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Evaluation of Selected Management Options against Post Harvest Diseases of *Mangifera Indica* L.

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ABSTRACT

Mango is one of the main fruit crop produced in and exported from Ethiopia. Its production and productivity is limited by several biotic and abiotic factors. Mango anthracnose, caused by Colletotrichum gloeosporioides isconsidered as the most important mango disease in the country that contribute significantly to pre and post-harvest fruit loss. The successful management of anthracnose relies on understanding the conditions that promote disease development, and the economics, efficacy and market acceptability of the various control measures. Therefore, this study was conducted to select effective management option against post-harvest diseases of mango specifically anthracnose. Four treatments namely fungicides (Mancozeb 80 WP) , hot water at 50-550C for 15min, the conventional cultural practices which include washing fruits with tap water and untreated control for comparison were tested. The analysis of variance showed that, the tested treatments were significantly different (P<0.05) in severity of anthracnose but, they were not significantly different in their incidence. Severity ranged from 33.33 to 80.833%. The most effective treatment in managing of anthracnose was hot water treatment and chemical treatment, with scores of 33.33% and 50.833% respectively. Treating mango fruits with tap water (cultural practice) and the control (Untreated) were not effective in managing of mango anthracnose with the score of 68.33.00% and 81.667% of severity respectively. Therefore, dissemination of these methods alone and together to the farmers will be vital in increasing production and productivity of mango in the studied area.

Keywords: *Mango, Anthracnose, post-harvest loss, colletotrichum gloeosporioide*

INTRODUCTION

Ethiopia has a comparative advantage in a number of horticultural commodities due to its favorable climate, proximity to European and Middle Eastern markets and cheap labor. However, the production of horticultural crops is much less developed than the production of food grains in the country (MoARD, 2009).

Fruit crops play an important role in the national food security of people around the world. They are generally delicious and highly nutritious, mainly in terms of vitamins and minerals that can balance cereal-based diets. Fruits are also a source of raw materials for local industries and could be sources of foreign exchange. Moreover, the development of fruit industry will create employment opportunities, particularly for farming communities. In general, Ethiopia has great potential and encouraging policy to expand fruit production for fresh market and processing both for domestic and export markets. Besides, fruit crops are friendly to nature, sustain the environment, provide shade, and can easily be incorporated in any agro-forestry programs (MoARD, 2009).

Mango is one of the most widely cultivated and globally traded tropical and subtropical fruit trees in the world (Clarke et al., 2011). Mango serves as a fruit crop and as a subsistence crop for family farms. As it ripens at the end of the dry season and at the start of the rainy season, mango is a fundamental source of nutrition for rural populations. Mango fruit is an excellent source of dietary antioxidants, such as ascorbic acid, carotenoids, and especially phenolic compounds (Ma et al., 2011). Mango fruits are relished for their exotic flavor and delicious taste. They are also an excellent source of dietary fiber, pro vitamin A and vitamin C. A fruit with many versatile properties has naturally found application for processing into several

products (Elias, 2007). Mango is a highly seasonal tropical fruit, very popular among millions of people in the tropics. It also occupies a prominent place among the best fruits of the world. However, there is a pre-harvest scarcity and at times a post-harvest glut for this fruit. To increase the availability of this fruit throughout the year, the surplus production must be processed into a variety of value-added products (Singh et al., 1987). Approximately 50% of all tropical fruits produced worldwide are mangos.

In Ethiopia, mango is produced mainly in Harari region, west and east Oromia, Southern Nations, Nationalities and People's Regional state (SNNPR) and Amhara (Dendana et al., 2005). There is a declining trend in yield and quality of the fruits from the trees. Some of the factors contributing to this include foliar diseases, old age, poor management and variability of the trees (Yeshitela and Nessel, 2003). It is now well recognized that the most economically feasible and expedient means to increase the world food supply is to reduce losses in food crops that occur after they are harvested. Post-harvest losses of perishables(e.g. fruits) in developing countries estimated to be in the range of 5-50 %. Due to itsfleshy and hence perishable nature;a mango fruit suffers high post-harvest losses. Among factors causing post-harvest loss, post-harvest diseases take the highest share. Anthracnose caused by *Colletorichum gloeosporiodes*is one of the post-harvest diseases of mango. It is the most important disease wherever mango is grown. The disease develops on all the tender plant parts and is especially serious on fruits. Most of fruit infection takes place from the start of the blooming period until the fruits are more than half grown.

