CHAPTER- VI

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Mango (*Mangifera indica* L.) is one of the most important fruit crop grown mostly in tropical and subtropical regions of the world and almost all parts of the India. Some this crop suffers seriously by malformation disease particularly in Northern belt of India because of its widespread and destructive nature. More than one hundred years since the disease was first recognized, controversy regarding its etiology and control is still unresolved. Therefore, it was necessary to workout the studies on isolation, pathogenicity, morphology and physiology of pathogen, and histological changes, spread, varietal susceptibility and control of the disease. The results during the course of investigation are summarised below.

1. Isolations from bunchy top tissues of different cultivars yielded the colonies of *Fusarium* sp. on both PDA and Czapek's dox malachite green agar media whereas no such colonies were obtained from the healthy seedling.

2. The presence of *Fusarium* sp. was successfully determined in the malformed panicles and shoots. This *Fusarium* sp. was also isolated from the corresponding healthy panicles obtained from the
diseased tree but in a lesser proportion, while fungus was isolated from the healthy panicles and shoots of healthy tree in both cultivars i.e. Amrapali and Dashehari mango.

3. Isolations from different parts of malformed inflorescences i.e., main axis, secondary axis, flowers and fruits yielded the colonies of *Fusarium* sp. though per cent recovery of the fungus varied from part to part. The fungul population was less in pea stage fruits produced on diseased panicles. On the contrary, the different parts of healthy panicles did not yield this fungus.

4. Isolations from different parts of BT-affected seedlings revealed the presence of *Fusarium* sp. though the percent recovery of the fungus was comparable in different parts of the seedlings. However, the recovery of fungus was maximum from the apical portions and roots of the malformed seedling.

5. No much variation was found in *Fusarium* population of rhizosphere and rhizoplane soil of all the three types or seedlings, however, the fusarial population was quite high in rhizoplane soil in comparison to rhizosphere soil.

6. *Fusarium* population was high in isolations made from the extracted sap of BT-tissues of severely infected seedlings as compared to moderately infected seedlings. No fungus was obtained in isolations from the extracted sap of healthy tissues.
7. Isolations from the extracted sap of fully malformed panicles of severely and moderately malformed tree yielded high population of *Fusarium* sp. compared to isolations from partially malformed panicles of severely and moderately malformed tree, respectively. *Fusarium* sp. population was also obtained in isolations from the extracted sap of healthy panicles of severely and moderately malformed trees but in a lesser proportion. However, no fungal growth was found in isolations from the sap of healthy of the healthy tree.

8. Stem inoculation of young seedlings of Dashehari mango in the month of February by different types of inoculum (i.e., spore suspension, culture filtrate and panicle extract) separately, could not produced the BT symptoms even after 10 months of inoculation. However, other symptoms like stunting of seedlings, necrosis of leaves and shortening of internodes could be observed in some seedlings. No such symptoms were developed in uninoculated seedlings.

9. No symptoms of vegetative malformation could be obtained by inoculation of seedlings through soil except only in one seedling out of twenty drenched with panicle extract in pot after one year of inoculation, and only in three seedlings drenched with spore suspension of fungus in nursery after 4-5 months of inoculation. However other remarkable symptoms like wilting/stunting
of seedlings, Necrosis of leaves and shortening of internodes were observed in some seedlings. No such symptoms were found in uninoculated seedlings.

10. Typical symptoms of floral malformation were produced successfully in Amrapali and Deshehari mango when flower buds sprayed/inoculated with spore suspension of isolate F-1 and F-2, however, symptoms of floral malformation were also observed in some extent when flower buds inoculated with culture filtrate of isolate F-1 and apnicle extracts. No such symptoms were produced in uninoculated floral buds.

11. No MI symptoms could be reproduced on the inoculated shoots except only on two shoots inoculated with the spore suspension of isolate F-1. However, other characteristics symptoms like necrosis/burning of leaf margins, drying of apical buds and drying of emerging panicles were more pronounced in the shoots inoculated separately with different types of inoculum. No such symptoms were developed in uninoculated shoots.

