CHAPTER V

SUMMARY AND CONCLUSION

One each laboratory, pot culture and field experiment was conducted to investigate the phosphorus and sulphur studies in soils of district Ghaziabad and response of black gram (*Vigna mungo* L.) to phosphorus and sulphur fertilization, in Department of Agricultural Chemistry, A.S. College, Lakhaoti (Bulandshahr). The results of each experiment are summarized as under:

LABORATORY EXPERIMENT

The present investigation revealed that the highest electrical conductivity of all soil samples varied from 0.21 to 0.55 dSm$^{-1}$ with mean value of 0.35 dSm$^{-1}$ indicating that whole district has the normal soils most suitable for growing different crops. Light textured soil pertaining to eastern, central and western plains had comparatively lower value of EC than those of heavy textured soils of Ganga and Yamuna Khadar zones. The pH of the collected soil samples ranged from 6.7 to 7.5. This range of soil pH again considered to be best for crop production because almost all the nutrients remained available in the soil. All the soil samples contained very low to medium contents of organic carbon and none of them belonged
to high category. The soils of Ganga and Yamuna Khadar (I and V zones) were comparatively richer than other three zones. In case of sand percentage, it was ranged widely from 13.4 to 76.3 per cent. The maximum value of 63.0 per cent sand was found in central plain (Zone III), and started to decrease in eastern and western plains of district. However, in case of silt and clay content, the highest percentage were recorded in Yamuna and Ganga Khadar and decreased continuously towards central zone. The central part of district had light texture soil either sandy loam or loamy sand while alluvial soils of Ganga and Yamuna Khadar contained comparatively heavy texture but varied from sandy loam to silty clay loam.

In case of available phosphorus status, it was ranged from 2.5 to 13.9 µg g⁻¹ with the mean value of 6.8 µg g⁻¹ in whole the district. The highest available-P (13.9 µg g⁻¹) was recorded in the soils collected from Nagla Udairampur of western plain (Zone IV) while the lowest (2.5 µg g⁻¹) was in Muradpur village of Ganga Khadar (Zone I) as well as in Kalchhina village of central plain (Zone III). In whole district, 25, 72.5 and 2.5 per cent of surface soil samples, respectively, fell into deficient, medium and high category of available phosphorus. A very wide variation ranging from 78.7 to 187.6 µg g⁻¹ organic-P content was observed in the soils of Ghaziabad district. The highest (187.6 µg g⁻¹) organic-P was recorded in the soils of Chitaura Mahuddingpur village of Ganga Khadar (Zone I) and lowest (78.7 µg g⁻¹) was in the soils of
Ajampur of central plain (Zone III). The total P contents was fluctuated from 322.1 to 610.6 μg g⁻¹ with the mean value of 377.8 μg g⁻¹ in all the soil samples. The maximum total-P content was recorded in Ganga Khadar Zone I and minimum in eastern plain Zone II.

Among various inorganic phosphorus fractions Ca-P found dominant in all the samples and its quantities increased with increasing the clay content in the soil. The correlational study revealed that no definite trend of correlation between P status and physico-chemical properties of soils of Ghaziabad district. The available-P had positive significantly correlated with clay content while it was significantly negatively related with organic carbon in zone IV and V. The similar trend of 'r' (significant negative) was also observed in case of pH in zone I, IV and V and EC (Zone V). Organic P was found to have positive significant relationship with EC (Zone I) organic carbon and clay (Zone I and V). Almost similar pattern of correlation coefficient was also observed in total P indicated that total P had significant and positive relations with EC (Zone I and V), organic carbon (Zone I, IV and V) and clay (Zone I). In case of inorganic-P, it was found to have significant positive correlation with organic carbon and clay content more or less in Ganga and Yamuna Khadar. Similar trends of correlation coefficients were observed in case of inorganic-P forms.

The study further revealed that the highest available sulphur was found in Yamuna Khadar (Zone V) followed by Ganga
Khadar (Zone I), western plain (Zone IV), eastern plain (Zone II) and central plain (Zone III). A very high percentage of (77.5%) of total soil samples belonged to high category of available sulphur status whereas 17.5 and 5 per cent of the total samples fell into medium and low categories. The wide range from 28.6 to 161.2 μg g⁻¹ soil of organic sulphur was observed in the soils of Ghaziabad district. The highest and lowest content of organic-S were registered in Ganga Khadar (Zone I) and central plain (Zone III), respectively.

