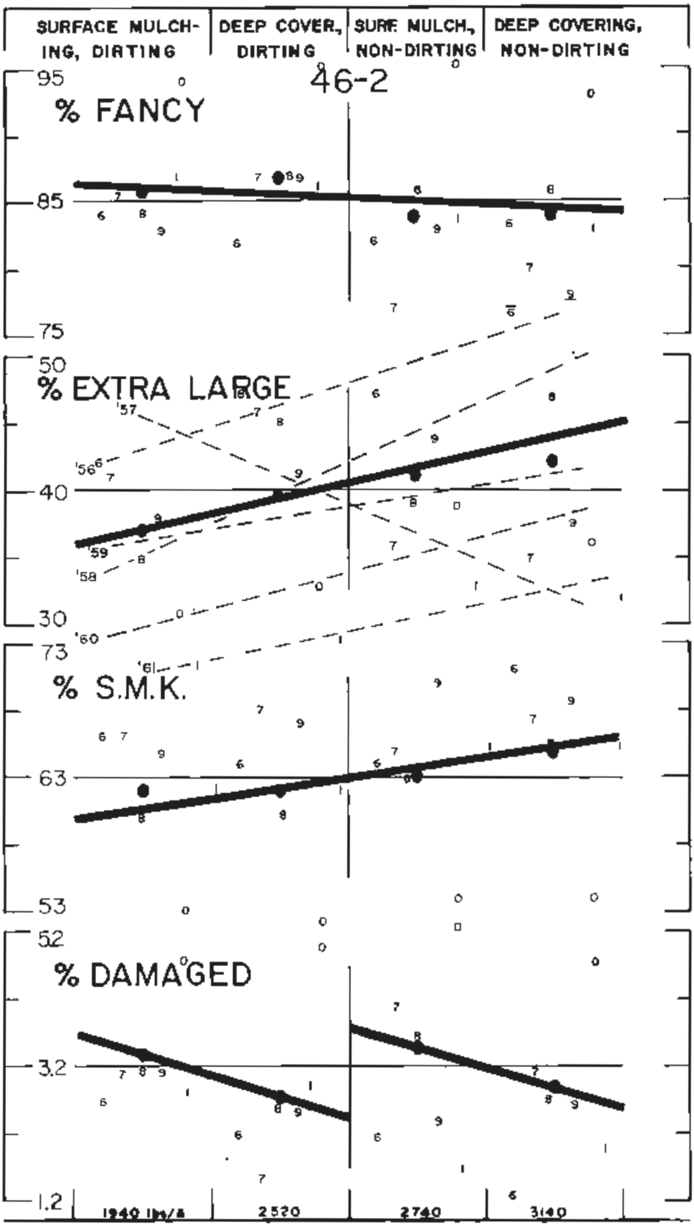

Figure 3. Relation of four treatments to market-grade components of Virginia Bunch 46-2 peanuts over a 6-year period in Virginia. 6 = 1956 results, 7 = 1957 results, etc. Thinner horizontal lines = averages of all observations. Black ovals = averages of all results for treatment. Heavy lines = linear trends of treatment averages. Dashed lines = trends by years in percentages of extra-large kernels.

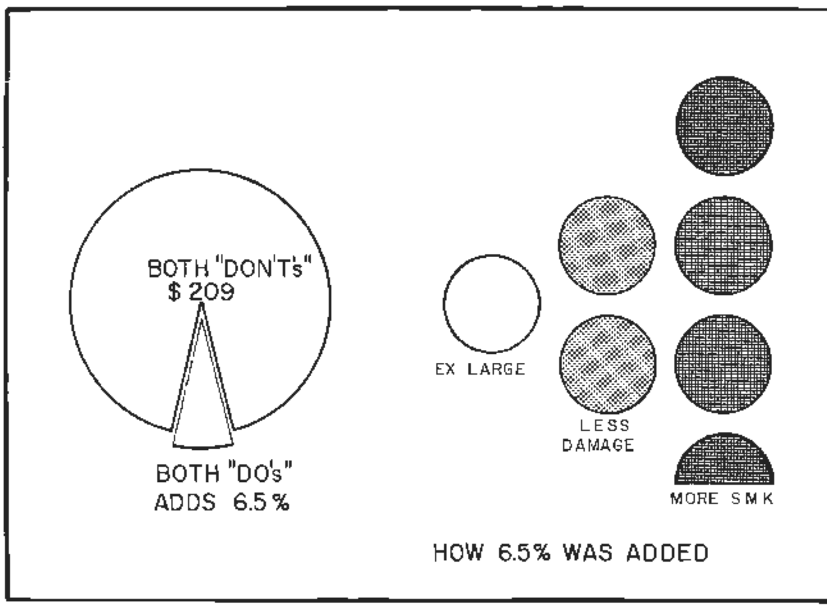

Figure 4. Breakdown of contribution of individual market-grade components to the 6.5% greater potential price per ton (see figure 2) for peanuts produced by both recommended procedures for peanut stem rot control as compared with peanuts produced by both contrasting procedures (or "don't's" of stem rot control). Each small disc = one percent.

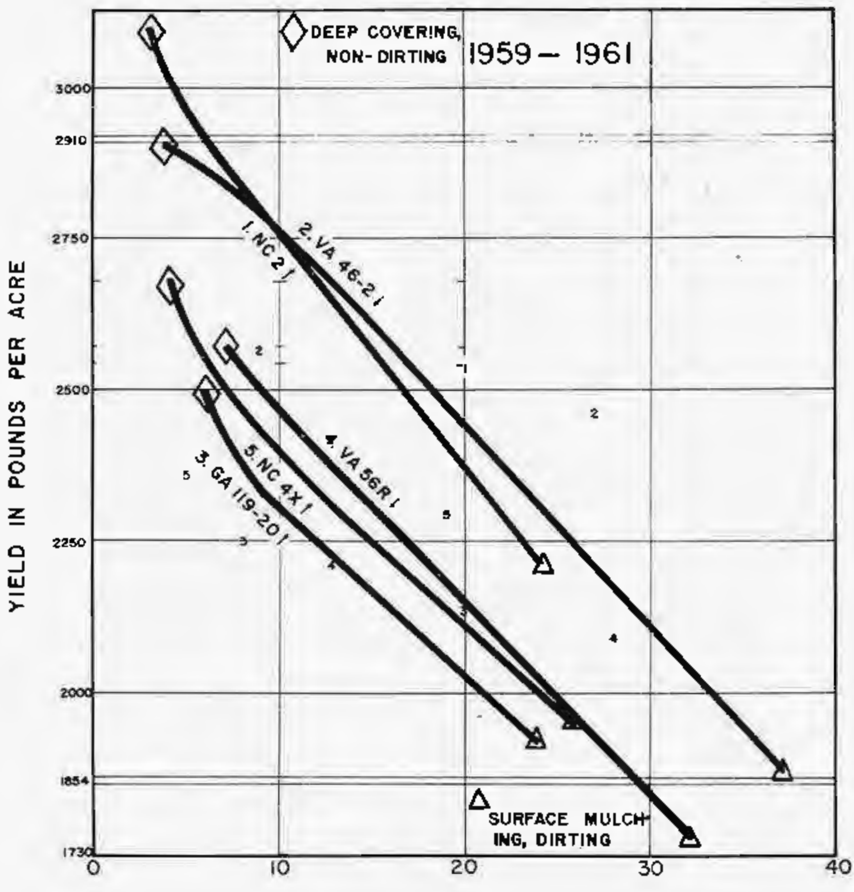

Figure 5. Effects of deep covering of trash and non-dirting cultivation on yield and stem-rot development contrasted with effects of surface mulching of trash and dirting cultivation, for five varieties of Virginia peanuts for 3 years at Holland, Va.

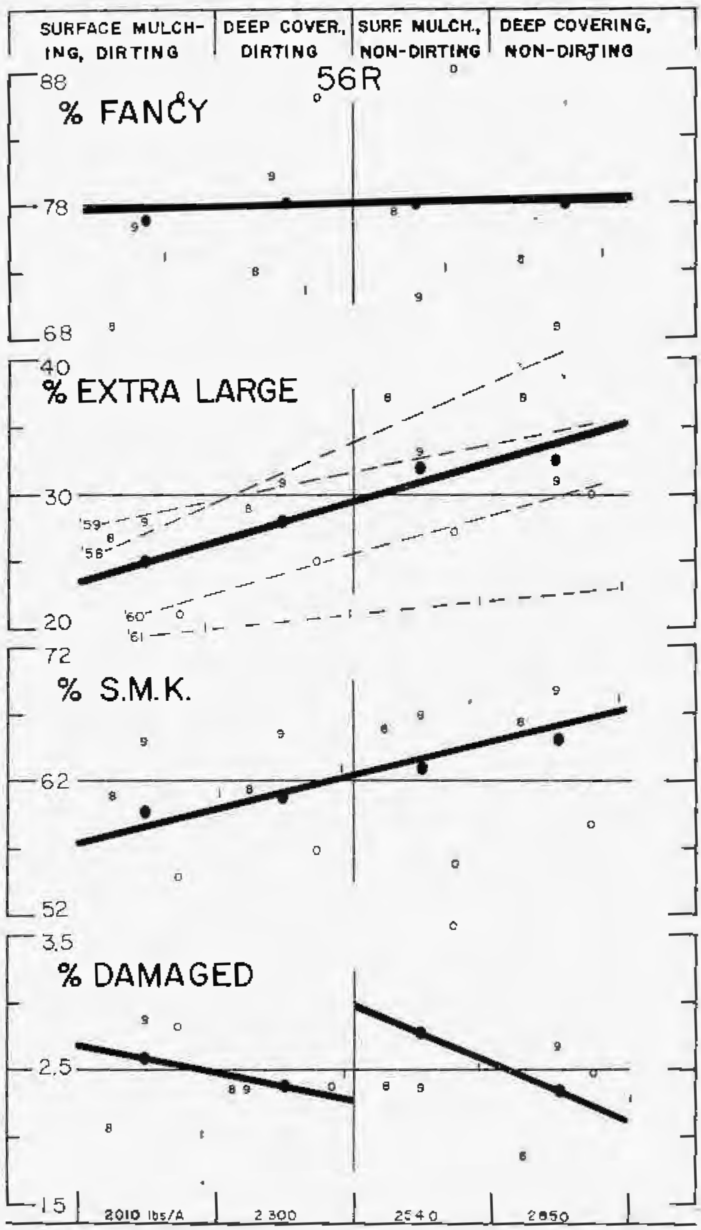

Figure 6. Relation of four treatments to market-grade components of Virginia 56R peanuts over a 4-year period in Virginia. 8 = 1958 results, 9 = 1959 results, etc. Thinner horizontal lines = averages of all observations. Black ovals = averages of all results for treatment. Heavy lines = linear trends of treatment averages. Dashed lines = trends by years in percentages of extra-large kernels.

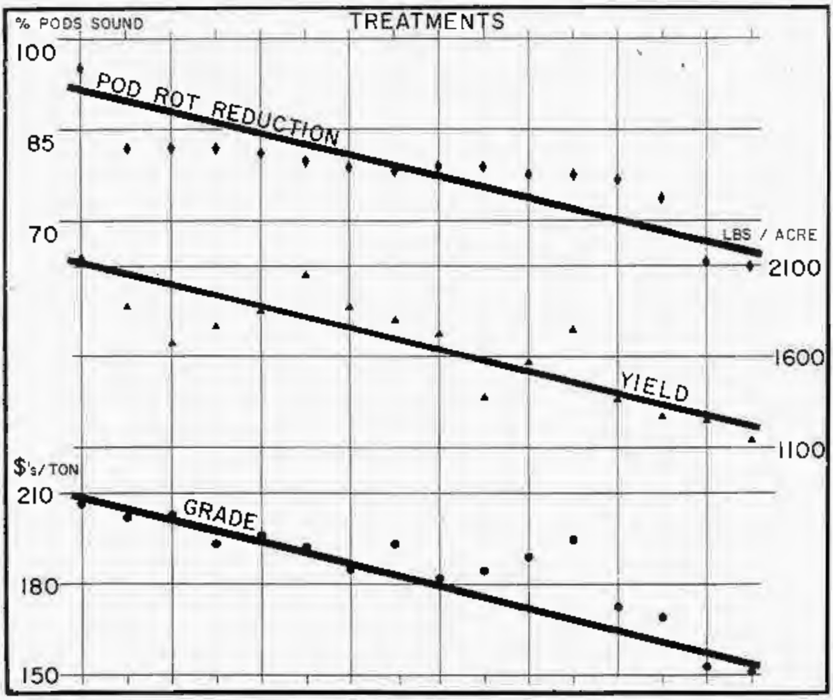

Figure 7. Effects of 16 different soil-additive treatments on pod rot, yield, and market grade of Virginia Bunch 46-2 peanuts at Holland, Va., 1961.

STORAGE FUNGI—MOLDS AND PEANUT QUALITY

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It might not appear that this paper is not a plant pathological topic and is unrelated to the effect of "Diseases on Quality of Peanuts." We tend to think of peanut diseases as the farmer's problem associated with the growing plant and producing the raw peanut. Let us remember that the peanut, even after curing and storage for a period of time, is actually an embryonic plant. Deterioration of peanut seed by fungi (molds) in a slightly humid environment has a progressive, injurious, and physiological effect on the seed, in that the germination may be abnormal or impaired and quality changes such as off-flavor or discolored oil may occur, resulting in economic losses. Thus, deterioration of seed by fungi has many of the attributes embodied in a concept of plant disease.

Evidence accumnlated in the past 30 years has demoustrated that the microflora is an important factor in the deterioration of stored seed. Christensen (1) and Semeniuk (8) have reviewed the seed microbiological research relating fungi to deterioration in stored graius, soybeans, and cotton seed. Studies of peanut seed microflora in the South have dealt primarily with the fungi associated with concealed damage (6, 11) and seed discoloration (7).

Investigations on the relationship of the microflora to deterioration in stored peanuts were initiated at Auburn University in the fall of 1954 on a cooperative basis with Dr. H. S. Ward, Jr., a plant physiologist who had worked for 10 years on curing and storage problems of peanuts and other seed crops. After a method for the quantitative determination of molds in peanuts was developed (2), the dominant species of fungi were found to be *Aspergillus tamarii*, 5 species of the *A. glaucus* group, *Penicillium citrinum*, *P. funiculosum*, *A. candidus*, and *Cladosporium sp.* The relative abundance of these fungi iu stored Dixie Runner peanut seed was reported (3). The fungi isolated were identical or closely related taxouomically to the fungi reported by Christensen and his coworkers.

These fuugi appeared to have several unusual characteristics. Optimum temperature for growth of some species was around 30°C. whereas others grew best at 39°C. Furthermore, these fungi grew profusely ou agar media containing high salt (16-32%) or high sucrose (20-40%) concentrations, but poorly on a standard laboratory medium such as potato-dextrose agar. The medium used by Thom and Raper (9) for the identification of the *Aspergillus glaucus* group is Czapek's solution agar with 20% sucrose, whereas most species of Aspergilli and Penicillia are cultured on a 3% sucrose agar.

Subsequent investigations have been directed a) to the role of a given fungus species in causing biochemical changes in the peanut aud b) to determine which components of the peanut the fungus ntilizes as substrate. When pnre cultures of 10 storage fuugi were grown ou antoclaved shelled peanuts (4, 10), the principal biochemical chauges noted were a loss in organic matter, a complete degradation of sucrose, a decrease in total oil, an increase in free fatty acids, and changes in oil color and odor (flavor). Significant chauges for 9 of these fungi were not observed for peroxide values, total carbonyls, total tocopherols, iodine value, or protein nitrogen. Thus, the main type of deterioration was a hydrolytic rancidity of the oil, which resnlted in a darkening of oil color to an orange to deep red-orange. Odor of the oil, as an evaluation of flavor, changed from the typical nutty peanut odor to off-odors, rangiug in character from flat and bland to strong acrid-burnt and moldy varying with the fnngus species.

One species of fungus appeared to cause an oxidative type of rancidity as well as hydrolytic, since an increase in total carbonyls and peroxide values was recorded repeatedly. The precise and complete significance of this particular finding has not been determined.

The biochemical changes produced by these storage fungi in autoclaved peanuts were of the type associated with seed deterioration. The next step would probably be the determination of the peanut components being utilized by these fungi to find the particular chemical changes associated with off-flavor, oil discoloration, and other evidences of qnality deterioration.

These storage fungi grew profusely on a water extract of 10% peanut meal some producing large amounts of acids. Five of the 10 species grew on an agar medium containing 2 to 4% homogenized peanut oil as the only carbon source. Seven species were cultured on a liquid mineral salts medium containing oleic acid, the major component of peanut oil, as the sole carbon source. In this study (5), well developed mycelial mats were prodnced in 7 to 30 days in flasks held at 30°C. with continuous shaking.

Investigations are being continued to determine the growth of these fungi on linoleic, stearic, and palmitic acids as well as other components of peanut oil and the peanut seed. Additional studies will be initiated on the organic acids, alcohols, esters, and other metabolic products of fungi growing on peanuts and peanut hulls.

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NEMATODE DISEASES OF PEANUTS AND THEIR EFFECTS ON QUALITY

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There are three major genera or groups of nematodes that are serious pathogens of peanuts. These include certain species of the root-knot, root-lesion, and sting nematodes. Species of other genera are sometimes associated with poor growth and severe chlorosis (3) and undoubtedly feed on peanut roots and pods, but conclusive evidence of their pathogenicity is lacking.

There are two species of the root-knot nematode that attack peanuts. These include *Meloidogyne hapla* and certain populations of *Meloidogyne arenaria*. Both species cause stunting of growth, chlorosis of foliage, root restriction, gall formation, and pod damage in the form of swellings and necrosis. Quality and yields are greatly affected, the degree depending upon the population level of the nematode.

Above ground symptoms of the root-lesion nematode, *Pratylenchus brachyurus*, are similar to, but usually less noticeable than, those caused by the root-knot nematode; that is, stunting and premature yellowing of foliage. Root and pod damage is of a different nature. According to Good, Boyle and Hammons (2), large populations of the root-lesion nematode *P. brachyurus* were found in elongating pegs, mature pegs, pods and roots. Lesions on the mature shell, or pericarp, were purplish-brown and could be distinguished from lesions resulting from soil microbial decomposition by their darker color and distinct boundaries. That is, lesions associated with the lesion nematode did not fade gradually into the healthy surrounding tissue, as with microbial decomposition. These investigators found large numbers of adults, larvae and eggs in these lesions. Nematode populations were reduced by soil fumigation and this was correlated with a reduction in necrotic peg and shell lesions.

The sting nematode, *Belonolaimus longicaudatus*, also causes a very severe stunting of growth and yellowing of the foliage. Root systems are greatly reduced by the feeding of the nematode. Subsequent decay of the roots and pods caused by secondary invaders results in a general discoloration. High populations of the nematode can, as indicated by pod and kernel size and percentage of damaged kernels, seriously affect quality and yield.

Control Programs.—The general principles of control for plant-parasitic nematodes are essentially the same as that for other pathogens of crop plants. These include crop rotation, certain cultural practices, breeding for resistance and use of chemicals. All of these methods of control have been successful for certain nematode species-crop combinations. The success of the control method employed is highly dependent upon what is known about the particular nematode to be controlled; for example, its ability to attack and reproduce on the various crops grown in the area. Some nematodes are highly host specific and can be successfully controlled by rotation with crops which the nematode does not attack. The emphasis in such cases is usually directed toward the control of a particular nematode species and usually has little effect on decreasing population levels of other species. On the contrary, population levels of other species may be increased considerably. In actual practice, the grower concerns himself with the control of those nematodes which infect and cause serious damage to his cash crops.

Another method of control, mentioned above, is that of breeding for resistance. In the case of peanuts, there is no major effort at present toward developing peanut varieties resistant to the major nematode parasites listed above. However, Cooper and Gregory (Unpublished) and Miller (Unpublished) have screened the available *Arachis hypogaea* germ plasm including Spanish, Valencia and Virginia types for resistance to *Meloidogyne hapla* and *Belonolaimus longicaudatus*, respectively, and found no appreciable resistance to these pests.

Since the early 1940's, several field nematocides have become available and tests have shown that these are effective against the nematode pathogens of peanuts and are available at prices economical to the peanut grower. Tests conducted over the past several years in Virginia (4), North Carolina (1, 5, 6), and Georgia (2), have proven the effectiveness of these fumigants in controlling the various nematodes, and as a result of this control, improving quality and with heavy infestations tripling yields.

Tables 1 and 2 below illustrate the effectiveness of 1, 2-dibromo-3-chloropropane (DBCP) and *0, 0*-diethyl *0*-2-pyrazinyl phosphorothioate (Zinophos) respectively, when applied to soil heavily infested with the sting nematode. In all cases where the nematode population is controlled, quality is increased as indicated by high support prices. Coupled with this is a 2 to 3 fold increase in yield. Acre values give an even greater contrast as a result of the combined effect of improved quality and increased yields.

SUMMARY

1. There are at least three genera known to cause extensive damage to peanuts. These include certain species of the root-knot, root-lesion, and sting nematodes.
2. There is little or no evidence of resistance in peanuts to these nematodes.
3. Control by rotation is in most cases slow or completely ineffective because of the susceptibility of crops commonly grown in rotation with peanuts to the nematodes present. The exception to this is *Meloidogyne hapla*, which shows fair control with 2 years of a non-susceptible crop such as corn and/or cotton between peanut crops.
4. The most effective and expedient method of controlling the nematode pathogen is through the use of nematocides.
5. Reduction of the nematode populations by nematocides results in improved quality, higher yields and greater acre value to the grower. In moderately to heavily infested fields the cost of the treatment is small compared to the increase obtained.

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Table 1. Quality, market price, and value per acre of peanuts as influenced by rate and time of application of DBCP to sting Nematode infested soil.

Treatment Date	Rate (Gal./A)	Quality evaluation: Percent fancy sized pods	Percent indicated kernels/100 gm. pods: SMK[a]	DK[a]	OK[a]	Support price cents/lb.	Calculated value/acre
Check	0.0	15	58	11	6	6.00[b]	$ 43.94
Preplant	0.5	38	66	7	3	9.65	248.10
(4/15/58)	1.0	41	72	4	1	11.49	289.89
	1.5	46	71	4	2	11.43	404.16
Postplant	0.5	34	62	10	3	6.00[b]	82.62
(6/9/58)	1.0	38	69	3	4	11.31	196.91
	1.5	43	72	3	1	11.66	236.81
Postplant	0.5	25	61	10	4	6.00[b]	42.24
(7/11/58)	1.0	34	66	7	2	9.44	129.80
	1.5	50	69	2	4	11.42	137.38

[a]SMK = sound mature kernels; DK = damaged kernels;
OK = other kernels.
[b]Quality too low to qualify for support price; valued at 6.00 cents/lb. for oil stock.

Table 2. A Comparison of Zinophos Treatments of Sting Nematode Infested Soil on Sting Nematode Populations, Plant Size, Disease Control, Yield, Grade, and Acre Value of Peanuts—1961.

Zinophos formulations and lb/acre		Nemas/pint soil[1]	Sting nematode symptoms on			Yield lbs/A	Grade cents/lb	Value dollars/A
			Plant size[2]	Roots[2]	Pods[2]			
Non-Treated	0	75	1.12	1.00	1.25	1026	10.80	$111
Granular	1	50	3.25	3.00	3.25	1948**	11.18	218
Granular	2	25	4.38	3.54	3.71	2363**	12.25	289
Liquid	2	25	3.19	3.54	3.21	1913**	11.01	211
Granular	3	38	4.12	3.83	3.54	2387**	12.26	293
Granular	4	6	3.56	4.04	3.62	2283**	12.42	284
Liquid	4	56	3.62	3.62	3.42	2185**	12.51	273
Granular	6	31	4.62	4.25	4.04	2604**	12.64	329
Liquid	6	13	4.31	3.96	3.96	2384**	12.34	294
Correlation with yield (r)		—	0.974	0.961	0.975	—	—	—
Regression of yield on (b)		—	435	453	552	—	—	—

[1]Estimated number of sting nematodes per pint of soil based upon Baermann funnel assay, 7/18/61.

[2]The ratings were from 1 (for most severely stunted plants or most severe symptoms) to 5 (for normal plants or no sting nematode sym 9/19/61.

**Significant at .01 level.

Entomology

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FOLIAGE INSECTS OF PEANUTS[1]

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At the first Peanut Research Conference, which was held in Atlanta in February of 1957, Dogger (1957) of the North Carolina station discussed the nature of insect damage in peanuts, the effects of insects on quality, and the effects of insecticides on quality. His paper covered soil and foliage pests as well as insects of peanuts in storage. Prior to the first Conference, Arant (1951) summarized the available information on peanut insects and pointed out some needs for additional information on peanut insects. It is our purpose here to review developments on foliage insects that have occurred since the first Conference.

I. Defoliators

As reported previously by Dogger (1957), Arant (1951), and various other workers on peanut insects, the most important defoliators *per se* are the velvetbean caterpillar, *Anticarsia gemmatilis* (Hbn.); corn earworm, *Heliothis zea* (Boddie); and the fall armyworm, *Laphygma frugiperda* (A. and S.). No important new defoliators have appeared on the scene within the last five years.

There has been surprisingly little data published within the last five years on control of defoliating larvae on peanuts. Most peanut growers are using the old and effective recommendations of DDT or toxaphene and/or cryolite or methoxychlor near the end of the season. DDT and toxaphene are more effective than cryolite or methoxychlor but residues on the vines that are frequently used for forage have been a problem. Probably one of the most significant developments in connection with insecticidal control of defoliators is the use of Sevin. Although I failed to find any published data on the use of Sevin for worm control on peanuts, there is an U. S. D. A. approved label for its use. Eden and Yates (1960), Wilson (1958), Callahan *et al* (1960), Luckmann (1960), and others have shown Sevin to be highly effective against earworms and other insect pests on other crops. There is no time limitation on the use of Sevin on peanuts. It may be used right up until harvest and the hay can still be used for forage.

King *et al* (1961) from Texas have reported some interesting data on the influence of simulated chewing insect damage to peanuts (table 1). They concluded that removal of more than one-half of the foliage of the peanut plant reduced yields of peanuts on dry land, and that defoliation late in the season may result in lower yields on both dryland and irrigated soils.

II. Others

There have been some interesting developments on some foliage insects of peanuts other than defoliators since the last Peanut Research Conference.

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[1]Prepared for Second National Peanut Research Conference, Raleigh, N. C. August 13-15, 1962.

Table 1. Effects of simulated chewing insect damage to peanuts by foliage removal 53 and 94 days after planting, 1960 (from King et al 1961).

Treatment	Age at leaf removal	
	53 days Yield	94 days Yield
Top 1/3 removed	544	530
Top 2/3 removed	342	309
Top entirely removed	73	23
Not disturbed	696	613

1. Tobacco Thrips, *Frankliniella fusca* (Hinds)

The recommendations for thrips control on peanuts in most of the peanut-areas for several years have been DDT. In general, the recommendations have been to apply the insecticide when thrips injury becomes prevalent. DDT, as well as most other commonly nsed insecticides, will kill thrips. Application of insecticides when injury is prevalent has seldom resulted in yield increases except where stands were threatened.

Systemic insecticides, it appeared, would be a natural for thrips control. There has been considerable work done on this problem. Procedures and resnlts have varied in different locations.

