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FUNGICIDE INJECTION, AN EFFICIENT MANAGEMENT TECHNIQUE OF MANGO SUDDEN DEATH DISEASE IN PUNJAB, PAKISTAN

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ABSTRACT

Mango sudden death disease is known to be a very destructive disease for mango orchards. In this study, we applied two fungicides namely Topsin M and Aliette at the rate of 75 g L⁻¹ and 150 g L⁻¹ to infected tree trunks through injection method, three times at an interval of 10 days. The disease severity significantly decreased from 18.7% to 7.10% (57% reduction) in year 2007 while from 21.42% to 14.82% (35% reduction) in year 2008. There was also a significant difference in number of fruits of treated (952 fruits per tree) and untreated trees (776 fruits per tree). There is further need to explore other systemic fungicides and their compatibility with other existing integrated management practices for a sustainable management package.

Keywords: Disease severity, fungicides, injection technique, mango, sudden death disease.

INTRODUCTION

The mango production is hampered by the attack of number of significant diseases (Khalid *et al.*, 2002). Among all diseases infecting mango, disease complex known as mango sudden death disease or the mango quick decline is the most severe threat to mango growers in Pakistan (Kazmi *et al.*, 2005) that is caused by a fungus *Ceratocystis fimbriata* (Masood *et al.*, 2011). Trees are dying suddenly in their numbers and there is no end in sight. Recently, incidence of this menace was found 20% and more than 60% in Punjab and Sindh Provinces of Pakistan respectively and 60 percent in Al-Batinah region of Oman (Al-Adawi *et al.*, 2006; Saeed *et al.*, 2007). Initial disease symptoms appear as gummosis from the stem bark and branch decline on affected trees, other contributing symptoms include vascular discoloration beneath the bark and tree death usually occur within six months of first symptom appearance (Masood *et al.*, 2010a). Other symptoms include terminal and marginal necrosis of leaves, which ultimately lead to the death of leaf blade (Al-Adawi *et al.*, 2006; Saeed and Masood, 2008). The aforementioned symptoms may be

found alone or in combination of two or more in different mango orchards (Ploetz *et al.*, 1996; Iqbal *et al.*, 2007). Recently, incidence of this menace was found to be 20 percent in Punjab and more than 60 percent in Sindh Provinces of Pakistan, and 60 percent in Al-Batinah region of Oman (Al-Adawi *et al.*, 2006). This phenomenon has also been reported from some other parts of the world i.e., Brazil and Oman (Ribeiro, 1980; Al Adwai *et al.*, 2006).

In Brazil, Oman and Pakistan, *Ceratocystis fimbriata*, *C. omanensis* and *Lasiodiplodia theobromae*, the main causal organisms of mango sudden death disease were mostly isolated from diseased mango tree (Ribeiro, 1980; Malik *et al.*, 2005; Al-Adawi *et al.*, 2006; Saeed *et al.*, 2008; Masood *et al.*, 2010b). The infection of all fungi is facilitated by different bark beetles especially *Hypocryphalus mangiferae* Stebbing (Coleoptera: Scolytidae) as a wounding agent for penetration of spores within the tree vascular system (Batista, 1960; Masood *et al.*, 2008). Some other factors also speed up the quick decline including water stress, extreme summer and winter temperature, sun scorch, high humidity in propagation nurseries, hardpan soils, nutritional deficiencies and improper cultural practices (Das-Gupta and Zacchariah, 1945). Besides these biotic

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and abiotic factors, the poor orchard management practices also facilitate this disease e.g. improper irrigation, intercropping with unsuitable crops, and deep plowing result in root injuries (Saeed *et al.*, 2007).

Regarding integrated disease management, worm wash, chemical growth activators, botanical pesticides and micronutrients etc. as disease management strategies have shown positive results (Masood *et al.*, 2010a). Successful chemical control of diseases caused by fungi requires that all susceptible parts of the plant be thoroughly coated with the fungicide before infection occurs. Sprays must be re-applied as new tissues become exposed by growth and spray residues are reduced by weathering (Akem, 2006). For the sustainable integrated program, it is therefore suggested that systemic insecticide and fungicides could be used as injections, field sanitation, proper pruning, balanced use of macro and micronutrients, avoid deep ploughing and intercropping and plant protection measures according to the situation of pest and disease (Poland *et al.*, 2006). Therefore, the main aim of our experiment was to evaluate efficacy of fungicides through injection method for the management of mango sudden death disease as a preventive as well as curative measure in mango orchards.

