SUMMARY AND CONCLUSIONS

The mango *(Mangifera indica* L.*)*, a member of family Anacardiaceae is the most important fruits crop of India In area, production, nutritive value and popularity of appeal no other fruit can be compared with it The mango fruit has many uses and has a high food value, as it is rich in total solid, proteins, starch, sugars and vitamins. Many medicinal properties are also ascribed to mango

The wide range of climatic conditions and environmental situation in which mango grows indicates the nature and diversity of associated diseases at all stages of its development, right from plant in the nursery to the fruit in storage or transit. Hardly any plant organ is immune and almost every organ viz stem, branch, twig, leaf, petiol, root, flower and fruit are affected by various disease causing organisms. *M. indica* is known to suffer from a number of diseases caused by fungi, bacteria, insect, phanerogamic parasites and epiphytes Of all these, fungi are the main disease causing organisms in mango. Among the diseases, those affecting flowers and fruits are most destructive ones

Malformation, also known as bunchy top, is one of the serious diseases of mango. It is very serious problem for mango industry causing considerable losses to growers The malady has been reported from several mango growing countries like India, Pakistan, Egypt, Israel, South Africa, Central America, Maxico and U.S.A. Besides mango malformation, leaves, fruits, woods and roots are also infected by a number of fungal pathogen

Disease in an interaction among the host, parasite and environment. Disease resistance is the capacity of an organism to prevent, restrict or retard disease development to occur at high, moderate or low level. Protection and defence are two primary component of disease resistance Disease resistance through structural and biochemical methods are well known phenomenon found in every plant. During pathogenesis host content changes drastically. These changes may have resulted from altered metabolism due to infection and also due to the metabolism of parasite in the host

The present study was carried out with an aim to isolate, culture and identify pathogenic fungi from various plant organs The healthy and infected inflorescences, leaves and fruits of different varieties were compared based on their post infectional chemical and biochemical changes The anatomy and histochemistry of healthy and infected organs and antifungal activity of various phytoalexins were also examined.

Post infectional chemical, biochemical and structural changes form major form of defence activity in plants. The present study focuses on the post infectional chemical, biochemical and structural changes occured as a result of fungal infection in *M. indica* L. var *rajapuri*

Baside *rajapuri* other popular varieties grown in Gujarat viz. *kesar, totapuri, alphanso, ladva, langra* and *dasheri* were also selected to study their post infectional chemical and biochemical changes

Mango malformation disease was found severely infecting the inflorescences of all varieties Leaves, inflorescences, fruits, woods and roots also showed the various diseases. Fungi from different plant organs isolated and identified were maintained on PDA Pathogenicity test were performed to establish the pathogenicity of the different fungi The leaves and inflorescences of the plant were analysed for their post infectional chemical and biochemical changes, both quantitative and qualitative changes were observed The antifungal activity of the phytoalexins and other post infectional compounds were studied by mycelial growth, spore germination and chromatogram bioassay

Fourty two fungi including *Fusarium moniliforme* and one sterile mycelium were isolated from different plant parts.

Production of phenol and p-OH banzoic acid and increase in concentration of quercetin, gallic acid, ferulic acid and mangiferin was observed in malformed and fungus treated inflorescences of *rajapuri* Diseased leaves also showed increased concentration of phenolic acids

Degradation of flavonol quercetin was observed in diseased and treated leaves and inflorescence of *totapuri* variety as a result of fungal infection. An increase in concentration of phenolic acids and mangiferin content was observed. Mangiferin showed significant inhibitory action against *Curvularia lunata.*

Production of p-OH benzoic acid and ferulic acid was observed in malformed and treated panicles of *lalva* variety Diseased leaves showed increased concentration of quercetin, mangiferin and p-OH benzoic acid

Diseased leaves and inflorescences of *kesar* variety showed degradation of flavonol quercetin in response to infection Synthesis of new compound ferulic acid was observed in infected panicles Concentration of mangiferin and phenolic acids was relatively high in diseased plant organs

In diseased leaves and panicles of *alphanso* variety, 3' OMe quercetin and 3'4' di OMe quercetin were replaced by hydroxylated compound quercetin. In addition, p-OH benzoic acid, vanillic acid and ferulic acid were also found synthesised in malformed and treated inflorescences Increased concentration of mangiferin and phenolic acids was observed

No chemical changes were seen in diseased leaves of *langra* variety but the concentration of flavonoid and phenolic acids was found to be relatively higher than healthy ones. In diseased panicles demethylation of 3' OMe quercetin and 3'4' di OMe quercetin and degradation of ferulic acid were observed

Infected leaves and inflorescences of *dasheri* variety showed high concentration of phenolic acids Ferulic acid was found synthesised in infected leaves where it was destroyed in diseased inflorescences as a result of fungal infection. Degradation of quercetin also observed in infected leaves. Concentration of mangiferin was found to be very high in diseased plant parts

An increase in the concentration of flavonoid, phenolic acids and other phenolics were noted in infected leaves and inflorescences of all the varieties.