In Texas, King *et al* (1961) in 1958 compared DDT, parathion, phorate, and Di-Syston by applying granules to peanuts 39 days after planting but before thrips injury was noticeable (table 2). In 1959 the work was repeated, the insecticides being applied when thrips injury became noticeable. They conclnded that applications of insecticides for thrips control resulted in improvements in foliar growth and appearance a week or so after treatment but that thrips control did not result in increased yields or accelerated maturation of peanuts.

In Virginia, Bousch (1962) obtained excellent thrips control with the systemics phorate and Di-Systou but phytotoxicity was so severe the work was abandoned. Campbell (1962) obtained excellent control of thrips on peanuts with phorate and Di-Syston in the furrow at planting time as well as with other treatments (table 3). As yet, no yield data are available.

Table 2. Thrips infestation levels and yields of peanuts treated with granular insecticides, 1958 (from King et al 1961).

Treatment	No. thrips per 10 terminals days after application			Yield lb./a.
	6	13	20	
DDT, 3 lb./a.	7.1	11.7	47.5	537
Di-Syston, 1 lb./a.	7.9	1.7	7.1	537
Parathion, 1 lb./a.	5.4	5.0	32.1	479
Phorate, 1 lb./a.	4.6	2.5	24.2	696
Check	56.2	30.8	84.6	566

Table 3. Thrips control on peanuts with systemic and contact insecticides. North Carolina, 1962 (from Campbell 1962).

		Average number thrips on 20 plant terminals			
		Gates County		Lewiston	
Insecticide[1]	Toxicant lb./acre	# 1 June 8	# 2 June 18	# 3 June 21	June 14
Phorate	1	0.3	0.3	0.7	0.7
Phorate	2	0.3	—		—
Di-Syston	1		14.0		—
Bayer 25141	1				45.7
Bayer 25141	2			2.0	24.0
CL 43064	1		37.0		48.0
CL 43064	2			7.7	27.7
CL 43064	4				5.0
Nia. 9205	1				64.3
Nia. 9205	2				32.3
SD 3562[2]	1				194.0
SD 3562	2				134.0
SD 3562	4				57.3
Aldrin	2			241.3	72.0
DDT[3]	1	4.3		4.3	3.3
Malathion[3]	1	8.7		15.3	5.7
Untreated	—	176.3	417.0	413.7	231.7

[1] and [2] Applied in furrow at planting May 10 (Lewiston) and May 18-23 (Gates Co.).
[2] E. C.
[3] Applied as a foliage spray.

In Alabama we have had very good results on thrips control with systemic insecticides. Both phorate and Di-Syston have looked good. Most of our work has been with phorate because residue data and U. S. D. A. clearance have been obtained for phorate. For several years we have obtained good yield increases with phorate (table 4) (Eden and Brogden 1960). Yield increases obtained with one pound of phorate granules in the soil at planting have averaged about 200 pounds per acre. Significant correlations have been obtained between numbers of thrips and yields of peanuts. We have done a considerable amount of research on methods of application, fertilizer mixes, etc., which time does not permit us to go into here. We have been recommending one pound of phorate per acre under peanuts for two or three years. This year over 12,000 acres of peanuts were treated with phorate in Alabama. Over 20,000 acres were treated in North Carolina.

2. Red-necked peanut worm, *Stegasta bosqueella* (Chambers)

Arthur *et al* (1959) conducted experiments on this insect for four years and published their results in 1959. They studied damage to the plants, control with insecticides, and relationship of control to peanut yields. Peanuts were heavily infested with larvae late in the season. Larvae retarded terminal growth by feeding on unopened leaflets and on the meristematic region of the buds. Three or four applications of dusts of 10% DDT, 20% toxaphene, 2% eudrin, 2% dieldrin, or 5% Guthion were highly effective in controlling the insect. Malathion and heptachlor were less effective. No significant gains in yield resulted from control of the pest.

3. Lesser cornstalk borer, *Elasmopalpus lignosellus* (Zeller)

The lesser cornstalk borer does severe damage to peannts dnring some years. We have had more reports of damage from this insect this year on peanuts, as well as corn, peas, and soybeans, than ever before.

Table 4. Peanut Yields Following Soil Treatments at Planting Time with Phorate, Wiregrass Substation.

Phorate rate/a.	1955[1]	1956[1]	1957[2]	1958[2]	1959[2]	1960[2]	1961[2]
lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
0	1,762	1,584	924	1,339	325	1,601	1,712
0.5				1,496			
1.0		1,853	1,127	1,623	334	1,822	1,924
1.5							
2.0				1,673	352		
2.5		1,772	1,358				
3.0							
3.5							
4.0				1,615			
5.0	2,278	2,019					
LSD	325	None	218	257	None	200	70

[1]Dust in row at planting.
[2]Granular in row at planting.

Reynolds *et al* (1959) reported that the most effective cultural control of the insect in California consisted of destroying infested host plants within a field some weeks prior to planting; however, this work was on crops other than peanuts. In the case of sorghums, which are often planted flat for flood irrigation, a well-timed irrigation decimates the population sufficiently that satisfactory stands are usually obtained. They obtained successful control on several crops, though peanuts were not one of them, with preventive applications of sprays or granules of endrin, aldrin, heptachlor, and dieldrin. Applications made at plant emergence were slightly superior to those made at planting.

Some of the most promising work on the lesser cornstalk borer in peanuts was reported from Texas by Cnnningham *et al* (1959) and Harding (1960) and was summarized by King *et al* (1961). They fonnd that several insecticides reduced lesser cornstalk borer injury. The only ones that have been approved by F.D.A. are DDT and parathion. They showed that DDT was effective for control under conditions of heavy infestations. Sprays as well as granules gave control. DDT at 1.5 pounds per acre as a spray was applied with a nozzle on each side of the row to cover the lower stems and a band of soil 6 to 8 inches on each side of the row. Best results were obtained with applications which began with full-grown larvae were observed and repeated at 3- to 4- week intervals as needed (table 5).

We have had several experiments in Alabama on control of the lesser cornstalk borer in peanuts. We have never had in experiments what we consider severe infestations but have had some infestation almost every year. In one test this year we were able to rednce the number of larvae somewhat with several different insecticides (table 6).

4. Mites

Spider mites attack peanuts and, if infestations are severe enough, may cause defoliation. King *et al* (1961) in Texas reported damage to peanuts from the desert spider mite, *Tetranychus desertorum* Banks. In their work one application of one pint of 25 per ceut parathion emulsifiable concentrate or 25 pounds of 93 per cent sulfur dust per acre effectively reduced the mite infestation. Sulfur had the best residual effect. Sulfenone, aramite, and malathion were less effective.

We have had some infestation of mites in Alabama this year. As yet the species is undetermined. We have some control underway but, as yet, we have not completed the work. We did get excellent control of this species for a month on some other peanuts with 0.25 pound of demeton per acre. We had to retreat the peanuts one month after first application.

5. Potato leafhopper

The potato leafhopper, *Empoasca fabae* (Harris), has long been recognized as an important insect on peanuts. As in the case of defoliators, there has not been much work published on control of the insect on peanuts since the last Conference. Most peanut growers have been using the old and effective recommendations of DDT and toxaphene.

The potato leafhopper at one time, 10 to 15 years ago, was an important pest in Alabama. In the past few years there have been almost no significant leofhopper infestations on peanuts in our state.

The systemics seem a natural for control of this sucking insect on peanuts. Unpublished data from North Carolina (Campbell 1962) indicate very good control of the insect with applications of phorate or Di-Syston at planting.

Table 5. Per cent damaged peanuts on October 3 following the varying dates of application of DDT, Stephenville, Texas (from King et al 1961).

Time of application	Per cent injury
July 1	3.1
July 29	5.2
August 27	2.7
July 1, 29	3.2
July 1, August 27	1.2
July 29, August 27	2.8
Check	8.9
L.S.D. (.05)	3.5

Table 6. Numbers of live lesser cornstalk borers in peanuts following treatments with various insecticides. Faulkner Farm, Headland, Alabama, 1962.

Treatment[1]		Average No. Live Larvae	
		Per 10 examined on 6/22	Per 20 plants on 6/27
Untreated check		9.0	3.5
Endrin, 0.25 lb./a.,	e.c. spray	9.0	1.2
DDT, 2 lb./a.,	"	7.0	2.5
Dilan, 2 lb./a.,	"	8.0	1.2
Thiodan, 2 lb./a.,	"	7.8	1.0
Parathion, 0.5 lb./a.,	"	8.8	0.8
SD 7438, 1 lb./a.,	"	7.5	1.2
Dimethoate, 1 lb./a.,	"	7.5	0.0
DDT, 2 lb./a.,	granules	8.0	1.2
Dilan, 2 lb./a.,	"	7.0	0.2
Endrin, 0.25 lb./a.,	"	9.2	0.2
Sevin, 2 lb./a.,	"	9.0	0.0
AC 43064, 2 lb./a.,	"	8.0	0.0
Heptachlor, 1 lb./a.,	"	8.2	1.2
Diazinon, 1 lb./a.,	"	9.0	0.8
VC-13, 1 lb./a.,	"	8.5	0.8
Zectran, 2 lb./a.,	"	8.2	0.0
Phorate, 1 lb./a.,	"	7.0	0.5
Di-Syston, 1 lb./a.,	"	8.2	0.0
Toxaphene, 4 lb./a.,	"	8.2	0.0

[1]Treatments were applied on 6/20 and plowed under on 6/21.

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SOIL INSECTS

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The topic, "Soil Insects", is especially timely as we are currently faced with the resistance of a number of these pests to previously recommended and effective iusecticides. As an example, in most of the Virginia-North Carolina belt and in southwestern Georgia, the southern corn rootworm can no longer be controlled by chemicals of the chlorinated hydrocarbon group. The economic importance of this particular pest is enormons. It is estimated that the peanut farmers of Virginia alone lose an estimated three million dollars annually when rootworms are nncontrolled.

On a national scale, a similar pattern appears to be developing with virtually every producing area reporting resistance of soil pests to previously satisfactory control methods. As would be expected, new chemicals have already been found which adequately control many of these resistant populations. Almost all of these newer chemicals belong to the organic phosphate group of pesticides.

From past experience, it seems reasonable to expect eventual resistance to these "new compounds," in which case we will probably continue to move from chemical group to chemical group.

Perhaps at this stage, when we have an adequate but costly chemical control measure for rootworms, it would be wise to thoroughly investigate other methods of control as well as learning more of the insect pest's biology. Wonld it be possible to develop varieties of peanuts resistant to insect attack, or could cultural practices be altered and insect injury reduced? How about the possibility of more effectively using biological control agents such as introduced or naturally-occurring insect parasites and predators? It would appear foolhardy to continue to rely on pesticides alone when such an array of possible control techniques exist.

INSECT CONTROL IN STORED PEANUTS

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Prevention and control of insect infestation aud damage in stored peannts is one of the more difficult problems in stored-product entomology.

Peannts are subject to damage and contamination by stored-prodnct insects from the time they are dug out of the ground until they are consnmed. Dense popnlations of insects result from the abundant food supply, the long warm season in which many generations of insects can develop, and, in most areas, the absence of severe winter cold that might kill back the infestations to low levels. The design and construction of many warehouses make proper insect-control measures difficult or impossible to apply. Some of the same insects that attack peanuts also feed on grain, animal feeds, and other stored products, which may harbor infestations in and around storage warehouses throughout the year.

Research on the control or prevention of insect infestations in stored farmers stock peanuts has been given added emphasis since 1952 at the Tifton station of the Stored-Product Insects Branch, Market Quality Research Division of AMS.

Our studies have established several important factors: (1) Two general classes of insects attack stored peanuts—moths that feed in the surface layers, and beetles that work deep in the bulk. (2) Beetles are responsible for most of the kernel damage during storage. (3) The peanuts are generally infested with moths or beetles by the time they arrive at the warehouse. (4) Old sacks used to catch and store peanuts coming from the combine can be a source of insect infestation. (5) Warehouse sanitation aids in decreasing insect populations and consequent damage.

The most important of the several species of moths that feed in the surface layers of peanuts are the Indian-meal moth and the almond moth. The adults are readily observed flying about and are often very numerous in the headspace of the warehouse or between stacks of bagged peanuts. The larvae crawl over the peanuts and bags, leaving a webbing on the surface.

The saw-toothed grain beetle, the red flour beetle, the cigarette beetle, the cadelle, and the cornsap beetle also infest peanuts. These beetles work deep in the bulk and may not be observed until very heavy infestations are present. They are responsible for a large part of the kernel damage during storage.

Surveys of hundreds of truckloads of peanuts arriving at warehouses during the harvest period revealed that insects were already present in practically all peanut stocks as received. Usually, the level of infestation was low, but it was enough to start an infestation in the warehouse. Nearly every case of heavy infestation on arrival was found to have occurred while the peanuts were held for drying on the farm near infested feed or grain.

Infested burlap bags are sometimes used to catch the peanuts coming from the combine. It is important to use only cleaned or fumigated bags for this purpose, especially if the peanuts are to be stored in sacks. Some warehousemen have made available a fumigation service to farmers interested in having infested bags fumigated. Combines, truck beds, drying trailers, and other equipment, if not cleaned up, are potential sources of insect infestation.

Cleanup and application of a residual insecticide to the warehouse and surrounding areas before load-in of the peanuts have proved to be important factors in controlling insects. Peanut warehouses often have quantities of old peanuts lodged on ledges and beams, between double-walled partitions, and in elevators, dump pits, conveyors, and other places. When warehouse sanitation was first required, several tons of peanuts were cleaned from some of the warehouses. This food supply would carry over a large population of stored-product insects until the new-crop peanuts were harvested. Today warehousemen recognize the importance of a good sanitation program and start their warehouse cleanup as soon as the buildings are emptied.

When this research began, the most common method of harvest consisted of digging, stacking, and picking at a later date. Although some beetles were present within the bnlk of peanuts harvested in this manner, the major storage problem was damage and contamination of the surface layers by moths. Control efforts, therefore, were largely directed to the elimination of the moth infestations.

Initially, an aerosol treatment using synergized pyrethrum was developed for application in the overhead space. Later, a wettable powder spray applied periodically over the surface of the peanuts proved more effective against the moths than did the overhead space treatment. The residual deposit left by the surface spray served as a protective barrier to infestation from outside sources. Although this treatment was effective against flying moths, the peanuts still had many worm cuts because of the larvae of beetles and moths below the surface. The damage or worm cuts lowered the quality and grade of the peannts and added the expense of picking out damaged kernels, thus causing a substantial loss to the industry.

The transition in harvesting practices from stacking peanuts to mechanical harvesting from windrows made the insect problem in storage more severe. The combine harvester increased the number of cracked pods and loose-shelled kernels. This made an abundant and readily available food supply, which caused an increase in the numbers of beetles and consequent damage within the bnlk. Of greater importance, the earlier date at which combined peanuts are stored provided more time for insects, especially moths, to develop a heavy infestation in the warehouse before the cooler weather of winter arrived. The extra time in storage—from August to October—was sufficient for a complete generation to develop.

Entirely different control procedures are required for infestations on the surface and in the bulk of the peanuts. Instead of an attempt to control only the moths, the approach to the problem became one of eliminating an existing beetle infestation in farmers stock peanuts at load-in and preventing further infestations of beetles and moths from developing during storage. During the past two years, the Tifton Stored-Prodnct Insects Laboratory, with the help of the Savannah laboratory on certain phases of the problem, has succeeded in developing such a treatment.

Preliminary small-scale experiments indicated that premium-grade malathion or a synergized pyrethrum applied on farmers stock peanuts during load-in would effectively control existing infestations, and that supplemental surface sprays might prevent reinfestation from outside sources.

Other preliminary experiments, in which malathion residue analyses were made immediately after treatment, showed that only about 60 percent of the actual malathion sprayed was deposited on farmers stock peanuts. Residue analyses also showed that this deposit decreased rapidly during the first few months and at a more gradual rate thereafter.

Based on the results of these preliminary tests, large-scale field studies were begun to determine the effectiveness of malathion and synergized pyrethrum in protecting farmers stock peanuts from insect damage in commercial storage.

These large-scale tests were conducted over several storage seasons. Malathion and syuergized pyrethrum were applied iu three ways: (1) Directly to farmers stock peanuts at the time of storage, followed by supplementary surface sprays, (2) bulk application, with only one surface spray applied after all the peauuts were in storage, (3) surface sprays only, at regular intervals of time.

Samples of farmers stock peanuts were taken immediately after treatment and at monthly intervals thereafter to determine the initial residues as well as residues on the peanuts during storage. The amount of residues was checked closely before and after each supplementary surface spray. Throughout the storage period, samples were taken and the numbers of insects and amounts of damage were recorded. At each sampling date, the nnmbers of flying insects and other conditions in the warehouse were recorded. At load-out, samples were obtained from truckload lots of peanuts by probing. Representative samples were examined for numbers of insects and damage, and other samples were submitted for residue analysis.

Results of these large-scale experiments under actual warehouse conditious showed that malathion bnlk treatments plus supplementary surface treatments produced the best results. However, satisfactory control was obtained by nsing the synergized pyrethrum as a bulk treatment followed by supplementary surface sprays. The greatest amonnt of insect damage occurred when only surface sprays of either premium-grade malathion or synergized pyrethrum were applied.

The bulk treatment eliminated insects that were present when the peanuts were placed in storage. The surface sprays applied periodically dnring the storage period maintained the residue on the exposed peanuts at a level high enongh to prevent reinfestation from the surface by beetles and moths.

The same snrface treatments may be nsed for spraying outside surfaces of stacked bagged peanuts. The farmers stock peanuts in bags shonld be stacked leaving 3-foot aisles so that the operator can spray the outside surfaces of each stack of bags. This facilitates insect control and aids in rodent control and in handling as well.

Studies conducted in cooperation with the shelling industry showed that most of the insecticidal residues were present on the peanut hulls and foreign material, and only a small fraction on the kernel.

Residne data obtained in these stndies were used in establishing tolerances for these materials. Tolerances of 1 p.p.m. of pyrethrins, 10 p.p.m. of piperonyl butoxide, and 8 p.p.m. of malathion on the peanuts after the shells have been removed have been approved by the Food and Drug Administration.

On the basis of these studies, malathion is the insecticide recommended as the most effective treatment for farmers stock peanuts. Synergized pyrethrum may be used but is not as economical as malathion.

Tests conducted cooperatively between the USDA and several food industry firms show that the recommended malathion treatment had no adverse effect on the odor or flavor of peanut butter made from treated farmers stock peanuts.

Although the malathion treatment is more effective and less costly than the one using synergized pyrethrum, it is still far from being the perfect treatment. Research is being continued on the evaluation of other insecticides that may have more favorable physical and chemical properties than malathion.

The Agricnltural Marketiug Service has recognized the major importance of the problems involved in the storage of peannts and has steadily expanded its research program. At the Stored-Prodnct Insects Laboratory, 2 to 3 man-years of professional time and 4 man-years of subprofessional time are now involved in this research.

The growing insistence of the general public on cleaner foods, the increased activity of the Food and Drug Administration in enforcing the Pure Food laws, and the improved methods for detecting insect infestation and contamination in foods have greatly increased the importance of the insect problem. It will be necessary to extend our attention far beyond the warehouse for farmers stock peanuts to include all types of shelling and processing plants, transportation facilities, and wholesale and retail channels. Our concern now goes beyond the presence of insects in farmers stock peanuts to include insect infestations or contamination in all peanuts and peanut products, whether they be in the form of shelled peanuts, peanut butter, or nuts in candy bars. Our research program, therefore, must be broadened in scope and expanded accordingly.

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Mechanization Phases

PROGRAM COMMITTEE

W. T. MILLS, *Lilliston Implement Co., Albany Ga., Chairman*
J. L. SHEPHERD, *Tifton, Ga.*
J. W. DICKENS, *N. C. State College*

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REVIEW OF MECHANIZATION PROGRESS

WILLIAM T. MILLS

Lilliston Implement Co., Albany, Ga.

Peanut growers of the U. S. have made much progress in the past five years in mechanizing their production operations. Because of the high labor requirements of the harvesting operation and the high level of mechanization already accomplished in the other operations harvesting mechanization during the past five years has received most of the attention. I will therefore limit my remarks in reviewing mechanization progress to the harvesting operation.

At the first National Peanut Research Conference in 1957 we heard a report giving the percent of the peanut acreage in each state that had been harvested with the windrow method. Let us compare the percentages given them with those for 1961 as one measure of mechanization progress.

Table I. Acreage Harvested with Windrow Method

State	1956	1961
Virginia	0%	22%
North Carolina	1	30
Alabama	5	65
Florida	40	85
Oklahoma	80	90
Texas	95	97
Georgia	55	98

Windrow harvesting equipment was only designed at first to reduce the problem of handling the peanut vines prior to picking. Later efforts were made to reduce the labor required for handling the peanuts after picking. As a second measure of mechanization progress let us look at the percent of the 1961 acreage that was handled in bulk from digging to market.

Table II. Acreage Handled in Bulk in 1961

State	
Texas	25%
Oklahoma	25%
Florida	60%
North Carolina	23%
Virginia	22%
Georgia	10%
Alabama	No report

When we bear in mind that bulk handling was not mentioned at the 1957 conference we recognize that this progress has come about during the past 5 years.

Yes, the grower has made rapid strides in mechanizing his high labor operations. He was able to do this because of the research that preceded this five year period. The research that has been conducted during the past five years will be the basis for much of our progress during the next five years so let us review the research activities of our State Exp. Stations as a further measure of mechanization progress.

Table III. Research investigations in peanut mechanization 1957-62.

State	Investigations
Texas	None
Alabama	None
Florida	None
Oklahoma	1—Preliminary testing of components suitable for direct harvesting machine.
Georgia	1—Curing equipment and methods
Georgia	2—Land preparation, planting, weed control, and row spacings.
N. C.	1—Onceover harvester development.
	2—Mechanical and Economical Evalnation of Windrow Harvesting Method.
	3—Basic studies on peannt maturity, peg strength, and effect of impact on peanut kernels.
	4—Pilot scale field curing stndies
	5—Economics of Curing
	6—Basic stndies on flavor, milling quality, moisture migration, air velocity and moistnre-maturity as they relate to curing treatments.
Virginia	1—Effect of land preparation and cnltural practices on yield.
	2—Row spacings
	3—Effects of windrowing methods on rate of drying
	4—Green Harvesting and curing
	5—Developing Equipment for Applying Nemotocides

While there has been a high level of activity in N. C. and Virginia it is disturbing to discover *no* activity in three states and only a small amount in two others. Does this mean that we have about reached the ultimate in mechanizing our peanut operations? Are we now producing the highest quality peanuts at the lowest cost per pound? The answer is *No* and we must take immediate steps to revitalize onr research endeavors if we are to continue to progress.

Table IV. Publications resulting from mechanization research 1957-62

State	Investigations
Virginia	
	Bul 144—The Stem Rot of Peanuts and its Control.
	Cir 852—Planting and Cultivating Peanuts for Stem Rot Control
Virginia	
	Bul 520—Peanut Nematode Disease Control
	In Preparation—Row Spacing Study Results Land Preparation
N. C.	Bul 405—Harvesting and Curing the Windrow Way
	Bul 413—Evaluation of Mechanized Peanut Harvesting System
	Folder 192—Measuring Air Flow Throngh Peanuts
	ASAE Paper 61-630—Effective Heat Units as a Method for Predicting Peanut Maturity
	1961 Transactions of ASAE—New Method of Harvesting the Virginia Bunch Peanut

USDA MS Report #452—Kernel Splitter and Inspection Belt for Peannts

USDA MS Report #528—Shelling Equipment for Samples of Peanuts

Agri. Marketing Apr. 1962—A New Peanut Sampler

1962 Trans. of ASAE—A Peanut Sheller for Grading Samples

Peanut Journal and Nut World, Nov. 1958—Improving the Curing Operation in Peanut Production

PIWG Minutes May 1960—The Effect of Various Curing Treatments on Peannt Quality

In Preparation—Ext. Bnlletin on Peanut Cnring (N. C. and Va. coop)
Research Bulletin on Peanut Curing
Ag. Engr. Info. Cir. on Influence of Curing Environment on Some Physical Properties of Peanuts

Georgia — Mimo Series—Recommended Procedure in Peanut Production

Florida — Agronomy Report 61-4—Increase Peanut Yields and Use Less Labor

Alabama — Bulletin 330—Cost and Returns of Producing Runner Peanuts

NEW DEVELOPMENTS IN PEANUT PRODUCTION EQUIPMENT AND PROCEDURES

JAME L. SHEPHERD, *Head*

Agricultural Engineering Department
Georgia Coastal Plain Experiment Station
Tifton, Georgia

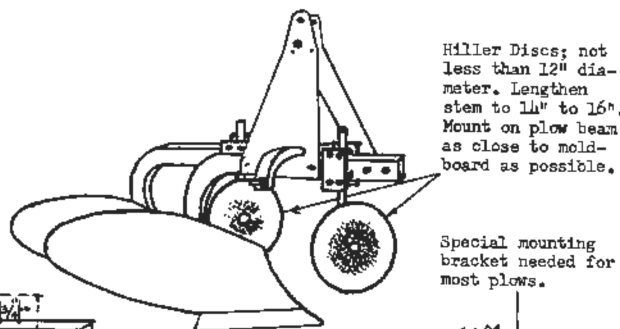
Recommended Procedure in Peanut Production

1. Select land in the fall for peanuts the following year.
2. Obtain soil analysis with recommendations for liming and fertilizing.
3. If liming is recommended, apply it in the fall as early as convenient.
4. Harrow litter from previous crop into surface of soil. Before harrowing litter shonld be shredded well with rotary mower. It is nsually advantageous to harrow corn stalks both with and across the rows.
5. Broadcast recommended fertilizer and turn land as near planting time as feasible, but not longer than abont one month before planting. Use moldboard plows equipped with conlters for burying litter to a depth below all later tool movements. It is feasible to bury all litter below a four-inch depth, and very important that none of it be brought back near the surface during the growth of the peanut plants.
6. Mark rows with tractor wheels set for desired row pattern. This shonld be done soon after turning while soil is soft, permitting tractor tires to depress 3 to 4 inches into soil. The tire depressions form a "bed", in effect, with uniform profile which is necessary for precision planting, cultivating and harvesting.
7. Control grass and weed growth between land tnrning and planting with shallow-rnnning cultivators during or after row marking operation, arranging and adjusting equipment to leave "bed" uniform and

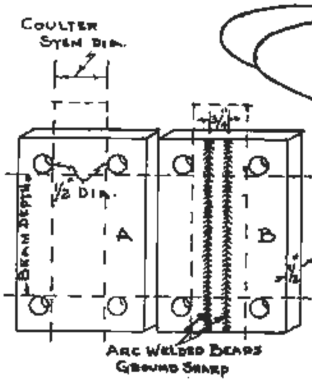
as smooth as feasible. *Avoid random harrowing between turning and planting.*

8. Bed lightly for each row to be planted, with bedding tools adjusted to operate above depth level of all litter which was buried in turning. Bedding should be done not longer than one week before planting. A smoothing blade or board mounted ahead of bedding tools helps in obtaining uniformity in size and shape of beds. Positive depth control of tools is necessary. (Details of recommended row patterns are provided).
9. Determine weed control plan and prepare to plant accordingly. Plan may provide for chemical herbicide as pre-emergence or post-emergence treatment or fully mechanical weed control.
10. Plant peannts in either one of the recommended 4-row or modified 2-row patterns. Recommended drill spacings are: In 4-row pattern, Spanish 2½″ in outside rows and 3″ in inside rows; runners 3″ in outside rows and 6″ in inside rows; small seeded Virginia bunch 4″ in all four rows; large-seeded Virginia bunch and runners 6″ in all four rows. In both rows of modified 2-row pattern, Spanish 2½″; runners 2½″ or 3″; small seeded Virginia bunch 3″ or 4″; large seeded Virginia bunch and runners 4″ or 6″. Recommended planting depths are: with pre-emergence herbicide; 3″ in sandy soil and 2½″ in clay soil; with post-emergence herbicide or mechanical control 1½″ to 2″, all soils, in shallow furrow. (Details of several optional procedures to be provided).
11. Cultivate only to extent absolutely necessary for good grass and weed control. Where effective pre-emergence herbicide is not employed considerable advantage may be gained in combating grass and weeds by carefully employing the following procedure: as peanut seed have sprouted and cracked the soil, but before the emerging plant is visible, apply over the row about ½″ of additional soil coverage in a band about 8″ wide. The depth of this additional soil coverage should be the minimum necessary to destroy noxious seeds germinating during the first few days after peanuts are planted. This practice gives the peanuts about a week's "jump" on grass and weeds, and provides good conditions for effective employment of post-emergence herbicide or fully mechanical control. Best conditions for peanut productivity and disease control are provided when no additional soil is added to plants after emergence, and "minimum tillage" practices are extremely essential to optimum net yields.
12. Effectively control insects and disease. Timing may be extremely important. Minimize damage to peanut vines by tractor tires. Use smallest tires available.

