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COMBATING MANGO MALFORMATION THROUGH AN INTEGRATED MANAGEMENT STRATEGY

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ABSTRACT

Malformation has assumed an alarming position due to increasing losses day by day. The problem is intensified due to lack of resistance in available local and exotic cultivars. In order to maintain the economic status of mango crop, a solution oriented approach was devised to combat the disease and maximize production during the year 2002-2004. A 10 year old orchard of susceptible cultivar Anwar Rataul was selected for the study. Malformed branches were subjected to clipping at ½, 1 and 1½ ft. distance behind the panicles followed by spray of Benlate 50 wp @ 1.5 gm/litre of water in the respective treatments to increase healthy growth flushes during the same year and reduce the severity of malformation during alternate flowering season. Maximum pretreatment severity of 83.33% on tagged branches was recorded in control in the year 2002. Post treatment data were recorded during the 2004 flowering season. The treatment where clipping was done at 1½ ft. distance with spray of Benlate proved to be the best giving 72.04% decrease over previous years count. Pruning 1½, 1 and ½ ft. descended with 69.38, 48.77 and 38.59% decrease over previous year's count. This study elucidates the effective role of clipping and chemical spray to reduce the malformation severity in affected mango orchards.

Key words: *Mangifera indica*, Anwar Ratolel, clipping, benlate, control.

INTRODUCTION

Mango (*Mangifera indica* L.) is the most important and delicious fruit grown in many tropical and subtropical regions of the world. It is the most favourite fruit of Indo-Pakistan and is called as the king of fruits (Purseglove, 1972). Being useful and delicious, it is a part of cultural heritage since long time. The mango production has increased in non-traditional mango producing areas and includes parts of Asia, West Africa, Australia, South America and Mexico. In 2004, 26.28 M t fruits were produced from an area of 3.69 M ha (FAO, 2004).

Mango contributes about 15.19% of the total fruit area of the Pakistan (651700 ha). About 52.52% of the mango area (54000 ha) lies in the province of the Punjab and most of the rest is in the Sindh with minor averages in frost free pockets of Baluchistan and NWFP (Anonymous, 2002-2003). To achieve the target of high production, obstacles in mango culture are required to be eliminated. Mango suffers from several biotic and abiotic stresses at all stages

of its life. The major impediment to the establishment of economically viable orchards is malformation. Overall yield losses may range as high as from 80% to 90% (Ginai, 1965; Ploetz, 1999).

The object of disease control is to prevent economic loss and increase the value of crop. The conventional breeding has little impact on cultivar development in mango. Infection disseminates to new areas from infected germplasm and within orchard from infected to proximal healthy branches (Ploetz, 1994, 1999).

Many control measures have been devised to minimize the damage caused by malformation which includes clipping practices, spray of chemicals and growth regulators. Attempts to control malformation by spray of growth retardants, regulators and nutrients show variable response. Effect of some growth regulators in one year is entirely different during next year (Srivastava, 1998).

Control strategies have concentrated mainly on clipping and chemical spray. A good general programme of disease control keeps mango malformation under control if it is combined with prompt removal of diseased tissues from the trees (Campbell and Marlatt, 1986). A combination of pruning and chemical spray strategy results in slower rates of epidemic development and lower levels of initial and final disease incidence. The benefit-cost ratio of 4.2 is three to four times higher than traditional practices (Noriega-Cantu et al., 1999). Mango diseases are mainly controlled by integrated management, including alternative disease prevention and strategies combining chemicals (Barbosa-Martinez et al., 2002). Mahrous (2004) sprayed two highly susceptible cultivars, Taimour and Mabrouka, with growth regulators (NAA, IBA and GA) and cuprous oxide (0.4%) after removing all affected floral panicles with three additional nodes behind the floral malformation. The incidence of floral malformation was best reduced in the next flower season by any of the used treatments. The produced fruit yield from treated trees was significantly higher during the first and the second seasons in comparison with that of the untreated trees.

