

CHAPTER - IV

SUMMARY AND CONCLUSIONS

How to increase the agricultural production in India is the question of supreme importance, particularly in case of cash crops like tobacco and sugarcane. Tobacco (Nicotiana tabacum L.) being one of the most remunerative cash crops in India, its cultivation has been expanding progressively. Tobacco holds unparalleled position among the crop plants in several industrial particulars. Management of tobacco needs attention from the view point of both soil fertility and water availability as well as plant protection from pests and other diseases. Brinjal (Solanum melongena L.) is also one of the most valuable vegetable crops of high nutritional value. Due to its high adaptability to various soil and climatic conditions, it is extensively cultivated.

Present day agriculture is the result of continuous and progressive researches in the field of various branches of agricultural science. Among the greatest hazards in crop production are the weather conditions and the plant diseases. It is stated that incalculable damage is being done to tobacco by various diseases like Tobacco Mosaic Virus (TMV), blue mold, black root rot and Orobanche. Orobanche is a total root parasite which is also found on brinjal, tomato and beans. Orobanche is the least studied and most neglected disease, therefore the time has come to understand much more about it. Although Orobanche is known to biologists for a long time,

only a few investigations have been made on the physiology of its host-parasite relationships. Previous studies on Orobanche concern mainly with its anatomy, mode of penetration and seed germination (Schmucker, 1959; Rangaswami, 1963; Brown, 1965). Very little work has been done on the extremely harmful parasite, Orobanche, under Indian conditions, especially on tobacco crop. Therefore, only the detailed investigations on various fundamental as well as applied aspects of this disease would be of immense use to evolve the most effective, safe and economical method for its control.

Keeping this view in mind the present investigation was undertaken. For the pathophysiological studies in tobacco and brinjal, healthy plants and those infected with Orobanche, a total root parasite, were collected from Lingnoor (Tal. Kagal, Dist. Kolhapur). Plant material was collected fresh from time to time for analysis. Anatomical changes in healthy and infected root with its parasite were studied by microtomy. Physiological changes in healthy and infected plants were studied by using various standard and recent techniques. These include, double beam spectrophotometry, flame photometry, atomic absorption spectrophotometry which are used for estimation of chlorophylls, polyphenols, carbohydrates, various nitrogen fractions and inorganic constituents respectively.

Some of the significant findings of the present investigation can be summarized as follows :

1. Pathological Anatomy :

Orobanche infection brings about considerable changes in the anatomy of roots of the infected host plant. Vascular cylinder in Nicotiana tabacum root is drastically reduced in size. Vessels are smaller as compared to those in healthy roots. The phloem cells are reduced in size. Cells of parasitic root parenchyma in Solanum melongena grow upto the xylem elements and almost encircle the xylem cylinder of the host root. No vascular connection is observed between the host and parasite of both the plants. It seems that absorbing parenchyma is responsible for absorption and translocation of nutrients. The cells connecting phloem cells and the main body of the parasite are not identified under light microscope. It appears that the parasite obtains the required metabolites from the host through some specialized parenchyma cells or by destruction of host tissue.

2. Physiological Studies :

i) Organic constituents :

Orobanche infection brings about considerable changes in the level of various organic constituents. A marked effect of infection in S.melongena was reduction in the total amount of chlorophylls, while in N.tabacum there was an increase in the amount of those in response to infection by Orobanche. Decrease in the level of chlorophylls may impair the rate of photosynthesis with consequent decrease in the yield of brinjal. The level of polyphenols is increased in both N.tabacum and

S.melongena infected by Orobanche. An increase in the number of soluble amino acids in the infected plants may be responsible for increasing the phenolic content or it may be in response to infection as phenolic compounds govern the extent of disease resistance. Higher concentration of polyphenols in the parasite on both the plants seems to be a general feature of angiosperm parasites.

Infection raised the level of soluble sugars, starch and total carbohydrates in N.tabacum, while, the level of starch and total carbohydrates decreased in S.melongena. The reduction in the level of total carbohydrates represents the probable predominance of hydrolytic activity in the infected host. Higher concentration of total carbohydrates in Orobanche on S.melongena than that in the host tissue indicated a high demand for sugars by the parasite.