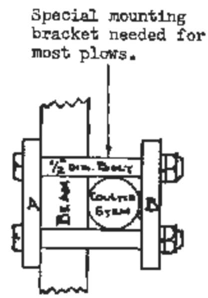
COULTERS FOR DEEP TURNING LITTER WITH MOLDBOARD PLOWS



· SIDE VIEW · MOUNTED ·



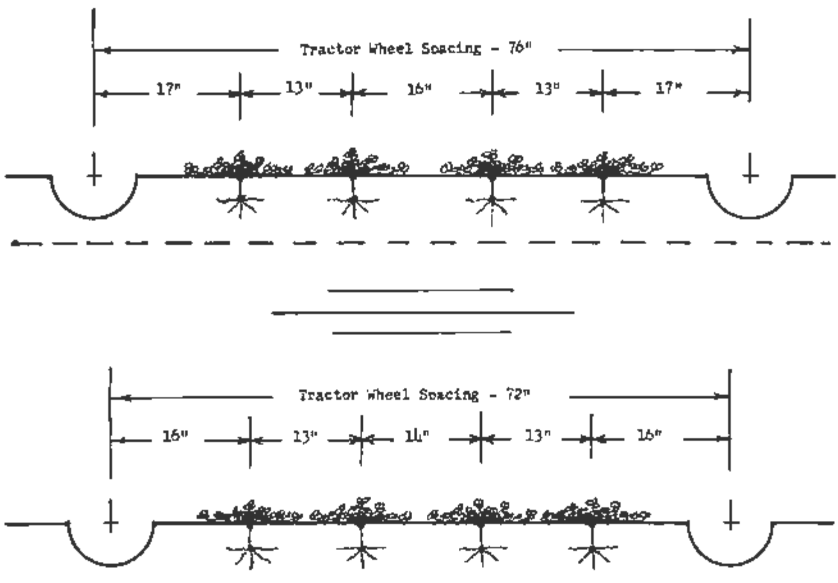
· DETAIL OF BRACKET PLATES ·



TOP VIEW · BRACKET ASSEMBLY

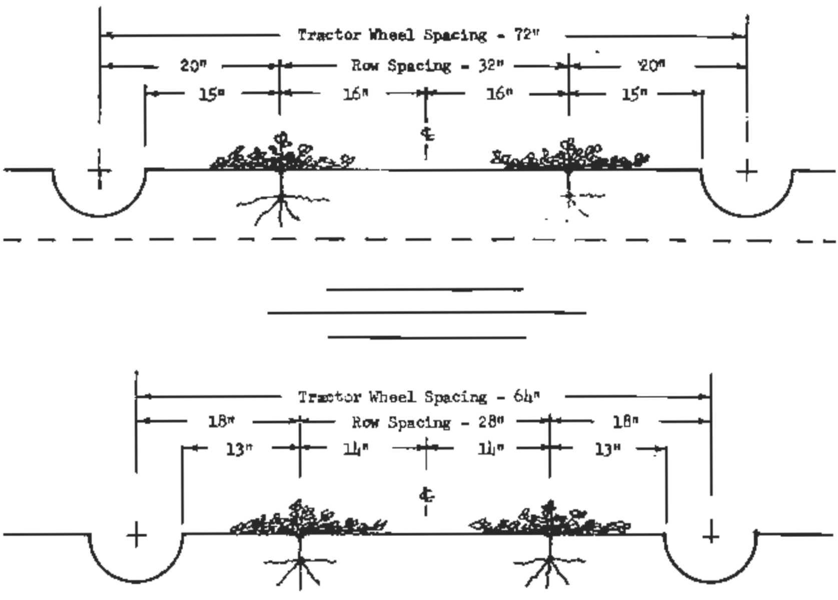
FRONT VIEW - MOUNTED

RECOMMENDED ROW PATTERNS FOR GROWING PEANUTS



Note: Maintain flat bed between wheel furrows as shown. Smallest tractor tires used leave greatest net productive width of soil. To obtain row spacings seed outside rows with double hopper planters and inside rows with single hopper planters. Four-row patterns recommended only where soil is sufficiently loamy for feasible digging operation. (The modified two-row patterns are recommended for very heavy soils).

RECOMMENDED ROW PATTERNS FOR GROWING PEANUTS



Note: Maintain flat bed between wheel furrows as shown. Advantages of the above new row patterns: (1) Wider wheel middles permit later dusting with tractor without damaging vines; (2) more nearly balances productive width on each side of rows; (3) easier to dig, shake and form good windrow.

WHEEL TRACK BOOT

LEGEND OF DETAILS

1- Regular sweep.

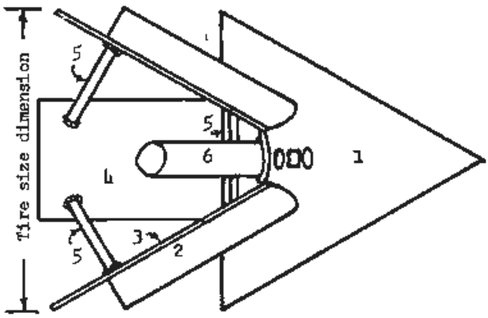
2- Strap-iron, 3/16"x 2½", welded to sweep.

3- Strap-iron, 1/8"x 2", welded to bottom strap.

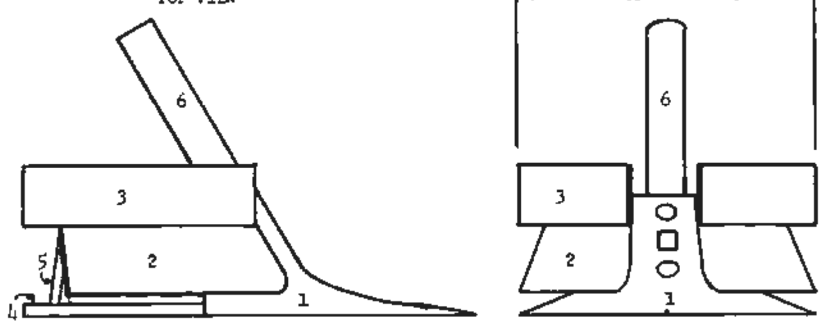
4- Skid plate, of scraper blade material, approx. 5" x 8", ¼" to ½" thick.

5- Supporting ties for skid plate, ½" Sq. or Rnd rods, welded.

6- Regular stem.



TOP VIEW



SIDE VIEW

FRONT VIEW

The Wheel Track Boot is designed for a dual purpose. It functions as a depth regulator for tillage tools and as a tool for finishing the tractor wheel furrow.

In peanut production it is mounted ou tool bar or cultivator frame, in line with tractor wheels, to provide precision in depth control and forming the furrow and bed profile of the recommended 2-row and 4-row patterns. Chisels are used in wheel tracks in prebedding. Boots are mounted for the planting operation, and the resultant smooth-bottom wheel furrow permits free gnidance on the crop row in all later cultivation operations. The boots are used in all cultivations, as well as in planting. Normally, a flat setting is proper. However, if at lay-by time the wheel furrows need deepening to allow for fill-in the boots are pitched to dig the desired amount. At lay-by the shoulders of row beds should be formed slightly high to allow for weathering.

To minimize wear on sole of boots the mechanical depth control should be adjnsted to carry greatest portion of the load.

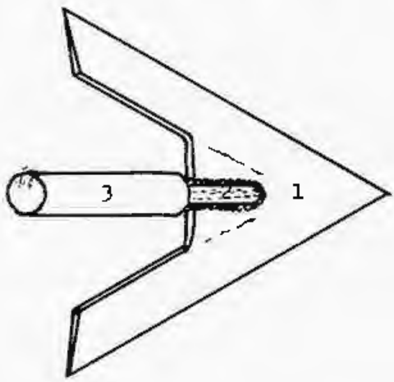
MODIFIED SWEEP UNIT—(For plowing peanuts)

LEGEND OF DETAILS

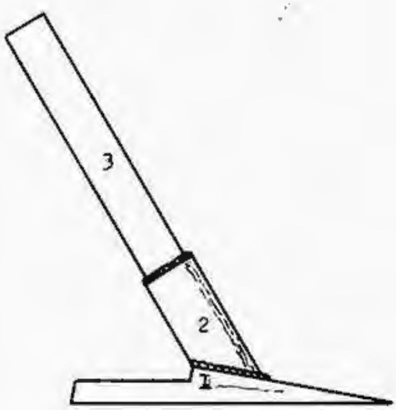
1- Regular sweep, with tongue cut out.

2- Bar-iron, 3/8", 7/16", or 1/2" x 2", 4" to 6" length, bottom end 45 deg. bevel, welded to sweep on ground seat.

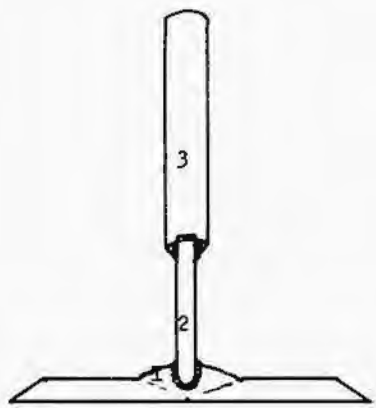
3- Stem, $1\frac{1}{4}$" Rnd, 8" length, welded to bar.



TOP VIEW



SIDE VIEW



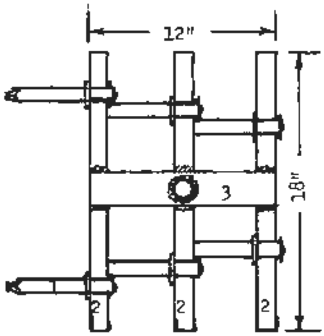
FRONT VIEW

The Modified Sweep Unit represents a necessary principle in cultivating crops such as peanuts which do not tolerate excessive soil build-up around plants.

Regular sweeps of various sizes may be simply modified in this manner to form units which will move a minimum of soil to the sides, and also, render it feasible to travel at higher forward speeds in cultivating.

This design typifies a principle which may also be applied in variations of detail to better suit certain conditions. The slanted stem and shank of this unit is suitable for use on the Ford-Ferguson *type* cultivator frame. For some other types of equipment stems and shanks mounted straight upward may be more suitable. Size of bar stock selected to form the shank of the unit should be determined by the size of the sweep to be modified. Larger sweeps reqnire larger and stronger shanks, and the smallest shank with adequate strength should be used. As the sweep portion wears beyond effective usability it may be cut from the shank and replaced by a new one.

ONE-ROW WEEDER UNIT—(For peanuts, corn, and general row crops)



TOP VIEW
(Unmounted)

LEGEND OF DETAILS

1- Spring weeder tine, clamp type.

2- Angle-iron, 3/16"x 1¼"x 1¼".

3- Bar-iron, ½"x 2", welded to /s.

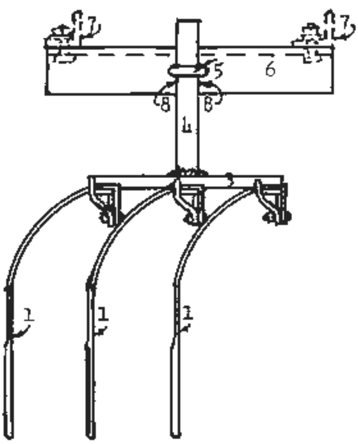
4- Mounting stem, 1¼" Rnd, 10" lgth.

5- U-bolt, 5/8", w/bend to fit stem.

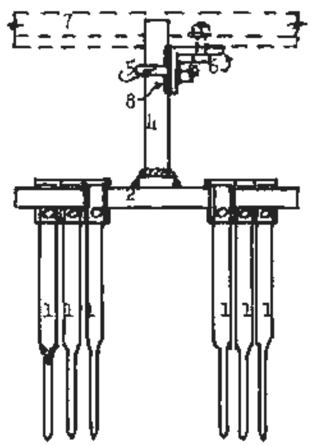
6- Angle-iron, ¼"x 3"x 3½", bolted to cultivator frame.

7- Frame members of cultivator.

8- ¼" keystock, each side, forms edge support to oppose turning of stem.



SIDE VIEW
(Mounted to cult. frame)



FRONT VIEW
(Mounted)

The One-Row Weeder Unit is an adaptation of simple spring tooth weeder tines to provide a high degree of utility, versatility and economy in cultivating many row crops. The open-end mounting bars make it convenient to place and arrange various numbers of the clamp type tines for precision functioning in cultivating crop rows.

The weeder unit, as illustrated, functions ideally for each individual row of the modified 2-row pattern for peanuts. For the 4-row peanut pattern the frame of the unit is constructed the same as illustrated, except that the angle iron bars which carry the tines are 28" long, instead of the 18" length for the single row unit. This permits arranging a sufficient number of tines for each unit to cultivate two rows of the 4-row pattern. With the double-row nnit it is very important that the key stock is used to support and resist turning of the stem.

New and full length weeder tiues may be used for the unit. However, worn and shorter tines generally function better.

Recommendations on Procedure in Harvesting Peanuts in Georgia

1. Digging and windrowing runners and heavy-vined Spanish and Virginia Bunch varieties of peanuts can best be done after some of vine tops have been mowed off. It is recommended that with a rotary mower the top one-third of Spanish and Virginia Bunch and the top one-half of runners be removed from one to four days prior to digging. Better aerated windrows will result and the load on the harvester will be reduced. Care must be taken to avoid excessive cutting of vine tops. The primary objective is to remove as many leaves as feasible and leave sufficient lengths of vine stems for efficient picking by the harvester.
2. It is important that the digging operation be accomplished with well sharpened digger blades which are set flat and at proper depth. Blades shonld simply move throngh the soil, doing no more than shearing the peannt tap roots jnst below the area of nuts. The thickness and very slight pitch of the blades will lift the soil sufficient to provide the looseness necessary for peannts to be lifted straight upward from the soil.
3. Shaking and windrowing is best accomplished with the overhead peanut shaker. For best resnlts, care should be taken that the shaker is properly adjusted as to height of teeth and bars in relation to gronnd, speed of the shaker-conveyor nnit, position of windrowing rods and the forward traveling speed of the unit. If digger blades have functioned properly, it is easy to adjust shaker height to permit only a soil combing action by the teeth and avoid dragging of shaker bars into the soil. Dragging of bars unduly increases the load on the machine and also may prevent good separation of soil and pebbles from the vines in the windrow. The speed of the shaker-conveyor nnit should slightly lead the forward travel of the machine to avoid piling np of peanut vines ahead of the picknp point of the shaker unit. Windrowing rods should be adjusted to form the widest windrow to suit the particnlar combine harvester to be used. It is strongly recommended that the shaker-windrower be equipped with a heavy drag bar for smoothing and firming the soil bed nnder the windrow. This will contribute substantially toward uniformity in drying and in avoiding damage to the peanuts from rainfall.
4. It is usually advantageons to reshake peanut windrows within two days after digging and windrowing. This will apply particularly when digging was done nnder very damp soil conditions, where heavy vines were left on peanuts and when heavy growth of grass prevented a good first shaking operation. Also, nnder severe weather conditions some additional reshaking may be profitable, even with the loss from shattering of some peanuts. In this case reshaking should be done at very low speed.
5. The side delivery rake is not recommended as best for shaking peanuts. However, if care is exercised and circumstances warrant, it may be used to gently turn the windrow one or two days following digging and shaking with overhead type nnit.
6. Peanuts should be harvested as soon after digging as conditions will permit efficient functioning of the harvester. Mechanical finish drying of nuts may be necessary.

MEASURING THE MILLING QUALITY OF PEANUTS WITH A SAMPLE SHELLER

J. W. DICKENS, E. O. BEASLEY
and W. K. TURNER[1]

Introduction

Recent developments in harvesting and curing peannts have bronght forth considerable discussion concerning the effects of those treatments on the quality of farmers' stock peanuts. One of the major quality factors which has been reported to be affected by harvesting and curing treatments is the milling quality of peanuts. Milling quality may be rated by measuring the undesirable tendency of peanut kernels to split or skin during mechanical shelling operations. Since excessive kernel splitting or skinning reduces the value of shelled peanuts, the peanut-shelling industry wishes to place more emphasis on the milling quality of peanuts purchased.[2]

Prior to 1961 when mechanical shellers were first nsed for grading samples, the Federal-State Inspection Service shelled all the samples by hand.[3] The hand-shelling method split or skinned few of the kernels and indicated very little about the milling quality of a load of peanuts.

The sample sheller was designed to cause as few splits as possible during the shelling operation, because in peanut grading it is necessary to keep the kernels whole in order to determine their size distribution by screening. However, the sheller does subject the kernels to rougher treatment than hand-shelling and will damage some of those kernels which split or skin easily. Although the percent of split or skinned kernels is lower when peanuts are shelled with a sample sheller than with commercial shellers, it seems reasonable to expect a correlation between the degree of milling damage caused by the two types of machines.

A sample sheller, similar to those used by the Inspection Service, has been used for several years as an objective means of determining the milling quality of samples of peanuts in a cooperative peanut-research program between North Carolina State College and the Agricultural Marketing Service. The following studies are presented to demonstrate the use of the sample sheller as an objective means of determining the effects of harvesting and curing treatments on the milling quality of peanuts.

Effects of Harvesting Treatment on Milling Quality

General observations indicate that some harvesting and handling treatments subject peanuts to more impact than do other treatments. A study was made to determine the effects of various degrees of impact on milling quality.

In the study, peanuts were struck by a flat steel surface traveling at velocities of 20, 30, 40, 50 and 60 feet per second. For each impact

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[1]The authors—J. W. Dickens, E. O. Beasley and W. K. Turner—are, respectively, agricultural engineer, Market Quality Research Division, AMS, USDA, Raleigh, N. C.; research instructor, and research assistant in agricultural engineering, N. C. State College, Raleigh, N. C.

[2]Pace, Stephen. National Peanut Research Center. 1961. [Paper presented to the 21st Ann. Conv., Natl. Peanut Council, Washington, D. C. Unpublished.]

[3]Dickens, J. W. Shelling Equipment for Samples of Peanuts. 1962. Marketing Research Report No. 528. U. S. Department of Agriculture, U. S. Government Printing Office, Washington, D. C.

velocity, the peannts were oriented so that one-third of them were struck in each one of the following three locations: the peg end, the end opposite the peg, and the side. The orientation of the impact surface with respect to the suture of the hull was random. Green-harvested, windrow-harvested, and stackpole-cured peanuts were tested. The moisture content (wet basis) at time of impact for the green, windrow and stackpole peanuts were 43 percent, 29 percent and 11 percent respectively.

Three 400-gram samples of peanuts from each treatment were dried at room temperature and stored until shelling tests were conducted with the sample sheller. The peanut kernels contained approximately 5 percent moisture (wet basis) at the time of the shelling tests. Table 1 shows the effects of impact velocity on the amount of kernel damage caused by shelling. The splits increased with impact velocity while there was very little effect of impact velocity on the amount of skinned kernels (kernels with ¼ or more of their skin removed). Impact causes relative movement between the cotyledons of the kernels which breaks or weakens the skin along their suture. Because the skin helps hold the cotyledons together this damage makes the keruels more easily split during shelling. One would not expect the adherence of the skin to the cotyledon to be affected by impact.

Figure 1 shows the effects of impact velocity on percent splits at the three moistnre levels. The dried stackpole-cured peanuts were damaged considerably more than the higher moisture peanuts when subjected to impact velocities greater thau 30 feet per second.

Effects of Curing Treatment on Milling Quality

Studies were made during 1960 to determiue the effects of curing euvironment on the milliug quality of peanuts. Peanuts were cnred at various temperatures and relative humidities under closely controlled couditions. After curing was completed, three 1000-gram samples of peanuts were selected from each during treatment for shelling tests.

Table 2 shows the data arranged to indicate the effect of relative humidity on milling quality at the several constant temperatures used for the various treatments. For any given temperature, the amonnt of milling damage increases as the dryiug rate increases (relative humidity decreases).

Table 3 shows the same data rearrauged to indicate the effects of curing temperature ou milling quality at constant drying rate. Withiu each block of this table drying rate is considered to be about constant, because higher relative humidities were used with the higher temperatures within each block. The higher relative humidities reduced the effect on drying rate of the increased vapor pressure of the moisture within the peanuts at the higher temperatures. Temperatures below 105°F. appear to have uo effect on milling damage, bnt above 105° the amount of damage increases perceptibly.

Tables 2 and 3 also show that the percent of skinned kernels increases with an increase in splits. This indicates that, unlike impact, curing treatments loosen the skins on the cotyledons and causes more of them to be removed during shelling.

Since temperatures below 105°F do not appear to influence milling quality, the data within each block of Table 3 were averaged with the exception of data from curing treatments of 105° and above. Figure 2 was plotted from those averaged values. A relatioaship is shown between drying rate and the milling quality of peanuts.

A Study of Grading Samples

In order to determine the milling quality of peanuts marketed during 1961, approximately 6,000 inspection certificates of the Federal-State Inspection Service in North Carolina were stndied. The certificates show the percent of splits caused by the sample sheller and the percent moisture of the kernels when shelled. All peannts graded on certificates dated prior to October 31 were considered to have been harvested from the windrow, while all peanuts graded on certificates dated after November 15 were considered to have been cured on the stackpole.

As shown in Fignre 3 the milling quality of windrow-harvested and bulk-cured peanuts on the average was better than the quality of the stackpole-cured peannts. The average percent of splits in windrowed peanuts shelled at 9 percent moistnre was 1.1 percent, while the average percent of splits in stackpole-cnred peanuts shelled at 9 percent moisture was 1.5 percent. It appears that most of the windrow-harvested peanuts received harvesting and curing treatments which produced good milling quality.

The windrowed peanuts were harvested at high moisture contents and dried down to the moisture content at which they were marketed, while the stackpole-cured peanuts were probably picked at the same moisture content at which they were marketed. The impact studies which have been discnssed show that the drier stackpole-cured peanut kernels are damaged more by impact in the picking operation than the higher moisture windrow-harvested peannt kernels.

Fignre 3 also shows the effects of moisture content on the percent splits caused by the sample sheller. The dried peanut kernels split more than the higher moisture kernels dnring the shelling operation.

Although the average milling quality of peannts marketed in 1961 appears to be good, there were many loads of peanuts which had poor milling quality. Table 4 shows the distribution of samples of Virginia-type peanuts according to the percent splits caused by shelling on the sample sheller. The samples which fall below the stepped horizontal line in Table 4 had more than donble the average percent splits cansed by the sample sheller at the various moisture levels. Of all the samples stndied, 8.6 percent split more than double the average amount. Those loads of peanuts probably split excessively during commercial shelling operations.

Conclusion

Extensive studies have shown that the sample sheller enables an objective measnrement which reflects the effects of harvesting and curing treatments on the milling qnality of peanuts. These studies indicate that the sample sheller can be used to evaluate the milling quality of small samples of peanuts from tests in breeding, fertilization, harvesting, curing, and other types of research on cultural practices.

A study of gradiug certificates from the 1961 marketing season snggests that the sample sheller can be used to provide important information about the milling quality of farmers' stock peanuts at the marketplace.

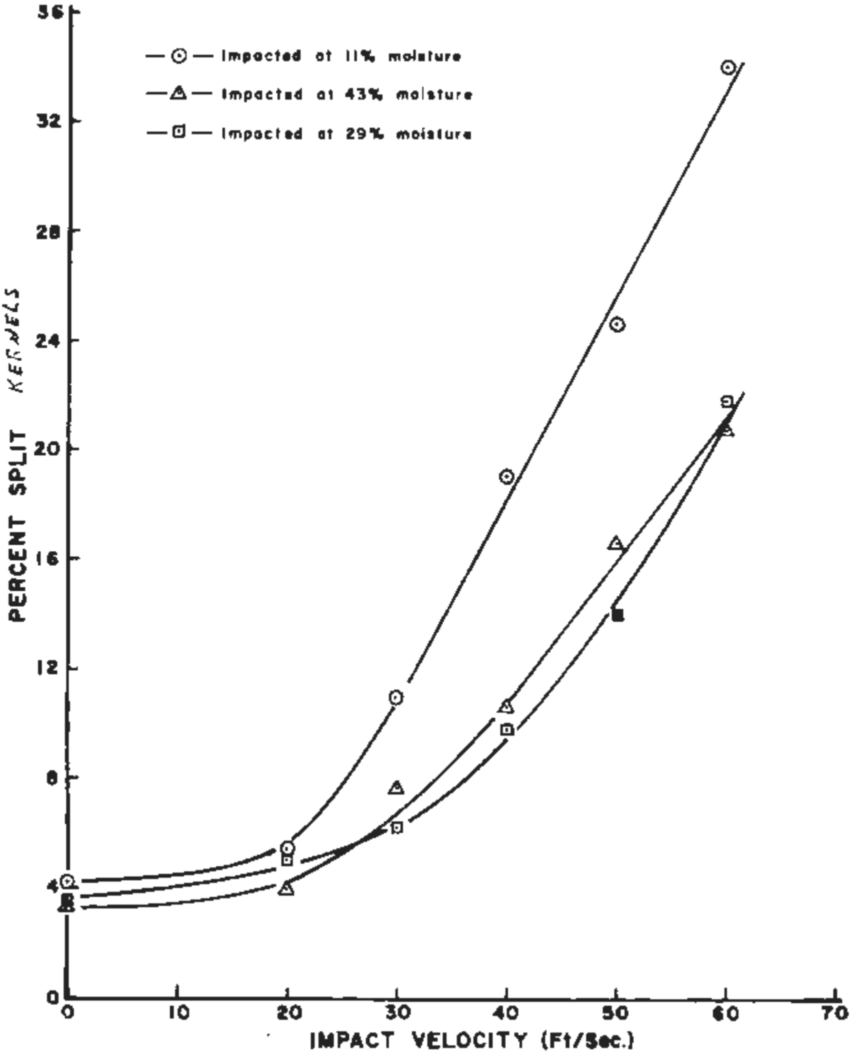

Figure 1. The effect of impact on split kernels caused by subsequent mechanical shelling.