MATERIAL AND METHODS

Application of fungicide injection: We selected two 25 to 35 years old mango orchards of one acre each (having clear symptoms of mango sudden death disease) i.e. one orchard was treated with fungicides and other kept untreated. In treated orchard, we selected 25 infected trees of variety Chounsa. Fungicide dose for injection was calculated based on recommended foliar dose that was demonstrated in earlier study (Malik *et al.*, 2011). We selected two fungicides i.e. Topsin-M 70WP (thiofenate methyl) and Aliette 800WP (foestyl alluminium) and calculated the dose for one fully grown mango tree. For injection purpose, formulation was prepared by dissolving 250 g Topsin M and 250 g Aliette in 1.0 L of water, separately as stock solution according to the prescribed procedure (Malik *et al.*, 2011).

During the month of March in each year (2007 and 2008), 10 mango trees were randomly selected and 6 inches deep holes were made in the collar region (reaching in xylem/phloem tissue) with the help of a drill machine at an angle of 45 degree from soil surface. From stock solution as prepared earlier, Topsin @ M 25 mL per injection and Aliette @ 50 mL per injection were

injected through surgical syringe into 3 holes and plugged with cotton. The application was repeated three times with 10 days interval. Therefore the total dose for one mango tree was 75 g for Topsin M and 150 g for Aliette. All other management practices were kept same in both the orchards except the fungicide injection. Cultural practices including pruning and hoeing was also practiced for proper shape and vigor of mango tree.

Disease evaluation technique: After the application of fungicides, data was recorded thrice with one month interval. The disease severity was calculated as:

$$\text{Disease severity} = \frac{\text{Area of diseased tissue}}{\text{total tissue area}} \times 100$$

The scales established by Masood *et al.* (2010a) were used to evaluate the progress of disease on mango tree by dividing the tree portion equally into four halves i.e. seven scales (0 to 7) corresponding to 0%, 1-10%, 11-20%, 21-30%, 31-40%, 41-50%, 51-60% and 61-100% disease severity symptoms, respectively. The mean disease severity was calculated by following Masood *et al.* (2010a):

$$\text{Mean disease severity} = \frac{\text{Sum of numerical ratings on the trees}}{\text{Total number of trees observed}} \times 100$$

Statistical analysis: Means of disease severity on ten trees before and after treatment were compared by using paired sample t-test at 5% level of significance.

RESULTS

First application of fungicide injection: Before the application of fungicides in 2007, the disease severity ranged from 9 to 35% on ten trees with an average of $18.7 \pm 2.25\%$. Three months after treatment, the disease severity ranged from 5 to 10% on ten trees with an average of $7.10 \pm 0.79\%$. There was a significant difference between means of percent disease severity before and after fungicide injection (t-test; $P \leq 0.001$, d.f = 9.0, t-observed = 4.52, t-critical = 2.26, alpha = 0.05). The overall reduction of disease severity percent was found to be $57.26 \pm 6.02\%$ (Figure 1).

Second application of fungicide injection: In 2008, before the application of fungicides, disease severity ranged from 14-31% on ten trees with an average of $21.42 \pm 3.79\%$. Three months after treatment, the disease severity ranged from 11 to 23% on ten trees with an average of $14.82 \pm 6.30\%$. There was a significant difference between means of percent disease severity before and after fungicide injection (t-test; $P \leq 0.001$, d.f = 9.0, t-observed = 7.96, t-critical = 2.26, alpha = 0.05).

