Simulating Aflatoxin Contamination of Peanut with the CROPGRO-Peanut-Aflatoxin Model

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Aflatoxin contamination of peanut (*Arachis hypogaea* L.) seed poses a continuing health risk to consumers around the world. Our objective was to add capability to the CROPGRO-Peanut model to simulate infection of pods by *Aspergillus* and subsequent synthesis of aflatoxin in peanut seed. The model simulates soil water status, soil temperature of the podding zone, and tracks daily cohorts of peanut pods. *Aspergillus* infection and aflatoxin synthesis of pod cohorts are simulated as a function of daily plant water status, soil water status of the podding zone, and soil temperature of the podding zone. The corresponding algorithm is coded in Fortran and linked to the CROPGRO-Peanut model. Rate constants and temperature thresholds for *Aspergillus* infection and aflatoxin synthesis were calibrated based on 4 years of data on percent infection and aflatoxin concentrations in seeds of the JL-24 cultivar in Sadore, Niger (Waliyar et al., 2003; Peanut Sci. 30, 79–84). The experiments had the following irrigation schedules: 1) 7-day irrigation, 2) 14-day irrigation, 3) 21-day irrigation, and 4) rainfed. The solved soil temperature sensitivity of aflatoxin synthesis was a 4-point lookup function (Tb=26, Topt1=28, Topt2=30, and Tceiling=38 ^{o}C), while the soil temperature sensitivity of percent infection was 22, 32, 35, and 45 ^{o}C (also a 4-point lookup function). These temperature functions were required along with simulated pod zone soil water status and plant water status. After calibration, the simulated versus observed aflatoxin had an R^2=0.57. Sensitivity analysis with rainfall data from Tifton, Georgia, indicates that 1 in 12 years had aflatoxin greater than 20 ppb, and 2 in 12 years greater than 2 ppm. Simulated aflatoxin concentration had a strong negative relationship to simulated peanut yield, both controlled by drought.