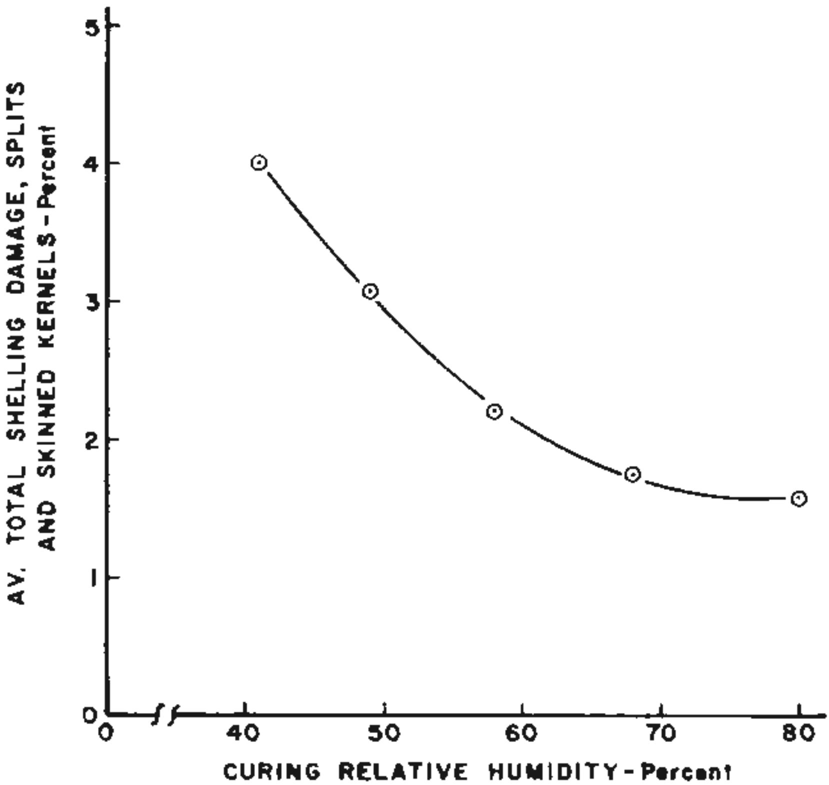

Figure 2. The effect of relative humidity on shelling damage of peanuts cured at temperatures between 70° and 100°F.

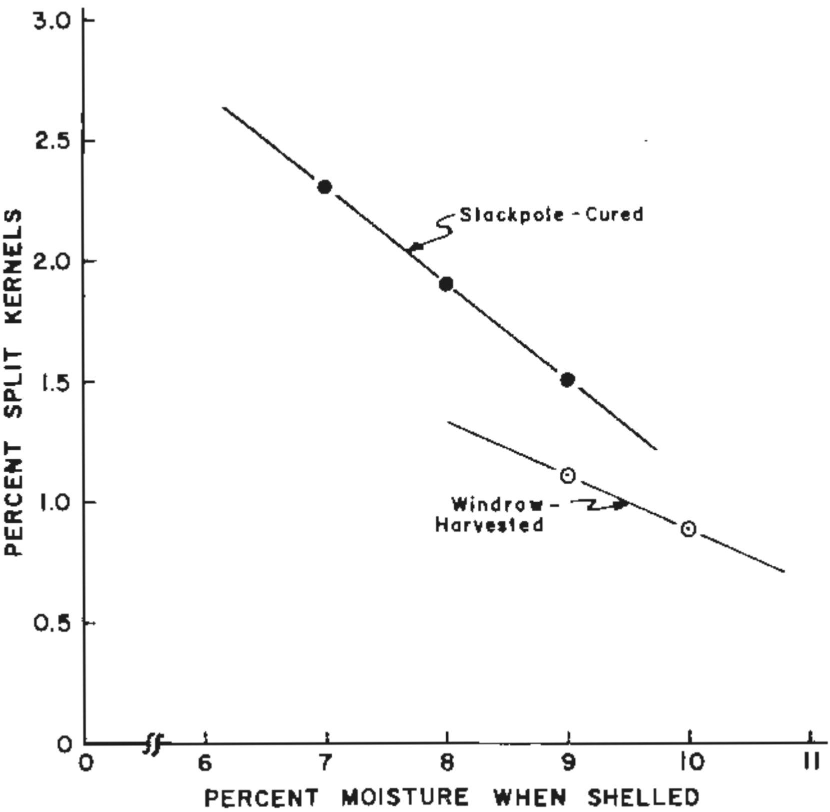

Figure 3. The effect of moisture content and harvesting treatment on split kernels caused by mechanical shelling.

Table 1. Measurement of damage caused by impact to Virginia-type peanuts.

Impact Velocity (ft./sec)	Harvesting Treatment: GREEN		WINDROW		STACKPOLE	
	% Split	% Skinned[a]	% Split	% Skinned	% Split	% Skinned
0	3.23	0.00	3.50	0.00	4.21	0.08
20	3.97	0.22	5.02	0.00	5.36	0.00
30	7.62	0.28	6.53	0.00	11.43	0.47
40	10.56	0.06	9.81	0.25	19.02	0.73
50	16.58	0.07	14.08	0.19	24.57	0.26
60	20.68	0.05	21.77	0.12	34.06	0.44

[a]Skinned kernels had ¼ or more of the skin removed during shelling.

Table 2. The effect of curing relative humidity on the milling quality of peanuts.

Temp. °F	Relative Humidity %	Split %	Skinned %	Total Damage[a] %
70	77	1.61	.18	1.70
75	65	1.77	.30	2.07
	79	1.62	.20	1.82
80	55	2.03	.45	2.48
	67	1.43	.18	1.61
	80	1.10	.27	1.37
85	47	2.40	.86	3.26
	57	1.83	.40	2.23
	69	1.23	.37	1.60
	80	1.38	.07	1.45
90	40	2.71	1.59	4.30
	49	1.87	.57	2.44
	59	1.47	.45	1.92
	69	1.60	.20	1.80
	81	1.32	.07	1.39
95	41	2.50	1.22	3.72
	50	2.58	.72	3.30
	59	1.73	.27	2.00
	70	1.50	.24	1.74
	82	1.47	.18	1.65
100	43	2.93	1.10	4.03
	51	2.77	.47	3.24
	60	1.92	.81	2.43
	71	1.37	.33	1.70
105	44	3.35	1.37	4.72
	52	2.73	.94	3.67
	61	1.23	.40	1.63
110	45	4.41	2.19	6.60
	53	3.00	1.35	4.35
115	46	4.87	2.18	7.05

[a]The shelling moisture content was 5½ to 6 percent for all samples.

Table 3. The effect of curing temperature on the milling quality of peanuts.

Relative Humidity %	Temp. °F	Split %	Skinned %	Total Damage %
77	70	1.61	.18	1.79
79	75	1.62	.20	1.82
80	80	1.10	.27	1.37
80	85	1.38	.07	1.45
81	90	1.32	.07	1.39
82	95	1.47	.18	1.65
65	75	1.77	.30	2.07
67	80	1.43	.18	1.61
69	85	1.23	.37	1.60
69	90	1.60	.20	1.80
70	95	1.50	.24	1.74
71	100	1.37	.33	1.70
55	80	2.03	.45	2.48
57	85	1.83	.40	2.23
59	90	1.47	.45	1.92
59	95	1.73	.27	2.00
60	100	1.92	.81	2.43
61	105	1.23	.40	1.63
47	85	2.40	.86	3.26
49	90	1.87	.57	2.44
50	95	2.58	.72	3.30
51	100	2.77	.47	3.24
52	105	2.73	.94	3.67
53	110	3.00	1.35	4.35
40	90	2.71	1.59	4.30
41	95	2.50	1.22	3.72
43	100	2.93	1.10	4.03
44	105	3.35	1.37	4.72
45	110	4.41	2.19	6.60
46	115	4.87	2.18	7.05

Table 4. Distribution of samples of Virginia-type peanuts as related to percent splits caused by machine shelling at various moisture contents.

Percent Moisture Content at Time of Shelling

Percent Splits	7% Moisture (653 Samples)		8% Moisture (2,453 Samples)		9% Moisture (2,098 Samples)		10% Moisture (954 Samples)	
	number	percent	number	percent	number	percent	number	percent
0	13	2.0	97	4.0	314	14.9	328	34.4
1	145	22.2	955	38.9	968	46.1	447	46.9 [a]
2	233	35.7	937	38.2	606	28.9	144	15.1
3	168	25.7	346	14.1	169	8.0	28	2.9
4	71	10.9	94	3.8	36	1.7	5	.5
5	21	3.2	19	.8	4	.2	2	.2
6	2	.3	3	.1	1	.1		
7			1	.04				
8			1	.04				

[a]8.6 percent of 6,168 samples examined are below indicated line.

Marketing Phases

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THE NEED FOR ECONOMIC RESEARCH AND EDUCATION IN PEANUT PRODUCTION AND MARKETING

NEWTON M. PENNY

Department of Agricultural Economics
Georgia Experiment Station
Experiment, Georgia

I am pleased to have the honor and special privilege of meeting and being with yon at the second National Peanut Research Conference. Prior to the first meeting in Atlanta in 1957, much of my time at the Georgia Experiment Station was devoted to varions aspects of the economics of peanut production and marketing. Recently, my attention has been directed toward other commodities and problems, and I am not as conversant with immediate problems of the peannt industry as I have been.

My purpose is to impress you with the need for economic analysis of basic questions relevant to the peanut indnstry and illustrate briefly the specific economic knowledge that is needed for charting and appraising possible, reasonable approaches to economic problems of the industry.

In a recent article[1], Commerce Secretary Luther Hodges said, "If ignorance paid dividends, most Americans could make a fortune out of what they don't know about economics. Hardly one person in 20 has the sketchiest idea of how onr economy fnnctions. Fifty years ago our ignorance might have been excusable. Today it is intolerable."

Simply stated, science is an organized, classified body of knowledge. Education is simply a process of diffusing knowledge among people, but extensive diffnsion of knowledge is not easily accomplished. Development of economics into a science has a mnch shorter history than development of biological and natnral sciences, but considerable knowledge has been organized, classified, and is available for nse in college teaching—one means of diffnsing knowledge. In a modern society, we say that we need more than this limited means of education. We need to provide a working knowledge of basic economics to our agricultural firms (farmers, processors, handlers, etc.). It seemed hopeless in the not too distant past, to provide such nnderstanding to masses of farmers and businessmen, but with fewer farmers, higher levels of schools and larger firms, the task is less hopeless. As in all other snbject matter, research in economics should be continuons in order to bnild a solid body of reliable information and thns contribute to the science of economics. The degree to which economics is developed as a science will be the degree to which it is useful as a tool for economic and social development. This is the only way that long-run interpretation and prediction can be made of results of alternative courses of action for economic growth and development.

I refer to basic economics with intent and purpose of excluding technological production and marketing for it is my contention that research and education in these fields have been developed more extensively than basic economics. Moreover, I believe that most economists and industry people have divergent concepts of what constitutes economic research and edncation and by whom it should be accomplished.

The industry concept embraces mostly the technology of production and marketing, but concepts of economists embrace mostly the economic aspects of production and marketing. The indnstry point-of-view seems

[1]The Saturday Evening Post, March 10, 1962.

to be that economics can be taken care of by industry, but technology—finding better ways to do something, developing a gadget, containers, new packages, product testing, etc.—is primarily a responsibility of colleges.

If my appraisal of the industry viewpoint is correct, my view is directly opposite because I believe that industry is much better equipped now and will be even better equipped in the future to solve the problems of practical, techuological developments and that the basic economic research and education will be primarily a function of colleges, although not reserved to them.

Product development and testing in the market are fuuctions that should be performed by iudustry. They are non-academic and non-basic, but expensive. Private enterprise should do its own practical research, advertising, and promotion. These are things that are being done by the larger business units. They employ competent analysts to make economic analyses and make the results available to management.

The legitimate function of the college is to study and analyze basic, fundamental questions, to chart alternative cuurses of action, and to provide reliable information on the consequences of various alternatives. The final decision should rest with the firm management or industry. Questions of policy are subjects for analysis but the college has no place in policy decision.

Relative to mechanisms, such as price, income, and supply control measures to implement policy, it appears to me that fundamental economic principles conflict with political expediency and social welfare concepts. If the latter prevails, this leads to establishmeut of policies and programs whose purpose and consequences run counter to the dictates of economic principles whose consequences would result in use of resources balanced with demand for goods aud services.

Interests of segments of the industry center on immediate gains to be derived from winning their point with the controlling authority. Exercise of countervailing power by all segments of an industry on the short-run basis lowers interest in the total, loog-run economic consequence. This is the basic reason why I believe that peanut industry people are passive about economic research and education.

It is a common occurrence for an indnstry to ignore economic consideratious when in a period of prosperity or equilibrium, and even more common to ask for immediate analysis of problems wheu iu a depressed state—after it is too late—after economic illiteracy has caused them to choose the wrong path.

As we view the peanut industry, we see today an industry in which supply and demand balance ont at a price which has been determined to be reasonable, and which provides an income sufficient to attract ample numbers of people aud resources into the industry to assure that the consumers are supplied the peannts desired at the prevailing price.

Despite this situation, the predominant thinking within the composite industry mind today is probably concerned with proposals for profitably expanding the industry. That is to say, how can the industry move from the present supply-price relationship to a higher level of output? The desire for growth within a relatively prosperous industry is instinctive. This is the "American Way." Prestige rests with the side recommending expansion.

Many proposals have been recommended. Many paths to expansion of the industry have been suggested. It is the task of the economist or person making use of economic principles to analyze each of the paths suggested, and give the industry leaders a picture of the indnstry as it moves up each of the proposed paths, without the industry ever having moved at all. Often it is found that proposed paths to growth are not profitable. We can think of many industries in which expansion took place, only to find that net or even gross income for the industry has diminished. A commonly suggested remedy for agricultural snrpluses, or for the expansion of an industry where no snrplus presently exists, is that of developing new products or new uses. Before recommendations for such diversion of part of a commodity can be safely given, it is necessary to make some rather detailed economic analyses. Even thongh the product may be appealing to the eye and palate, it may not be financially rewarding to the industry producing the raw product to produce this extra quantity of the product.

The amonnt of economic analysis which can be completed before an industry moves from its present economic position is limited only by the knowledge of economic tools and skills in conducting the analysis. The economic tools that may be used are limitless, one of which is price elasticity of demand. The degree of elasticity of demand is the main key to appraising the possibilities for profitable expansion.

This concept is concerned with the effect ou price of an increase or decrease in volume of the commodity supplied. It is one of the three general areas of economics that Secretary Hodges said needs to be known by the public. He said, "They ueed to know how snpply, demaud, and prices operate, why competition is essential in the market, and how the government infinences competition and the use of resources."[1]

From an economic standpoint, the problem facing us at this meeting today can be reduced to a single proposition—at what level of peannt production would the industry be best off? That is, how many peanuts should the industry produce to maximize net income? Only economic analysis can supply the answer to this question, but such an analysis has not been made.

There are two economic concepts which are often confused in the discussion of expansion or contraction of the peanut industry. Stated in question form the problem might read, what is the distinction between a change in demand for peanuts, and a situation in which more peanuts are sold but at a lower price?

It is obvious at times that the intended objective is to move aloug the demand curve to a new price-quantity relationship rather than move the curve to a new position on the chart (Figure 1).

The phrase "a rise in demand" is confined to the concept of a rise in the quantity which will be bought or consumed at each price. That is, a rise in demand means not merely a rise in the quantity demanded, but a shift to the right of the whole demand curve (Figure 2). The term "a rise in demand" should never be used in describing a situation in which the quantity demanded is increased due to a fall in the price because there would be no change in the demand curve or schedule.

This distinction is very important to the peanut indnstry because it is interested in means of increasing the demand so that it can expand profitably. Increasing the demand for a commodity is difficnlt. The possible methods of increasing demand are: (1) increase in total population, (2) increase in individnal income, and (3) increase consumer preference.

I would now like to conclnde my remarks by briefly commenting on Figures 3-6 and Table 1.

We have condncted a consumer research panel in Atlanta, Georgia, for the past 5 years and have collected enormous quantities of data on food

[1]op. cit.

purchases—quantities, prices, form, etc.—according to income, race, size of household, and other characteristics of the household. The data have not been analyzed, but I have some preliminary figures on per capita consumption of shelled peanuts, peanut butter, and other nuts for a one-year period in Atlanta compared with the Lansing, Michigan, panel.

A comparison of expenditures for shelled peanuts by income groups in Lansing and Atlanta, with the Atlanta data separated for the white and colored population is shown in Figure 3.

Apparently, the low income group of households spend less for shelled peanuts than either the medium or high income groups. It should be pointed out that these are only peanuts pnrchased in stores for home use. It does not include shelled peanuts purchased for snacks.

Per capita expenditures for peanut butter, with the same breakdowns as shelled peannts, are presented in Figure 4. It seems rather surprising that the low income group is the low consumer of peanut butter. It is significant that the colored populatiou is such a low consumer of peanut butter. Generally, peanut butter is considered the poor man's diet. This chart may be snggestive of profitable areas for advertising and promotion.

In Figure 5, per capita expenditures for shelled peanuts by size of household are shown. It is interesting to note that the households with fewer family members spend more for shelled peanuts than the larger households.

In Figure 6, a similar comparison is made for per capita expenditures for peanut bntter by size of household. In this case, the households with fewest family members spend less per person for peanut butter.

Finally, in Table 1, annual per capita consumption of shelled peanuts, peanut butter, and other nuts according to income groups is shown.

We have been rather surprised to learn that as income increases, consumption of peanut bntter also increases. It is not snrprising to find that the consumption of shelled peanuts, and especially other nuts, increases with income. Generally speaking, such nuts are considered a luxury item.

It has been a pleasure to be with you and discuss this subject. You have been very attentive and a grand audience.

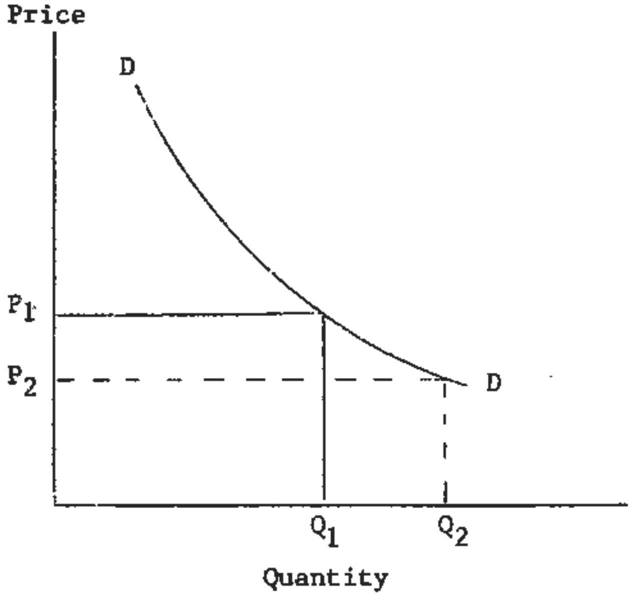

Figure 1.

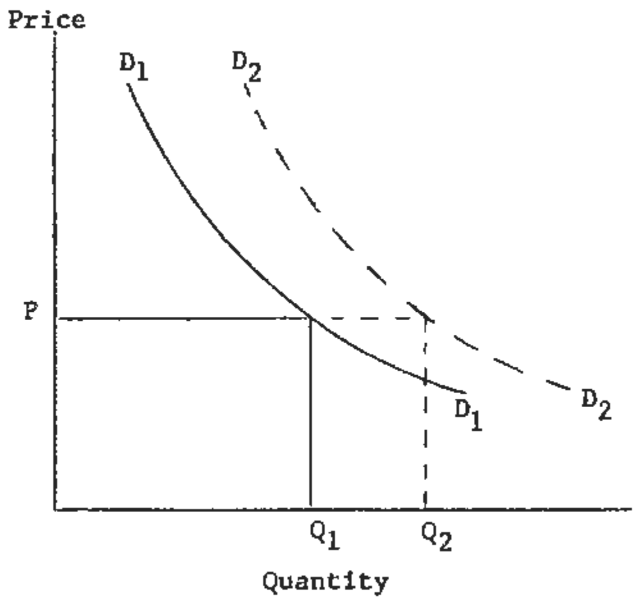

Figure 2.

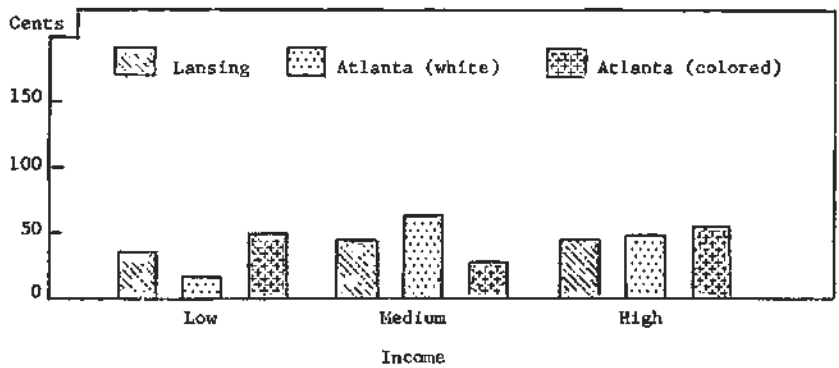

Figure 3. Per Capita Expenditures for Shelled Peanuts by Income Groups, Lansing, Michigan, and Atlanta, Georgia, 1958

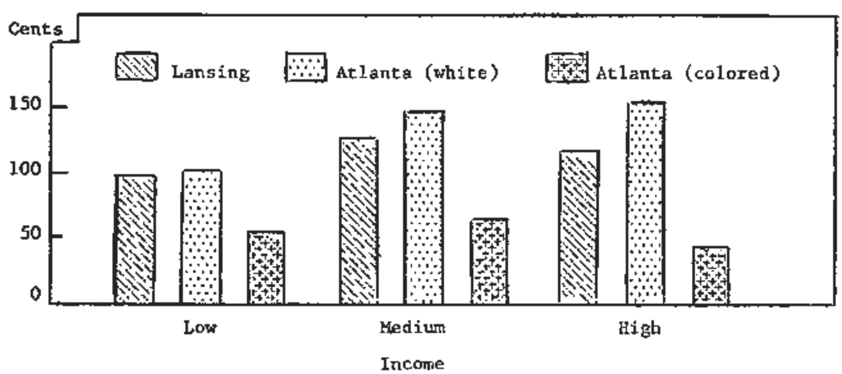

Figure 4. Per Capita Expenditures for Peanut Butter by Income Groups, Lansing, Michigan, and Atlanta, Georgia, 1958

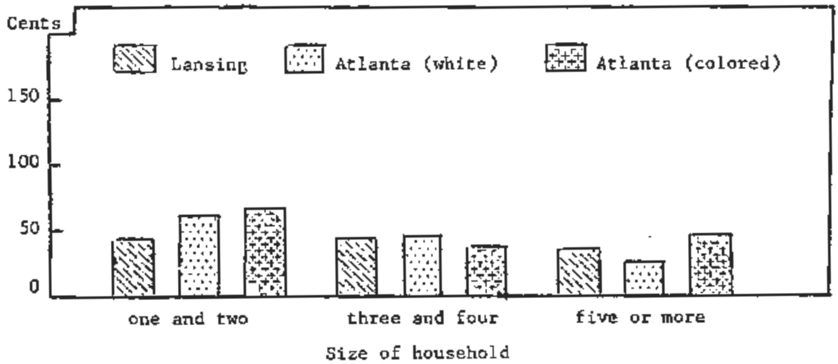

Figure 5. Per Capita Expenditures for Shelled Peanuts by Size of Household, Lansing, Michigan, and Atlanta, Georgia, 1958

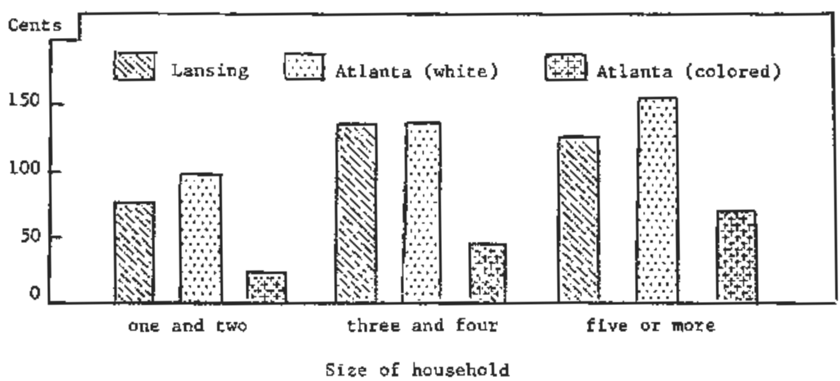

Figure 6. Per Capita Expenditures for Peanut Butter by Size of Household, Lansing, Michigan, and Atlanta, Georgia, 1958

Table 1. Annual Per Capita Consumption of Shelled Peanuts, Other Nuts, and Peanut Butter, Atlanta Consumer Panel, 1959

Income group	Peanuts (shelled basis)	Peanut butter	Other nuts (shelled basis)
		Pounds	
Less than $4,000	.6981	1.4950	.9880
$4,001—$6,000	.3874	1.9890	1.3585
$6,001 and over	1.2584	2.4661	2.8821

A PEANUT BREEDER LOOKS AT MARKETING

DON EMERY

Crop Science Department

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My remarks are directed primarily to those factions of the industry dealing with Virginia type peanuts.

In a 1961 issue of Farm Journal it was reported that approximately $50,000 was speut annually iu North Carolina for the promotion of peanuts. In that same year a little over 300 million pounds of peanuts were produced in this state at a value of approximately 30 million dollars. Peanuts are big business in North Carolina and 90% of that big business comes from the planting, shelling, manufacturing and promotion of a single peannt variety . . . NC2.

Our eutire Virginia type peanut belt is built on an extremely narrow varietal base and some of these varieties in turn were created from narrow genetical fouudations. The reasons for this development are several fold but one of the most obvious is the fact "If the variety pays it stays". Under our preseut support system the U. S. Government makes the first bid at every auction. No one can deny that this is reassuring to the grower but is it always iu keeping with the specific demands of end users and consumers.

The agronomic versatility, the high shelling percentage and average to good amounts of large kernels in NC2, for example, have paid the farmers and salters well over the past 10 years with the existing price structures. The roasters on the contrary have received the penalty for support of a thin shelled variety.

The peanut marketiug system as it now exists has serious limitations for the advancement of the peanut industry. Varietal popularity is not indicative of varietal superiority but rather of its conformity to a package plan. A plan which demands that the salter, the roaster and the peanut-bntter-candy manufacturer dip out of the same bag. All components of the industry must necessarily rise or decline according to the trends of this one variety. Roasters suffer when thin shelled peanuts result from increased percentages of sound mature kernels and peanut bntter processors put up with off-flavored immature kernels when large seeded liues are encouraged for salters.

Why is the peanut indnstry so different from others? Do we expect pickles and cucumbers to come in the same jars? Do we expect hens to lay pullet, large and extra large eggs at the same time? It is true that peanuts are an indetermiuate crop with some degree of flexibility in sizes of kernels. This is not to say that all of these kernel sizes are of the same quality nor would they be expected to be.

