CHAPTER - I

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an important leguminous oilseed crop, which occupies 31 per cent of the total area under oilseed and contributes about 34 per cent of the production. With the present level of production the country has to resort to large-scale import of edible oil to meet the demand of ever increasing population. The projected demand for oilseeds by 2010 AD is 34 million ton. This needs a growth of 5% in oilseed production from the present level of 22.2 mt (FAI, 1999).

In the irrigated rice growing regions, two or even three crops of rice are being grown successively. Under such a system, the water requirement of crop particularly during dry season being very high, over exploitation of the natural resource - water is difficult to avoid and hence the dry season rice area has remained restricted. Cultivation of a high value, low water requiring, soil restorative crop like peanut may prove helpful in most effective utilization of the available water and even in extending the area under dry season cultivation. Therefore, there is ample scope to include peanut after wet season rice in rice based cropping system.

Peanut is traditionally grown during wet season (June-November) as a rainfed crop. However, the peanut productivity is generally higher when grown as irrigated crop and more so when it is grown in dry season (January-May). Thus, extending area under dry season with irrigation is one of the best options to increase the production of peanut. In this regard, high rainfall areas of eastern India hold considerable promise for cultivation of peanut crop after wet season rice. In this region, the acid lateritic soils, which occupy 11% of the coastal states, possess the desired physical conditions as required by peanut. But peanut growth may be affected due to low pH, low fertility and water holding capacity of the soil. Therefore, appropriate agronomic management practices like nutrient and water management, besides, correction of soil reaction is imperative for augmenting production.

Like any other leguminous crop peanut requires host-bacteria symbiosis for N-fixation. By providing this, the yield of peanut can be increased substantially. Nambiar *et al.* (1988) reported poor yield of the crop, which was grown with chemical fertilizer and sparingly fixed atmospheric nitrogen. Thus, it becomes essential to provide a condition, which supports host-bacteria symbiosis in the soil.

In high rainfall region of eastern India, rice, a major wet season crop, is cultivated with continuous land submergence throughout the crop growing period. This causes major changes in physical, chemical and biological properties of the soil, the most important one being depletion of molecular oxygen resulting in anaerobic condition of the soil. This condition is adverse for sustainability of nitrogen fixing aerobic bacteria. Roughley *et al.* (1995) reported decline in *Bradyrhizobium* population in soil after growing wetland rice. After harvest of rice, during dry season, the soil becomes aerobic and can support better growth of bacteria. However, the sufficiency of bacterial population and its effective association with a host is to be established. It is therefore necessary to find out the population dynamics of bacteria in a calendar year covering the crop growing season and the fallow period. This information will be useful in deciding the inoculation requirement of a dry season peanut grown after wet season rice. Further, the behaviour of bacterial population will change with the type of crop included in the cropping system. It is expected that repeat cultivation of host plant may encourage better host-bacteria association, thereby maintaining an increase in the bacterial population as compared to when a non-host plant is grown in a cropping system.

Any crop when grown during dry season needs supplemental irrigation for better productivity. This acquires much more importance in peanut because the moisture condition of the soil should be congenial both for bacteria and the crop. This calls for finding out a suitable irrigation scheduling. Among the different methods practised, soil moisture depletion approach appears to be appropriate. It is necessary to find out the optimum level of available soil moisture depletion for better growth and development of both bacteria and the crop.

The lateritic soils being low in organic carbon and available nutrient content require supply of essential nutrients through the organic sources. Organic materials also help in increasing the water holding capacity of the soil, which is advantageous for better multiplication and growth of bacteria. Vermicompost is rich in nutrient content and because of its low C:N ratio and good physical condition it is a good source of organic fertilizer. Farmyard manure is being used as an organic source since time immemorial and was the only source of plant nutrients before the introduction of chemical fertilizers in mid nineteenth century. In rice growing areas azolla, an aquatic fern, is also being used as a potential source of organic matter. This biofertilizer can be applied after composting before sowing of any crop.

Low pH of acid lateritic soils is one of the important factors for reducing the productivity of peanut. To raise the level of pH in this soil, lime application is important. The rise in pH helps in better growth and development of bacteria. Liming also supplies Ca, which is an essential nutrient element for better pod development and helps in releasing the fixed P thereby increasing its availability (Tisdale *et al.*, 1985). Therefore, it is important to find out the exact doses of lime and phosphorus for the acid lateritic soil for higher nodulation, N-fixation and yield of peanut.

Micronutrients like Zn, Mo, Co, and B play an important role in nitrogen fixation and nodule formation in the leguminous crops. All these micronutrients have specific physiological role in either nitrogen fixation or improving growth of peanut plant. Earlier studies have confirmed that in acid lateritic soil Zn increased flower number, pod number, pod weight and kernel weight in peanut (Tomar *et al.*, 1996). Molybdenum is an active constituent of the nitrogen fixing enzyme nitrogenase and is responsible for the decrease in the strength of nitrogen bonds (N≡N) to an optimum extent to facilitate reduction of nitrogen (Subba Rao, 1988). Boron helps in absorption of nitrogen and also helps the vascular system in roots to give out branches (rootlets) to supply the nodule bacteria with carbohydrate-food so that they may not become parasitic (Yawalkar *et al.*, 1977). Cobalt is a component of vitamin B_{12}, and the element is found in nodules in the form of compounds containing this vitamin. Bacterial cells also have compounds containing vitamin B_{12}. Cobalt enhances the proliferation and metabolism of the microsymbiont in its habitat within the root (Alexander, 1976). Peanut is responsive to the application of these nutrients and deficiency of these nutrients would adversely affect its growth and production.

To achieve desired level of nodulation and N-fixation while introducing peanut in a new site, bacterial inoculation is essential. Sometimes native bacteria, even though present in large number in soil, fail to nodulate the crop satisfactorily. Under such circumstances, use of an effective strain is necessary for better symbiosis. A large number of N-fixing bacterial strains have been identified for various abiotic stress conditions, which require testing for their performance under local conditions. Further, efficacy of strains could be improved by suitable inoculation technique. Brockwell (1962) reported that for acid soils pelleting the inoculated seeds with lime was beneficial and lime coating of the inoculated seeds enhanced nodulation in legumes (Lowther, 1975). While all methods of inoculation were successful under favourable conditions, liquid and solid methods were superior to seed inoculation under adverse conditions (Brockwell *et al.*, 1980). In case of soybean, when it is introduced as a new crop or where stress such as high temperature is encountered, it may respond to higher numbers of bacteria provided in the form of granular or spray inoculation as compared to seed applied inocula (Bezdicek *et al.*, 1978; Scudder, 1974).

Keeping all these points in view, the present investigation was carried out with the following objectives:

- to investigate the bacterial population dynamics in peanut-rice and peanut-peanut cropping sequences
- to study the effect of soil moisture and fertilizer sources on bacterial population, nodulation and production of dry season peanut crop
- to find out the effect of liming, phosphorus and micronutrients on bacterial population, nodulation, nitrogen fixation and production of peanut in acid lateritic soil
- to identify a suitable bacterial strain and its mode of inoculation for promoting nodulation, nitrogen fixation and production of peanut