CHAPTER VI. SUMMARY

The present thesis entitled “Physiomorphological response of *Cicer arietinum* L. to urban wastewater and inorganic fertilizers” comprises of following six chapters:

In chapter I, the importance and justification of the present work were emphasized.

Chapter II is the review of literature. It deals with the literature on the aspects of wastewater its utilization and effect on different crops including leguminous crops and cicer as well besides also the effect of NPK fertilizers alone on the crop under study. This chapter has been divided into sections for better understanding of the work undertaken related to present problem.

Chapter III describes the details of the materials used in the study and methodology adopted to determine various characteristics recorded in the four experiments. Relevant information on the experimental design, location of study and environmental conditions during the data collection has been incorporated. The mode of data analysis, correlations and regression has also been given.

Chapter IV includes the results on the crop response to various treatments tested during the four experiments. The results were statistically analyzed and the significance at P<0.05 was determined.

**Experiments I-IV**

Experiment I was conducted to assess the effect of three water treatments (GW, 50%WW and 100%WW) together with different nitrogen levels (N₀, N₁₅, N₃₀, N₄₅). The aim of the study was to obtain the optimum dose of nitrogen with wastewater determined on the basis of growth and physiological parameters studied at vegetative, flowering and fruiting stages while the yield characteristics and protein content were determined at harvest. The design of the experiments was factorial randomized block design. Growth characteristics determined included root and shoot length, plant fresh and dry mass, leaf area, nodule number and their fresh and dry mass. The physiological and photosynthetic characteristics were leghemoglobin content in the root nodules, chlorophyll content, carbonic anhydrase and nitrate reductase, NPK contents in the leaves, photosynthetic characters including net photosynthetic rate, stomatal conductance, transpiration rate, water use efficiency and
internal CO₂ and finally at harvest yield characteristics determined included number of seeds per pod, number of pods per plant, 100 seed weight, seed yield and protein content.

Maximum increase in the growth and photosynthetic characteristics were observed under wastewater irrigation viz., 100%WW. Among the fertilizer treatments N₃₀ proved better while the higher dose could not increase it further but instead decreased the said parameters and resulted in decreased yield and toxicity was even more severe under this treatment when given along with wastewater. However a comparatively lower fertilizer dose of nitrogen in combination with wastewater (100% WWxN₁₅) proved optimum for most of the parameters studied including the yield and the protein thereby showing some economy of nitrogenous fertilizers.

Experiment II and III were conducted simultaneously during the winter season of 2007-08 on the same crop. In experiment II four levels of phosphorus (0, 20, 40 and 60 kg ha⁻¹) were tested with uniform basal dose of N at the rate of 15 kg ha⁻¹ obtained from experiment I while K at the rate of 20 kg ha⁻¹. Better growth and development including nodulation, photosynthesis and seed yield was observed under wastewater irrigation with maximum values recorded for 100%WW. Among the phosphorus doses P₄₀ proved best while P₆₀ was luxurious. The combination 100%WW×P₄₀ proved optimum combination and resulted in improved growth, nodulation, NPK contents and photosynthesis which finally led to increase in seed yield and the protein content. This optimum combination was similar in its effect with higher phosphorus (P₆₀) dose together with GW again indicating the higher requirement of P if the crop is irrigated with GW.

While in experiment III, potassium treatments (0, 20, 40 and 60 kg ha⁻¹) were also given along with the fixed basal application of nitrogen at the rate of 15 kg ha⁻¹ and phosphorus at the rate of 20 kg ha⁻¹. Here also the wastewater proved efficacious with better growth and development. The potassium dose K₄₀ proved optimum for most of the parameters including seed yield however, maximum protein content was obtained under K₆₀. Among the interactions, 100%WW×K₂₀ was optimum combination resulting in increased growth, development and yield of the crop. It was concluded from these three experiments that application of wastewater seems to pose
no harm to the crop and instead could supplement if not fully at least partly the nutrient requirement of the crop.

The experiment IV was conducted in the rabi season of 2008-09 to evaluate the performance of the same crop under different combinations of fertilizers obtained from the experiments I-III. Wastewater again proved effective in increasing the plant growth and physiological characteristics and there by the yield and protein content. Among various fertilizer combinations, N$_{30}$P$_{60}$K$_{40}$ proved more effective in increasing nearly all the parameters studied and also proved good for the quality in terms of protein content. However when interactions with wastewater were analyzed two combinations 100%WW × N$_{15}$P$_{40}$K$_{40}$ and 100%WW × N$_{15}$P$_{60}$K$_{20}$ proved equally effective for yield as well as protein content.

Chapter V, results have been discussed in the light of the observations recorded and supported with earlier findings on the subject. Possible explanations of the data obtained have also been included to reach over final conclusions.

Chapter VI (Summary) is the present chapter. It gives the glimpse of the entire study. It is followed by an up-to-date bibliography comprising references cited in the text. An appendix comprising of the composition of the reagents used during the experimental work, is also appended.