The time is approaching when the peanut breeder may be able to select varieties for special soil types or regions and for specific end product users. Specialization of this sort is desirable since it makes better use of the farmer's land, his time, and his talents and yet produces an unadulterated quality end product designed for a particular class of processors. We are living in a day when quality is being stressed in all food products. It seems logical to me that a quality roasted nut can best be produced from a variety designed for roasting and grown by a farmer who is willing to give them the special attention that in-shell products need.

The breeder can and will produce such a variety. Similarly he can create especially adapted and high yielding lines for salting, peanut butter and candy but he cannot and should not be expected to satisfy all four groups at the same time.

A revamping of our present support system on an end user basis could help. Price supports today are categorized for Spanish, Runner, and Virginia type peanuts. Of the three only Spanish accurately defines the product as grown in a farmer's field. Virginia type peanuts as described for support purposes could and does include components of Runner and Spanish ancestry and manufacturers know the variety from experience only. Similarly a mutant selection from a pure Virginia type line with all of the attributes or disadvantages of Virginia peanuts is classified as a Runner if it happens to have small pods.

With support prices playing such an important role in determining the varieties released to the grower, it is of utmost importance that the characteristics supported be clearly defined and those desired by the user.

We now have many loose ends in our market grading system. These include the inability to record texture, flavor and shape of kernel as well as kind or shape of pod. In the future, however, it may be desirable to support peanuts according to use. For example, support could be allocated to peanuts nsed for roasters, salters, and peanut butter-candy manufacturers and premiums utilized as desired withiu these groups.

I realize that this limits the flexibility of responding to supply and demand but it enhances the opportunities for sellers to contract directly for the prodnct they desire without footing all of the bill out of their own pocket.

Finally if all of these adjustments are impractical and the package system must stay, the farmer or the sheller could mix selected varieties of comparable kernel shapes, colors, and qnality to the proportions desired for each break down of the industry. Purposeful blending has proved highly desirable by the coffee importers. With whole peanut belts limited to one or two varieties the opportunities for bleuding are nil.

Whatever the *method* of change, be it political, or mechanical, it's change we must. Promotion is only as effective as the repertory of quality products it sponsors. The breeder has among the hundreds of germ plasms he collects or creates the flexibility that industry needs for future expansion. He must be given the opportunity to show his wares and evaluate his products in a competitive market place.

CONSUMPTION PATTERN OF PEANUTS CHANGES LITTLE IN POSTWAR PERIOD

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Originally, this presentation was to have been made by Mr. George W. Kromer, Head of the Fats and Oils Section, Economic Research Service. However, the issue date of the *Fats and Oils Situation* for Angust coincides with this conference. Because of this, Mr. Kromer conld not attend and asked me to take his place. I'll do my best to pinch-hit. I might add, incidently, that after onr meeting here in which we cover the major facets of the peannt industry, we can all go back home, open our copy of the "Sitnation" and find out what *really* is going on in the peanut business.

In this talk, I want to mention some of the more important factors which affect peanut consumption and summarize what has happened in this area during the past decade. Before discussing this phase, however, I would like to touch briefly on trends in peanut acreage and production.

Since 1951, total Uuited States acreage allotments have been held at their legal miuimum of 1,610 thousand acres. This acreage will remain constaut as long as there is no change in the basic legislation. The nptrend in per acre yields, however, has kept output somewhat above edible reqnirements, and over the years CCC has acquired the surplus under the snpport program.

In 1960, the U. S. average yield was a record 1,265 pounds per acre (farmers' stock basis) which was 75 percent above the 721 pounds for 1947-49. While all the three main growing areas have shown an uptrend iu yields, some have grown faster than others. The Virginia-Carolina Area now has the greatest yield, with a 1960 average of 1,840 pounds per acre, 56 percent above the 1,179 pound average of 1947-49. The Southwest Area is second, the 1960 yield of 1,212 pounds up 66 percent above the 1947-49 average of 729 pounds. Although the Southwest is third with 965 pounds per acre, its yield is up 90 percent over the 507 pouuds of 1947-49.

In 1961, the Virginia-Carolina Area accounted for 20 perceut of the total U. S. acreage harvested compared to 14 percent for the 1947-49 average. The Southeast area had 51 percent as agaiust 53 percent in 1947-49, and the Southwest harvested 29 percent of the total acreage compared to 33 percent for 1947-49. (See Figure 1, attached.)

Now let ns cousider the main topic of this discussion. Use of peanuts aud peanut products per person in the United States during the postwar period has been characterized by a relatively stable consumption pattern. As we all know, the main edible uses of peauuts are peauut butter, salted peanuts, roasted peauuts, peauut candy and peauut butter sandwiches. Due to the relatively inelastic demand for peauuts, cousnmption rates are not as sensitive to price swings as for products with high elasticities. Consequently, total peanut consumption in the postwar era has been affected mainly by the growth in populatiou, while per capita consumption has remained fairly stable.

Currently, total civilian domestic disappearauce of peanuts for food use is about 900 million pounds (kernel basis), or about one-third above the 680 million pounds of 1950. On a civilian per capita basis, however, nse now stands at about 5.0 pounds (kernel basis) compared with 4.5 pounds in 1950.

Today, the average American consumes his 5.0 pounds per capita of peanuts in the following manner: abont 2.5 pounds of shelled peanuts in the form of peannt butter, 1.0 pound as salted peannts, 0.8 ponnd in peanut candy and 0.2 pound in peanut butter sandwiches and other products. Abont one-half pound per person is consumed as roasted peanuts (the ball park type).

Certain peannt products, especially peannt butter, must share the place on the consumer's table with other foods. For instance, cheese spreads, jams, jellies and meats are used in making sandwiches. While no attempt was made to measure any changes occnrriug among these various prodncts, it is interesting to note that per capita consumption for cheese and cheese products (excluding full skim American, cottage, pot and bakers) rose about 10 percent since 1950 compared to 11 percent for peannts. Per capita consumption of various nuts, though quite small, also registered changes during this period. Pecans, for example, rose by 45 percent while walnuts dropped by about 20 percent.

As mentioned earlier, shifts in price relationships have little effect on the per capita consumption rate of peannts. Althongh the 10.9 cents per ponnd received by growers for their 1961 crop peanuts (farmers' stock basis) was about the same as in 1953, the retail price of peanut butter dnring this same period increased from 49.0 cents per ponnd to 56.0 cents, a gain of 14 percent. The greater spread was due to increased marketing costs. This situation is not confined to peannts. In general, costs and margins for other agricnltnral commodities have also risen. From 1953 to 1961 the farm-retail spread for peanut butter increased 24 percent compared with an average increase of 18 percent for all farm-originated foods.

Using 1951-54 as a base, the price relatives for peanuts, cashew nuts and popcorn show that in the early 50's prices for peannts were low compared to cashew nnts and popcorn. Dnring the middle 50's, this situation was reversed and in the last few years peanuts and cashew nut prices showed a mixed trend in their relationship. The price of popcorn declined after the middle 1950's and never regained its former position. (See Table 1 attached.)

Fewer peanuts now go into the support program than was true in the late 40's and early 50's, when almost 50 percent of the annual production was placed under loan. Today, less than one-fifth of the annnal production is acquired by the CCC, the 1956-60 total averaged about 14 percent (farmers' stock basis). However, it must be remembered that there were no acreage controls in the immediate postwar period, the 1947-49 average being around 3.0 million acres compared to the 1.6 million acres today.

CCC diversion activities have consisted primarily of crushing for domestic use and some export of nuts to Canada. Dnring the early 1950's, about 90 percent of the peanuts were crushed. Lately, however, this trend has changed and only about two-thirds are crnshed and about one-fonrth exported. Of significance since 1957 has been the amounts diverted into peanut butter for donation to the needy and the School Lunch Program under the Agricultural Act of 1935. In 1957, about 6 percent of the total peanuts used in the diversion program was allocated for this purpose. For the 1961 crop year, about 30 percent of all peanuts in the diversion program will be utilized in this manner. The prospects for continued disposition in this area appear promising.

Peannt utilization patterns changed only slightly in the postwar period. Of the total amount of peanuts used in primary edible products, about

51 percent (shelled, raw basis) go into peanut butter. Salted peanuts acconnt for about 25 percent and peanuts in candy account for about another one-fifth of the total. The balance is used in peanut butter sandwiches and other uses. These percentages are basically the same as they were in 1950.

Changes occurred, however, between the types of peanuts used in these various products. The Virginia peannt now accounts for 31 percent of all peanuts nsed in these primary prodncts compared with 24 percent in 1950. The Runner now accounts for 32 percent, about the same as in 1950. The Spanish holds 36 percent of the market today compared to 45 percent in 1950.

Use of the Virginia peanut increased in all products, particularly for use in peanut butter, peanut candy and for items as peanut butter sandwiches. Use of Spanish peanuts dropped in all these products except in salted peanuts, where consumption remains near its 1950 level. The Runner decreased in usage in salted peanuts and for sandwich use but gained in peanut butter, making its overall usage for all products about equal to the rate of 1950.

Based on a one-week consumer survey taken in 1955, the distribution of nationwide consumption patterns reveals that about 6.8 percent of total U. S. households used peanuts and about 35 percent nsed peanut butter. The greatest percentage of households nsing peanuts was concentrated in the urban sections of the United States where 7 percent of all households were users at an average of .04 pound (shelled weight) per week. The heaviest concentration of peanut butter consnmers, however, was located in the rural non-farm areas where 38 percent of households were users at an average quantity of .22 pound per week.

On a regional basis, the Northeast section was highest in the number of households using peanuts, where 8 percent of all households used them. This area was also one of the highest in quantity consumed at .05 pound per week. The South had the smallest percentage of households, 5.0 percent and also the smallest quantity consumed, .03 pounds.

The region with the highest percentage of peanut butter users, however, was in the West, with a total of 40 percent. The greatest quantities used were in the North Central area, with over one-fifth of a pouud per week. The South again, was one of the lowest in both households and quantities consumed, 31 perceut of households aud .18 pound per week. (See Table 2 attached.)

A quick look at the coming year indicates that prospects are generally favorable for a good crop with output agaiu exceeding total requirements, and CCC acquiring the surplus under the support program. As in the case for most recent years, prices to growers for 1962 crop peanuts are likely to average at about the support level of 221.00 dollars per ton or about the same as the previons year. Future trends in the consumption and utilization of peanuts and peauut products over the near term are expected to continue about the same as iu recent years. Should basic acreage allotments remain near their present total, increases in yields will mean a continued abundance of peanuts above total, commercial, edible requirements and related uses. Unless consumption patterns change significantly or new markets for peauuts are opened, per capita usage is likely to move along at about its present rate, and total domestic consnmption will be related mainly to the rate of population growth.

Table 1. Wholesale price of shelled peanuts and specified tree nuts, and price received by farmers for popcorn, 1951-60

Calendar year	Price per pound							Price relatives 1951-54 = 100		
	Wholesale						Price received by farmers for popcorn 7	Peanuts	Cashews	Popcorn
	Peanuts 1	Cashews 2	Almonds 3	Filberts 4	Pecans 5	Walnuts 6				
	Cents	Cents	Cents	Cents	Cents	Cents	Cents			
1951	27.4	41.8	69.1	66.9	96.2	75.0	4.3	96	106	116
1952	26.2	41.8	64.2	49.4	74.2	75.5	4.4	92	106	119
1953	27.2	41.8	63.1	54.3	86.0	74.6	3.7	95	106	100
1954	28.9	33.0	64.7	64.5	71.4	74.8	2.9	101	84	78
1955	33.0	38.7	86.7	66.9	127.5	95.4	3.1	116	98	84
1956	37.1	50.6	98.5	75.3	108.1	90.2	2.7	130	128	73
1957	27.8	43.6	80.2	59.0	82.9	89.0	2.6	98	111	70
1958	28.8	33.3	85.9	60.5	79.8	8	2.4	101	85	65
1959	26.9	36.3	93.3	60.4	8	82.0	2.5	94	92	68
1960	27.6	43.2	74.1	62.8	9/138.9	93.3	2.6	97	110	70

1. Peanuts, shelled, Va. Extra Large, N. Y.
2. Shelled, Fancy Pieces, N. Y.
3. California, domestic, shelled, average, all sizes, N. Y.
4. Shelled, Levant, Extra Large, N. Y.
5. Domestic, shelled, Fancy Pieces, Large, N. Y.
6. California, domestic, shelled. 1951-54, Light Amber halves and pieces; 1955-57, halves; 1959-60, halves and pieces, N. Y.
7. Season average price, U. S. average.
8. None reported.
9. Halves, Medium, N. Y.

Fats and Oils Section
Commodity Analysis Branch, ERS
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Table 2. Household use of peanuts and peanut butter[1] percentage of households using, average quantity and average money value per household in a week, April-June 1955

All households (Average, by specified areas)	Percentage of households using, average quantity used and average money value					
	Peanuts			Peanut butter		
	Percentage of households using	Quantity used (lb. per week)	Money value (dol.)	Percentage of households using	Quantity used (lb. per week)	Money value (dol.)
	Pct.	Lb.	Dol.	Pct.	Lb.	Dol.
All urbanizations—U. S.	6.8	0.04	0.02	34.6	0.19	0.10
Non-farm (urban and rural)	6.9	.04	.02	35.2	.19	.10
Urban	7.0	.04	.02	34.0	.18	.09
Rural non-farm	6.5	.04	.02	38.0	.22	.11
Rural farm	6.5	.04	.02	30.4	.19	.09
Northeast	8.4	.05	.03	33.9	.18	.10
North Central	7.3	.05	.03	37.3	.21	.10
South	5.0	.03	.01	31.0	.18	.09
West	6.7	.04	.02	39.0	.20	.11

[1]Based on data taken from the 1955 Survey of Food Consumption of Households in the United States.

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August 6, 1962

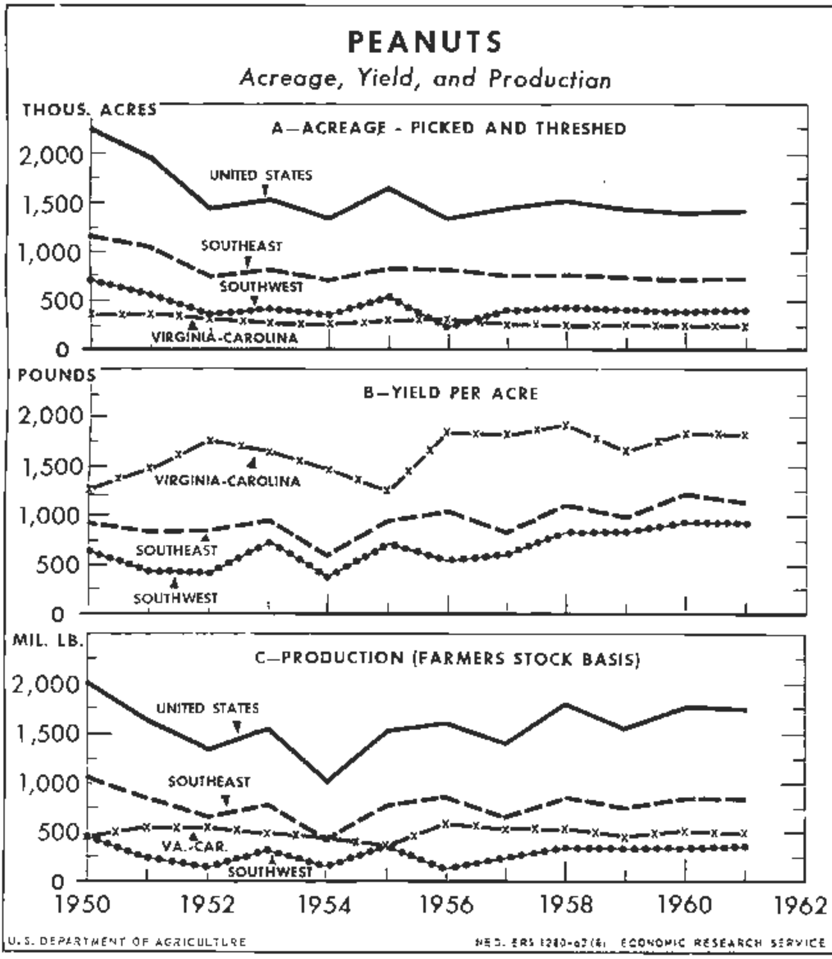
PEANUTS
Acreage, Yield, and Production
THOUS. ACRES
A—ACREAGE - PICKED AND THRESHED
UNITED STATES
SOUTHEAST
SOUTHWEST
VIRGINIA-CAROLINA
POUNDS
B—YIELD PER ACRE
VIRGINIA-CAROLINA
SOUTHEAST
SOUTHWEST
MIL. LB.
C—PRODUCTION (FARMERS STOCK BASIS)
UNITED STATES
SOUTHEAST
VA.-CAR.
SOUTHWEST
0
500
1,000
1,500
2,000
1950
1952
1954
1956
1958
1960
1962
U.S. DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE

Figure 1.

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Chemical Evaluation

Aaron M. Altschul, *U.S.D.A., New Orleans, La.*

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SOME COMPONENTS OF THE PEANUT SEED[1]

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The classical approach of food technology has been generally to treat the foodstnff in its entirety, to determine its composition and determine how the composition may be modified to suit the requirements of man. Food technology generally does not concern itself with the internal structnre of the natnral food material nor with the meaning or activities of the natural ingredients except insofar as they ohviously affect the material as a food.

The qnestion is whether this type of an approach suffices to obtain all of the information necessary to permit the fnllest utilization of a foodstuff. We were faced with this problem when we nndertook a program of investigation of seed proteins. We could use the current approach of not worrying about the function of the proteins in the seed or of their location within the seed strnctnre, bnt concentrate rather on the chemical properties of isolated seed proteins as being snfficient to obtain the necessary information. This particnlar approach has had a long history and has reached a point of diminishing return; little more abont seed proteins is known than when they were first investigated in the late 19th century. It then became apparent that perhaps a more frnitfnl approach to the problem of understanding seed proteins was not the approach of physical chemistry alone or of food technology, but that of trying to nnderstand the meaning of these proteins within the context in which they are found—their meaning in the biochemistry of the seed. Hence, a study of seed proteins of necessity became a stndy of protein metabolism in seeds and more generally of the biochemistry of seeds.

I shonld like to present some examples of the ontcome of such an approach and discuss possible consequences of the information obtained thereby.

The Proteins of the Peanut

The peanut seed contains between 20% and 25% protein. In general there is a wide variation in the protein content of seeds. The avocado contains about 5% protein and the soybean over 40%. It is probably a fair assnmption that a certain, more or less, constant concentration of the protein is the "machinery" of the seed. These are the enzymes and either mitochondria or premordia of mitochondria and plastids. The large variations in protein content must therefore be in proteins which have a special function in the seed, either being stored as protein particles or being involved in the elaboration and storage of other materials such as carbohydrate and fat. The total soluble proteins of the peanut may be separated into groups either by chromatography on DEAE cellulose or by electrophoresis on Cyanogum gel. In chromatography we distinguished four groups on the basis of the salt concentration at which they elute. A study of the changes in the soluble proteins in the first stage of germination indicated that the proteins of Group III disappeared very rapidly from the chromatogram and for this reason this protein was isolated by an

[1]Presented at 2nd National Peanut Research Conference, Raleigh, N. C., August 14, 1962.
[2]One of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

extension of the process of chromatography; the isolated protein has been named alpha-conarachin. We have obtained some properties of this protein. It has a molecular weight which varies from 150,000 to 300,000 depending on the ionic strength of the solvent. It has a low cysteine content and is also low in tryptophan, tyrosine, and methionine.

By zone electrophoresis we recognize six well-defined fractions for the total protein, but these are in no way related to the fractions obtained by DEAE cellnlose, nor is there any theoretical reason for their being so related. Although there are six main groups indicated on tracers of the electrophoreogram, there are visible large numbers of discrete protein fractions, each present in low concentration. Indeed, we are dealing with a very complex system.

There is a great degree of interaction between the major proteins of the peannt and this makes it difficult to identify them properly and to separate them completely and cleanly away from each other. Even alpha-conarachin, which is pnre by chromatography and ultracentrifngation, shows about 15% of another component when tested by zone electrophoresis. It is of conrse a possibility that this high degree of interaction provides a clue as to the nature of proteins. It might be that actually we are dealing with aggregates of small molecules which aggregate uniformly and repeatedly into well-known particle weights, but that these are not covalently bonded units.

The fact that a substantial portiou of the peanut proteins has a very low methioniue and cysteine content, mnch lower than the average for methionine and cysteine of the total peanut protein, would suggest, as no doubt might have been expected, a great disproportionation of composition between the various protein species. There must, for example, exist either a large fraction of proteins which contain a little bit more than the average cysteine content or, perhaps equally likely, certain proteins in small concentration with high cysteine contents to bring up the overall average.

The major proteins of the peanut can he distiuguished from, let ns say, the cytoplasmic proteins by the fact that they are not solubilized in the presence of osmotic agents such as Carbowax or sucrose. They exist in subcellular particles which can be seen nnder the microscope aud which can be isolated by procedures which do not rupture these bodies. (One step in that direction was takeu by Dr. A. A. Woodham.) Oue such procedure is that used by Dr. Dieckert, which involves fragmenting the peanut in vegetable oil, in the absence of water. In such a fragmentation process it is possible to isolate the particles containing as high as 80% protein.

Phosphorous

The same fractiouation procedure of Dr. Dieckert was followed for phosphorous and phytic acid determinatiou. Phytic acid is the major storage form of phosphorous iu seeds. It turns out that there are two particles of protein content, one which has about 80% and one which has over 70% proteiu, but only one of these particles, the so-called aleurone grains, contains all of the phytic acid of the seed and most of the phosphorous. This means that there is uo geueral distribution of phosphorous or phytic acid in the seed; they are concentrated in certain very special organelles.

Carbohydrates

There are two major carbohydrates in the peanut. There are starch grains which can be isolated. During germination wheu the fat disappears, there is a concommitant appearance of small starch grains which apparently are intermediate in the net synthesis of mobile carbohydrate from fat.

All of the sucrose is confined in a small portion of the seed, in the so-called network that appears to be three-dimensional, and which might be the honeycomb snrronnding the deposits of fat.

Nucleic Acids

The same portion of the honeycomb which contains 36% sucrose also contains most of the nucleic acids of the seeds. Nncleic acids of seeds in general is pretty low.

Metals

There is a well-defined distribution of metals in the seed. Calcium is mostly in the cell wall; potassium and magnesium in the aleurone grains.

Germination

a. *Nucleic Acids*

Dr. Cherry in our laboratory has found that the nucleic acids in peanuts increase rapidly upon germination for a few days and then show a general decline. The meaning of this increase in nucleic acid is not clear; it may be the nucleic acid of mitochondria which are synthesized to carry on the metabolic activities of the cotyledon.

b. *Protein Bodies.*

These particles undergo an ordered series of changes on germination. First they swell, coalesce, and develop vacuoles. They then become open and sponge-like, and finally fragment into numerons particles which become smaller and finally disappear. Therefore the process of change of the proteins in the peanut upon germination is first reorganization, followed by digestion.

Discussion

We might try to assess the meaning of some of the results of our experiments in terms of food technology. We treat the seed as if it were one homogenous material containing the average composition and we attempt to predict reactions on the basis of what the average composition would do. We are, therefore, very much surprised when things happen which are not predicted by the average composition. Only if the entire seed is mashed completely, if all of the cells and subcellular particles are broken, and all is one homogeneous solution, does the average have any meaning. But under the ordinary processing conditions, even in the making of peanut butter, many cells are not disrupted and many subcellular components remain intact. Therefore, the chemical interactions which take place during roastiug, for example, which might be predicted ou the basis of the sucrose and the amino acid contents, do not happen as expected because the amino acid composition varies from one location to another. That near the sucrose may be far different from the average, and storage of seeds, which hardly makes any changes in the average composition, might introduce profound changes in the flavor of the components. This could easily come about if there were changes in the permeability of components or if there were changes in local concentrations which would not be detectable in averages.

There is no question but that the average composition of a seed tells little of the location of the materials in the seed. There is a great, and perhaps even a complete compartmentalization of all components in the cell. Moreover, all of the components such as the protein are complex; there is no equal distribution of the amino acids in the seed; there will be some proteins which will be devoid of certain amino acids and others which will be rich in the same ones. Therefore, the average composition of seeds will tell you nothing about the diversity of the composition among the various components. The average composition of a seed does provide an orientation on the general aspects of composition: a seed is high or low in protein content or high or low in fat or carbohydrate. Aside from this, it tells little about what is inside the cells and allows little predictability of what might happen during the food processing operations. Certain components of the seeds which are not picked up when an average determination is made exist actually in high concentrations in certain small areas. The sucrose or RNA content which is difficult to isolate from the entire seed is rather easily identified in the three-dimensional network described by Dieckert *et al.* It is obvious, therefore, that if anyone wants to really understand what happens in food processing operations, he needs the same type of information required by one who wants to understand the biochemistry of the seed: the actual architecture of the cell must be understood.

It is for this reason that we believe that in the future there will have to be a closer interchange of information between those who are interested in the food technological applications of the peanut and those who are interested in peanut cell physiology. These are not two independent and unrelated sciences; one must draw for its basic information from the other so as to be in a position to understand, predict, and control the changes during processing to obtain the best suitable products, whether from the point of view of nutrition or from the point of view of appearance and taste.

Table 1. Composition of subcellular fractions.[a]

Fraction	Yield (%)	Moisture (%)	N (%)	P (%)	Starch (%)	Sucrose (%)	Phytic Acid (%)
Protein-rich fraction 1	6.6	9.0	13.3	0.32	0	4.3	0.5
Protein-rich fraction 2 (aleurone grains)	11.6	9.7	11.4	1.87	0	9.5	5.7
Starch grains	3.1	7.9	1.5	0.31	55	17.7	0.5
Fines material	2.0	8.0	6.7	0.71	0	36.0	0.01
Cell wall	1.8	12.9	2.7	0.09	0	2.8	0.01
Vascular tissue	6.0	10.4	7.7	0.78	—	13.1	0.01
Lipid-free cotyledons		10.0	9.0	0.90	8	9.9	1.7

[a]Taken from: Dieckert *et al.*, J. Food Sci. *37*, 321-325 (1962).

Table 2. Distribution of some metals in sub-cellular fractions.[4]

Fraction	Ash (%)	Ca (%)	K (%)	Mg (%)
Protein-rich fraction 1	4.68	0.03	1.38	0.09
Protein-rich fraction 2 (aleurone grains)	11.07	0.04	2.78	0.73
Starch grains	2.63	0.01	0.63	0.09
Fines material	3.37	0.01	0.97	0.06
Cell wall	2.87	0.35	0.54	0.34
Lipid-free cotyledons	6.44	0.06	1.66	0.38

[4]Taken from: Dieckert *et al.*, J. Food Sci. *27*, 321-325 (1962).

