CHAPTER-VI
SUMMARY AND CONCLUSION

With a view to see the effect of graded doses of nitrogen, phosphorus and potassium, to see the first order interaction effect on French bean as well as to work out the maximum and economical doses of three nutrients viz., N, P and K for French bean, a field trial was carried out at the Research Farm of A.S. College, Lakhaoti, during rabi seasons of the year 1994-95 and 1995-96. Twenty seven treatment combinations (of three experimental factors viz., N, P and K each at the level of control, 60 and 120 kg/ha) replicated three times were tested in a confounding design. The soil of the experimental field was sandy loam, very low in the available nitrogen during both the years and medium in phosphorus & potassium content in both the years. Soil pH was 7.6 and 7.7 during 1994-95 and 1995-96 respectively. Soluble salts were normal in both the years. Weather conditions remained also normal during both the years of study.

A popular variety of French bean (PDR-14) was sown in both the years. The required doses of nitrogen, phosphorus and potassium in the form of Urea, single Superphosphate and Muriate of potash, respectively were added to the soil treatment wise. Full doses of phosphorus and potassium and 1/3rd dose of
nitrogen were applied at the time of sowing as basal application whereas remaining 2/3rd dose of nitrogen was applied in two split doses after first and second irrigations. The experimental crop received in all three irrigations each year in addition to pre-sowing irrigation. Remaining agronomic practice were adopted as per normal recommendations of the crop. The observations on all the important growth, yield attributes as well as yield and protein production were recorded each year and were subjected to statistical analysis. Since the error variances of grain yield data of two years in question were not found homogenous, therefore, the experimental findings were described on the basis of individual year rather than pooling of the same. The salient results based on such findings are summarised in the ongoing chapter in the following manner:

6.1 **EFFECT OF NITROGEN ON GROWTH**:

(i) Initial plant stand was statistically equal under graded doses of nitrogen in both the years.

(ii) Significant increases were recorded in the area per leaf at harvest in the first year, plant height & number of leaves per plant at 60 DAS and area per leaf at 60 & 90 DAS in the second year with increasing the nitrogen dose upto 60 kg/ha only.
(iii) The increasing level of nitrogen up to 120 kg/ha increased the plant height at 90 DAS, area per leaf at 60 & 90 DAS during 1994-95, plant height at 60 DAS & area per leaf at harvest during 1995-96, plant height at harvest, number of leaves per plant at all the stages (except 60 DAS in second year) and dry weight per plant at all the stages in both the years, significantly.

(iv) Increasing nitrogen levels benefitted all the four physiological parameters in general and leaf area index & duration in particular.

6.2 EFFECT OF NITROGEN ON YIELD CONTRIBUTING CHARACTERS AND YIELD:

(i) Application of nitrogen delayed the time of flowering & pod formation in the second year and maturity in both the years.

(ii) A response to 120 kg N/ha was evident in all the important yield attributes as well as yield.

(iii) The response was restricted to 60 kg N/ha in the matter of number of pods on tertiary plus other branches and grain weight per plant in the second year.
(iv) Application of 120 kg and 60 kg N/ha and control yielded 26.07, 23.25 and 17.80 q/ha respectively during 1994-95 while the respective figures for 1995-96 were 31.53, 28.02 and 21.46 q/ha.

(v) The increase in the grain yield was evident by the significant positive correlation of final plant height, number of leaves per plant, area per leaf & dry weight per plant, leaf area index & duration, number of branches per plant, number of pods on primary & secondary branches, as well as number of pods per plant, number of grains per pod & per plant, grain weight per plant, hundred grain weight, protein production and straw & stover yield with the grain yield.

6.3 **EFFECT OF PHOSPHORUS ON GROWTH :**

(i) Number of leaves per plant at 30 DAS, area per leaf at 90 DAS in the first year, area per leaf at 60 DAS & at harvest and dry weight per plant at 30 & 60 DAS in the second year showed response upto 60 kg P₂O₅/ha.

(ii) The response was seen extended upto 120 kg P₂O₅/ha with respect to number of leaves at 30, 60 DAS & at harvest and area per leaf at 60 DAS in the first year.
6.4 EFFECT OF PHOSPHORUS ON YIELD ATTRIBUTING CHARACTERS AND YIELD:

(i) The grain yield of French bean produced by 60 kg $P_2O_5$/ha (being 22.87 & 27.76 during 1994-95 & 1995-96, respectively) was statistically equal to the yield at 120 kg $P_2O_5$/ha but significantly higher than the yield with control i.e., 20.57 24.19 g/ha in the first second year, respectively.

(ii) Harvest index in the first year, number of grains per pod, straw & stover yield in the second year, number of pods total as well as on primary & secondary branches, number of grains, grain weight per plant and protein production in both the years were found responsible for increasing the grain yield by phosphorus application.