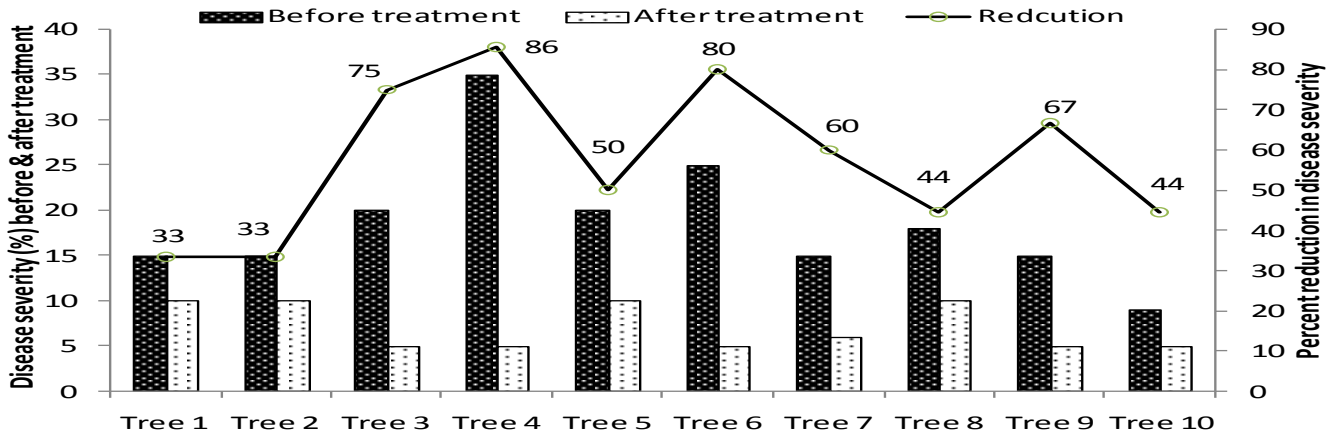


Figure 1. Disease severity before and 3 months after fungicide injection in mango trees during 2007.

The overall reduction of disease severity percent was found to be $34.79 \pm 3.36\%$ (Figure 2). There was also a significant difference between mean number of mango fruits of treated (952.2 ± 53.6 fruits per tree) and untreated trees (776.2 ± 54.3

fruits per tree) (t-test; P-value = 0.018, d.f = 9.0, t-observed = 2.88, t-critical = 2.26, alpha = 0.05) (Figure 3). This technique has proved to be very effective in suppressing disease severity and increasing the fruit production.

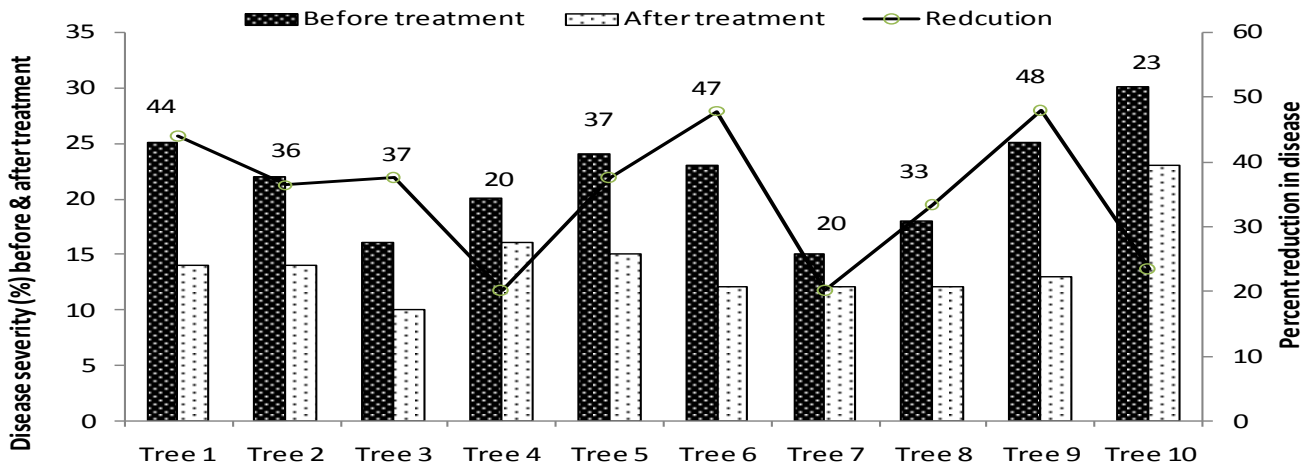


Figure 2. Disease severity before and 3 months after fungicide injection in mango trees during 2008.

