CHAPTER I
INTRODUCTION

Peanut (*Arachis hypogaea* L.), an important oil and cash crop, is cultivated widely in rain-fed regions where drought is a major constraint limiting productivity and quality (Dwivedi et al., 1996; Nageswara Rao et al., 1985; Ravindra et al., 1990; Wright et al., 1991). Furthermore, terminal drought occurring during the seed filling phase (Boote, 1982) has been observed to decrease pod yield and induce preharvest aflatoxin contamination (PAC) on peanut (Dorner et al., 1989; Nageswara Rao et al., 1985; Ndunguru et al., 1995; Ravindra et al., 1990; Wright et al., 1991). Improvement of drought tolerance is an important and sustainable part of the solution.

Use of drought-resistant cultivars can increase long-term productivity in drought prone environments. In addition, PAC may be reduced with improved resistance to drought (Cole et al., 1993; Holbrook et al., 2008; 2009). However, progress in breeding for drought resistance in peanut based on selection for yield and PAC have been hindered by large genotype x environment (G x E) interactions. Breeding approaches utilizing physiological traits having high heritability and low G x E interactions have been proposed to improve selection efficiency for superior drought-tolerant genotypes and to supplement selection based on yield (Blum, 1988; Falconer and Mackay, 1996).

Aflatoxins are well known as potent carcinogenic, teratogenic and immuno suppressive substances (Turner et al., 2000; Wild and Hall, 2000; Hall and Wild, 2003). PAC in peanuts occurs when toxigenic strains of the fungi *Aspergillus flavus* Link. ex Fries and *A. parasiticus* Speare grow on peanuts subjected to drought (Azaizeh et al., 1989; Blankenship et al., 1984; Cole et al., 1989; Sanders et al., 1993) is an important health concern throughout the world. Hence, approaches for eliminating PAC are necessary. Adoption of drought-resistant cultivar could be an effective and sustainable way to reduce PAC, especially under rain-fed regions.

Research has documented an association between drought tolerance and reduced aflatoxin contamination (Arunyanark et al., 2009; Cole et al., 1993; Holbrook et al., 2000a; 2008; 2009). Stilbence phytoalexins, an immune response for counteract fungal colonization, may be important factors preventing PAC. Under drought, the loss of the capacity of peanut seeds to produce phytoalexins may result in higher PAC. The ability to maintain higher pod moisture contents during drought periods may be important traits enabling cultivars to resist aflatoxin production (Dorner et al., 1989; Wotton and Strange, 1985). Thus, physiological traits for drought tolerance might help breeder to reduce PAC in peanut.

Morphological and physiological traits that can be used as selection criteria to increase drought tolerance in peanut have been identified (Craufurd et al., 1999; Hubick et al., 1986; Nigam et al., 2005; Wright et al., 1988; 1994; Wright and Nageswara Rao 1994). Wallace et al., (1993) suggested that indirect selection for yield will be most effective when applied to traits that already integrate most of the genetic and environmental effects that lead to yield. Transpiration (T), water use efficiency (WUE), and harvest index (HI) are simple model components that contribute to pod yield (Passioura, 1986). Hence, drought tolerance could be enhanced by improvement of soil water extraction capability (large root systems or T) or improvements in WUE, or integration of both (Wright and Nageswara Rao, 1994; Hebbar et al., 1994).

Root systems are importance drought-resistant traits that could be used as breeding criteria (Meisner and Karnok, 1992; Songsri et al., 2008b). In breeding programs, selection of large root systems can increase drought resistance by the increasing of WUE in peanut (Songsri et al., 2008a). Root responses and the ability to extract soil water under drought conditions are also important drought-avoidant mechanisms (Ketring, 1984; Songsri et al., 2008b). In addition, peanut genotypes with large root systems, deeper rooting depth, and high root to shoot ratio can maintain high plant water status and yield under water stress (Rucker et al., 1995). Root study approaches are available to study roots of diverse crops but none of them is without shortcomings. Taking root samples, washing, and measuring are tedious, time consuming, and labor intensive. Timely, labor efficient methods for assessment of peanut root development that are applicable for breeding programs are needed to develop drought-resistant peanut genotypes with enhanced root systems.

The relationships between physiological traits and PAC of peanut under terminal drought are not well understood. A better understanding might lead to the development of peanut cultivars with drought tolerance and reduced PAC. The effectiveness of selection for a trait in breeding programs depends on the relative magnitudes of the genetic and non-genetic causes expressed as the heritability or inheritance of the trait. Relatively few studies to date have investigated the heritabilities and genotypic correlations of physiological traits for drought resistance and agronomic traits and PAC in peanut. Moreover, none have been done under terminal drought conditions.

Hence, the goals of this research were i) to investigate genotypic variability of peanut root characteristics under hydroponic and soil cultures, and the association between root characteristics of peanut grown in hydroponics and in pot studies to determine if hydroponic culture is feasible to identify peanut genotypes with large root systems, ii) to determine the effects of terminal drought on *A. flavus* colonization and PAC, and identify physiological traits associated with PAC under terminal drought stress, and iii) to estimate the heritabilities of terminal drought-resistant traits, agronomic traits, and PAC resistant traits, and estimate genotypic and phenotypic correlations between the traits.