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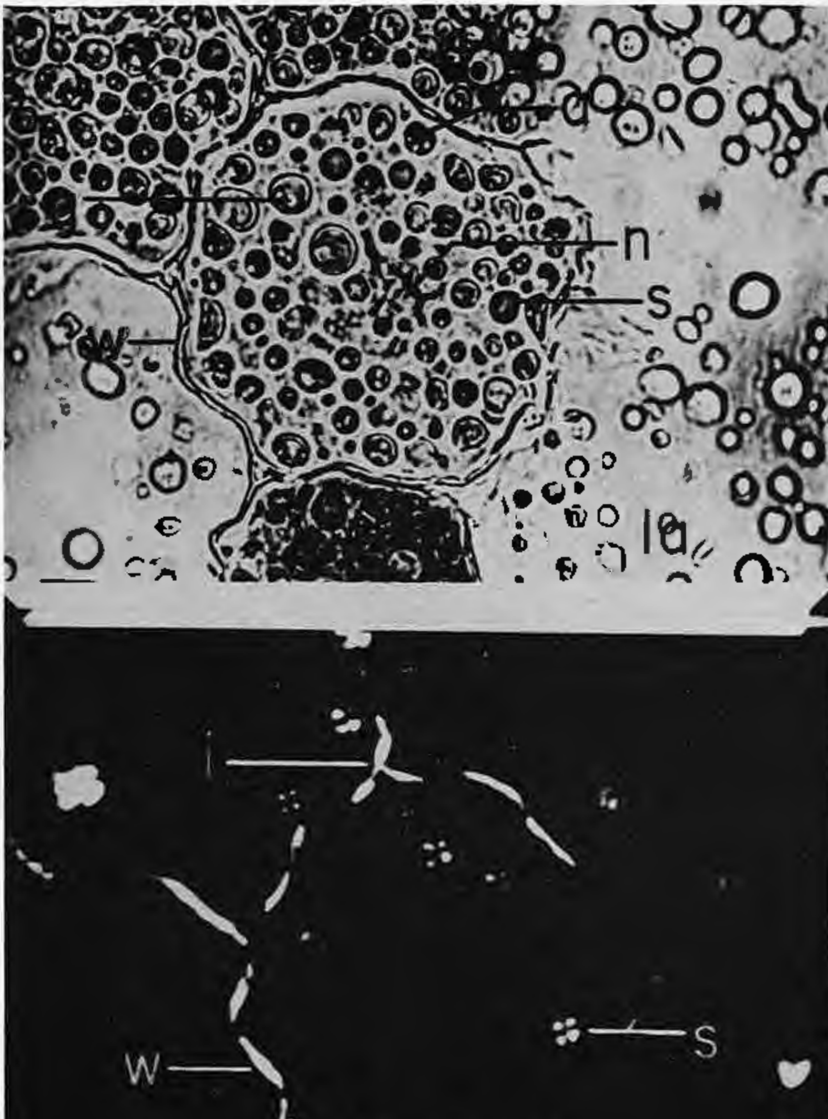

Figure 1. Photomicrograph of section of peanut cotyledonary parenchyma showing intact cell; lipid removed, fixed with OsO_4 in CCl_4; n-nucleus, S-starch grain, a-aleurone grain, g-globoid within aleurone grain, i-intercellular space, w-cell wall.

A. normal light, B. identical field of A in polarized light showing typical birifringence of cell wall and starch grains. (Courtesy of J. W. Dieckert, J. Snowden and Anna T. Moore).

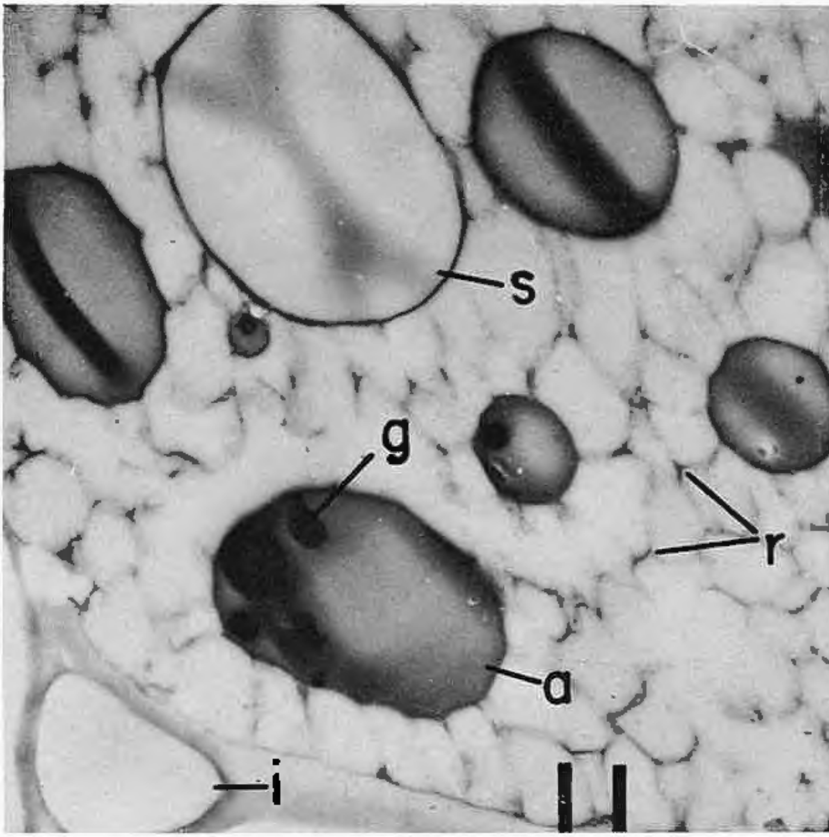

Figure 2. Electron micrograph of section of peanut cotyledonary parenchyma showing individual particulates and intracellular network; lipid removed, fixed with OsO_4 in CCl_4; S-starch grain, a-aleurone grain, g-globoid within aleurone grain, i-intercellular space, r-three dimensional network (reticulum). Spacing between bars is equivalent to one micron. (Courtesy of J. W. Dieckert, J. Snowden and Anna T. Moore).

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Shellers Role

PROGRAM COMMITTEE

JOHN HASKINS, *Durant, Oklahoma, Chairman*
JAMES C. ROE, *Dallas, Texas*
T. J. WHITE, *Norfolk, Va.*

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THE SHELLERS ROLE

JOHN HASKINS

Durant Peanut Company
Durant, Oklahoma

For argument sake, let us consider three segments of our industry for comparison—the growers, the shellers, and the manufacturers.

When I was a youngster, more years ago than I would like to admit, the three segments were in balance as far as efficiency in operation was concerned. The producer was in no strain or hurry so he harvested his crop when the crop was ready to be harvested. He shocked all his peanuts in well prepared shocks, and forgot about them as far as weather was concerned and so forth. While in the shock they continued to mature on the vine and cured evenly. When he was ready to thrash he picked his own day or days at his convenience to thrash and then brought them to market. What were the results of this process? First of all the peanuts were matured which resulted in easier and better shelling, grading, sizing, and produced more uniformity in the kernels.

The kernels were tougher as opposed to what we expect today in hardness and brittleness—this made for better shelling with fewer baldies, less skin slipping, and less splitting. I might add, too, we had no problems with off-flavor peanuts because the peanuts were sweet with the desired nut flavor we have a right to expect in peanuts. In thrashing, because they were cured properly, they thrashed well and the foreign material content was low.

Our shelling plants were engineered to handle this kind of a peanut. We shelled the peannts when the manufacturers needed them—therefore, they were delivered freshly shelled and complaints from manufactnrers were few and far between.

As we all know, times have changed. Research. coupled with a change in conditions such as labor problems and so forth, has caused the producer to mechanize his harvesting. The method of shocking is almost unknown because peanuts now are placed in windrow usually with side delivery rakes and then thrashed with combines. Too often the peannts are thrashed green before they have had time to cure and are carried to artificial driers. What is the resnlt of this? More burdens have been placed on the sheller to shell a mixtnre of immature odd sizes, peanuts that have shrunk within their skins causing skin slippage and more splits and the presence of more foreign material that has to be removed. The shellers have had to cope with this situation with machinery that was designed to handle peanuts that were harvested under the shock method.

Our segment of the indnstry is too small for machine manufacturers to invest large snms of money in research and experiments because their potential sales of this equipment would not return them enongh money on their investment. The shellers themselves are relatively small and their capital is too limited to engage in mechanical research individually. So we struggle along with antiqnated machinery trying to do the best job we can which we readily admit is not what it should be. True, there has heen some advancement made in the cleaning and stoning eqnipment as well as in the sizing and electronic eyes but this is about the extent of it.

We are trying to shell peanuts today as we have always done—by a method that is actually whipping the hull off by revolving bars in perforated baskets or grates. Personally I believe that there is a better and more economical way to shell peannts but I have no concrete ideas on how it could be done. While the producers were mechanizing their harvesting methods, the manufacturers were improving their methods and by the same token their end products. By usiug their own laboratories and their technical and trained personnel. In the main the shellers are too small to maintain laboratories or to employ technical personnel. We need assistance from some source if we are to keep our segment in step with the other two. As long as our segment is antiquated we will create problems for the other two segments. If we are unable to supply quality merchandise to the manufacturers then our problems are multiplied and their profits are lessened. At the same time we are not giving the consuming public au acceptable product at a cheaper price.

I think we can liken the three segments mentioned to the "Three Mnsketeers"—'all for one and one for all.' It seems to me that it is necessary that we have a more common understanding of the problems existing in each of these segments and that we try to help each other to solve these problems.

Onr agronomists have developed new strains of peanuts which are well and good but the emphasis has been primarily on the type of peanut that will produce more income to the producer either by size or prodnction or disease resistant and too often the shelling qnalities of the peanuts has not been taken into consideration. The numerous strains that have been developed have become alarmingly mixed on the farms, more storage, and in the hands of the shellers with the result being that we have so many varions sizes and shapes that it creates a very difficult problem to properly process the peanut. Perhaps rather than put the burden on the agronomists of producing a peannt with proper shelling qnalities we shonld learn how to shell peanuts efficiently regardless of size and shape when they are mixed.

As shellers we are willing and anxious to modernize and improve our eqnipment bnt we covet not only yonr indnlgence but your active support.

IMPROVEMENTS IN SHELLING PEANUTS

JAMES C. ROE

Partner, Tate and Roe Company
Dallas, Texas

I want to thank Mr. Haskins and Mr. Suggs for inviting me to appear on this panel. We are not shellers bnt we have worked with the shellers in the Southwest for the past 20 years or so, on many of their shelling problems. We are Engineers and a Sales Organization located in Dallas.

In the beginning, our friends in the shelling plants asked us for help and told us their problems. Being Engineers, we tried to approach the problems purely from an analytical point of view. Onr first job was to locate the cause of the troubles. Let me state right here that every sheller has his own method of shelling peanuts. There is no set remedy for the ills of a peanut shelling plant. Each plant has its own flow, we did not attempt to change the flow or offer any suggestions until we had made a snrvey of the plant and tried to determine where the problems originated. This is not always as easy as it may appear. The results of a malfnnction are usnally apparent but the canses are sometimes hard to pin point without some detailed study.

We found it necessary to start at the head end of the plant and examine each phase as we went throngh the flow. Our first approach was to get a sample of the product going to and coming from each elevator, conveyor, screen, sheller, etc. We did this by fastening a small can, about the size of a "pork & beans" can to a stick about 3 feet long. This can was turned upside and put into the stream, it was then turned to the upright position and filled to overflowing before removing it from the stream. We tried to take the sample at the head end of a process and immediately take a sample at the tail end to make sure that a change in the product did not occur during the sampling. All of you know that the character of peanuts will change several times a day. If there was a marked difference in the product to and from a machine we would take several samples at different times and average the results.

Without going into all the details, it is enough to say that the worst offender in the plant was the bucket elevator. Most of the early bucket elevators were home made and from time to time they had been speeded up to get more capacity. The ratio of head pulley diameters to belt speed had been overlooked or not considered, and as a result, the peanuts were being discharged at such a high speed that we were splitting the peanuts by impact in the head of the elevator. In some cases we found as much as 5% splits being made in one elevator on shelled goods.

This was not a hard problem to solve. By installing slow speed elevators with continuous cups and the proper loading of the cups in the boot, we were able to overcome this problem on shelled goods. On Farmers Stock, the elevators were made larger with larger cups and minimum belt speeds, based on head pulley diameters. Bear in mind that our shelling plants did not jump in and change all their elevators at one time. In the first place it was necessary to find manufacturers who would build elevators for peanuts. This was almost as big a problem as getting the sheller to buy them. In the early days a good many of our plants were line shaft driven and the elevators were located to accommodate the line shaft; resulting in improper loading by feeding on the back side of the leg, improper discharge spouts and the worst offender, the use of screw conveyors to convey peanuts to or from the elevator.

Having had experience with the Pure Food People in the flour and corn meal industry and being told they were going to "hit" the peanut processors next, we recommended that when an elevator was replaced, it be done with a metal leg and that all screw conveyors be removed. If it was necessary to use a conveyor, we recommended a vibrating all metal conveyor on shelled goods. On Farmers Stock, we recommended troughing belt conveyors of the idler type or the drug belt type.

Next, on our list of offenders were the shaking screens. Due to the inefficiency of this type of separation on peanuts, it was usually necessary to keep a hoe beside each screen and from time to time the operator would scrape the deck to keep it from "blinding".

Samples taken during the unblinding would show as much as 20% splits and oil stock.

Strange as it may seem today, early in onr work there were no manufacturers who built a rotary type separator for peanuts. We worked with a manufacturer building rotary screens for sizing corn, barley and other grains and got them to make a screen that could be used in the peanut industry. The machines made at that time were equipped with screw conveyors that had to be removed in the field before the machines could be used on peanuts. These machines were first used on streams more or less as a salvage operation.

The advantage of this type of separator became more apparent and the manufacturer began to see the potential market and began to build machines for peanuts. The screw conveyors were removed and belt conveyors used in the machine, these were later replaced with vibrating conveyors so that today you can get rotary type screen machines to do almost any grading job on shelled peanuts.

Sticks have always been a problem in the southwest. There are several Farmers Stock Pre-cleaners available and in most cases, they do a good roughing job on sticks. We still have many short sticks that the pre-cleaners will not take out. In "shelled goods" streams the problem became a length separation, as well as a thickness separation. Knowing that there were machines made for length separations, we worked with the manufactnrer of these machines and fonnd that with the proper size pockets in the discs, we could lift the peanuts and reject the sticks. We found that there were many short sticks that would follow the "middling" product from the gravity tables. Upon examination, it was discovered that the most of these sticks were smaller in diameter than the unshelled peannts. By putting the "middling" product from the gravity through a rotary screen, we could drop the sticks and shelled goods through the screen and retain the unshelled on the screen. This gave us a clean product to send to the nub shellers. The sticks and shelled goods would be put over a disc machine to recover the shelled peanuts.

Strange as it may seem, most of the shellers, when kept clean of sticks and rocks, wonld not split too many good peannts. By good peanuts, I mean peanuts that have been properly cured. Peannts improperly cured or dryed will split even if yon shell them by hand. This curing problem is a big one but there are many qualified men working on this problem and I believe we can expect some improvement in the near future. There is some thinking that improper cnring causes off flavor and when you start to effect the flavor of a peanut everyone gets into the act. For now, let me say that a method to properly cure peanuts is being sought and some improvement can be expected.

We are now working on a sizing reel for farmers stock ahead of the shellers. This is not new and it may be that many of you have tried several methods to do this. Purely from an analytical point of view progressive shelling is a sizing operation. The peanuts that fall through on sheller baskets are retnrned to a sheller with smaller openings—that is a sizing operation. Why can't we do this ahead of the shellers and have the peanut go through a sheller only once? As soon as the proper type sizing reel is developed, we believe it can be done.

In an effort to clean the plants up there has been a number of improvements in the gravity tables and stoners. The new machines and conversion units available for most gravity tables are designed to give a clean operation without red skins and hull fragments being blown all over the floor. Plants with this problem should contact the manufacturer of his machine and see if there is not something that can be done to clean up his machine.

In the past 15 years there has been some improvement in the hnll removal problems. When we had only an air leg it was very difficult to keep the flow nniform. At times we would lift light peannts and nubs and at other times we would let hulls go with the shelled goods. By taking off part of the hulls immediately under the shellers and by using more efficient aspirators in the stream at other points, the hull removal problem has been improved. At the present time we have a hnll purifying system that is doing a good job. All of the hulls are put over a floatation type separator where about 30% of the hulls are lifted by the air and the balance are discharged at the low end of the machine. The heavy fractions consisting of hearts and broken meats are conveyed up hill and discharged.

In the Sonthwest, we are going more and more to mechanical picking. Most of our plants have some electric eye picking. In some cases, the mechanical picking is limited to peewees, small 1s and splits. Other plants go so far as to have all mechanical picking.

After picking in some plants all the streams are combined and go to a sizing operation. In other plants, the streams are kept separate and go to finish sizing operations. In all cases, the sizing is being done on precision graders. These machines have been developed for peanuts so that we have a qnick change of shell sizes and vibrating conveyors under the machines where necessary.

There is a trend to mount the sizing machines above a large sacking bin that has been divided into a number of small bins. The various sizes are spouted to the proper bin. We nse "ladders" in most bins so the peanuts will not fall the height of the bin bnt will be let down gently.

Our larger plants have automatic scales under the bagging bin and one or two men handle the complete sacking operation. The bagged peanuts are either stacked on pallets at the scale or conveyed to the warehouse on conveyors and stacked on pallets in the warehouse.

Due to the fact that most of our plants are located in smaller towns, some have put in refrigerated storage at the plants.

I have run through this rather hurriedly and have passed over some items that might be of interest to some of yon. I understand there is to be a question and answer section to this panel and if you have any qnestions I will try to answer them at that time.

Thank you.

CHANGES AT THE SHELLERS LEVEL

T. J. White

Columbian Peanut Company
Norfolk, Va.

It is a pleasnre to appear here today and take part in this very interesting program. As all of you know, onr theme is "Peanut Progress Through Research" and I have been asked to speak briefly on how the shellers can participate in contributing to this progress.

I am sure you all realize that the role of the sheller in the peanut indnstry has undergone a complete change in the last few years. Shellers today clean and shell peanuts with the purpose of performing a function jnst as much as the butter manufacturers in making peanut butter, salters and the candy manufacturers in making their product.

Whereas it is true that there has not been a substantial change in a peanut sheller since the first one was made, there has been a number of changes in cleaning machinery, precision grading machinery, stemming and picking machinery, as well as other eqnipment.

Peanut shellers that have remained competitive have been called upon in the last few years to spend more money on equipment and capital improvements than in the entire history of the industry preceding this time.

Not too many years ago the predominating factor in marketing shelled peanuts was "price" and, whereas quality was a consideration, a deficiency was easily off-set by a price concession in the form of allowable claims. I am happy that, in more recent years, the higher standard of quality being songht by manufactnrers of peanut products has resulted in much greater emphasis on high qnality of raw peanuts and a relnctance to accept claims in lieu of quality.

Now the money that was formerly paid out in the form of claims has to be used to purchase new and modern equipment that will enable a sheller to remove from shelled peannts more of the undesirable factors such as foreign material and damaged kernels.

There have been some improvements in the shelling process and I believe all shellers are doing everything they can to keep abreast of the new developments and now, with the exception of concealed damage, most mills are in a position to turn out peanuts freer from the objectionable factors than ever before.

There is little or nothing that a sheller can do to remove damage that is disclosed only when the peanut is split. Peanuts that contain this type of damage have to be segregated at the time of purchase and not milled together with high quality peannts. Fortunately, this type of damage has been snbstantially reduced in recent years due to developments at the farm level.

In order to eliminate damaged kernels during periods of storage caused by infestation, we have and, I am sure most other mills have, developed a program of fumigation that has substantially reduced this source of trouble; in fact, I sometimes feel that maybe in the industry we might be over-extending the fumigation program.

By recognizing the effect of moisture on the quality of peanuts and treating it so as to avoid adverse effects in storage, I believe that we have eliminated many of the problems that we once had, such as mold.

I think that all of us must recognize the fact that in peanuts, like in all other crops, the biggest factor in the quality of the crop that is available for use, is the growing and harvesting conditions and under certain of these no amount of machinery can produce good quality.

Now I do not want to give the impression that I think our part of the industry is up to date because we have much room for improvements and a long way yet to go now. I presume that inasmuch as there are other shellers on this panel that it is expected that I should concentrate my thoughts a little more in the direction of the sheller's role in handling the Virginia type peanuts.

As you know, the peanut industry in the Virginia-North Carolina area has undergone and is still undergoing a complete revolution. We have not yet even completed the change over from bag handling to bulk and, already, we are faced with combining and artificial "drying" . . . I understand that I am not supposed to use the word "drying" at this meeting so I will change this to "artificial curing." These changes have necessitated the shellers in the Virginia-North Carolina area to have to make tremendous changes in warehousing and handling equipment at a considerable expense. Now, it is known that the manner in which we handle peannts can be greatly improved, and it is also known that the segregation of peanuts at the farmers stock level can enhance the quality of our end prodncts, and I realize that there is machinery, electronic equipment and better picking equipment that can be, and is being, installed, to increase the quality of our prodncts.

We are trying to accomplish these things while at the same time keep step with the revolution that is going on in the industry in this area.

I am snre you all know that it is very hard to put the final refinement on a system or a piece of equipment that you have on order or probably haven't even installed, and this is the position that we are in at the present time. For example: in the conversion to bulk peanuts, some of the very crudest equipment was installed for unloading trucks, loading and unloading warehouses. I feel certain that I speak for most of us in our industry when I say that a lot of this equipment has been abandoned and we are trying to handle and segregate peanuts at the farmers stock level a lot better than we did when we first made this conversion. Practically all of the farmers stock is now sampled with the spout type sampler which I understand to be the most accurate yet devised and this in itself will contribnte to the sheller's ability to handle quality problems to a lot better advantage than in the past.

Once again, I would like to impress upon this group the terrific problem we have had in the last few years just trying to keep pace and, as mentioned before, we still have the mechanical harvesting and artificial cnring procedure that we are going to have to conquer before we can continue with the refinement of all of onr other processes.

As previously stated, the shellers part in the peanut indnstry has completely changed and I believe that the shellers are in a position to know that their contribution toward the inprovement of the peannt is just as important as any other segment of the industry.

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Manufacturers Role

PROGRAM COMMITTEE

EDWIN L. SEXTON, *Bayonee, N. J., Chairman*
J. D. WELLS, *Springfield, Ohio*
ROBERT F. DELONG, *American Can Co.*

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MODERN PEANUT PROCESSING EQUIPMENT

MR. JOHN D. WELLS

The Bauer Bros. Company
Springfield, Ohio

This paper is a review of the progress in the processing of peanuts over a period of more than 30 years as reflected by the experience and progress of one equipment supplier to the industry.

In 1930, Peanut Processing Equipment was just emerging from the stage of Farm Mechanic Handicraft. Most equipment was relatively crude, inaccurate, inefficient, underpowered, producing variable quality end-products at low volume rates for a not too discriminating market. Construction of equipment utilized considerable wood and mild steel and/or cast iron with little attention being paid to the sanitary requirements of producing quality edible foodstuffs. The country was in the midst of a severe depression, peanuts and peanut products were hard hit. It can be said, without exaggeration, that this was the dark ages of the industry.

In 1930, the Bauer Bros. Co. purchased the assets, patents and complete line of the Lambert Manufacturing Company of Marshall, Michigan, and moved the scene of manufacture of this equipment to the Bauer plant at Springfield, Ohio.

The Lambert line at acquisition consisted of the following basic equipment:

1. Peanut Roasters of the underfired solid cylinder type.
2. An 8" V-belt driven Peanut Butter Mill with a 5 HP motor.
3. Split Nut Blanchers of the old brush type with many deficiencies.
4. Canvas Belt Elevators with sheet metal buckets, and a crude cooling car.
5. A crude Airlift Stoner for cleaning and conveying peanuts.

Beginning in 1933, this line of equipment was completely re-designed to reflect use of more modern materials, design, etc., to produce more efficient equipment capable of producing higher quality end-products.

Outstanding in this activity was the development of an improved direct connected mill that could utilize 5, 7½ or 10 HP motors. This unit would produce 500-1, 400 pounds per honr of peanut butter depending, of course, on the power applied and the fineness of the grind desired.

The first integrated plant using the newly designed eqnipment was installed at the Hale Hassle plant, McAllister, Oklahoma, in 1934. This plant had a capacity of 800 pounds of peanut butter per hour.

During the 30's, minor improvements were made in the basic 8" Butter Mill. After World War II, we developed the No. 148-8" Texturizer which was nsed as a regrind mill in connection with the standard 303 Mill to produce an ultra-fine grind. The No. 248-18" Mill equipped with 30 HP was then developed. Later the power applied to this unit was increased to 40 HP and is now offered with 50 HP.

At present this unit is capable of producing 1,800 to 2,000 pounds per hour on a single pass grind or 2,000 to 3,000 pounds per hour when used in series operation, again depending upon power and fineness of the grind.

Early in 1961, the 24" No. 247 Mill was designed and tested. This unit, equipped with a 75 HP motor, is capable of producing 4,000 pounds per hour on a single pass basis, or 6,000 pounds per hour when used in series.

Here we can see the transition of 30 years from an 8" Mill capable of handling a maximum of 5 HP producing 500 to 800 pounds per hour of questionable quality peanut butter to the latest uuit using 75 HP and producing as high as 6,000 pounds per hour of high quality, ultra-fine peanut butter.

As indicated previously, the roaster Bauer inherited from Lambert was of the batch underfired drum type. This unit was improved in the 1930's and by 1935 firing was changed to the Radiant Ray type of heat application with excellent improvement in efficiency, and uniformity of end-product quality. Roasting time was reduced from approximately 55 minutes on the old type roaster to approximately 20 minutes per batch on the new design.

In the late 30's, considerable design and development work was done on a continuous roaster in co-operation with The Kroger Company, The J. W. Leavitt Company of Boston, Massachnsetts, Holsum Products of Brooklyn, Planters of Snffolk, Virginia, A & P in Brooklyn and The Kelly Company in Cleveland. After considerable development with the prototype models and pilot plant work, this activity was abandoned in favor of batch roasting. The problems of the continuons roaster were high maintenance of units, non-nniformity of roast due to non-uniform raw material and resultant lack of a control over the roasting process accnrate enongh to compensate for raw material variations.

In retrospect, this experience on continnous roasting is no more than should be expected. Peannts are a commodity prodnced by natural growth under highly variable conditions and ever changing varieties. This is expressed as a highly variable raw material for the roaster where we find variation in moisture content, peanut size distribution and degree of contamination factors over which the producer has only a minimnm of control. Continuous antomatic roasting of a variable natnral product like peanuts to prodnce uniform results depends upon detection of the variations and change of roasting conditions to handle these variations. As of today, it is our opinion that these variables are uucontrollable and, therefore, satisfactory uniform continnous roasting cannot be achieved.

On the other hand, when the roast is confined to several bags of peanuts which are blended into a composite batch which can be roasted into a good uniform end-product by varying roasting conditions to suit the individual batch requirements, satisfactory results can be obtained.

This problem is not confined to peanuts, bnt is true to a greater or lesser degree on all naturally prodnced materials or agricultural products. Baner produces process equipment for a wide variety of continuons processing industries, and experience indicates such variation is the expected rather than the exception to the rule on such prodncts.

The Radiant Ray Roaster was developed over the years and equipped with color controls and improvements that provided greater reliability, efficiency, and uniformity. In 1959, this activity culminated in the Ray-O-Matic Roaster and stationary Elevator Cooler.

