ALLEVIATION OF DROUGHT STRESS AND AFLATOXIN INCIDENCE IN PEANUT USING SHORT MATURING VARIETIES

G.C. Wright

Queensland Department of Primary Industries, Kingaroy, Qld, 4610

Abstract

Droughts of unpredictable timing and duration in southern Queensland severely limit peanut pod yields and late in the season can lead to aflatoxin contamination. Reductions in yield and high aflatoxin levels both reduce grower returns and profitability. A crop modelling approach was used to assess whether shorter maturing varieties, which can ?escape? end-of-season droughts, could produce higher pod yields with reduced aflatoxin incidence. These simulations conducted for the Kingaroy region indicated that varieties of 20 days shorter maturity would achieve higher yields, with reduced aflatoxin levels, compared to standard maturing types in a majority of years.

Keywords: peanuts early maturity varieties aflatoxin drought crop modelling

Introduction

The majority of peanuts produced in Australia are produced under dryland farming systems where drought severely limits pod yield and quality, which has lead to problems in continuity of supply for domestic and export markets. In addition to drought, aflatoxin contamination, which results from toxin production from the *Aspergillus* fungus, has recently become a major constraint for the industry, as shellers have begun passing costs of cleaning up contaminated product onto growers. Aflatoxin has been shown to have carcinogenic properties in humans and animals and has recently become a major health issue for the peanut industry. The aflatoxin problem is also closely linked with end-of-season drought stress, where the *Aspergillus* fungus favours drought stressed conditions in the plant to produce aflatoxins. There is therefore an urgent need to minimise its incidence at the farm level. through agronomic or genetic means.

A potential strategy to reduce the impact of late season drought on pod yield and aflatoxin contamination is to mature the crop earlier and thereby ?escape? the worst effects of reduced soil water availability. The QNUT peanut crop simulation model was used to assess the impact of growing a ?hypothetical? shorter maturing variety in the Burnett region on pod yield responses and aflatoxin contamination.

Materials and methods

The QNUT crop model (1) can accurately predict crop growth and pod yield given data inputs of maximum and minimum temperature, solar radiation, rainfall and irrigation and soil water holding properties. An aflatoxin prediction module has also been recently added (2), which simulates aflatoxin contamination based on the duration and severity of crop water stress during the last month of crop growth. Long-term crop simulations were run using the QNUT model with historic climate data for the Kingaroy region. A standard commercial variety of approximately 155 days maturity was compared with a ?hypothetical? shorter season variety which matured approximately 20% earlier (about 3 weeks) then the standard type. Cumulative probability distributions for pod yield and aflatoxin incidence were derived to enable a comparison of the effects of shorter maturity over a long term cropping sequence.

Results and discussion

The model simulations clearly show there are predicted advantages of growing shorter maturing types in terms of increased pod yield in the Kingaroy region. Fig. 1 presents this data as a probability of exceedance plot, where it is evident in nearly 70% of years (80 year simulation), the shorter maturing type produced similar or substantially higher pod yields of the order of 0 to 50 g/m2. The higher yield response of the early maturing type is associated with a drought escape strategy which allows earlier reproductive development prior to the onset of severe terminal drought stress which have been shown to predominate in this region (3). It should be noted however that in about 30% of years, the standard variety is able to substantially out-yield the early type by around 0 to 150 g/m2 owing to its ability to more fully exploit the better water availability conditions in these (less frequent) years. Over the long term however, it is suggested that early maturing types could offer growers with an option to minimise risk and offer better yield stability in this unpredictable rainfall environment.

Figure 1. Probability of exceedance for pod yield of a standard versus early maturity variety at Kingaroy.

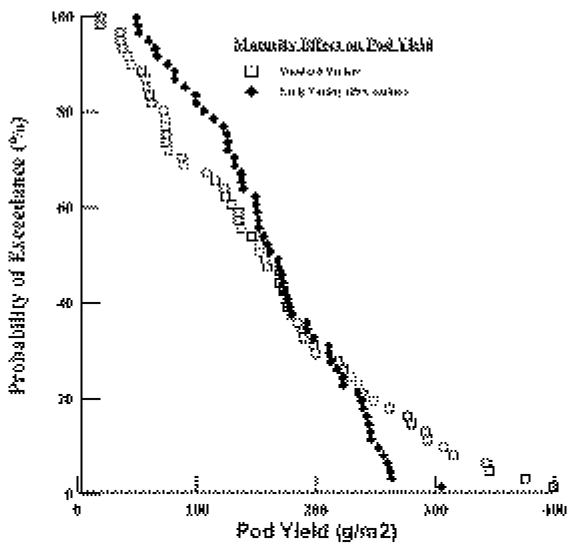
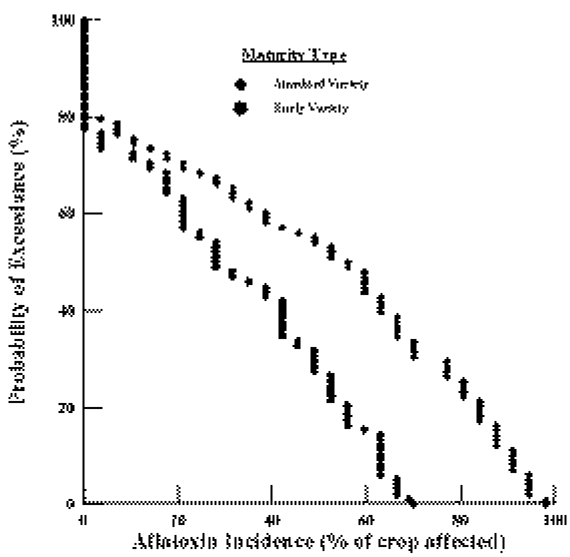


Figure 2. Probability of exceedance for aflatoxin contamination for a standard versus early maturity variety at Kingaroy.



Aflatoxin incidence is predicted to be substantially lower over the long term in shorter maturity types as illustrated in Fig. 2. It is evident that in over 70% of years aflatoxin incidence is predicted to be between 10 and 30% lower compared to a standard maturity type. This reduction is associated with reduced crop water stress in the shorter maturity types during the late podfilling period.

These simulations clearly indicate that growers may be gain significant pod yield and reduced aflatoxin benefits by using shorter maturing varieties. A major focus of the DPI peanut breeding program is to develop short season types with acceptable quality characteristics.

Conclusions

Crop modelling simulations showed there may be significant benefits in terms of higher pod yields and reduced aflatoxin incidence by using varieties that mature about 20 days earlier than current commercial varieties. A major focus of the peanut breeding program is to develop short season types to validate this approach. The example illustrated here has shown how simple crop models can be applied to test potential strategies to overcome production constraints and thereby focus future research priorities.

References

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