Chapter 1

General Introduction

1.1 Background

1.11 Value of Groundnut

Groundnut or peanut (*Arachis hypogaea* L.) is an annual herb of the Leguminosae family. It is a major world oilseed and food legume cultivated in 96 countries worldwide. Groundnuts originated in the area of southern Bolivia and north-western Argentina of South America. However, this crop is now widely grown in most tropical, sub-tropical and warm temperate countries, especially in Asia, Africa, and North and South America. In Asia, the groundnut is a major crop in India, China, Indonesia, Burma, Vietnam and Thailand. It is considered to be a very important crop not only for domestic consumption but also as an export commodity.

Groundnut seed contains 44 to 56% oil and 22 to 30% protein on a dry weight basis and is a rich source of minerals (phosphorus, calcium, magnesium, and potassium) and vitamins (E, K, and B group) (Savage and Keenan, 1994). Moreover, the groundnut residue from oil extraction is an animal feed rich in protein and a source of groundnut flour, used in many human foods. The peanut grown primarily for human consumption has several uses as whole seeds or processed to make peanut butter, oil, and other products. In addition, it is used in the preparation of various traditional food products, candies and confections (Nigam, 2004). Per 100 g edible portion groundnuts contain roughly: 5.4 g of water, 30.4 g of protein, 47.7 g of fat, 11.7 g of carbohydrates, 2.5 g of fiber and 2.3 g of ash (Shorter and Patanothai, 1997).

A half kilograms of groundnuts is high in food energy and provides approximately the same energy value as 0.9 kg of beef, o.7 kg of Cheddar cheese, 4.3 liters of milk, or 36 medium-size eggs (Woodroof, 1983).

Nonfood products such as soaps, medicines, cosmetics, and lubricants can also be made from groundnuts. The vines with leaves are excellent high protein hay for horses and ruminant livestock. The pods or shells serve as high fiber roughage in livestock feed, fuel (fireplace "logs"), mulch, and are used in manufacturing particleboard or fertilizer (Putnam *et al.,* 2003).

1.12 Consequence of *Aspergillus flavus*

The aflatoxigenic fungi, *Aspergillus flavus* and related species infect a wide variety of crops, all of which produce oil–rich seed. Although *A. flavus* is a cosmopolitan, filamentous fungus that is known to occur mostly in soils it is also found in living plants and plant products, particularly oil-rich seeds. *A. flavus*, the main species occurring in groundnut (McDonald, 1969), produces aflatoxins which persist in groundnut products and are associated with liver cancer and other diseases in human and animals (Wogan, 2000). These toxins are carcinogenic, mutagenic, teratogenic and hepatotoxic compounds formed as secondary metabolites during the growth of *A. flavus* (Forsythe, 2002; Moss, 2002; Stark, 2001; Wogan, 2000). Because of these harmful toxins, aflatoxins regulations limiting their concentration in food and feed for exports are present in at least 77 countries worldwide (Dohlman, 2004). Given an abundance of available nutrients (as is usually the case with foods), mycelia growth and aflatoxin production, are controlled primarily by temperature and moisture management. Other methods such as heat treatment, modified-atmosphere packaging

and application of preservatives, have also been effective (Molina and Giannuzzia. 2002). Developing strategies to reduce or eliminate aflatoxin contamination from groundnut grain has become a priority in recent years. It is suggested that host-plant resistant is considered the most effective method for reducing aflatoxin accumulation (Sommartya, 1997).

1.2 Rationale

Plants defend themselves successfully against microbial attack by preformed structure and by mechanisms that are induced in response to environmental changes and / or infection by pathogens (Isaac, 1992; Johnson, 1992). In the groundnut - *A. flavus* pathosystem, factors that contribute resistance to plant against *A. flavus* and aflatoxin accumulation in the kernel may include pericarp structure, such as thickness and surface wax (Russin *et al.*, 1997; Zambettkis and Bockelee- Morvan, 1976), and subpericarp components which may induce proteins to inhibit fungal growth or aflatoxin production (Guo *et al.*, 1997; Cuero and Osuji, 1995). For example, plant resistant proteins include chitosanase, which inhibits a fungal growth (Cuero and Osuji, 1995), lypoxynase enzymes (LOX), which inhibit Aspergillus colonization (Burow *et al.*, 2000), and methionine-rich protein, which promotes phytoalexin production (Mohanty *et al.*, 1991). In addition, seedcoat-resistant genotypes could characterize a cellular defense structure (Suriyong, 1997).

Variability in aflatoxin contamination was found among the 11 groundnut genotypes (Anderson *et al.*, 1996). Combining ability was found to be significant only for general combining ability, indicating that an additive gene effect is responsible for *A. flavus* resistance in groundnut. A test of gene action in the F_2 generation also

confirmed an additive effect. Furthermore, two major genes were responsible for resistance (Mongkolsiliwat, 1998), which are likely to follow the gene for gene compatibility of pathogen and plant (Flor, 1956). Groundnut genotypes resistant to *A. flavus* showed lower levels of seed infection than susceptible genotypes (Mehan and Mayee, 1991). Several resistant groundnut germplasms to infection by *A. flavus* have been registered, J11 (Zambettakis *et al.*, 1981), ICGV 91278, ICGV91283 and ICGV91284 (Upadhyaya *et al.*, 2001). However, most of these studies were only concerned with post-harvest elimination of aflatoxin and attempted to identify groundnut genotypes with *A. flavus* contamination in the seed or grain. However, flowering, pod maturing or pre-harvest stages may also be critical periods for infection of this pathogen (Anderson *et al.*, 1995; Sanders *et al.*, 1985; Yingthongchai, 1994). Moreover, Kisyombe *et al.* (1985) found that there was no correlation between genotype ranking for resistance to dry seed infection and resistance under field condition at the pre-harvest period. Normally, occurrence of disease resistance or susceptibility probably originates at or during the initial contact between the host cell and the pathogens (Isaac, 1992). Although there have been several studies of groundnut resistant to *A. flavus*, information on resistant characteristics and inheritance of groundnut genotypes resistant to *A. flavus* at both pre-harvest and post-harvest periods are still lacking.

Hence, there is a great need as well as ample scope for comprehensive studies identifying and evaluating genotypic inheritance of groundnut genes resistant to *A. flavus* infection at both pre-harvest and post-harvest periods.

1.3 Objectives

The present study on the inheritance of resistance to *A. flavus* in groundnut has the following objectives.

- To find appropriate screening procedures for identification of groundnut genotype pre - harvest and post harvest resistance or tolerance to *A. flavus*.

- To determine the level of groundnut genotypes resistance to *A. flavus* infection.

- To evaluate the inheritance of groundnut genotype resistance to *A. flavus* infection on the hybrid genotypes.