The magnitude of losses necessitated to devise a solution oriented approach to combat the disease and rejuvenate the declining orchards. The prime objectives of the studies were to determine the effect of clipping at various distances alone and combined with spray application of systemic fungicide. The results of these studies will be helpful to the mango growers of Pakistan to adopt an integrated and easily applicable strategy.

MATERIALS AND METHODS

The experiment was laid out in Randomized Complete Block Design (RCBD) during the year 2002, in a 10 year old orchard of susceptible cultivar Anwar Rataul at Horticultural Research Institute, Faisalabad, Pakistan with eight treatments and three replications. Single mango tree was taken as an experimental unit. Three major limbs growing from the main trunk having many large and small branches were selected and designated as L_1, L_2 and L_3. Pre treatment data on every nine limbs representing three replications/tree and one treatment were recorded by counting diseased, healthy and total number of panicles on each branch. Severity of malformation on each tree was calculated. Clipping was done at $_{1/2}$', 1 feet and $1_{1/2}$ ' distances from top (behind the panicles) to downward followed by spray of Benlate in the respective treatments in the month of July.

A fungicide spray schedule based on mode of active ingredient, effective dosage and time of panicle emergence was devised. Two scheduled sprays of Benlate @ 1.5 gm l^{-1} water were done in the months of January, February, at 15 days interval before flowering in the treatments where Benlate was to be applied. Third spray was done in the month of September to avoid infection in new flushes emerging after monsoon rains. The schedule was followed every year till the completion of the experiment. Spraying was done with tractor mounted sprayer giving full foliar coverage. Standard cultural practices such as irrigation, fertilization and weed elimination were the same for all treatments. Next year (2003), the malformed panicles were removed from

the experimental branches, already subjected to pruning, in the previous year. Due to alternate bearing habit of mango, final observations were recorded during third year (2004).

RESULTS

Disease severity data were recorded on the selected experimental branches tagged on complete differentiation of healthy and malformed inflorescences. Maximum pretreatment severity of 83.33% on tagged branches was recorded in control followed by 73.89% in T_3 (Pruning 1.5 feet) in the year 2002 (Table 1). Malformed branches were subjected to clipping to increase healthy growth flushes during the same year and reduce the severity of malformation during alternate flowering season. Post treatment data were recorded during the 2004 flowering season. Maximum disease severity of 76.01% was observed in the control. Least severity (16.0%) was noted in the treatment, pruning 1.5 feet + Benlate spray. The similar treatment without Benlate spray followed with 22.62% severity. The treatment where clipping was done at 1.5 feet distance with spray of Benlate proved to be the best giving 72.04% decrease over previous years count (Table 1). Every treatment with pre-treatment observation figure served as control to calculate % decrease over previous years count.

Pruning 1.5 feet, 1 foot and 0.5 foot descended with 69.38, 48.77 and 38.59% decrease over previous count. Simple pruning at 1.5 feet distance was still much effective and was statistically at par where pruning was combined with Benlate spray. Spray of Benlate alone could not prove effective and showed least difference (25.84%) over previous count after control.

DISCUSSION

The measures taken to prevent incidence of a disease, reduce the amount of initiating inoculum and finally minimize the loss caused by the disease, have traditionally been called as control measures. There is a tendency to consider these measures under a system of disease management or pathogen management (Singh, 1984).The present study shows the efficacy of combining practices, such as pruning of diseased shoots to promote the production of healthy vegetative shoots and protection of these shoots with systemic fungicide to reduce the severity of malformation.

