SUMMARY AND CONCLUSIONS

Physiological processes reflected by change in the metabolism of carrot due to temperature and light were investigated. The basis for the approach has been described earlier in "Introduction" part.

The two extrinsic factors, namely light and temperature were considered. Vernalisation given to seedlings could not be studied fully because most of the vernalised seedlings did not survive the high temperature after transplantation. So, gibberellic acid was tried as a substitute for vernalisation. This also helped in understanding the probable physiological role of gibberellic acid in growth and development.

The interaction between GA$_3$ and photoperiods as reflected on the metabolic status of carrot roots was studied. Also the effect of GA$_3$ and photoperiods on the metabolic status of the shoot apex was studied to understand the changes occurring at cellular level during the transition from vegetative to floral stages.

Standard biochemical and histochemical techniques and statistical methods were employed in the present study.

The results obtained and the conclusions drawn from these are as follows:
1. Processes involved in growth, development and differentiation are highly interrelated with one another.

2. These processes are influenced by various environmental factors such as light and temperature.

3. The decrease in protein content with a concomitant increase in aminoacid content is indicative of protein hydrolysis associated with germination. The appearance of new proteins suggest formation of some new proteins or perhaps enzymes that might be helpful in metabolism. This is akin to the results from gel electrophoresis of proteins.

4. Low temperatures do not influence the type of aminoacids in the seedlings as observed by paper chromatography experiments.

5. Accumulation of sugars during vernalization might be to provide energy for the vernalized seedlings during their growth.

6. Seed vernalization was unsuccessful because the seedlings got devernalized. This was perhaps, because the seedlings were too delicate to withstand the high field temperatures in all the three photoperiods studied.

7. Of the three concentrations of GA_3 tried, only 10^{-4} \text{M} \text{GA}_3 could cause flowering in long day conditions during the first growing season.
8. Repeating the experiments again confirmed that $10^{-5}M \text{GA}_3$ could cause flowering in cv. Early lantes long day plants as well as normal day plants. cv. Pusa Kesar showed an earliness in flowering when treated with $10^{-5}M \text{GA}_3$. Perhaps, it can be concluded that \text{GA}_3 is close to the substance, if not the flowering substance itself, that induces flowering.

9. \text{GA}_3 treatment, although enhances floral development, does not encourage root development. This was seen by biochemical estimations that especially during the treatment the plants failed to accumulate the reserves as they should. It is, hence, likely that \text{GA}_3 does not permit the easy mobility of photosynthates downwards and instead uses them perhaps in the making of floral primordia either directly or indirectly. Once the hypothesised use of \text{GA}_3 is over and the treatment is discontinued the roots begin to develop as usual. And because of \text{GA}_3's initial effect the plants switch over from the normal vegetative phase to the reproductive phase quickly.

10. It was noteworthy, that \text{GA}_3 application was required at an early age. This was confirmed by experiments where cv. Early lantes plants were treated with $10^{-5}M \text{GA}_3$ after they were three months old. Such a treatment only evoked a slight stem elongation but could not result in flowering.
11. GA$_3$ application influences the carotene content of carrot roots. This means that the treated plants had roots which were lacking normal or near normal levels of carotene. So, it appears that if this method is used widely for early production of seeds, it would hamper the biological potency of the root specially in terms of vitamin - A. Thus, one can either employ GA$_3$ and get more seeds or refrain from GA$_3$ and get healthy roots! However, later in the growth period even GA$_3$ sprayed plants had near normal root size and slightly less of carotene.

12. GA$_3$ improved the RGR in case of normal day and short day plants. The long day plants underwent a fluctuating rate perhaps because they had to switch over to the reproductive phase sooner than the other two sets.

13. LAR was also following similar trends as RGR. The number of leaves and dry matter in long day was not as high as was anticipated perhaps, once again because of the early floral response.

14. Also, correlated were the KAR values. GA$_3$ perhaps resulted in early metabolism of photosynthates and so the, GA$_3$ treated plants showed a low KAR as compared to the control plants.

15. Histochemical studies revealed that the dome shaped apex needed to flatten out for floral buds to emerge. The control
zone appeared to have less metabolites as against the peripheral zone, at least initially. This was found to be related to the development of the umbel in carrot. Because, the first floral primordia appear along the periphery of the flattened disc (i.e. from the peripheral zone).

16. Each floral primordia in turn develops a flattened disc apically which means, that, in turn it develops into an umbellet. Thus, resulting in a compound umbel, typical of carrot.

17. All the substances localized histochemically appeared to be concentrated in the bud region. GA$_3$ resulted in only improving the amount of the substances like total nucleic acids, RNA, protein and insoluble polysaccharides marginally as against the control in case of cv. Pusa Kesar. However, GA$_3$ does result in earliness of flowering.

18. That the treatments photoperiodic, GA$_3$ and vernalization did make a significant impact on the metabolism of seedlings and carrot plants was confirmed by the use of statistical analysis of variance.

19. The yield in terms of number of seeds was better in GA$_3$ treated plants perhaps because of increased number of heads (umbels) and further, increased number of umbellets per umbels.
20. There exists a close correlation between vegetative differentiation and reproductive components of the plant.

Thus, as Zeswaart (1964) concludes, it is clear from the foregoing account that determination of the nature of the floral stimulus remains as a challenge to plant physiologists. Once this problem has been solved, important questions can be tackled, such as: Is the same stimulus necessary for flowering in all plants? How is its biosynthesis controlled by daylength? How does it cause flower formation? Although, there are many techniques now available to investigate the effect of daylength on GA metabolism, it is not proper to define GA as the flowering hormone, simply because its role in the flowering process has not been universally accepted. At least, in case of carrots, it does help in converting the otherwise biennial cultivar cv. Early Mantes into an annual, thereby, confirming its positive impact on the floral development. Yet, that is not the end. Seed vernalization and allowing the plants to grow in refrigerated chambers to simulate the cold environment could perhaps enable researchers to identify and specify the exact role of GA_3 and/or cold and/or light at the cellular level.