Effect of Drought Tolerance on Preharvest Aflatoxin Contamination in Peanut

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Abstract

Peanuts become contaminated with aflatoxins when subjected to prolonged periods of heat and drought stress. The objective of this research was to evaluate the effect of drought tolerance on preharvest aflatoxin contamination (PAC). Two drought-tolerant genotypes (PI 145681 and Tifton 8) and an intolerant genotype (PI 196754) were evaluated in two studies using rain-protected shelters in Tifton, Georgia, USA. Drought and heat stress conditions were imposed for the 40 d preceding harvest. The drought-intolerant genotype had greater preharvest aflatoxin contamination than Florunner, the check cultivar. Both drought-tolerant genotypes had less preharvest aflatoxin contamination than Florunner in these tests. We are using drought-tolerance as an indirect selection technique to develop peanut cultivars that are less susceptible to preharvest aflatoxin contamination This has resulted in late generation breeding lines that have high relative yield and low relative aflatoxin contamination when subjected to late season heat and drought stress.

Media Summary

Aflatoxin contamination can be a serious problem in peanut which have been grown under heat and drought stress. In these studies we have shown that drought tolerance can be used to reduce aflatoxin contamination in peanut.

Key Words

Peanut, Drought tolerance, Aflatoxin.

Introduction

The issues surrounding agricultural water use are increasing in importance, and the development of cultivars with improved drought tolerance should help to alleviate these concerns. Water use in peanut is even more important since it is closely related to the level of aflatoxin contamination. Aflatoxin contamination is mainly a problem in peanut which have been subjected to heat and drought stress late in the growing season (Sanders et al., 1985).

Rucker et al. (1995) conducted several studies to evaluate 19 peanut genotypes for drought avoidance characteristics. They evaluated root characteristics of these genotypes in a pot study. Under drought-stressed-field conditions, they evaluated these genotypes using canopy temperature measurements and visual stress ratings, two potential measures of drought tolerance. Differences were observed among these characteristics for this set of germplasm.

The objective of this research was to evaluate the effect of drought tolerance on preharvest aflatoxin contamination (PAC).

Methods

Four genotypes were examined using two planting dates (2 and 24 April) to simulate two environments in Tifton, Georgia. Seed were planted (four seed/30-cm linear row) in single-row plots, 1.5 m long in a randomized complete block design with 20 replications.

Inoculum of *A. flavus* Link ex Fries (NRRL 3357) and *A. parasiticus* (NRRL 2999) was prepared and introduced into test plots to insure the presence of sufficient aflatoxin-producing fungi in the peanut pod zone. *Aspergillus* inoculum was prepared using the organic-matrix method (Will et al., 1994). The test were inoculated on 18 June and 1 July. Drought and heat stress was imposed by covering the test plots with a mobile greenhouse on 25 June and 30 July. Peanut plants were dug and pods were hand picked on 9 Aug and 16 Sept for planting dates one and two, respectively. Harvested pods were dried to 7% moisture and hand-sorted to remove and discard visibly damaged pods.

Peanuts were shelled and then ground in a household food processor for about 1 min. Aflatoxin concentrations was measured on a 100-g subsample with the immunoaffiinity column fluorometer method (Trucksess et al., 1991).

Results

PI 196754 had the greatest amount of preharvest aflatoxin contamination (Table 1). This genotypes is highly sensitive to dry soil conditions (Rucker et al., 1995). PI 145681 had less preharvest aflatoxin contamination than Florunner. Rucker et al. (1995) reported that this genotype had relatively low visual stress ratings under dry soil conditions. The germplasm line Tifton 8 exhibited a significant reduction in aflatoxin contamination in comparison to Florunner. This line also had relatively low visual stress ratings under dry soil conditions (Ruckers et al., 1995).

We are using drought-tolerance as an indirect selection technique to develop peanut cultivars that are less susceptible to preharvest aflatoxin contamination This has resulted in late generation breeding lines that have high relative yield and low relative aflatoxin contamination when subjected to late season heat and drought stress.

Table 1. Aflatoxin contamination in a drought-tolerant, a drought-intolerant, and three check peanut genotypes in two tests at Tifton, Georgia.

Genotype	Aflatoxin contamination ng/g	Visual stress rating
PI 196754	18,693 a	3.9 a
Florunner	10,872 b	2.8 bc
PI 145681	4370 c	2.4 cd
Tifton 8	3771 c	2.2 d

[a]Means followed by the same letter are not different (P=0.05) according to Duncan-Waller multiple range test.
[b]Mean drought stress ratings from three environments reported by Rucker *et al.* (1995). Ratings are visual ratings on a 1-5 scale where 1 = no stress and 5 = most stressed.

Conclusions

Drought tolerant peanut genotypes had significantly less aflatoxin contamination. A similar relationship between drought tolerance and reduced aflatoxin contamination has been observed in a drought tolerant peanut cultivar in Australia (Cruickshank et al., 2000).

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