The Ray-O-Matic system operates completely antomatic. The roaster will automatically receive raw peanuts from bnlk storage in batch lots of uniform volume. After roasting, the peannts pass to the cooler where they are thoroughly cooled. Both roaster and cooler are controlled automatically by the product variables giving all the benefits of continnous roasting with added benefit of batch control. The variables in the prodnct controls the automatic roasting in the Ray-O-Matic batch system, resnlting in uniform roasting from batch to batch.

With the Ray-O-Matic system, one unit can handle 2,100 pounds of feed in stock per hour, the same capacity as two No. 322 Radiant Ray units with separate cooling units. The one Ray-O-Matic system will require less floor space than the 322's. Numerous Ray-O-Matic systems have been sold within the past year and half, and is rapidly becoming the accepted standard unit of the industry.

Cleaning of Peanuts

The early cleaning unit of peanuts consisted of an air lift type stoner. This equipment was gradually improved during the early 1930's, but still was handicapped by being hard to keep clean, broke up too many peanuts into splits, provided fair stoning, but little or no removal of sticks and trash. In other words, provided a relatively poor cleaning job.

During the 30's, Bauer designed and built the No. 208 Specific Gravity Separator which provided a vast improvement over conventional stoners and cleaners. This unit has been further improved and is now the standard unit of the industry on both roasted, cooled and raw peanuts. The separators were originally installed by the shelling plants. However, modern requirements for cleanliness have led to installation of units in the end user plants as well. In addition, in 1950, we incorporated a built-in stoner into the No. 208 Separator which proved much more efficient than the old type open stoner.

Blanching

The original Lambert Blanchers were of the brush type. These units were relatively inefficient and ineffective. The units were completely redesigned in the early 1930's with a basic change to rubber blanching elements in both whole and split nut types. Rubber blanching belts have no abrasive action as compared to brush type, resulting in higher yield of quality meal free peanuts. These units provided much more efficient operation.

The units were improved over the years, and now are the accepted standards for the industry on this phase of the operation. Several years ago, a basic change was made on all this equipment from nse of angle iron to tubular steel for improved sanitation and cleanliness.

Existing Problems and Future Developments

We have previously indicated how improved equipment has provided a major contribution to the peanut processing industry. There are a number of problems apparent and still to be solved to provide improved end-product, customer acceptance and more efficient production of peanuts and peanut products. The following are a few of these items requiring attention:

1. Roasting peanuts in the shell still leaves much to be desired. Improved processing to provide more uniform results and higher quality is a major problem.
2. Improved blanching efficiency requires improved grading of peanuts to provide more size uniformity to the blancher units.
3. Development work on butter mill plates to provide finer grind at lower temperatures is highly desirable.
4. Eqnipment is also needed to provide lower speck count in finished peanut butter.

I have with me a colored photographic album of a modern np-to-date peanut butter plant and anyone wishing to see this album can contact me after the meeting.

The above provides an up-to-date and historical picture of a modern line of equipment for Peanut Processing. I would like to thank you for the opportunity of presenting this short story, and I will be very happy to answer any questions, to the best of my ability, from the floor within the time limitations.

Thank you.

PACKAGING OF NUTS

ROBERT F. DE LONG

Research and Development Division
Marathon
A Division of American Can Company

Packaging materials for food mnst perform several fnnctions: contain it, identify it, keep it clean and protect it. This protection inclndes control of moisture, oxygen, grease and light as well as resistance to physical abnse. It is these protective functions as they apply to nnts which we will now consider.

Water Vapor Permeability

The texture of shelled nnts depends upon their water content and varies with the kind of nnt—dried peanuts contain 6% to 7% water, walnuts 4.2% and pecans 3.5%[1]. The nnts become soft as they gain moisture and brittle as water is lost. Therefore, the packaging material must minimize or prevent this movement of water.

There are many packaging materials available and more are being developed continnally. The selection of the proper one is difficult nnless some method is available in the laboratory to test for moistnre transfer. The method of the Technical Association of the Pulp and Paper Industry designated as T-464 is nsed in onr laboratory. This inclndes the use of a flat aluminum dish, containing calcium chloride as a moistnre absorbent, with the test sample sealed to the dish by means of wax. This test dish assembly is allowed to equilibrate at 100°F. and 90% Relative Humidity (R.H.) until there is a constant daily gain in weight. It is possible to calculate the weight of moisture passing through the test sample and it is reported as the grams of water vapor transmitted per square meter per 24 hours. This moisure is water vapor and not water droplets. These valnes are known as the Water Vapor Permeability Rate or abbreviated as WVP Rate. These values are like a golf score, the higher the nnmber the poorer the results. Some organizations nse an area of 100 square inches and this rate can be converted to a square meter basis by mnltiplying by a factor of 15.5.

Care is taken to prevent folding or damaging the sample, so the results are known as the flat WVP Rate. Most packages have one or more creases or folds and it is at this area that measurable damage may occur. Some wax coatings on paper become damaged while films of cellophane or plastic, such as polyethylene, do not crack. Unsupported aluminnm foil is quite vulnerable to damage. Therefore, part of the test samples are uniformly folded to simnlate actual use conditions according to Method T-465 and these valnes are known as the creased WVP Rate. It is important in comparing WVP Rates to be sure that the same test conditions, area and type of creasing were employed.

It is interesting to compare the flat WVP Rates for typical packaging materials. It can be seen in Figure 1 that papers are the least protective with foils the most protective. The amount of moisture protection required is relatively little for nuts in the shell, increases when the unts are shelled and becomes greatest when they are cut or ground. These factors must be considered in selecting the proper packaging film.

An accelerated packaging test of shelled pecans was condncted to determine the degree of protection offered by four films based on the moisture change during storage and this gives us a chance to compare package performance results with WVP Rates on test sheets. The test data from Table I shows that under dry storage conditions moistnre was lost from the nnts in pouches of cellophane, cellophane-polyethylene and Mylar-polyethylene while under moist storage conditions nuts in cellophane or cellophane-polyethylene pouches gained moisture. However, a foil-polyethylene barrier prevented any transmission of moisture. This change in moisture

Table 1. Moisture Content of Pecan Halves After Six Weeks' Storage

Pouch Material	Moisture Content of Pecans in Per Cent 100°F. & 20% R.H.	100°F. & 90% R.H.
K-Cellophane and Polyethylene	2.0%	4.7%
M-Mylar and Polyethylene	2.0	4.1
Paper and Foil and Polyethyleue	4.3	3.9
MST-54 Cellophane	1.5	5+

Initial Moisture = 4.2%

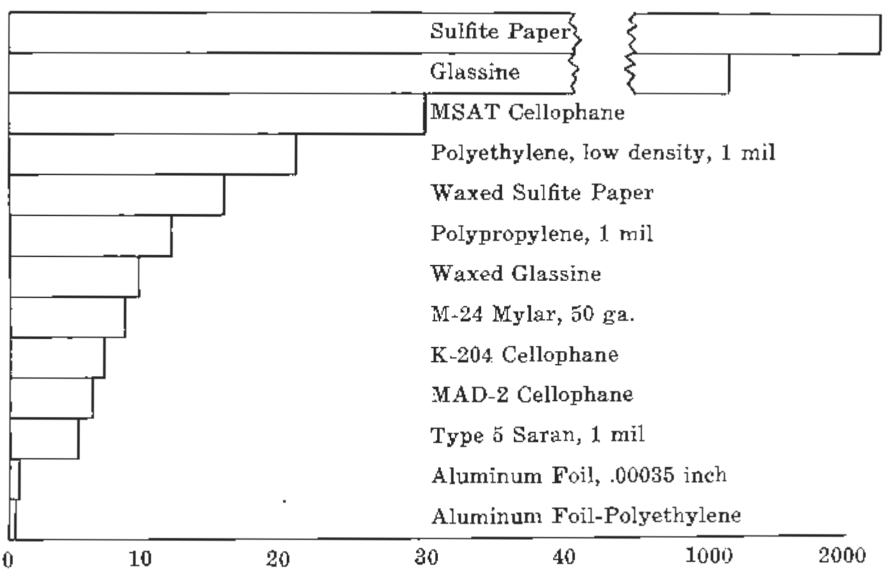

Figure 1. Comparative Flat WVP Rates of Packaging Materials

content conld be predicted from WVP Rates of samples which indicate that cellophane and/or polyethylene are not as protective as a foil barrier. The advantage of the WVP test over the packaging test is the shorter time required for resnlts, approximately one week instead of six. However, the packaging test does not inclnde snch variables as sealing, damage to the pouches during storage and handling as well as different storage conditions.

Oxygen Permeability

The flavor of nuts quickly deteriorates as the oils start to oxidize and rancidity develops. The oxygen in the air is ever ready to start such a reaction. While the nut pellicle does contain tocopherols as natural antioxidants, the protective effect is lessened as the skin is abraded. This allows the surface oils to excude, becoming more susceptible to oxidation. The removal of the pellicle permits a faster reaction due to the removal of the antioxidant and release of the oils[2]. This is particnlarly serious with walnuts which have a larger proportion of unsatnrated oil than peanuts, pecans, almonds or filberts[3]. The control or prevention of rancidity depends upon the elimination of practically all oxygen from the package. This can be done by evacuating the package or by dilnting the oxygen with an inert gas. The packaging problem then becomes the prevention of the transmission of oxygen through the packaging material into the container.

Since there are so many materials available, the selection of the proper one becomes a problem. Two methods are used in onr laboratory to measure the permeation of gases throngh films—the isostatic and pressnre methods. The isostatic method is very accurate, somewhat slow and does not subject the sample to stresses. This consists of exposing one side of a test sheet to oxygen, removing the permeated oxygen from the other side with an inert sweep gas at essentially the same pressure and volumetrically measuring the collected gas. The pressure method consists of subjecting one side of the test sheet to one atmosphere of oxygen and drawing a high vacunm on the opposite side; the gas permeating through the sample is measured by the decrease in level of vacuum. With both methods a specific sample size is used and the gas transmission rate is reported in millimeters per square meter per 24 hours at specific temperature and humidity conditions. As in WVP Rates, the gas transmission rates can be compared only if the samples are of similar area as well as being tested at comparable conditions of temperature and relative humidity.

Varions packaging materials have been tested for oxygen permeability as is shown in Figure 2. It is evident that many of the films with good water vapor barrier properties are also good oxygen barriers but polyethylene and polypropylene films are well known exceptions. A test of shelled peanuts in protective pouches was conducted in which the oxygen was reduced by an inert gas flush. The data in Table II shows that the foil-containing pouch did minimize the entrance of oxygen because of its low oxygen permeability. It is interesting to note that much of the original oxygen was nsed by the peanuts within the first 1.5 weeks and the small amount permeating the pouch material during the weeks of storage resulted in a gradual increase in oxygen residual.

We have evaluated both nitrogen and carbon dioxide flnsh gases as a means of reducing the oxygen level in packages. The nitrogen flushed pouches of peanuts remain soft and pillowy for the entire storage period.

Table 2. Oxygen Content of Roasted Shelled Peanuts in Various Pouches

Pouch Material	Storage Time (weeks)	Oxygen Content of Pouches in Per Cent	
		86°F. & 65% R.H.	100°F. & 90% R.H.
Cellophane-Foil-Polyethylene	0	1.6%	1.6%
	1.5	0.4	0.4
	3	0.3	0.4
	6	0.6	0.4
	9	0.7	1.1
Mylar-Foil-Polyethylene	0	2.1	2.1
	1.5	0.3	0.3
	3	0.3	0.5
	6	0.6	0.3
	9	0.7	0.8

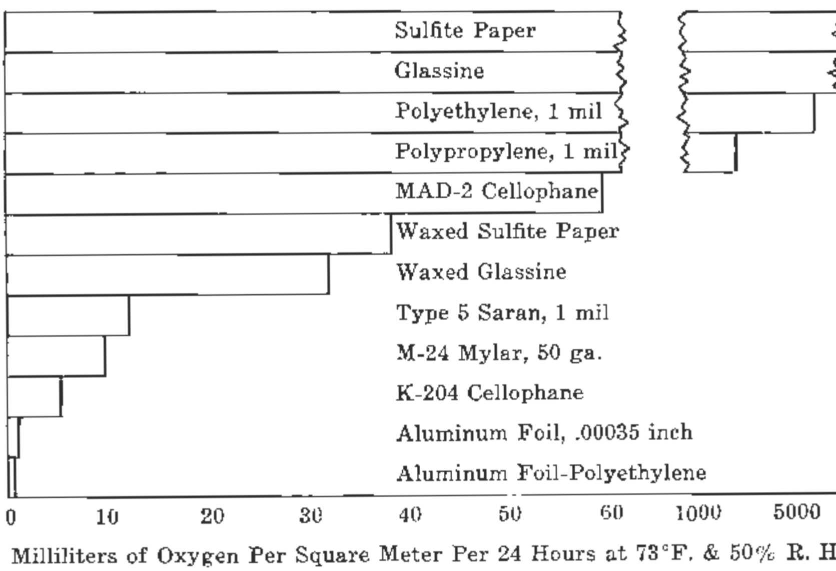

Figure 2. Comparative Oxygen Permeability Rates of Packaging Materials

However, if carbon dioxide is used to flush peanut pouches, the pouch shrinks and adheres tightly to the nuts—actually a partial vacuum had been formed. Flushing with either hot or room temperature carbon dioxide produces the same result. This phenomenon of package shrinking has been reported by Wells[4] as occurring with walnut meats. He found that the nuts absorb 0.3 to 0.4 ml. of carbon dioxide per gram during the first hour and very little thereafter. He further proved that it was the nut oil which primarily absorbed the carbon dioxide; the extracted oil absorbed 0.6 ml. of gas per gram in the first half hour while the fat-free nut meats absorbed 0.17 ml. per gram in 24 hours. This mechanism of oil absorption by the nut oils undoubtedly applies to the other nuts. This suggests that carbon dioxide or a mixture of carbon dioxide and nitrogen might be used to secure the desired degree of snugging of the pouch material.

In the study of evacuated or carbon dioxide flushed pouches of peanuts, we found that the nuts were causing holes in some of the pouches. Peanuts were pouched and abused in the laboratory shaker for 30 minutes. When a 28 inch vacuum was used, abused pouches of Mylar-polyethylene as well as cellophane-foil-polyethylene exhibited numerous punctures. If only 15 inches of vacuum were used, a few pinholes resulted. Carbon dioxide flushed packages had a lesser vacuum and no fractures developed. This illustrates the importance of selecting the proper protective packaging material aud testing it under simulated nse conditions.

Grease Permeability

It has long been kuown that the high oil conteut of nuts affect the packaging materials used. Nuts in the shell may be packaged in plain kraft paper bags, but the oil of shelled nuts quickly stains the bag. It is possible to use a glassine or a waxed paper bag to retard this staining, but these will stain in time. We have found that polyethylene is a barrier relatively resistant to peanut and pecan oils and no staining of cellophane-polyethylene or Mylar-polyethylene pouches has been observed.

Light Permeability

This development of rancidity in fatty prodncts is generally activated by light and Woodroof and Heaton have reported this for packaged pecans[5]. It has been reported that the ultraviolet wavelengths are more harmfnl than the visible wavelengths of light. We have found in tests with potato chips, cheese, hutter and lnncheon meats that the entire visible spectrum has a detrimental effect. This suggests that complete opacity to light is the best answer, but this means the food product cannot be seen.

Summary

I have tried to show the various aspects of protective packaging and how laboratory data on package materials could be related to packaging of nnts. Particular emphasis has been placed on the need for control of moisture and gas transmission as well as physical stability of packaging films. The effect of grease penetration as well as light has been indicated.

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UNITY OF EFFORT FOR GREATER PROGRESS IN THE PEANUT INDUSTRY

JOHN T. PHILLIPS, JR.

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Albany, Ga.

Before talking with you on the assigned subject, I would like to state for the record the highly complimentary comments I have heard from many of you citing the truly superior job accomplished by the conference co-chairmen, Joe Sugg and Astor Perry. We are all so very grateful to each of you gentlemen and exceedingly proud of you.

Feel very much at home here in North Carolina having been born and reared at Suffolk, Virginia, just over the North Carolina line.

The first Peanut Research Conference was sparked by Professor Giles, former head of the Agricultural Engineering Department here at North Carolina State College, back in 1956.

No happenstance that North Carolina State persons and projects were awarded the two annual Golden Peanut Awards, for the records reveal that North Carolina has exerted more time and effort to research than any other state in our peanut belt.

I have attended numerous meetings of peanut industry folks throughout this country and a number of foreign countries and know conclusively that in all of the commodity groups, organizations and institutions in which I have taken an active interest, none have finer group of individual people. This is why it is so very, very difficult for me to understand why we cannot have more unity, harmony, thus cooperative effort in our peanut industry.

For three generations my family has worked with peanut folks. The majority of my close friends are in the peanut industry, and it therefore concerns me no end that our industry apparently is not making the progress it should. All that is necessary to prove this fact is to look at the per capita consumption of peanuts.

Chart 1

Gross national product increased.

The soybean industry has increased production seven-fold in 20 years from 78 million bnshels to 558 million bushels.

Note that the 4¼-4¾ per capita consumption of peannts has applied for many years. (With the exception of the years of World War II).

But let's deduct the total poundage channeled into the school and other food distribution programs by our government and see where we stand.

Chart 2

Note the curve downward. Used 53 million pounds to draw curve. Have just learned that 10 millions pounds went to lunch program and 48 million pounds distributed to needy between the period June 1, 1961 and June 1, 1962, so we actually should have used 58 million pounds.

Maybe we can depend on government programs and these other government gifts. And maybe we can't.

On the other hand, what if we can't? Will we sit back and accept loss of our market or will we gear ourselves to stop the decline and turn the curve in the other direction.

Commodity groups have proven time and again that progress of any industry cannot take place, in fact, an industry cannot survive, without a well balanced, aggressive research program supported by all segments and regions of an iudustry.

The fact is that successful commodity groups have found a rallying point in Research. Thus facilitating nnity of action and cooperative effort, because improving quality, lowering production costs and developing new uses and products can only be accomplished by RESEARCH. THERE IS NO OTHER WAY.

Let's consider what presently exists in our peannt industry. Then let's explore why this sitnation exists. And then, if yon please, allow me to make some observations as to what we might do to facilitate genuine progress and true prosperity in the peanut indnstry.

Not one original thought in the bunch. The great majority of the comments have originated with many of you who are sitting here tonight.

My Grandfather, C. A. Shoop, was a partner in Benthall Machine Company. He died when I was a boy, but I well remember seeing—from the time my eyes could reach the top of his desk—a cartoon showing two donkeys tied with a short rope and two bales of hay.

Yon have seen the sequence and know that while they were pnlling against one another, they realized that the only way to survive and progress was to team np and go in the same direction.

The two eating the stack of hay on the one side and together going over and eating the stack of hay on the other.

Grandfather loved people generally, but had a particularly warm spot in his heart for peanut folks. But he, like the two recent generations of Phillips's, and many other people of this country, never really nnderstood why areas, and so often segments, of our peannt industry could not work in harmony.

Mr. Bill Mills, our Research Analyst, and a number of you folks have assisted me in working up this presentation, and as best we conld evaluate our situation this cartoon represents the situation that exists at the present time in our industry.

Cartoon I

In certain instances—segments fighting segments. Areas fighting areas.

Cartoon II

This second cartoon shows what has been and is happening in our peanut indnstry.

Because we lack unity and cooperative effort in our industry, research dollars are oftentimes being allotted other commodities and, as a result of this our industry grows relatively weaker and the other industries become stronger.

Our industry is static as evidenced by the per capita consumption of peanuts remaining at approximately 4½ lbs. for many years.

To become dynamic, progressive, if you please, the peanut industry must lower production costs, improve qnality, broaden markets through the development of new prodncts, and aggressively advertise.

The sitnation boils down to one primary effort described by the one word RESEARCH.

But necessarily backed by a unified industry.

Progress in our industry, as in any other, is in direct proportion to nnity—harmony, evidenced by all industrial segments and all peanut growing areas.

Last night in his highly interesting, constructive and thought provoking address, Mr. Aaron Yohalem of Corn Products Company, stated that regardless of any problems affecting segments of the industry in the surplus, marketing or legislative programs, and certainly in the work of the peanut improvement working group, there should be no conflict and all should work toward a common end.

Surely all of us realize that only through complete unity can there be strength, that any conflict within the industry affects the impression and image of the industry on *all* matters.

The basic fact applies that our jobs are only as secure as our companies. And our companies are only secure as our industry.

Thus, believe we can say without fear of contradiction that our company's progress will be in direct proportion—relation to progress of our industry.

And industrial progress will be directly related to the degree of cooperative effort existing in a commodity group.

Let's prove this fact of inter-relation—inter-dependence by a simple cycle chart that reveals RESEARCH as the rallying point for progress in our industry, and the fact that RESEARCH represents the prime justification, in fact, necessity for unity-harmony in our peanut industry.

Chart 3

Peanut Industry Progress
 Depends Upon Sale of Peanuts
  Sale of Peannts Depends Upon Reasonable-Competitive Prices and Comparable-Superior Quality.
   These Depend Upon Research Effort.
    Research Effort Depends Upon Harmonious and United Industrial Effort.
     And Harmonious and United Industrial Effort Will Facilitate *Peanut Industry Progress.*

I want to state here and now that I feel an excellent job is being done throughout the peanut belt and throughout the peanut industry when we consider the comparatively few dollars going into this life blood phase of business.

But this is being accomplished in spite of small bndgets, the lack of nnity and coordinated effort.

One project alone should be a rallying point. And that is quality evaluation which, by the way, was the prime jnstification for onr Peanut Improvement Working Group's efforts in securing a National Peanut Laboratory.

The vital importance of quality evaluation was discussed by Mr. John W. Phenix, Executive of Proctor-Gamble, early this year in New Orleans at the Peanut Utilization Conference.

He stated, "All of the important quality considerations in a peanut butter product are related either directly or indirectly to the characteristics of the peanut raw material entering the process stream . . . variations in the quality of the finished product results substantially from nonuniformity in the physical and chemical make up of the shelled peanut as received by the manufactnrer.

"In order for peanut products to keep pace with the inevitable movement of the food industry from an art to a science, the peanut, in all stages of formation and use, must be physically and chemically defined."

Let's take a look at this chart and note the problems common to all peanut growing areas. And in turn note the vital dependence of each on *quality evaluation.*

Chart 4

To follow through on Mr. John Phenix's observations, and incidentally, this was the prime theme of our Atlanta Peanut Research Conference, "QUALITY THROUGH RESEARCH", how in the world can we do a satisfactory job of breeding, harvesting, curing, storing, cleaning, shelling, handling, grading peanuts if we do not know what is required in the first place or, just as critical, do not know what we have developed in the last place.

Standards of quality, taste and nutrition must be high today and we can put it in the book, are going to he much higher in the years ahead.

Now, let's look at the problems that are peculiar to each area in the peanut belt.

Chart 5

All we could find were: Customs, habits, fallacies. This, I believe, gives you a picture of the fact that we just could not find any appreciable or basic problems peculiar to any one growing area. I am sure if we searched hard and long enough someone would come up with some problem peculiar to their particular county or state. We just have not been able to find it.

There are, however, in all segments problems peculiar to each segment and only the above are generally common to all.

Time does not permit a discussion of the problems peculiar to each of our segments; the growers, producers, shellers, product users, but all of you would be interested in a publication financed by the National Peanut Council in 1946 and written by the Southern Research Institute of Birmingham, entitled, "A Survey of the Research Status of the Peanut Industry". In this publication is listed problems applicable to all segments of the industry, broken down into various segments and further divided between short term and long term projects.

It was interesting but heart breaking to go down the list, item by item, and see that every single problem of our peanut industry that existed sixteen years ago exists today and each of us could add items to this detailed list.

Believe we can say without fear of contradiction that the segments of our peanut industry have a number of problems common to all and a number of problems peculiar to each. Thus it is not only desirable that we continue to work on our individual problems and continue to work in our respective states and areas, but it is greatly to be desired.

The real eye opener to me in the search for information on this talk was the astounding fact that there are such a great number of problems common to all areas in our industry as compared with the few problems peculiar to any one area. Interesting to note further that these problems that are *common* to our entire peanut belt, from Virginia through North Carolina, South Carolina, Georgia, Florida, Alabama, Texas, on to Oklahoma and New Mexico, are *critical* to the well being of our industry. We know we can cooperate—we can unite. Other commodity groups are doing it. Producers, shellers and manufacturers are making wonderful progress in each growing area. Excellent examples of regional cooperative effort are the Virginia-Carolina Peanut Advisory Committee, Southwestern Peanut Research Foundation, Southeastern States Peanut Commodity Commissions.

Believe we have reviewed where we are, why we are where we are, and why it is essential that we take steps to improve our position in the market place, stated to the best of my ability based on discussions with many of you.

Now the question is, What can we do to facilitate harmony-unity in our peanut industry?

Unified action is requisite for a well balanced, progressive, prodnctive Research program if we are to lower production costs, increase gnality, design and develop new prodncts. Unified action is requisite for higher volume peannt sales which are essential if we are to acquire a higher volume of consumer dollars which is vital, of course, to the well being and necessary for progress in our peannt indnstry.

Let's see what *we* might do.

1. We might look at the National Cotton Council which many people think is a pattern we could follow.
2. We might look at the pattern set by the Southwestern Peanut Foundation.
3. We might again explore USDA setting up a communicator. The USDA in a number of instances has appointed communicators (persons) to work with agricultural and industrial groups interested in a particular commodity. And this unquestionably would be helpful. Know it has been particularly beneficial in the cotton industry.
4. Some regrouping in the National Peanut Council to tie in an aggressive Research Department.

   It was interesting to note in the first paragraph of the introduction of the Peanut Industry Research Survey (which I quoted earlier) published in 1946, states, "A primary aim of the National Peanut Council is to increase the consumption of American-grown peanuts and peanut products in the United States. It is envisaged that this purpose will be accomplished through the discovery, and development of new uses for peanuts and peanut products, of new and improved methods of production, processing, preservation and distribution and hy promotion, advertising and education. Clearly, a well integrated program of research is basic to such an undertaking."

   This, I assume, could be implemented by the Board of Directors and it seems to me, without thorough knowledge of the situation, that a Research Department to balance the advertising and promotion job being accomplished by Mr. Bill Seals and his staff would pay the industry dividends, thus gain for the National Peanut Council additional moral and financial support.
5. We might rally round a National Peanut Research Laboratory.

   To many of us iu this room the appareut death of a Peanut Research Laboratory was a severe blow. This, very frankly, could have been a rallying point for the peanut industry. And though I realize that this is a sore spot in many hearts, I do not think we should hide our heads iu the sand, but all, somehow, spend our time searchiug for justification for the facility aud reasons why we approve of the facility.

   Understand from folks here at the conference that there is less adverse feeling today than existed a while back. I hope and pray so.

   The apparent death of the Lab is regrettable and our industry has suffered, not only because of the loss of the Lab but here is something we must remember. Any fight, anywhere, means loss of peanut industry prestige in the eyes of persons who buy peanut products and persons who handle the purse strings of research funds. Every segmeut and region suffers wheu one suffers a setback.

The old adage about the chain is just as true today as it was yesterday, and it will be just as true tomorrow. "The chain is uo stronger than its weakest link." Quality of product must be upheld in every phase from preparing the ground, planting the seed, through cultivating, harvesting, shelling, process packaging, until the product reaches the consumer.