Post infectional biochemical studies also showed changes in the concentration of their metabolites. Fungi caused reduction in sugar and ascorbic acid content of diseased leaves, inflorescences and fruits An increase in peroxidase activity, total phenolics and mangiferin content was observed due to fungal infection. Mangiferin treatment reduced the peroxidase activity and sugar content, where as an increase in ascorbic acid, total phenol and mangiferin was seen in all the varieties

Diseased leaves had thick prominent cuticle as compared to healthy ones. The midrib is prominent with large cortical cells mostly filled with phenolic content. Inter and intra cellular fungal hyphae were seen in midrib region The cortex contained narrow gum-resin ducts and lumen diameter was relatively less in diseased leaves. Vessel element walls were thick and lignified as compared to that of healthy ones. Vessel frequency was more and vessel lumen diameter was found to be less in infected leaves.

General structure of xylem in normal and infected trees did not show significant differences Fungal hyphae forms a continuous network in all the ray cells. It also penetrates into the lumen of adjacent fibres and vessels Most of the vessels in infected xylem were blocked by the formation of tyloses. Considerable variation was noticed in the distribution of starch, protein and phenolic compounds in healthy and infected leaves and wood

Conclusions and Highlights:

(1) Fungal infection leads to an increase in production of phenolics. Phenolics form a major group of the post infectional compounds, flovonoids and phenolic acids are major phenolics found in plant parts of all the varieties

(2) Post infectional chemical changes both qualitative and quantitative are observed in leaves and inflorescence of all the varieties of *M. indica* L

(3) Mangiferin, a natural phenolic metabolite of *M. indica* L. is also found to increase as a result of fungal infection

(4) Alterations of existing biosynthetic pathways are observed in leaves of *totapuri* and *kesar* and inflorescences of *totapuri, kesar, langra* and *dasheri* varieties, as a result of infection.

(5) Methoxylated compounds are transformed to more toxic hydroxylated compounds, as seen in the leaves of *alphanso* and in the inflorescences of *alphanso* and *langra*.

(6) Fungal infection initiates new biosynthetic pathway for the production of phytoalexins in leaves of *rajapuri, alphanso* and *dasheri* and in panicles of *rajapuri, kesar, ladva, alphanso* and *langra* varieties.

(7) Fungi show their sensivity with different phytoalexins. Various bioassays followed strongly prove the antifungal nature of quercetin, mangiferin, p-OH benzoic acid, ferulic acid and gallic acid.

(8) Detoxification of the phenolics by the fungal pathogen is observed in *totapuri, kesar, alphanso, langra* and *dasheri* varieties

(9) Fungal infection brings changes in host metabolits. Fungi decrease the ascorbic acid and total soluble sugar content and increase the peroxidase activity, total phenols and mangiferin content.

(10) As a defence against fungal invasion vegetative organs develop thick cuticle.

(11) Lignification of elements is relatively more in leaves and wood following infection

(12) Gum-resin secretion is more in infected leaves

(13) Vessels become non functional by the formation of tyloses in infected wood.

(14) Vessel become narrow but their frequency increases in infected leaves and wood.

(15) Proteins and phenolics increase while starch depletes in diseased leaves and wood.

(16) The study brought to light the following new host record of fungi:

1 *Aspergillus ellipticus*

2. *Aspergillus nidulans* var. *latus* Thom & Raper

3 *Cephalosporium* sp corda.

4 *Chaetomium globosum* Kunze and Schm

5. *Cladosporium cladosporioides* (Fres) de

6 *Fusarium graminearum*

7 *Fusarium pallidoroseum*

8. *Gonatobotrys simplex*

9. *Helicosporium* sp

10. *Humicola grisea*

11. *Paecilomyces lilacinus*

12. *Thielavia terricola*

13 *Trichoderma harzianum*

14. *Trichoderma viride*