GENERAL INTRODUCTION

In Thailand, peanut (*Arachis hypogaea* L.) is often grown by small farmer on residual soil moisture and it's productivity is limited by water deficit (Pandey *et al*., 1984a, 1984b, 1984c; Rao *et al*., 1985; Senthong and Pandey, 1989). Drought stress influences various physiological and biochemical processes associated with crop growth and development (Stansell and Pallas, 1979; Levitt, 1980; Senthong and Pandey, 1998; Boonpradub, 2000). Previous studies on peanut and cowpea suggested that the most sensitive growth stage of these legumes to drought was the reproductive phase (Turk *et al*., 1980; Shouse *et al*., 1981; Rao *et al*., 1985; Senthong and Pandey, 1989; Senthong and Pandey, 1998). Many factors are categorized as limiting to peanut production. Some factors (weeds, insects, diseases) detract from yield potential, that is, they reduce the yield that might be obtained from the particular crop under that environment. Crop losses due to plant diseases appear in different forms but commonly are losses in yield and deterioration in quality. The yield and quality losses increase the cost of production per unit of product.

Peanut growth and development are integrated response to many aerial, soil and environmental factors. These factors often interact in a complex fashion. Although being the significant upland crop in Thailand, peanuts have been facing with a serious marketing problem, e.g., high level of aflatoxin contamination caused by *Aspergillus flavus*. Peanut and maize are susceptible to aflatoxin contamination under the hot and humid condition of the tropic. Ingram *et al*. (1999) observed that

Aspergillus flavus populations, as estimated by amount of fluorescence, increased at peanut root and pod surface and that, particularly under dry soil conditions, *A. flavus* populations appeared to be greater on roots and pods of drought-susceptible peanut genotypes than on roots and pods of drought-resistant genotypes.

Aflatoxin contamination occurs when peanuts are colonized by aflatoxigenic strains of *A. flavus* and pods develop under drought. Aflatoxin-resistant peanut genotypes have either resistance to *A. flavus* infection, or prevention of aflatoxin production, or both. In these studies, resistance to *A. flavus* infection was used to indicate aflatoxin resistance, because without the infection of *A. flavus,* there can be no aflatoxin contamination.

Under relationship of dry soil conditions, root exudates, sloughed cortical cells and leachates may provide growth substrates to promote *A. flavus* population. Hale and Griffin (1976) found that exudates in the geocarposphere are an important ecological factor affecting microbes in the soil and the colonization of peanut fruit by *A. flavus*. Sloughed root cells and soluble root exudates are the principal sources of organic carbon and nitrogen for microorganisms colonizing the rhizosphere and rhizoplane of plants (Griffin *et al*., 1976). Informations existing on the quantities of sugar, amino acids, organic acids and other compounds exuded by plant root and the amounts of exudates differ among peanut genotypes which have been shown to increase in response to stress (Griffin *et al*., 1976; Hale and Griffin, 1976; Nahdi, 1989).

The hypotheses of these research work were the genotypes that produce less root and pod exudates, sloughed cells or leakage of cell contents under drought conditions provide less substrate for *A. flavus* growth, and that smaller *A. flavus*

populations are less likely to infect these low-exuding genotypes. Thus, less root and less pod exudation would be most aflatoxin resistant in peanut genotypes.

The objectives of this research were to: i) to observe *A. flavus* growth on root and pod surface under soil surface in response to water deficit; ii) to examine genotypic difference in *A. flavus* colonization; iii) to evaluate the effect of exudates or leachate on *A. flavus* population in soil; iv) to develop inoculation methods that would attain high levels of *A. flavus* infection that are needed in aflatoxin resistance breeding program; v) to investigate the potential for *A. flavus* to infect peanut flowers and pegs and vi) to determine crop growth of peanut genotypes in response to water deficit and *A. flavus* infection. This research work consists of three experiments. The third experiment dealt with the studies of plant traits that determined the response to *A. flavus* infection under water deficit condition. Deficient water at early stage also leads to low vegetative growth, reproduction of final pod yield and quality of seed. During pod formation and development stages, the runner peanut is very sensitive to soil water deficit (Stansell *et al*., 1976; Stansell and Pallas, 1979). Peanut is susceptible to *A. flavus* infection under drought condition in the field. Soil temperature and moisture regimes have been reported to affect pod growth, the invasion of peanut seed by *A. flavus* and subsequent aflatoxin contamination (Blankenship *et al*., 1984).

Water contact roots in two ways: i) water may move to the root or ii) root may grow and intercept moist soil. Root length in deeper soil layer is important while deep root enables plant to resist water deficit which restricts root growth (O'Toole and Bland, 1987) and shoot growth. Deep root system, large root density and greater extraction of water from deeper soil (Boonpradub, 2000) are the most desirable characteristics for breeding program. This work required periodic monitoring of root

growth at different locations and consisted of 4 peanut genotypes, 2 water regimes and 4 soil locations in the greenhouse experiments. A fast non-destructive method of observing root growth and *A. flavus* growth under soil by minirhizotron was used. Minirhizotron are the clear tube installed under soil surface and facilitate periodic root observation through the use of a minirhizotron camera.

Experiment 1 deals with the invasion of *A. flavus* in the geocarposphere at pod zone of peanut plant under drought and sufficient water conditions. Hot and dry soil conditions favor high levels of *A. flavus* colonization of peanut pods. *A. flavus* population on the pod zone was estimated by using software that quantifies red, green and blue value of individual pixels or groups of pixel (QuaCos program).

A. flavus colonized in the fruiting zone and was observed with a minirhizotron camera that was presented in Experiment 1. Root exudates from peanut plants provided the substrates for *A. flavus* growth in the soil. The concept of this experiment is shown by the green line cycle in a framework.

Experiment 2 deals with a method of maximizing *A. flavus* infection of peanut flowers, pegs and ovaries by GFP *A. flavus* which strain was developed by J. Carey and G. Payne. When illuminated with UV light (350-380 nm), the GFP-producing *A. flavus* strain may be easily and quickly detected with either a simple UV illuminating (Wangeli *et al*., 1999) or with an UV illuminated microscope.

Spraying spore suspension of GFP *A. flavus* to the plant shoot was found to result in high level of infection to the flower and the peg. Thus, peanut infection by GFP *A. flavus* could occur during flowering or during peg formation. The combined application of spraying spore suspension and cracked corn inoculum applied to the soil should facilitate the efforts to screen peanut germplasm for aflatoxin resistance.

The blue line cycle in a framework showed the peanut flowers and ovary infection by *A. flavus* fungi.

Experiment 3 contains results of study on drought resistance involving a well-watered followed by water deficit. Shoot growth and *A. flavus* infection on peanut pods related with water regimes (see the pink line cycle in a framework).

A framework for research priority setting