The information regarding non-sulphate sulphur indicated that it varied from 38.8 to 165.9 μg g⁻¹. The highest and lowest values were recorded in Yamuna Khadar (Zone V) and central plain (Zone III), respectively. It constituted about 44 per cent of the total sulphur. The total sulphur was also found maximum and minimum in these two zones Yamuna Khadar and Central plain to the extent of 373.4 and 77.7 μg g⁻¹, respectively. Similar results were also recorded in case of water soluble sulphur. It was found highest (75.7 μg g⁻¹) in Yamuna Khadar Zone V and lowest (9.5 μg g⁻¹) in central plain Zone III of Ghaziabad district. The amount of different forms of sulphur content were also observed highest and lowest, respectively in Yamuna Khadar and Central plain. The correlation coefficient analysis revealed that all the forms of S content showed highly significant and positive correlation with organic carbon in all the five zones. However, the clay content had significant and positive
relations with all the forms of S only in Yamuna and Ganga Khadar (Zone V and I). The pH of the soil was found to have negative correlation with all the S forms in all the zones. While EC was positive (non-significant) correlated with S content.

**POT EXPERIMENT**

The soils collected for pot culture experiment were extracted by different extractants of available P and S. Among the five important methods of soil available P extraction, the maximum amount was extracted by the Olsen's method whereas minimum extracted by the 0.01 M CaCl$_2$ method. The highest dry matter yield, P concentration and uptake of P by black gram were recorded in the soils of Ubarpur village of central plain Zone III and lowest in soils of Agraula village of Zone V. The correlation study revealed that the available-P extracted by Olsen's method was found to have the highest positive and significant relationship with different plant parameters while 0.01 M CaCl$_2$ extractable available-P had lowest positive and significant correlation with these plant parameters. The critical limit of available-P 6.7 μg g$^{-1}$ was obtained by Olsen's method for black gram crop in Ghaziabad district which was found to be optimum among all the different methods of P extraction.

The highest and lowest value of available S was recorded when the soil samples extracted by the methods of Heat Soluble and Olsen's method, respectively. The sulphur concentration
and its uptake was found highest in Upara village of central plain Zone III and lowest in the soils collected from Chandner village of Ganga Khadar Zone I. The 0.15 per cent CaCl₂ method of S extraction had the highest significant and positive relationship with yield, S concentration and its uptake followed by Heat and distilled water extraction. The Olsen's had lowest positive significant correlation with the above plant parameters. The soil samples extracted for available S by distilled water, heat and 0.15 per cent CaCl₂ extraction were mostly placed in high category of S whereas Morgan's and Olsen's extractable S belonged medium to high category of available sulphur. The optimum critical limit recorded was 43.6 μg g⁻¹ for 0.15 per cent CaCl₂ extractable-S with respect to dry matter yield of black gram.

FIELD EXPERIMENT

The data obtained from field experiment showed that the grain yield of black gram was significantly increased with increasing levels of P and S upto 50 kg ha⁻¹ but at the higher levels of 0.75 kg ha⁻¹, it was decreased. The highest grain yield 12.86 and 12.94 kg ha⁻¹ respectively was recorded at P₅₀ x S₅₀ levels during both the year 1992 and 1993. The protein content of grain increased at all levels of both P and S but the increase between 50 and 75 kg ha⁻¹ was not significant. The highest protein content was recorded at P₇₅ and S₇₅ levels. The similar trends were also observed in case of nitrogen concentration.
The phosphorus concentration was significantly increased at all the levels of P but when applied along with S it increased significantly up to level of 50 kg ha\(^{-1}\) S and thereafter reduced at 75 kg ha\(^{-1}\) level. The S concentration of grain increased significantly at all levels of S application. The interaction effect of applied P and S was synergistic when both of them applied up to 50 kg ha\(^{-1}\) and thereafter an antagonistic effect was observed. It was interesting to note that the S:P ratio was 0.84 at which highest yield of black gram was obtained in both the years.

As far as the nutrients uptake were concerned, the uptake of nitrogen increased significantly up to the levels of 50 kg ha\(^{-1}\) of P and S but decreased at 75 kg ha\(^{-1}\) application of P and S during both the years. The highest N uptake was recorded at P\(_{50}\) x S\(_{50}\) levels. Similar pattern was also observed in case of P and S uptake by grains of black gram. This indicate that at lower level of both applied P and S, the interaction was synergistic up to a level of 50 kg ha\(^{-1}\) but at the higher level of 75 kg ha\(^{-1}\), the effect was antagonistic in relation to nitrogen, phosphorus and sulphur uptake. Therefore, the optimum doses of P and S was 50 kg ha\(^{-1}\) to obtain higher yield of black gram in Ghaziabad district. The critical difference of P x S interaction was found statistically significant in yield and other qualitative parameters in both the years. On the basis of these findings, it can be concluded that 50 kg ha\(^{-1}\) dose of phosphorus and
sulphur may be recommended to get the maximum yield and beyond this dose the black gram crop could not be responded economically in soils of Ghaziabad district.