12. Forty one isolates of *Fusarium* sp. differed considerably with respect to their colony colour and size of conidia. Six types of colonies viz., pinkish-white, olivaceous-white, yellow-white, creamy-white, whitish-violet and whitish-pink were recorded from different isolates. The conidial length of different isolates ranged between 6.8-50.9 μm and width 2.6-4.0 μm.
13. (a) Mycelium was aerial, dense, delicately floccose, white olivaceous to creamy white, often with a cottony appearance on PDA. Mycelium was branched with sparsely septate hyphae and measured in 3.5-6.5 μm in width. Mycelium was characterized by abundant, straight and densely branched conidiophores.

13. (b) Microconidia were aseptate, hyaline, oval to obclavate, mostly 6.8-11 x 2.6-3.2 μm, forming short chains, whereas, macroconidia formed rarely and were fusoid to falcate, 3.5 septate, 31-50.9 x 2.7-4.0 μm, and narrower at both ends.

14. Of the twelve media tested, potato-dextrose agar medium supported the best growth and sporulation of both isolates (F-1 and F-2) of the fungus. The potato dextrose broth (PDB) also gave significantly higher mycelial dry weight and sporulation of both isolates of the fungus.

15. The maximum size of the colonies of both the isolates of fungus on PDA was obtained at 28 °C, while the excellent sporulation of both isolates on PDA was found at 32 °C.

16. The isolate F-1 and F-2 of fungus could grow and sporulate at a wide pH range of 5.0 to 9.0. Among the different pH levels tried, pH 6.0 was found optimum for the mycelial growth and sporulation of both isolates.

17. Viability of fungal mycelium in BT tissues and malformed panicles was declined to almost half and one-third after eight months.
of storage at room temperature and refrigerator, respectively.

18. Histopathological studies on BT-tissues revealed that cortical and pith cells in diseased tissues are more in number and much hypertrophied. At later stages of infection, browning of vascular (i.e., Xylem) in stem and hypertrophy of epicermal, cortical, vascular and pith cells occurs. Intercellular fungal hyphae were rarely seen in the pith cells of BT-affected stem, whereas, inter-and intracellular hyphae were more common in sections of axillary buds. Some solitary crystals and a brownish material in the deformed damaged cells of BT-tissues were observed.

19. Histopathological studies on MI-tissues revealed that intracellular mycelial fragments were rarely seen in some of the cortical and pith cells. Mycelial agglomerations were observed in some cavities formed in the pith region. Moreover, fungal mycelium was also found in malformed flower buds and at the juncture of shoot tip and panicle. Ovule severely colonized by the fungus resulted into the degeneration of embryo. Some dumb-bell shaped structures were observe in the diseased tissues. No such structures and fungal mycelium were seen in the sections of healthy tissues.

20. Observations on the incidence of floral malformation revealed that disease incidence varied slightly, although the disease severity on individual trees changed gradually from to year. Hence, there did not found any directional trend in the spread of the disease.
21. Out of 107 cultivars observed for their susceptibility to floral malformation, 95 were susceptible showing various degree of infection. Only three cultivars i.e, Cecil, Naliyora and Vellakachi were completely free from malformation. However, cvs. Alib, Amin, Karutha, Columban, Rumani and Totapari were highly resistant to malformation.

22. Out of seven fungicides applied as foliar spray @ 0.25%, Tebuconazole was most effective fungicide in reducing the disease severity followed by benomyl and carbendazim, respectively, whereas carbendazim was found most effective fungicide in reducing the disease severity in some extent followed by Chlorothalonil, Tebuconazole and Captan, respectively, when used as soil drench @ 0.2%. However, complete control of disease was not occurred in any treatment.

23. Deblossoming of malformed panicles decrease the regeneration of panicles but showed a significant increase in the percentage of hermaphrodite flowers. Deblossoming in combination with Bavistin or Benlate proved effective in retaining significant number of fruits per panicle in all the three varieties of mango.

24. Pruning of disease shoots combined with spray of Captan @ 0.1% during July was found to be the best treatment in controlling the disease, followed by pruning of all the branches during July/August in mango trees of cv. Amrapalli and Bombay green.

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