CHAPTER 6

SUMMARY AND CONCLUSIONS
The study presented in this thesis has been described in six chapters.

Chapter 1 introduces the problem, elucidates its significance and justifies selecting this study. It also outlines the current status of agricultural production with special reference to leguminous plants in relation to potassium fertilization.

Chapter 2 presents an extensive review of research work conducted in the area of agricultural sciences with special emphasis upon potassium fertilization of leguminous plants. It includes literature available on the physiological analysis of various growth, photosynthetic and biochemical characteristics, enzymatic studies and yield of various crop plants under K fertilization. The importance of K and N nutrients in the regulation of plant growth and development are also reviewed. A critical appraisal of the review of literature has also been included to identify the gaps in the field of study.

Chapter 3 describes the detail of the materials, chemicals, instruments used in the study and methodology adopted to determine various characteristics recorded from four experiments of this study. In addition, this chapter also includes information on the location of the study and the environmental conditions during the data sampling times.

Chapter 4 describes the results of the four experiments carried out in the experimental field on lentil in relation to potassium, nitrogen and rhizobial treatments. The data obtained were statistically analyzed and the significance was determined at \( P<0.05 \) and \( <0.01 \). The results of the experiments are summarized below:

The first experiment was conducted to study the response of K fertilization on eight lentil varieties, namely, I.4076, PL406, DPL-15, L4147, L4594, Ranjan, Precoz and PL-639 obtained from Division of Genetics, IARI, New Delhi. For this experiment lentil varieties were grown using the factorial randomized block design under field conditions. Potassium was applied at 0, 25, 50 and 75 kg K ha\(^{-1}\) whereas a uniform basal dose of 20 kg N ha\(^{-1}\) and 30 kg P ha\(^{-1}\) was applied to all the plots. Two varieties, viz., High Potassium Responsive (HKR) and Low Potassium Responsive (LKR) were selected on the basis of the results of this experiment. The varieties were selected on the basis of plant response to applied K as observed in the growth, morphological, physiological, biochemical and yield parameters of the eight varieties studied. One possible reason for the differential expression of K response between the eight varieties might be associated with higher uptake, accumulation and utilization of K in the high potassium responsive
variety (L-4076). The results brought out a wide variation due to effect of K among the varieties studied throughout their ontogeny. Thus, the characteristics of varieties, especially in response to the applied K, must be taken into account when fertilization doses are decided for cultivation on a large scale. Moreover, it appears that a substantial variation for K acquisition and utilization exists in the lentil varieties.

Hereafter, the selected varieties viz., HKR and LKR, were further investigated for the impact of nutrient interaction with special reference to rhizobium. Potassium was applied at the rate of 0 and 50 kg K ha⁻¹ soil. Prior to sowing, the seeds were treated with two different rhizobial strains. Growth, physiological, biochemical and yield parameters along with the N-metabolizing system were analyzed. Application of *Rhizobium* without K resulted in a low rate of photosynthesis and stomatal conductance. Improvement in the photosynthetic pigment (chlorophyll), soluble protein content and NRA with application of K in combination with N might be due to a better utilization of these nutrients. K application significantly improved the N-metabolizing enzymes and a considerably reduced the toxic nitrate content. The rhizobium and K nutrition affected the C and N assimilatory pathways. K and rhizobial application positively altered and maintained plant nutrients at a normal level. Thus, coordinated operation of C and N partitioning and metabolism is another important aspect where K has a role to play. Plants fertilized with K and rhizobium showed better seed yield and quality attributes like 100 seed weight, harvest index and protein content, in comparison with control plants. Increase in K content in the dry matter was also observed with potassium and rhizobium application. As regards the interactive response of potassium x *Rhizobium*, potassium level of K₅₀ @ 50 kg ha⁻¹ and rhizobial strain RHZ₂ (strain L-2097). It can be considered as an optimum dose for cultivation of lentil on a large scale.

The third experiment was conducted to work out the best combination of foliar K application for the selected HKR and LKR varieties and the two widely employed sources of KCl and K₂SO₄ using the factorial randomized block design in field. A total of 12 treatments of foliar, soil and soil + foliar K applications were tested in three replications in a split plot design. Foliar K was sprayed at 0.25% and 0.50% through KCl and K₂SO₄ at 30 days after emergence (DAE) and 55 DAE, using a hand gun sprayer. Nitrogen and phosphorus were applied as basal to each plot. The growth, physiological and biochemical parameters were recorded at various stages of plant development. Yield and quality parameters were measured at harvest. The experiment was carried out under field conditions for the comparative study of the two available sources of K.
Comparatively higher yields and better yield attributes were obtained with K₂SO₄ in comparison with KCl. Application of the later also led to a higher protein content. Although K₂SO₄ is comparatively costlier than KCl, high yields of superior quality of lentil can fetch higher monetary returns for the growers which could offset the extra cost of fertilizer required for the production of quality crop.

In this study, it was observed that foliar K fertilization increased the yield and nutritive value of lentil; the foliar + basal K application further enhanced the amount of protein content. The best response was again obtained with the 50 kg K ha⁻¹ (K₅₀) as basal dose. Thus, these results suggest that yield components and nutritional properties have an association with K nutrition in lentil. These associations may have widespread implications in managing the growth, yield and potential K contributions of lentil to low K soils.

The fourth experiment was carried out to study the effect of intercropping on the two varieties of lentil viz., high potassium responsive (HKR) and low potassium responsive (LKR) that were selected on the basis of the findings of Experiment 1. These experiments were carried out in pots. The soil was homogeneously mixed with variable doses of K (0 and 50 kg K ha⁻¹) and N (0, 20 and 40 kg N ha⁻¹) and a uniform basal dose of 30 kg P ha⁻¹ was applied to all the pots. The experiments were designed as (I) wheat sole-cropping (II) lentil sole-cropping and (III) lentil-wheat intercropping (2:1 row proportion). The aim of this experiment was to assess the effect of intercropping of legumes on cereals (effect of intercropping of lentil on wheat). The response was assessed in terms of growth, biochemical parameters and yield characteristics.

Chapter-5 carries the discussion part of the thesis. The results obtained in the experiments have been discussed logically and supported with the earlier findings, wherever available. This chapter also presents the possible explanations of the data obtained in order to reach a conclusion and suggest for the prospective research.

Chapter-6 comprises of the summary and conclusions of individual chapters of this thesis.

Chapter-7 presents the relevant bibliography of all the chapters of this thesis.
Recommendations:

Based on the findings and conclusions mentioned above, we make the following recommendations:

- Substantial variation for K acquisition and utilization in the lentil varieties can be exploited in plant breeding programmes to improve crop yields in low fertility regime area.

- $K_{50} \times RHZ_2$ (50 kg K ha$^{-1}$ with *Rhizobium* Strain L-2097) are the optimum level of K fertilization and better rhizobial strain for the growth and yield response of *Lens culinaris*. Therefore, it can be considered as an optimum dose for cultivation of *Lens culinaris* on large scale.

- As inferred from the present study, foliar K nutrition can not only increase the crop yields but also can reduce the quantities of fertilizer applied through soil. Foliar K nutrition, when used as a supplement, and not as a substitute for standard soil fertilization, was beneficial for lentil crop. This indicates that it may have favourable effects on other field crops also.

- The study suggests that lentil–wheat intercropping is a cropping strategy that uses N sources more efficiently due to its spatial self-regulating dynamics where lentil improves its interspecific competitive ability in areas with lower soil N levels, and vice versa for wheat, paving the way for future options to reduce N inputs and negative environmental impacts of agricultural crop production.