6.5 EFFECT OF POTASSIUM:

(i) Application of potassium had no significant effect on the grains yield but the straw yield produced by 60 kg $P_2O_5$/ha closely following by 120 kg $K_2O$/ha was higher than control during 1994-95.

(ii) A response of potassium upto 60 kg/ha has been supported by grain weight per plant, number of pods on secondary branches, dry weight per plant at 90
DAS and number of leaves per plant at harvest in the first year, number of grains per pod, dry weight per plant at 60 DAS and area per leaf at harvest in the following year and number of grains per plant, total number of pods per plant, dry weight per plant and number of leaves per plant at 30 DAS in both the years but plant height at 60 DAS and fresh weight per plant at 90 DAS have shown response upto 120 kg K₂O/ha in the second year.

6.6 **INTERACTION BETWEEN NITROGEN AND PHOSPHORUS**

(i) Interaction between nitrogen and phosphorus was observed in the number of leaves, dry weight, time of 5% flowering, pod formation & maturity, number of pods, number of grains and hundred grain weight.

(ii) The growth characters were improved by nitrogen under all the levels of phosphorus but relative advantages of nitrogen in case of number of leaves was more with the application of 60 kg P₂O₅/ha followed by 120 kg/ha.

(iii) The yield attributes were better when both the nutrients were applied at their highest doses.

(iv) Nitrogen delayed the time of 5% flowering, pod
formation & maturity but the prolonging effect of nitrogen was neutralized up to a certain extent by phosphorus.

6.7 INTERACTION BETWEEN NITROGEN AND POTASSIUM:

(i) Number of pods per plant on tertiary plus other branches in the first year, plant height at 60 DAS, fresh weight at 90 DAS dry weight at 30 & 60 DAS, time of 5% flowering and pod formation in the second year and number of leaves at 30 DAS in both the years showed interaction between nitrogen and potassium. Nitrogen appeared to be helpful in improving the plant characters with all the graded doses of potassium but quantum of increase was slightly more with 60 or 120 kg K₂O/ha than its control.

6.8 INTERACTION BETWEEN PHOSPHORUS AND POTASSIUM:

(i) Dry weight at 30 & 90 DAS, number of pods on secondary branches during 1994-95, number of leaves at 30 DAS, dry weight at 60 DAS, time of 5% pod formation & 5% maturity during 1995-96, plant height at 60 DAS and fresh weight at 90 DAS in both the years showed significant interaction.

(ii) No definite trend in the data emerged out but indi-
cation of positive effect of phosphorus on referred growth and yield attributes was noted specially without or with the application of 60 kg $K_2O$/ha.

(iii) Both the nutrients applied each at the highest dose maximized the plant height at 60 DAS in both the years.

6.9 RESPONSE OF FRENCH BEAN TO NITROGEN AND PHOSPHORUS:

(i) The estimated maximum dose of nitrogen ($X$-max) ranged between 154.8 & 162.6 kg/ha as compared to economical dose ($X$-opt) between 144.6 and 153.5 kg/ha on the basis of grain yield recorded during 1994-95 and 1995-96, respectively.

(ii) The economical dose of phosphorus was estimated between 102.2 & 114.6 kg/ha as against the $X$-maximum between 121.8 & 126.7 kg/ha in the two years.
CONCLUSION

On the basis of field experimentation carried out at Lakhaoti (Bulandshahr) during 1994-95 and 1995-96 with the graded doses of nitrogen, phosphorus and potassium applied to French bean grown in sandy loam soil, having low content of nitrogen, medium of phosphorus and potassium, it can be concluded that French bean responded well to nitrogen upto 120 kg/ha while response to phosphorus was restricted to 60 kg/ha. Application of potassium did not show pronounced effect but a dose of 60 kg K₂O/ha was found beneficial. The interaction of N x P, and P x K were absent in the grain yield. The possibilities of even higher doses of nitrogen ranging between 155 & 163 kg/ha (economical doses being between 145 and 163 kg/ha) to French bean were explored by quadratic regression equation. Similarly the possibilities of applying maximum phosphorus dose came out to be between 122 & 127 kg/ha (economical being between 102 & 115 kg/ha). In rabi French bean, plant height, number of leaves, leaf area —— and dry weight, leaf area index and duration, number of branches, number of pods on primary, secondary and number of pods per plant, number of grains per pod and per plant, grain weight per plant, hundred grains weight, protein production, straw and stover yield were found positively correlated with the grain yield.

Finally a dose of 120 kg N, 60 kg P₂O₅ and 60 kg K₂O/ha may be recommended for yield maximization of French bean in sandy loam soil low in nitrogen and medium in Phosphorus and potassium.