CHAPTER - I

INTRODUCTION

Today as there is much scarcity of food which provide sufficient nutrient for the human body. In such condition we need to grow such food crops which are high in nutrients like protein, vitamins and several other nutritional supplements needed for a human body. The main role playing such important nutrient supplement is pulses. Pulses are such food supplements which complete the protein requirement of the body.

Black gram or *Vigna mungo* is one such crop which plays a vital role in filling up the protein deficiency (Hoshang *et al.*, 2011). Nitrogen based fertilizers may serve for better growth of crop plants but efforts should be oriented towards augmenting biological nitrogen fixation mediated by microorganisms. An average area of grain legumes like soybeans, beans, or peas provides sufficient protein for 1000-2000 days for one person, whereas an average area of plant materials converted to animal protein like beef and poultry provides only for 75-250 days (Burns and Hardy, 1975).

Salinization and nutrient depletion are serious and growing problems of agricultural land in different parts of the world (Dreschel *et al.*, 2001; Kijne, 2005). Soil salinity inhibits plant growth by reducing the ability of the plant water uptake and ion excess, which affects the cellular metabolism (Munns, 2002; 2005). Moreover, it induces nutritional imbalance in plants
and thereby reduces the yield of many crops. This ranges from a slight crop loss to complete crop failure depending on the type of crop and severity of the salinity problem. Though several treatments and management practices are available to reduce salt levels in the soil, there are situations where it is either impossible or too costly to attain desirably low soil salinity levels. Reclamation and management of such saline soils are therefore essential to meet the surplus need of food for ever increasing population of developing countries.

In India, coastal saline soils are spreaded over an area of approximately 3.1 million hectare including eight coastal states (Yadav et al., 1993). Among these, the state of Tamil Nadu has the highest area 1076 Km of coastal saline land. The salinity response of legumes in general varies greatly depending on factors like climatic conditions, soil properties, salt tolerance and the stages of crop growth (Cordovailla et al., 1995; Zahran, 1991). Successful cultivation of legumes can be achieved by the selection and/or development of a salt-tolerant legume/Rhizobium combination although high salinities are known to affect rhizobial activities. The legume Rhizobium symbiosis and nodule formation in legumes are more sensitive to salt or osmotic stress. Salinity is reported to affect the infection process by inhibiting root hair growth and decreasing the number of nodule per plant and the amount of N₂ fixed per unit weight of nodules. These cause a
decrease in the yield of leguminous crops in saline soils due to the lack of the successful symbiosis.

Rhizobia having some key tolerance mechanism/pathways against certain stress factor such as abiotic stresses, heavy metals and pesticides are required as these are the major constraints for sustainable agriculture. These mechanisms help rhizobia to execute their beneficial expand (PGP) traits under stress conditions. The following are some of the resistance mechanisms adopted by rhizobia for their survival and PGP traits for plants under stress conditions. Abiotic stresses, such as drought, extremes of temperature, soil salinity, acidity, alkalinity and heavy metals causes severe yield loss. The response of legumes to various stresses depends on the host plant reaction, but this reaction can be influenced by the rhizobia and the process of symbiosis (Yang et al., 2009). The role of microorganisms in adaptation of crops to various abiotic stresses is reviewed by (Grover et al., 2010). There are comprehensive reviews on tolerance and nodulating capacity of *Rhizobium* and *Bradyrhizobium* to soil acidity, salinity, alkalinity, temperature and osmotic stress conditions (Graham 1992; Kulkarni and Nautiyal 2000).

Rhizobia encompass a range of bacterial genera, including *Rhizobium, Bradyrhizobium, Sinorhizobium, Mesorhizobium, Allorhizobium,* and *Azorhizobium,* which are able to establish a symbiosis with leguminous plants. They elicit the formation of specialized organs, called nodules, on roots or stems of their hosts, in which they reduce atmospheric nitrogen and
make it available to the plant. Symbiotic nitrogen fixation is an important source of nitrogen, and the various legume crops and other species often fix as much as 200 to 300 kg. nitrogen per hectare (Peoples, 1995).

Muller et al. (1988) induced mutation in *Drosophila*, by using X-rays. This classical findings paved way for many research workers, to induce mutation in many organisms. The use of spontaneous or induced mutation appears to be more generally applicable to strain improvement because it may be used with any strain without compatibility restrictions. Mutations could be used to add desirable characters to an already effective inoculant strain (Bergersen et al., 1971). Numerous genetic studies have demonstrated that mutants are superior to their parent strains in their nitrogen fixing efficiency, polysaccharide production etc. (Thomas et al., 1993). An efficient rhizobial mutant has been derived by using chemical mutagens such as N-methyl N-nitro- N-nitroguanidine (NTG), ethyl methane sulphonate (EMS) etc.

Information on the use of physical and chemical mutagens in blackgram rhizobia is meagre. Therefore in the present study certain efficient nitrogen fixing rhizobial strains of *Vigna mungo* (L). Hepper. Blackgram were selected for possible further improvement of their N-fixing efficiency and stress tolerance by using chemical mutagens.

Keeping the above points, the present study was undertaken with the following objectives:
➢ Survey on the occurrence of root nodule bacteria, nodulation pattern of blackgram in the soils of Cuddalore and Nagapattinam districts of Tamil Nadu.

➢ Studies on the physico-chemical properties of soil and its relation to rhizobial population and nodulation.

➢ Isolation, characterization and screening of blackgram root nodule isolates for efficiency and stress tolerance.

➢ Studies on the development of mutants using NTG.

➢ Efficiency of selected wild and mutant strains of blackgram rhizobia for IAA, EPS, ARA and salt tolerance.

➢ Studies on the chemotaxis of the stress tolerant wild and mutant strains to blackgram root exudate fractions.

➢ Studies on the effect of agrochemicals on blackgram- *Rhizobium* symbiosis.

➢ Studies on the performance of stress tolerant mutant strains under pot culture conditions.

➢ Studies on the performance of stress tolerant mutant strains under field conditions.