CHAPTER IV

SUMMERY AND CONCLUSIONS

Turmeric is native of South-East Asia and widely cultivated in India, Indonesia, China, Bangladesh etc. In India it is mostly cultivated to major extent in Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra, Kerala and Assam. In Maharashtra State it is grown in about 9,000 hectares mainly in Sangli, Satara and Kolhapur districts. Annual production is about 16,000 tonns in Maharashtra State.

Turmeric (Curcuma longa L.) is a member of Family - Zingiberaceae. It is tall perennial herb, having large root - stalk ovoid fleshy rhizome with sessile cylendrical tubers. The height of the turmeric plant is about 41.5 to 106.2 cm in high yielding varieties of turmeric plant. Number of leaves per plant varies from variety to variety. Average leaf number per plant varies from 7 to 25.

Turmeric is a tropical crop which requires hot and moist climate with 24°C to 28°C.. of mean shade temperature. It is mostly grown under irrigation in Maharashtra. Planting of turmeric is done from June to August. Early planted turmeric gives more yield. Turmeric can be grown in different kinds of soils ranging from sandy to alluvial soils. It is propagated by planting mother or round rhizome. The mother rhizome is the best planting material. Turmeric plant requires 8 to 8.5 month for maturation and harvesting. The harvesting stage can be recognized by the symptoms indicated by the plants. The plant becomes yellow and

and lodges on the ground. The rhizomes are collected, cleaned and stored into round bulbs and fingers. After processing the rhizome dry polished marketable product is obtained.

Dry rhizome and its powder is commonly used for various purposes in human life. It is used in ayruvedic medicines, dyes, cosmetics and as spice. The main colouring constituent of turmeric is curcumin. Curcuma longa L. contains higher % of curcumin and used for various purposes.

However recent reports indicate that the yield is reducing day by day due to ill managed agricultural practices. More-over turmeric diseases like leaf spot and leaf blotch are also contributing to the decline in turmeric yield. In the present investigation three varieties of Curcuma longa L. Salem, Rajapuri and Krishna have been selected for pathophysiological studies. The salem variety of turmeric is affected by leaf blotch disease caused by Colletotrichum capsici, and leaf spot disease caused by Taphrina maculans. Rajapuri and Krishna varieties show severe infection of leaf blotch disease and resistance to leaf spot disease. These diseases change the morphology and physiology of the plant which ultimately affect the plant metabolism, growth and yield adversly.

Although overall retardation due to infection is well established. A systematic analysis of various growth parameter is performed by few workers only. Therefore, with this view

attempts have been made to study some aspects regarding organic, inorganic constituents and acivities of certain enzymes in healthy and infected leaves of three varieties of curcuma longa L. viz. Salem, Rjapuri and Krishna. The changes in physical properties, Mositure percenage, R.W.C., density and volume were studied in healthy and diseased leaves. Some orgaric constituents like Chlorophylls, Carotenoids, T.A.N., Polyphenols, Curcumin, carbohydrates, protein and inorganic constituents such as Nitrogen, Phosphorus, Sodium, Potassium, Calcium, Magnesium, Manganese, Copper, Zinc and Iron were stucied in the present investigation. The invesigation has also been extended to study the activities of certain enzymes such as Nitrate-reductase, Acid-phosphatase and Amylase in healthy and infected leaves of the three varieties of curcuma longa viz. Salem, Rajapuri and Krishna.

The significant findings in healthy and infected leaves are recorded as follows.

A) **PHYSICAL PARAMETERS** :-

(1) Leaf weight, Leaf - thickness and Leaf volume is increased in infected leaves of all the varieties of turmeric. The infected leaves of Salem are highly thickened as compared to Rajapuri an Krishna varieties. Leaf area decreased in infected leaves which decrease the photosyntheitc area. The density is decreased in the infected leaves. The low density in infected leaves may be due to the increased cellular volume, cellular water content.

(2) Moisture percentage - The leaf moisture percentage increases in diseased leaves of all turmeric varieties. These changes are due to excessive hypertrophid and enlargment of leaves. Higher moisture percentage was found in Krishna variety. It is mainly influenced by pathogenesis. Dry matter percentage decreased in infected leaves of turmeric varieties which may be due to loss of chlorophylls and enhanced catabolic activities of enzymes.

B) **ORGANIC CONSTITUENTS** :-

(1) Photosynthetic pigments -

The maximum decrease in the value of total chlorophylls was observed in Rajapuri variety during pathogenesis. All the three varieties of turmeric showed decrease in chlorophyll contents. Ratio of chlorophyll-a to chlorophyll-b was also decreased in all the varieties during pathogenesis. This decrease in chlorophyll contents may be due to metabolic distrubances and loss of strucural integrity of chloroplast in the infected leaves.

(2) Carotenoids -

Carotenoids were also affected by the entry of pathogen and exhibited a decrease with pathogenesis. Rajapuri variety appears to be very sensitive to leaf-blotch disease. The decrease in carotenoid content may be due to distrubances leading to the decrease of synthetic activity for caroenoids.

(3) Total Polyphenols -

Total polyphenols increased in all the three varieties of turmeric during pathogenesis of leaf blotch disease. In Salem variety, the maximum value of polyphenols observed in leaf-spot than the leaf-blotch disease.