I believe meetings like this Research Conference, attended by wonderful people like you folks, will in time break down the barriers of distrnst and non-cooperation. Bnt we just cannot wait any longer.

As is evidenced by the progress made in soybeans and other oil seeds, as well as other commodities, our consumer dollars that shonld be going to peanuts are going elsewhere. Research dollars that should be coming to peannts are going to other commodities, making them tastier, more nutritious, more reasonably priced and, in instauces, more attractively packaged.

The soybean industry is developing new products daily and some of them are filling the need that peanut prodncts conld have filled had we united and supported an aggressive, well-financed, well balanced research program.

Cartoon III

I travel all over the country and purchase peanuts wherever I go because I try never to let the sun set without eating some peanuts every day. Half the peanuts that I pnrchase at random are stale, or rancid, or maybe better stated, just not fresh.

A sorry product that has peannts written on it, purchased by a housewife, will drastically reduce sales to that family in the months to come. And I know this is what Mr. Yohalem, Mr. Phenix, and the other buyers have referred to when they say they cannot allow tolerance.

We know first hand, that one bad peanut in a bag spoils our taste and for weeks we don't buy peanuts.

Sitting in this room tonight are the people who for the most part will determine whether our wives pick up a peanut product one decade from tonight, or whether it is some other commodity, or a synthetic.

The amount of dollars that we in the peannt industry make available for research will determine whether Mrs. Housewife in 1972 reaches for a synthetic spread, a competitive commodity, or a peanut product. Whatever she reaches for it mnst be well balanced and she mnst have the definite assnrance of highest standards of quality, taste, merit and convenience. A well balanced research program is essential if our housewives are to reach for a peanut product. Bnt more important to the overall well being and progress of the peanut iudustry is the absolute necessity of unified cooperative action.

Unified action, cooperative effort by all segments and all regions of the peanut industry will enable us to climb over the wall separating us from maximum peanut production sales, for a united front will merit more research dollars thus enable us to improve quality, lower production costs, iu turn afford us more consumer dollars and a more profitable industry and insure more peanut industry progress.

Let us continne working and singing solos in our own back yard—it is essential to our own well being and the well being of our families.

Let's also, however, put on our two mile shoes and our PIWG hat, unite out thoughts, actions and voices together into a mighty crescendo that will be heard to the far corners of the earth and make the peanut industry the envy of every other commodity group.

It is imperative that we accept the challenge NOW in this year of our Lord 1962. We must act without further delay and we must act together.

PER CAPITA PEANUT CONSUMPTION

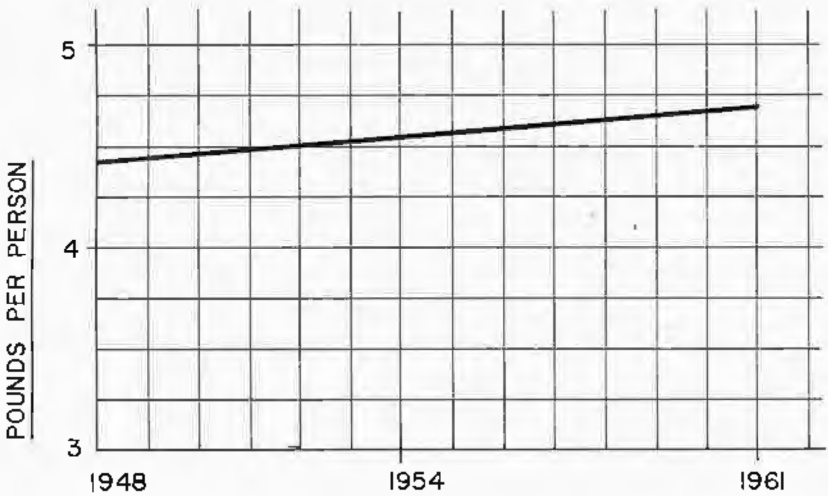


Chart 1

PER CAPITA PEANUT CONSUMPTION

WITHOUT GOVERNMENT PROCESSED PEANUTS

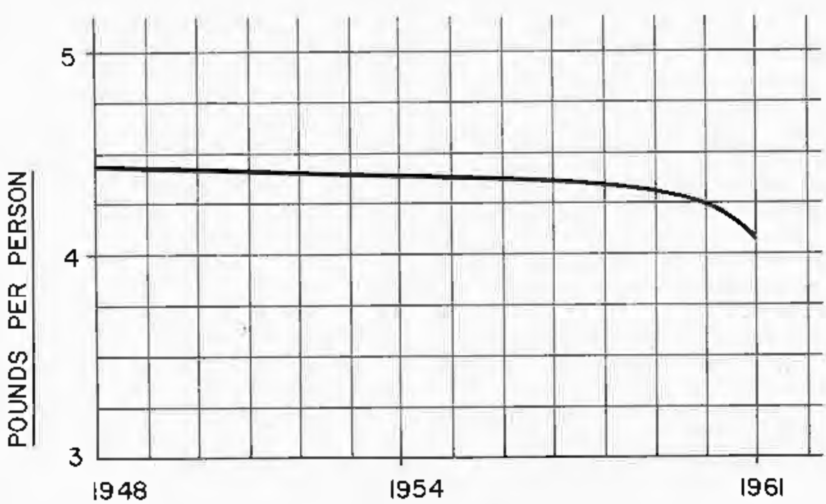
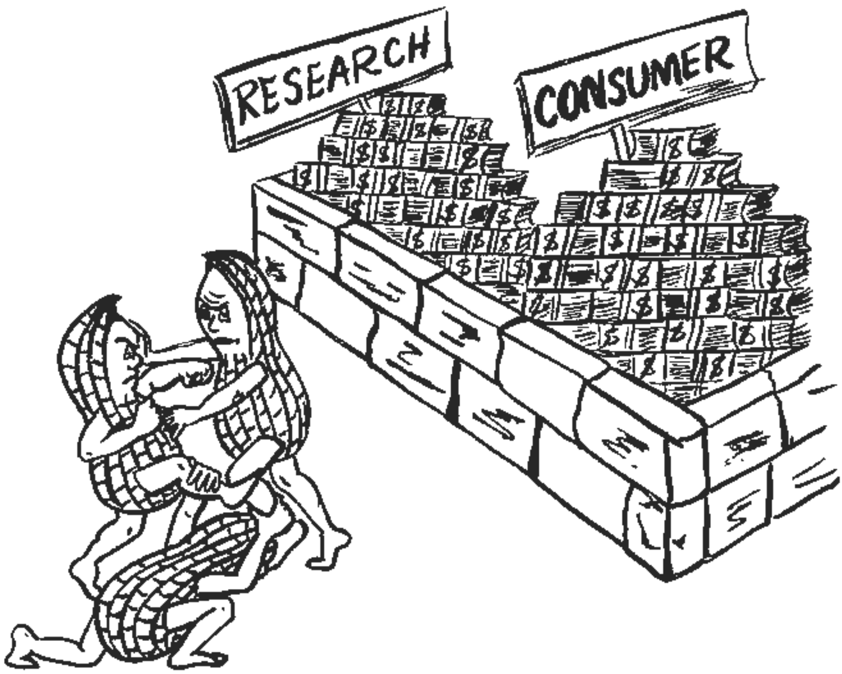
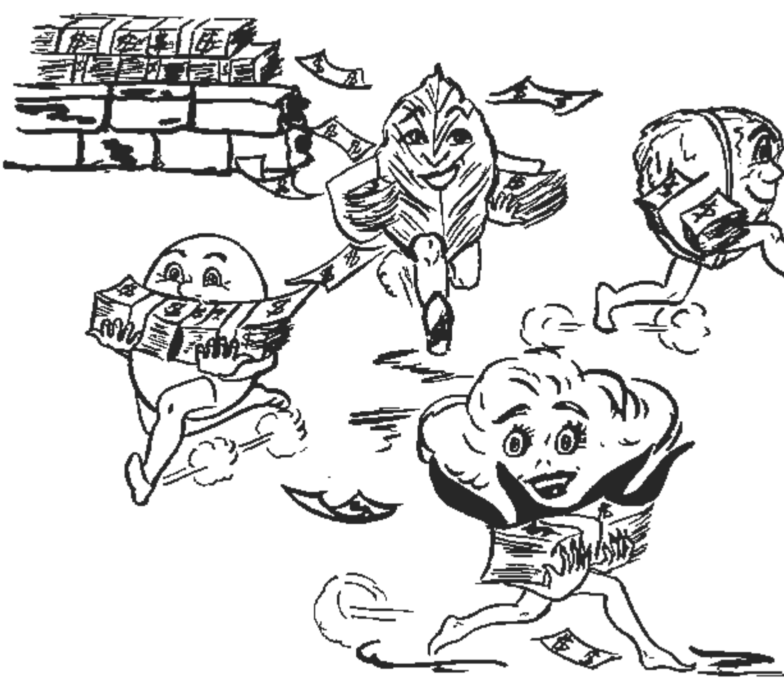


Chart 2



Cartoon 1



Cartoon 2

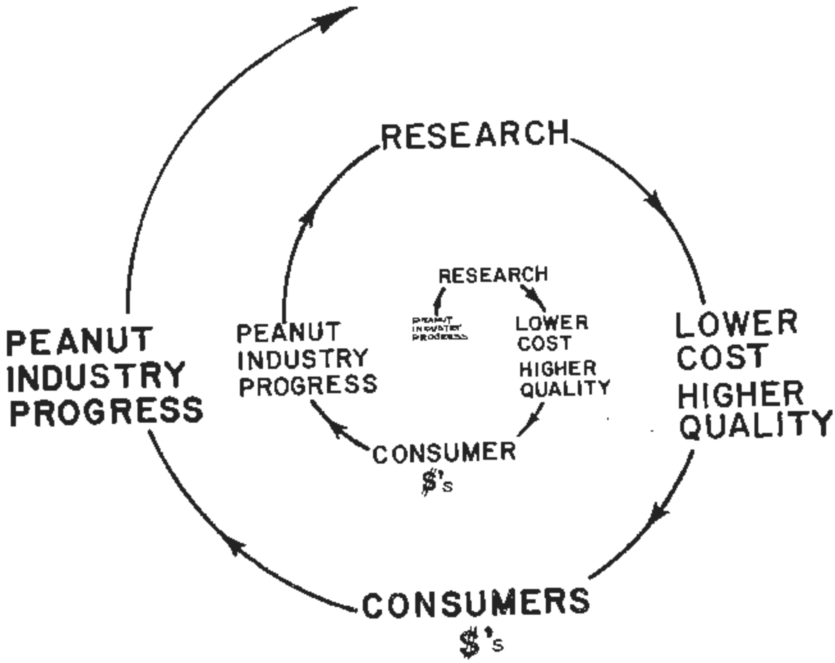
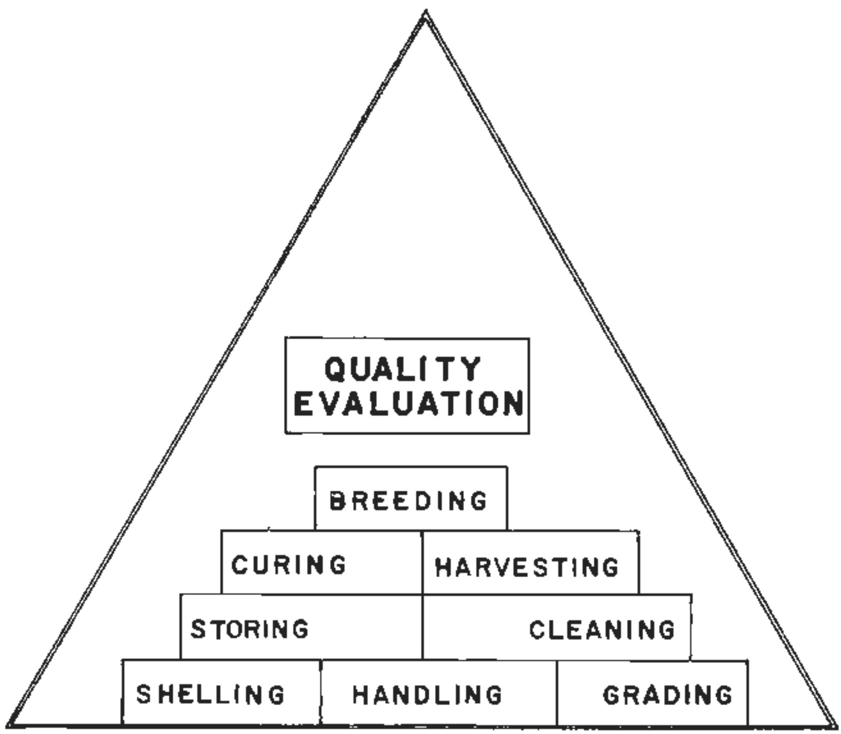


Chart 3



PROBLEMS COMMON TO INDUSTRY

Chart 4

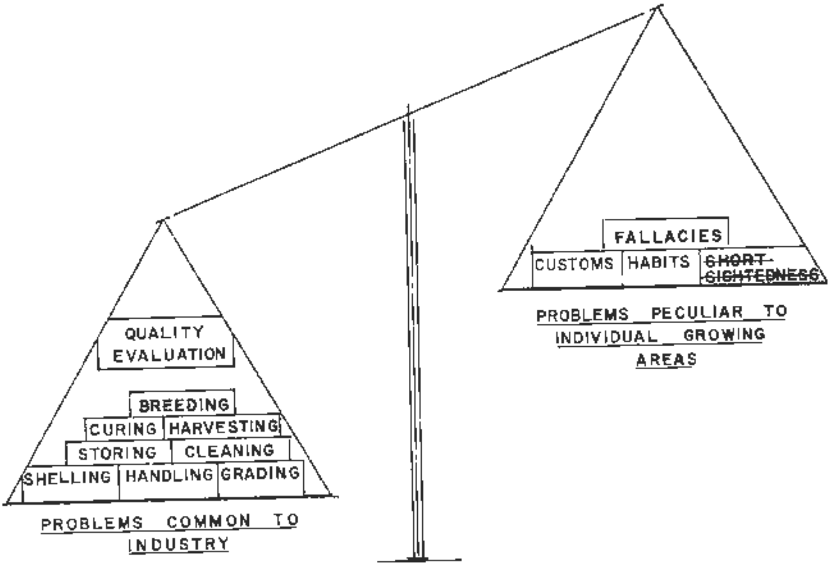


Chart 5

Cartoon 3

GROUP MEETINGS

At the conclusion of the general session in which papers were given in nine different phases of peanut production marketing, and manufacturing, participants of the conference were divided into four groups for group meetings. The purpose of the group meetings was to briefly review the papers given at the conference and to make recommendations in regard to future meetings, additional research needed, coordination between various research workers, etc.

The four groups were as follows:

1. *Plant Science:* Plant Breeding, Soils, Weed Control, Plant Pathology, Entomology, and Botany.................Coyt T. Wilson, Chairman
2. *Physical Science:* Agricnltural Engineering, Indnstrial Engineering, Shellers, Machinery Manufacturers..........W. T. Mills, Chairman
3. *Marketing Science:* Economists, Sales Directors, Coop Managers, Grading Service, Brokers.............Sidney C. Reagan, Chairman
4. *Food Science:* Chemists, Quality Control, Utilization, Purchasing Agents, Bacteriologists, Officials of Mannfacturing Concerns ....Ed Sexton, Chairman

REPORT OF THE PLANT SCIENCE GROUP

COYT T. WILSON

Auburn University, Chairman

Summary and Recommendations

The major general problems that affect the peanut research program in the areas of plant breeding, soils, weed control, plant pathology, entomology, and botany may be summarized as follows:

1. Inadequate financial support for research and testing

   It is recognized that this problem is not restricted to peanut research, bnt it is true that few, if any, research workers in these areas have enough support to do the jobs that they are capable of doing.

2. Isolation of personnel

   Scientists engaged in peanut research are scattered among numerous departments and laboratories of the USDA and the State Experimeut Stations of the peanut producing states. These people are not organized on a commodity basis as are the scientists engaged in corn improvement, weed control, and other similar groups. It is often difficult for an individual research worker to obtain active cooperation from other scientists possessing skills or experience that he lacks. Obviously, it would be impractical to put all peanut research workers together at one location but much could be accomplished by more frequent meetings.

   Communication among peanut researchers is not as efficient as it might be. This is particularly true of workers in industry and those in public research agencies. It is also a problem among State and USDA personnel. Papers reporting peanut research are published in a variety of places and each man finds it difficult to keep informed on the work of others.

3. Uncertain goals

Within the last few years, it has become clear to plant breeders, agronomists, plant pathologists, and entomologists that higher yields are only one of the many goals to be sought. However, standards of perfection have not been completely defined with respect to such factors as seed size and distribution of sizes, shell characteristics, pod size and shape, frniting habits, chemical composition of kernels and flavor. Progress is being made in establishing criteria for these characteristics, but much remains to be done.

Comments and recommendations made by the Sections included in Group A follow:

SOILS AND FERTILITY

Recommended Areas of Research

The Soils group pin-pointed the following problem areas which need special or greatest emphasis in soil fertility and nutrition research with peanuts:

1. Effect of soil moisture and temperature variability on—
   a. Nutrient uptake and requirements.
   b. Fruiting.
   c. Root development.
2. Importance and effect of subsurface root development and factors affecting their growth.
3. Effect of soil fertility factors on the chemical and physical characteristics of peanut fruits and their relation to the quality of peanut products.
4. Calibration of chemical soil tests against response to residnal phosphorus and potassinm in soils and determination of the nature of the nntrient sources.

In order to implement the solution of these problems, the following recommendations are made:

1. Higher finaucial allocations to peanut nutrition research projects are necessary since new methods ntilizing expensive equipment, such as plant growth chambers, are needed for more significant fnndamental advancement.
2. Continned and renewed emphasis must be placed on the elncidation of the principal chemical and physical characteristics affecting peanut quality.

PLANT PATHOLOGY

Summary and Recommended Areas of Research

Remarkable progress has been made in solving disease problems associated with peannt yields. Fairly good to excellent control measures have been developed for seed rots, seedling diseases and diseases of the growing plant. Progress on diseases that affect quality of peanut kernels has been much slower. It is in this area that the problems are most pressing.

In order for research on quality to be expanded it will be necessary to do the following:

1. Increase financial support for peanut research in the USDA and at the State Experiment Stations.
2. Develop more refined definitions of quality and more objective ways of measuring qnality.

3. Attract into this field of research scientists with training in such fields as biochemistry, instrumentation, physics, and the behaviorial sciences. This might be accomplished by developing more and better cooperative arrangements between and among departments and between public research agencies and industrial research laboratories.

Some specific qnestions that should be investigated immediately are:

1. What effects, if any, do various pesticides nsed in peanut prodnction have on flavor of peanuts and peannt prodncts?
2. What role do storage diseases play in flavor changes?
3. Is there a relationship between loss of germination and loss of flavor?
4. Do prodnction practices that increase yields effect distribution of sizes of kernels?

ENTOMOLOGY

Summary and Recommendations

The entomologist has the responsibility of making insect control recommendations which affect the quality and quantity of peanuts. New and old problems, however, complicate the task with the limited research personnel and the numerous potential economic pests of peanuts.

Several important insect pests have recently developed resistance to long-standing insecticide recommendations which necessitated devoting most of the research in some areas to this pressing economical problem. To keep np to date on the performance of new insecticides, it requires considerable research time. As a result, much basic research has been neglected on insect biology, insect ecology, population fluctuations, damage evaluations and conditions affecting insect damage. Such information is needed for making recommendations for insect control or strengthening recommendations.

The peanut variety or line is also of significance to the entomologist. Varieties will differ in their attractiveness to insects, their tolerance to infestation and injury and their response to chemicals, especially some of the newer, systemic insecticides in regard to both insect control and phytotoxicity. Varieties may also differ in off-flavor from the same chemical.

The following recommendations are offered:

1. Continue evalnating new and promising insecticides for more effective and more economical control of insects, both field and storage.
2. Devote more attention to the peanut variety from several aspects . . .
   (a) Natural resistance to insects.
   (b) Response to chemical from the standpoint of off-flavor, insect control, and phytotoxicity.
3. Coordinate research efforts where practical to alleviate manpower shortage.
4. Devote more time to certain basic areas as insect biology, ecology, physiology, and natural population control agents.
5. Establish a laboratory to handle quality evaluations of insecticide-treated peannts.
6. Research should be expanded on the prevention and control of insects in stored peanuts and peanut products; and in facilities where peanuts are stored, shelled, transported, or processed.

REPORT OF THE PHYSICAL SCIENCE GROUP

W. T. Mills

Albany, Ga., Chairman

The Physical Science Group makes the following recommendations:

General

1. More effective means of communication must be developed to inform research workers and all interested people in the peanut industry as to research underway and cnrrent findings. The PIWG is commended for its efforts to establish an organ of suitable character to carry peanut research publications.
2. To facilitate more effective communicatiou, a central information center is needed that could receive, reproduce, and distribute both preliminary and formal reports of research investigations.
3. Technical group meetings for an informal exchange of information should be held every two years, with a formal conference being held every four years. These meetings would be open to all people doing or interested in research on peanuts.

Specific

1. Production Losses—Study the cause, magnitude and value of peanuts lost during the production operations. Develop better production methods and equipment to prevent these losses if economically justified.

   This work should be done by at least one State Exp. Station in each of the three growing areas, with the wholehearted cooperation of the Growers Associations.
2. Mechanical Peanut Handling—Develop equipment for the specific purpose of handling peanuts without cracking pods or splitting kernels, and for all operations from harvesting through manufacturing.

   This work should be a coordinated effort of State Experiment Statious and the USDA Pilot Peannt Sheling Laboratory, and supported by every segment of the industry.
3. Peanut Curing—All curing work should be reviewed to see if the final objective is producing the highest quality peanut possible for the end product. Research studies should be expanded to include the effect on quality of air movement, relative humidity, time of exposure to heat, terminal moisture content, etc.

   This research is so vital to the industry, a general effort should be made by the industry to urge all State Experiment Stations in the major growing areas to initiate research programs on peanut curing. To avoid duplication and repeated experiments all the programs should be coordinated. The USDA should extend its research program on peanut curing off-the-farm and coordinate their work with that of the State Experiment Stations. There is still much to learn about the chemistry of a curing peanut and the best curing procedure can not be worked out until we understand this chemistry. With so much unknown, we need more than the 5 or 6 workers currently spending a part of their time on this problem.

   The support and cooperation of every segmeut of the industry is vital in this program.

4. Storage—Storage environment should be studied to determine how it affects shelling efficiency, flavor, germination, and insect infestation. Machinery should be developed to provide the optimum environment or environments for high peanut quality.

   The USDA Pilot Peanut Shelling Lab has already begun to work on this problem but will need additional support and cooperation from the industry.
5. Shelling—Develop new principles and equipment for shelling peanuts that will be more easily adapted to different shapes, sizes, hull thickness, etc., so that new improved varieties will not be rejected because of shelling difficulties. Maximum shellont would be a parallel goal along with maximum flexibility.

   USDA Pilot Peanut Shelling Laboratory has begun stndies on this problem and should receive full cooperation from the sheller groups and the machinery manufacturers.
6. Seed—Complete study of peanut production, harvesting, curing, and handling operations as they affect the germinating ahility of the seed. This study should inclnde effect of seed size on germination and vigor and planter operation.

   This work shonld be done at one Exp. Station in each growing area on a coordinated basis, with cooperation of seed associations, peanut breeders, and planter manufacturers.

REPORT OF THE MARKETING SCIENCE GROUP

SIDNEY C. REAGAN

Dallas, Texas, Chairman

The basic objective of marketiug research is to expand the market for peanuts and peanut products. Per capita consumption of peanuts has not been increasing. Further research by government and by private enterprise is needed to expand the per capita consumption of peanuts and peanut prodncts.

Within the past several years larger companies have become involved in the marketing of peanuts and peanut products. It is hoped that the application of the results of marketing research condncted by these companies, coupled with their experience in marketing other products, will stimnlate the expansion of the consumption of peanuts and peanut products.

It is fully recognized that a great deal more marketing research on peanuts by government is needed.

As consnmer incomes have increased, a wider selection of food items have become available to them—and each food item has become more competitive with other food items.

Among other things, the peanut industry needs to know why consumers purchase and, conversely, why they do not. It needs to know consumer attitudes towards peanuts and peanut products, their likes and dislikes, and the reasons behind them. Growers, shellers, and manufacturers need this information in planning programs to maintaiu aud expand markets for peanuts.

Specifically, areas of marketing research by government that should be initiated or expanded are:

1. Consumer quality preferences on peanuts and peanut prodncts and why. This could perhaps best be carried out through a stndy based on depth interviews.

2. Qnalities desired and qnalities not desired by mannfacturers in raw peannts, stated in objective and measnrable terms.
3. Development of improved methods and eqnipment to measnre qualities in peanuts desired and qualities not desired by mannfacturers.
4. Development of grade standards and grading methods for shelled, in-shell and farmer stock peanuts to reflect qualities desired and qualities not desired in peanuts by manufacturers.
5. Improvements in treatment dnring prodnction, harvesting, curing, storage and manufacturing to protect qnalities desired and to prevent development of qnalities not desired.
6. Development of improved varieties of peanuts to better supply the qualities desired and to avoid the qualities not desired.
7. Improvements in merchandising of peanuts and peannt products.
8. Evalnation of relative effectiveness of various advertising and promotional activities of gronps in the peannt indnstry.
9. Expansion in knowledge on the valne of peanuts in meeting hnman requirements for nntrients and the effect of major dietary components on the ntilization of the nntrient content of peanuts.
10. Development of new prodncts from peannts.

This listing of areas in which marketing research by government should be initiated or expanded is not intended to exclnde other areas of needed research.

REPORT OF THE FOOD SCIENCE GROUP

ED SEXTON

Bayonne, N. J., Chairman

The following comments and recommendations were made by the Food Science group dnring the Second National Peanut Research Conference:

1. As manufacturers, we have a healthy impatience toward the progress of research in areas such as the characterization of peanut immaturity, and the chemical and physiological changes which characterize peanut curing. We feel that this points up the need for more research programs devoted to the development of basic knowledge, such as genetics, as it relates to plant breeding, and physiological and biochemical reactions going on within the peannt at various temperatnres as they relate to peanut cnring. Obviously, there is a need for more people to be employed in *full time* peanut research and for adequate funds so that the talents of these individuals can be utilized to the maximum.
2. We recommend that standardized methods be developed for the evaluation of peanut qnality as it relates to specific end nses.
3. We rceommend that an up-to-date catalog of current peannt research activities at each location, together with the names of the individuals involved, be developed and distribnted to interested individnals throughout the indnstry.
4. We recommend that ways and means of improving our communications between segments of research workers and between research workers and the rest of the indnstry be explored. The progress which has been made at this meeting toward providing for a "Research Newsletter" and for a medium of pnblication for research materials is most enconraging. It is hoped that these objectives can be realized in the very near future.

5. We recommend that flavor be made a primary consideration in the development of any new peanut varieties.
6. We recommend that experiment stations insist, as a matter of policy, upon having adequate data in their possession regarding the influence of pesticides on the flavor of peanuts before the use of these materials is recommended. The Peanut Butter Manufacturers Association has offered its good offices to collect and disseminate information of this type.
7. We recommend that the grade standards and techniques of grading on peannts be improved so that peanut products reflecting a higher level of quality can he presented to the American public.

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at the

SECOND NATIONAL PEANUT RESEARCH CONFERENCE

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