A field experiment entitled "Studies on integrated plant nutrient supply (IPNS) for maize intercropped with blackgram" was conducted during the year 2004 and 2005 in Kharif season at the experimental farm of Amar Singh Post Graduate College, Lakhaoti, Bulandshahar, U.P. The findings of the experiment are summarized below:

6.1 Effect of Integrated Plant Nutrient Supply on Plant Growth and Yield

6.1.1 Maize

- The plant height and dry matter accumulation in maize increased with advancement of crop age and attained maximum at harvest during both the years. The mean plant height ranged from 40.83 to 72.86, 133.98 to 174.38, 135.62 to 175.49; 137.89 to 177.25 and 140.67 to 178.97 cm and average dry matter accumulation from 1.98 to 4.17; 47.14 to 86.19; 73.71 to 127.16; 106.74 to 145.24 and 120.01 to 161.01 g/plant at knee high, tassel, silky, milky and harvest stages of crop growth, respectively. Plant height and dry matter accumulation were maximum in T3 resulted due to integrated use of FYM + chemical fertilizer treatment which was at par with treatment that received FYM + Azotobacter + Rhizobium + PSB + Chemical fertilizers (T8) and these were significantly superior to remaining treatments at all the stages of crop growth during both the years.
• There were non-significant difference observed in number of leaves/plant of maize under various integrated plant nutrient supply treatments during both the years. However, the number of leaves/plant increased between knee high and tasseling stages and thereafter gradually declined up to the harvest stage during both the years.

• The crop growth rate (CGR) of maize was more at knee high to tasseling stage, which gradually declined towards the maturity during both the years of experimentation. Significant increase in CGR was recorded in treatments receiving organic, inorganic and bio-fertilizer sources of nutrients in combination.

• Yield attributes of maize viz., total number of cobs in net plot, cob weight, number of rows/cob, number of grains/row, number of grains/cob and 1000 grain weight on average basis ranged from 57.07 to 71.67 thousand ha⁻¹, 38.85 to 60.62 q ha⁻¹, 13.47 to 17.16; 32.70 to 35.07; 415.29 to 566.93 and 170.70 to 224.86 g, respectively. The values of these parameters recorded highest under treatment T₃ (FYM + Chem.) which were at par with T₈ (Azotobacter + Rhizobium + PSB + FYM + Chem.) and these were significantly superior to rest of the treatments during both the years of study.

• Grain yield 33.13 to 52.56 q ha⁻¹, stover yield 40.32 to 60.76 q ha⁻¹, total biological yield 73.44 to 113.32 q ha⁻¹, grain: stover ratio and harvest index of maize on an average ranged from 0.82 to 0.87 and 45.11 to 46.38%, respectively. Significant increase was recorded in these parameters in the treatments received organic, inorganic and bio-fertilizer sources of nutrients combinedly.
6.1.2 Urd

- In urd, the plant height, number of branches/plant and dry matter production increased significantly with increase in the age of the crop during both the years, while the number of trifoliate leaves/plant increase from branching to the flowering stage and thereafter, declined at podding stage of the crop. Above parameters were recorded highest in T₃ (FYM + Chem.) followed by T₈ (Azoto + Rhizobium + PSB + FYM + Chem.) and T₇ (Azoto + Rhizobium + PSB + Chem.).

- Yield attributes of urd viz., number of pods/plant, number of grains/pod and 1000-grain weight on an average ranged from 29.93 to 38.36; 5.65 to 8.03 and 34.12 to 37.57 g, respectively. The substitution of N & P by FYM or Azotobacter + Rhizobium + PSB or Azotobacter + Rhizobium + PSB + FYM along with chemical fertilizers registered statistically similar values of these parameters in both the years of study.

- Grain yield, straw yield, total biological yield, grain : straw ratio and harvest index on an average ranged from 5.82 to 7.88 q ha⁻¹; 23.88 to 34.61 q ha⁻¹; 29.70 to 42.48 q ha⁻¹; 0.23 to 0.25 and 18.54 to 20.19%. The grain, straw and total biological yield significantly increased in treatments which received nutrients through organic, inorganic and bio-fertilizers in combination.

6.2 Effect of Integrated Plant Nutrient Supply on Nutrient Content and Uptake

- Nitrogen, phosphorus and potassium content and their uptake in grain and straw of maize obtained highest under treatment T₃ (FYM + Chem.) followed by T₈ (Azoto + Rhizobium + PSB +
Chem.) and T7 (Azotobacter + Rhizobium + PSB + Chem.) which were significantly superior to other treatments during both the years of investigation.

- Treatment T8 (Azoto + Rhizobium + PSB + FYM + Chem.) resulted in significant increase in N, P, and K content as well as their uptake by urd crop. This was closely followed by treatments T3 and T7 in both the years.

6.3 Effect of Integrated Plant Nutrient Supply on Physico-Chemical Properties of Soil

- Statistically, there was no change in soil pH, while significant changes in electric conductively of soil due to IPNS was observed at harvest of maize + urd crop during both the years. Treatment T8 (Azoto + Rhizobium + PSB + FYM + Chem.) showed significant increase in organic carbon, available N, P and K content of soil over other treatments in both the years.

- After harvesting of both crops in intercropped study for both the years, decrease in bulk density of soil was recorded. On the other hand, porosity of soil increased in treatments which received nutrient through organic, inorganic and bio-fertilizer sources in combinations. EC of soil decreased. On an average basis, organic carbon of soil was not affected significantly due to different IPNS treatments over the control. However, significant increase in available N, P and K contents of soil due to IPNS treatments was recorded during both the years. Treatments T1, T3 and T8 resulted in significantly higher in available N, P and K content of soil over the rest of the treatments.
5.4 Effect of Integrated Plant Nutrient Supply on Economics of Maize + Urd Intercropped

Annual gross return, net return, return per rupee invested and benefit : cost ratio obtained highest under the treatment T₃ which was *at par* with treatment T₈ and was significantly superior to other treatments during both the years.

Conclusion

On the basis of the results of present investigation, it may be concluded that intercropping of maize with urd bean resulted increased in productivity of both the crops and higher net profit than sole maize and sole urd cropping system. Maize + urd bean intercropping system can be recommended to improve the soil fertility and organic carbon status by substituting inorganic fertilizers with combined application of FYM, inoculation by *Azotobacter*, PSB and *Rhizobium*. The plant growth, yield attributes of maize and urd under maize + urd inter cropping system were found better by partial substitution of inorganic fertilizers by bio-fertilizers and organic sources of nutrients (FYM and vermicompost). Simultaneously, physical and chemical properties of soil can also be improved by adopting proper combination of FYM, inorganic fertilizer and inoculation of seeds with bio-fertilizers.

The substitution of a part of inorganic fertilizer by organic sources and bio-fertilizers is the best approach to improve soil health for sustainable crop production. By adopting integrated plant nutrient supply we can get maximum yield with higher economic returns without causing soil pollution and spoiling soil health on long term basis.