(4) T.A.N. -

TAN values are increased in infected leaves of all the three varieties of turmeric viz. Salem, Rajapuri and Krishna. Enhanced chlorosis and breakdown of many metabolities leading to increased T.A.N. in Taphrina and Colletotrichum infected leaves of turmeric varieties.

(5) Curcumin -

Decrease in curcumin content in infected plant of turmeric. The more decrease in curcumin was observed in Salem variety infected by Taphrina than colletotrichum. However curcumin content is higher in Salem variety than Rajapuri and Krishna. Curcumin content is the least in Krishna variety.

(6) Carbohydrates -

Reducing sugar contents were enhanced during pathogenesis. The maximum increase was observed in Salem variety affected by leaf-blotch disease. Non-reducing sugar contents were remarkably affected by infection. All varieties show decrease in non-reducing sugar contents, however in Salem variety the maximum decrease was observed. Similar trends was observed in total sugar contents in all the varieties during pathogenesis.

Starch content was enhanced in diseased leaves. Starch contents increased in Salem and Rajapuri varieties as compared to Krishna variety. In Salem variety the value of starch contents were increased in leaf blotch diseased leaves as compared to leaf-spot diseased leaves.

(7) Soluble protein -

The soluble protein content was positively influenced by pathogenesis. The maximum value of soluble protein was recorded in Salem variety infected by leaf blotch disease as compared to Rajapuri and Krishna varieties. The leaf spot of Salem also shows increase in protein content. This increase in protein may be due to synthesis of protein by pathogen in the host tissue because plenty amino acids are available in the break down of proteins in host cells.

C) **ENZYMES**

(i) Nitrtate Reductase -

The enzyme nitrate reductase was influenced by pathogenesis. The activity of nitrate reductase decreased in infected leaves of all turmeric varieties. The maximum decrease was observed in Salem variety infected by Taphrina as compared to the infection of colletotrichum. Thus decrease in activity of nitrate reductase may be due to decrease in chlorophylls and carotenoid content and decrease in photosynthetic rate.

(ii) Acid.phosphatase -

The activity of acid-phosphatase was positively influenced by infection. The maximum increased activity was observed in Rajapuri varities as compared to other two varieties. Thus increased activity of acid-phosphatase in infected leaves of turmeric may lead to metabolic shifts in infected parts. Which may due to more accumulation of phosphorus or phosphorus metabolism.

(iii) Amylase -

The amylase activity was positively influenced by pathogenesis in all varieties of turmeric. The maximum increase in activity was observed in Krishna variety during leaf blotch disease development. In Salem variety more increase in activity was recorded in leaf blotch disease than the leaf spot disease.

D) **INORGANIC CONSTITUENTS**

(i) Sodium.

Sodium content is slightly decreased in infected leaves of all the turmeric varieties during pathogenesis. More decrease in Sodium content was observed in leaves of Salem variety affected by leaf blotch disease than the other two varieties. The decrease of sodium content may be due to either distructive changes in host tissue or infection might have inhibited the absorbance of sodium.

(ii) Potassium -

Accumulation of potassium was observed in the infected leaves of turmeric varieties, Salem, Rajapuri and Krishna. More increase was observed in Salem and Krishna varieties than the Rajapuri variety. K/Na ratios were greatly increased in all the three varieties of turmeric. This is due to increased K and decrease Na in the infected leaves of turmeric varieties.

(iii) Calcium -

Calcium values are higher in the infected leaves of all the three turmeric varieties. The maximum increase of calcium observed in Salem and Rajapuri as compared to Krishna variety infected by blotch disease. The vital role of calcium in disease resistance against fungal infection and it induces chlorosis.

(iv) Magnesium-

Magnesium content increased in infected leaves of all turmeric varieties viz. Salem, Rajapuri & Krishna. The maximum concentration was observed in Salem variety as compared to other two varieties.

(v) Nitrogen -

Nitrogen content was increased during pathogenesis. The maximum increase in nitrogen content was observed in Salem variety infected by leaf blotch disease. Thus increased content of nitrogen in infected leaves can be correlated with more protein content. These proteins (enzymes) may be newly synthesized by pathogen for its own metabolic activities and development.

(vi) Phosphorus -

Phosphorus content is highly increased in infected leaves of all turmeric varieties. Rajapuri variety shows high amount of phosphorus content in infected leaves. The greater content of phosphorus responsible for its greater suceptibility to leaf blotch disease.

(vii) Manganese -

Decrease of manganese content in all the infected varieties of turmeric. The maximum decrease was observed in Rajapuri variety. The decrease of maganese content responsible for lowering the yield and the quality of product of turmeric.

(viii) Iron -

We observed the decrease in iron content in infected leaves of Salem and Rajapuri varieties, but their is no change in iron content in healthy and infected leaves of Krishna variety.

(ix) Copper -

Copper content positively influenced by pathogenesis. Maximum copper content was observed in infected leaves of Rajapuri compared to other two varieties. In Salem variety increasing pattern of copper content is same in both diseases. This may be due to requirement of copper for the growth of pathogen in the host tissue.

(x) Zinc -

Decrease in zinc content in all the infected varieties of

turmeric. The maximum decrease was observed in Salem variety as compared to Krishna & Rajapuri varieties. The decrease in zinc content may adversely affect the disease resistant capacity of host plant against pathogen.