Infection caused an increase in the level of insoluble nitrogen in N.tabacum and S.melongena leaves. The insignificant difference between the relative proportions of various nitrogen fractions to the pool of total nitrogen in the healthy and infected host indicated that nitrogen metabolism was not deranged in any way due to infection. Lower content of nitrogen in Orobanche as compared to that in its host may be due to its low nitrogen requirement. Increased level of soluble protein-nitrogen in Orobanche may represent its capacity to synthesize its own proteins from amino acids obtained from the hosts.



Chromatographic analysis revealed that the level of amino acids increases in N.tabacum and S.melongena leaves in response to Orobanche infection. Increased amino acid content probably creates unfavourable conditions for the growth of the parasite and thus may induce disease resistance. While the decrease in amino acids in the parasite may be due to rapid utilization of amino acids by the parasite. It is found that the infection does not bring about any definite change in the sugar composition of the leaves of N.tabacum and S.melongena. Predominance of sucrose in the parasite on S.melongena may be due to its translocation from host to the parasite.

The level of nicotine in N.tabacum is increased in response to Orobanche infection. However, the parasite contains low nicotine. Increased level of nicotine content can be attributed towards increased resistance against parasite. Lack of chlorophyll in the parasite may also be one of the reasons for low nicotine content of the parasite. Orobanche infection also alters the organic acid composition of N.tabacum and S.melongena. Presence of succinic, malic, oxalic and tartaric acids in the leaves of healthy N.tabacum and their absence (except that of succinic acid) in the infected host may be due to their utilization by the pathogen. The presence of similar organic acids in the parasite of both the plants may be due to their translocation from the host tissue to the parasite.

ii) Inorganic constituents :

The concentrations of inorganic constituents of the leaves of N.tabacum and S.melongena infected by Orobanche and their comparison with those of healthy ones indicated that Orobanche infection brings about remarkable changes in the level of inorganic constituents of both the plants. It is observed that Na^+ content of the leaves of N.tabacum increases, while that in the leaves of S.melongena decreases in response to the infection. This increase and decrease in Na^+ content in tobacco and brinjal plants respectively may be due to the destructive activities of pathogen or it might have respectively stimulated or inhibited the absorption of sodium. Similar trend was noticed in case of potassium in both the plants. It is observed that in the parasite of both the plants the potassium content increases which may be due to its rapid and more absorption by the parasite. The level of calcium is increased in both N.tabacum and S.melongena leaves as a result of infection. The increased level of calcium in the host tissue may be involved in its resistance to the parasite. The level of Mg^{2+} is elevated in the leaves of N.tabacum while, it is decreased in the leaves of S.melongena in response to Orobanche infection. The decreased level of Mg^{2+} may be due to reduced absorption of Mg^{2+} through the infected roots. The level of Mg^{2+} in the parasite of both the plants remained relatively lower. Phosphorus content is elevated in the leaves of N.tabacum due to Orobanche infection. Iron is found to be accumulated in the leaves of N.tabacum while its level is decreased in the leaves of S.melongena which may

be due to the ability of host plant to resist the activity of parasite. The level of zinc increases in the leaves of N.tabacum while decreases in those of S.melongena due to infection. Increased copper content of the leaves of N.tabacum may represent the growth and development of Orobanche which is favoured by the host plant, but decreased copper content in the leaves of S.melongena in response to infection may result in low degree of parasitism. The lower amount of phosphorus, zinc and copper in the parasite of both the plants and that higher of Ca^{2+} in the parasite on N.tabacum and that of Mg^{2+} in the parasite on S.melongena suggests decreased rate of their translocation from the host to the parasite and may also represent low requirement of Ca^{2+} and Mg^{2+} by Orobanche. The differences in the amounts of different elements in the parasite may be due to the varying contribution of xylem and phloem from the host to the parasite.

In conclusion it can be stated that Orobanche infected tobacco (Nicotiana tabacum L.) and brinjal (Solanum melongena L.) show the considerable changes in anatomical structures. These changes are accompanied by the marked changes in some physiological parameters such as various organic constituents, mineral nutrition and nicotine content. The present investigation also revealed that the metabolic alterations are more pronounced in tobacco than in brinjal possibly indicating the greater degree of parasitism or susceptibility of tobacco to Orobanche infection.