6. SUMMARY AND CONCLUSION

To study the entitled **"Influence of *Rhizobium leguminosarum* inoculation and application of phosphorus and micronutrients on growth, yield, nodulation and seed quality of pigeonpea (*Cajanus cajan*)"**, a field experiment was conducted at research farm of Janta Vedic College Baraut (Baghpat) Uttar Pradesh. The seeds for the two cultivars viz., Pusa 992 and UPAS 120 was obtained from National Seed Corporation Beej Bhawan, Indian Agricultural Research Institute New Delhi. The *Rhizobium* culture was collected from Pulse Research Laboratory and Division of Microbiology, Indian Agricultural Research Institute, New Delhi. The chosen varieties were ecologically viable and suitable to western U.P. It was during the month of May in the years 2007 and 2008 that these varieties were sown as *kharif* crops. The nitrogen (20 kg N ha^{-1}) in the form of urea and phosphorus (40 kg ha^{-1}) in the form of single super phosphate (SSP), boron as borax (0.6 kg ha^{-1}), molybdenum (0.6 kg ha^{-1}) as sodium molybdate, zinc as zinc sulphate (4 kg ha^{-1}) and magnesium (8 kg ha^{-1}) as magnesium sulphate were applied as basal dosages at the time of sowing.

The Row to row distance was maintained at 85 cm and plant to distance was maintained at 65 cm. To raise successful crops all package and practice were adopted at the site of the field experiment.

The samples were collected at different intervals starting after 30 days of sowing. To record growth for different phases of growth, three plants per replication were taken. It was at Nuclear Research Laboratory, Indian Agricultural Research Institute, Pusa, New Delhi where seed quality test were conducted.

The main objectives of the study were to investigate the influence of *Rhizobium leguminosarum* inoculation and application of phosphorus and micronutrients on growth, yield, and nodulation and seed quality of pigeonpea. The influence of *Rhizobium leguminosarum* phosphorus and micronutrients in different treatment revealed that-

- As far as morphological characters are concerned, genetic difference existed between Pusa 992 and UPAS 120. UPAS 120 attained more total biomass than Pusa 992. Pusa 992 gave higher grain yield than UPAS 120 during 2007. However, owing to environmental conditions, during 2008 no significant difference existed between the two cultivars.
- cv. Pusa 992 attained more height than UPAS 120 but this difference was non-significant. UPAS 120 attained greater number of leaves per plant than Pusa 992 in both the year in different combinations.
- After 50 days of sowing UPAS 120 attained a greater leaf area than Pusa 992 in both the years in different combinations. cv. UPAS 120 produced greater number of branches per plant during 2008. However, owing to environmental conditions prevailing in 2007, this cultivar produced less number of branches per plant. In spite of slightly shorter plants in UPAS 120 than Pusa 992, the enhanced number of leaves and greater leaf area contributed to enhanced total biomass in UPAS 120.
- UPAS 120 attained more total chlorophyll content during 2008 at all the stage of measurement than Pusa 992. However, during 2007 the chlorophyll content was less than Pusa 992 owing to adverse ecological factors.

- In the improvement of these morphological attributes various micronutrients played a vital role. Zn acted as an activator of several enzymes. It also played an important role in protein synthesis. Zn also induced enhanced production of Indole Acetic Acid (IAA), a growth hormone which resulted into enhanced vegetative growth, greater number of branches per plant and greater leaf area. Application of phosphorus along with Zn maintained green leaf surface for longer period, which helped the plant to carry on higher rate of photosynthesis for fairly long time. Zn activated the photosynthetic enzyme. Consequently, more amount of photosynthetase got translocated to growing regions of leaf, stem and branches. Mo enhanced the protein production owing to its role in nitrogen fixation and nitrogen assimilation. Boron application resulted into improved growth. It induced enhanced cell division and elongation of leaves. Boron also increased the synthesis of DNA in meristem. It is also involved in cellular differentiation. Mg played an important role in the production of greater amount of chlorophyll. This resulted into more efficient absorption of sunlight and higher rate of photosynthesis.
- cv. Pusa 992 attained greater number of pods per plant and greater 100 seed weight than UPAS 120. Pusa 992 attained higher grain yield than UPAS 120 in 2007. However, in 2008 UPAS 120 performed better, the difference being non significant. Pusa 992 had better Harvest Index during 2007. However, UPAS 120 performed insignificantly better in 2008. The application of *Rhizobium* along with other combinations resulted into higher biomass production which in turn led to the formation of higher pod number and better seed size in both the cultivars, particularly in Pusa 992.

- Application of *Rhizobium* along with phosphorus and other micronutrients resulted into enhanced protein and carbohydrate contents in both the cultivars in both the years. Pusa 992 produced higher carbohydrates and protein contents than UPAS 120. *Rhizobium* application resulted into higher nitrogen fixation activity which in turn produced more amino acids and more proteins in both the cultivars. Carbohydrates are more readily transferred across the cell membrane as a borate complex. Zn and Mg enhanced chlorophyll and photosynthesis which resulted into the production of greater amount of carbohydrates. Mo helped in the production of protein as molybdenum plays an important role in nitrogen fixation and nitrogen assimilation.

CONCLUSION

It can be concluded that *Rhizobium* exerts a positive effect on nodulation in legumes and it can be exploited for the commercial benefits of farmers. It can be said with conviction that if utilized with discretion, *Rhizobacteria* have an extraordinary potential to act as an effective replacement for chemical fertilizer. Economically, it will save the poor Indian farmers a lot of money. The use of biofertilizer is ecologically and economically sustainable. It is assumed that the use of *Rhizobium* along with phosphorus and micronutrients enhance both the growth and yield of both the cultivars. To make the use of *Rhizobium* more efficient, a combined approach is desirable.

Various physiological and biochemical changes which affect the biomass production and its portioning can be accomplished by the use of *Rhizobium*. The combined use of *Rhizobium* and other micronutrients can be exploited to enhance protein quality. The improved protein quality will alleviate the malnutrition of the imbalanced diet of common man. To alleviate high levels of nutrient depletion and soil degradation, the use of biofertilizer is mandatory.

The injudicious use of non-biological fertilizer, which is encouraged by means of subsidies, gives rise to environmental hazards. Moreover, its production is dependent on non-renewable energy sources (National gas, Petroleum and gas). This is fraught with the danger of global warming.

Research in the field of biofertilizers holds an extraordinary potential for alleviating world-wide poverty, food shortage and environmental hazards. A lot of work remains to be done to improve the BNF technology and know-how. A research work needs to be undertaken to increase to competitive viability of BNF technology as compared to the technology involved in synthetic nitrogen.