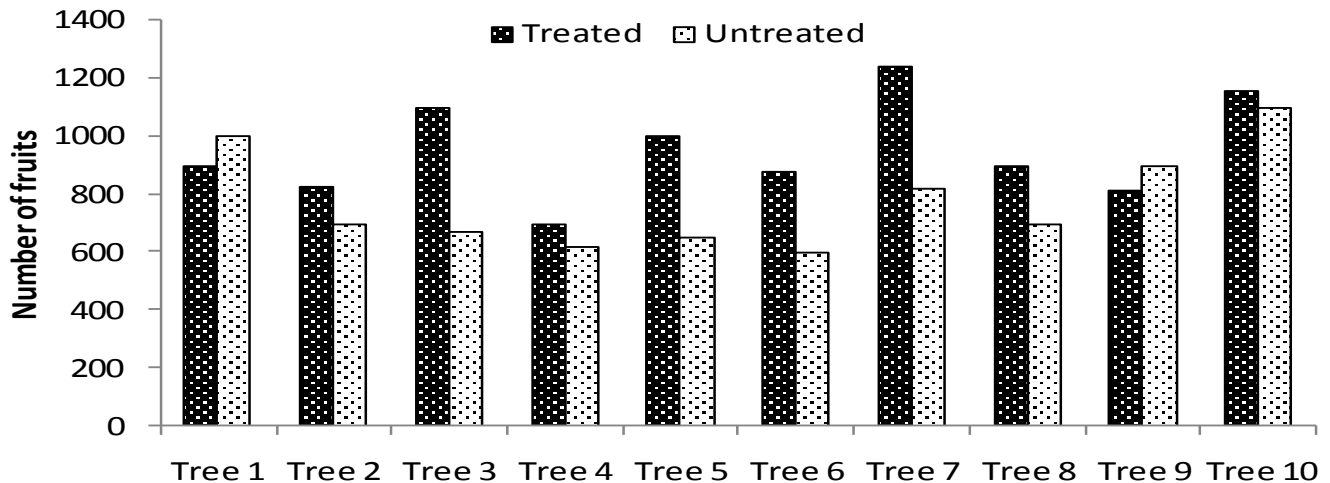


Figure 3. Comparison of number of fruits in treated and untreated mango trees during 2008.

DISCUSSION

Research to date suggests that mango decline is caused by deficiencies of manganese and iron. These deficiencies may predispose trees to infection by fungal pathogens (Hasna, 2007). At present, no mango cultivar can survive against the disease without the application of fungicide sprays as curative measure (Akem, 2006). For the integrated disease management program, it is therefore suggested that systemic fungicides are useful against this disease which could be used as injections (Poland *et al.*, 2006).

Previous studies deal with the foliar application of fungicides i.e. Malik *et al.* (2001) conducted a study at Mango Research Station, Shujabad, and Multan Pakistan regarding integrated management of declining mango trees and concluded that application of copper Oxylchloride and Topsin M in combination with soil amendment proved significant in suppression of disease. In Vitro and Vivo effectiveness of Topsin M, Daconil and Cuprocaffaro has also indicated 50-80% reduction in inoculums of mango decline (Mahmood *et al.*, 2002). Likewise, different fungicides in combination with other control measures i.e. pruning, soil and foliar application of fertilizers were tested which indicate each of this control measure contributed to suppression of the disease and its integrated use found be to more effective against this destructive disease (Sharma and Gupta, 1994; Ahmad *et al.*, 1995). Fungicide application as injection was initially demonstrated on few number of infected mango trees and found that response of Score 250 EC (Difenconazole), Shinkar 25EC (Carbendazim) and Topsin M 70WP (Thiofenate methyl) was at par in suppressing the disease severity in mango tree.

As our results that injection method of fungicides caused 57% and 34% reduction in disease severity symptoms of mango trees; it can be very effective for treating mango trees suffering from MSDD. It should be needed to further investigate other systemic fungicides through injection method so that farmer has broad option against management of this disease. There is further need to explore its compatibility with other existing integrated management practices for a sustainable management package.

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