Pruning 1.5 feet proved helpful to minimize the disease but effect was pronounced when clipping was combined with Benlate spray (72.04%). Percent disease decrease in 1.5 feet clipping was 69.38% which was much higher than 1 feetclipping (48.77%) and statistically significant than 0.5 foot clipping (38.59%). This finding confirms that clipping at 1.5 feet distance from top to downwards is the best to eliminate fungal infection and Benlate spray helps to kill the associated fungal inoculum to avoid the possibility of re-infection. Due to highly localized and erratic establishment of the fungus in a woody tree like mango, mere application of fungicide does not provide promising control. The major reason for emphasis on pruning is that *F. mangiferae* is almost completely restricted to shoot tissues (Ploetz, 1994). Invariable association of the fungus with the malformed tissues necessitates their removal. After picking and development of new growth flushes, disease incidence has the highest rate of incremental increase, with an incubation period extending from 2 to 5 months. Young infected vegetative shoots later turn into diseased panicles which become unproductive. Deformed vegetative and floral shoots remain in the tree until conditions of high humidity and appropriate temperature promote the dispersion of conidia and further spread of the disease. The development of vegetative and floral shoots is important to complete the inoculum production. Fungus *F. mangiferae* is frequently isolated from malformed tissues but infrequently from supporting branches. Systemic colonization of mango behind apical portions is rare. Distant isolations from panicles gradually loose fungal recovery (Ploetz, 1994). Removal at 1.5 feet distance eliminates most of the pathogen.

When Benlate was sprayed alone, it appeared least effective after control (25.84%). This shows the persistency of fungus in malformed shoots. Lignin is an important constituent of

mango. Binding of MBC (Methyl 1-2 benzimidazole carbamate, active ingredient of Benlate) with lignin disturbs its proper translocation in mango tree (Kumar and Beniwal, 1992). This is because fungicidal application alone is not effective. Fungicide is helpful to kill landing conidia and avoids chances of reinfection in pruned branches. Integrated management ensures tree protection and thus determines dynamics of the epidemic.

Mango malformation is a severe problem only if effective control measures are not used. Case histories in South Africa indicate that the disease can be reduced to insignificant levels by removing and burning affected shoots plus at least three additional, basipetal nodes (Crookes and Rijkenberg, 1985a; Manicom, 1989). Lahav et al. (2001) reported the efficiency of sanitation treatments to control the fungal pathogen in a 3 year survey. Yearly sanitation treatments were effective in reducing the presence, spread and severity of the disease. The initial number of infected trees and trees with 2 or more flowers were 86 and 38%, which were reduced to 34 and 3% respectively. In a similar study, removal of affected branches was found helpful to initiate disease free growth thus ensuring induction of healthy panicles during the observation year. It was observed that when the malformed panicles were left unpruned, the effect appeared carried over with great intensity during next blooming season particularly on late season flushes. This was due to the accumulation of the pathogenic fungus. The repeatedly removal of the infected panicles relieved the trees completely free from the problem (Muhammad, 2000). Noriega-Cantu et al. (1999) found that integrated management (IM) consisting of pruning and fungicide sprays, resulted in slower rates of epidemic development and lower levels of initial and final disease.

The inflorescences of individual tree may vary due to alternate year flowering habit of mango. To minimize the differences due to alternate cycling, the data were recorded in third year and final treatment effects were compared with preceding year count. This helped to prevent the inclusion of erroneous observations.

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TABLES

Table 1: Effect of clipping at various distances behind the panicles and chemical spray on severity of mango malformation

	Treatment	Severity before treatment (%)	Severity after Treatment (%)	Decrease over previous years count (%)
i.	Pruning 0.5 foot	65.14	40.00	38.59 bcd
ii.	Pruning 1 feet	52.28	26.78	48.77 abc
iii.	Pruning 1.5 feet	73.89	22.62	69.38 a
iv.	Pruning 0.5 foot + Benlate spray	56.56	23.04	59.26 ab
v.	Pruning 1 feet + Benlate spray	73.07	29.41	59.75 ab
Vi	Pruning 1.5 feet+ Benlate spray	57.24	16.00	72.04 a
vii	Benlate spray	49.69	36.85	25.84 cd
viii.	Control	83.33	76.01	8.78 d

Values sharing the same letters are not significantly different at $P<0.05$ by LSD test.