The affected areas usually are crack andsunken.The latent infection is carried from the field and develops further in store causing rotting. Healthy fruits develop infection after coming in contact with diseased fruits. The temperature range for disease development is 10-30^{o}Crelative humidity of 95-97% is highly conducive. Anthracnose in the field can be controlled by spraying Carbandazim (0.1%) or chlorothalonil (0.2 %) at 15 days interval. For the control in storage, hot water treatment at 50-55^{o}C for 15minutes (Tandon and Singh, 1968) gave good control.Anthracnose could be controlled by dipping the fruits in various fungicides. Therefore the present study was carried out to select effective management option against post-harvest diseases of mango specifically anthracnose with a view to recommendinga suitable method/s to end users.

MATERIALS AND METHODS

The experiment was conducted in laboratory using Complete Randomized Design (CRD) to evaluate and select relatively cheap control method for mango post-harvest disease management. For the experiment one fungicides namely Mancozeb 80 WP, hot water treatment at 50-55^{o}C for 15min, the known cultural practices which is washing fruits with tap water anduntreated control for comparison were tested.

Fruit Sampling

Green mature mangoes at harvest stage were sampled from major mango producing kebeles such as Alga,Bytsimal, Shepi, Tolta and Metser. Sampling was done by picking fruits in a random manner. Untreated mango fruit were used as control. After sampling, fruits were labeled and put in cleancarton, placed in cardboards for transportation to the laboratory.

Treatments

Fungicide Treatment

Matured mango fruits were harvested and fungicides arranged to the recommended concentration, 7 sampled fruits were dipped for 5min in the fungicides. After treatment sevenmango fruits wereput in toeach clear carton having 500cmx1m sizeand stored at room temperature(27˚C - 30˚C).

Fig1. *Mango fruit after some days of treatment in the laboratory*

Hot Water Treatment

Seven (7) matured mango fruits were used for hot water treatment.The fruits were dipped in water at 50-55^{0}C for 15min. The water temperature was determined by thermometer while agitating the water with glass rod. Treated fruits were stored at room temperature (27˚C - 30˚C).

Fig2. *Hot water and chemical treatment of mango fruits and mango fruits after some days of treatment*

Cultural Practice

For cultural treatmentphysiologically mature fruits were washed with tap water in order to remove the dirt. After washing seven mango fruits were put in to each clear carton and stored at room temperature(27˚C - 30˚C). To avoid contamination by post-harvest pathogens the water was not reused.

Assessing for the Incidence and Severity of Anthracnose

Assessment for incidence and severity of anthracnose on fruits were performed at two day interval using percent method. The presence of onespot on mango fruit surface was considered as 100 % in case of disease incidence but in case of disease severity the whole fruit considered as 100% so assessment of disease severity was done on the basis of area covered by the spot. The fruits were washed one by one under the tap water and placed in expedition boxes in a way to prevent contact between them and avoid contaminations. They were let to ripen at the room temperature (27˚C - 30˚C). The boxes were examined every two days for rotting syptom. Fruits showing rotting symptoms were sorted out for the identification of the causal agent. The symptoms observed were first described and classified. The isolation and identification of the causal agents was performed in case of doubt. The data were analyzed using Statistics 10 with a confidence interval of 95%($p<0.05$). Mean values were separated byLSD pair wise comparisonstest.

RESULTS AND DISCUSSION

The hazardous effects of chemicals used in plant disease management diverted plant pathologists to find out an effective alternative method with little or no adverse effect on environment. Hence considering the necessity, the present study tried to found out the effectiveness of chemical, hot water treatment and cultural practice (use of tap water to wash mango fruits) against mangoanthracnose disease. One fungicide, hot water treatment (50-55^{o}C) and cultural practice (washing the mango fruits using tap water) were evaluated and compared under laboratory condition for their efficacy against mango anthracnose during 2015 and 2016.Before making analysis of variance data normality test was made. As indicated below the data which was collected in both years were normally distributed(Fig 1).

Year1 Year 2

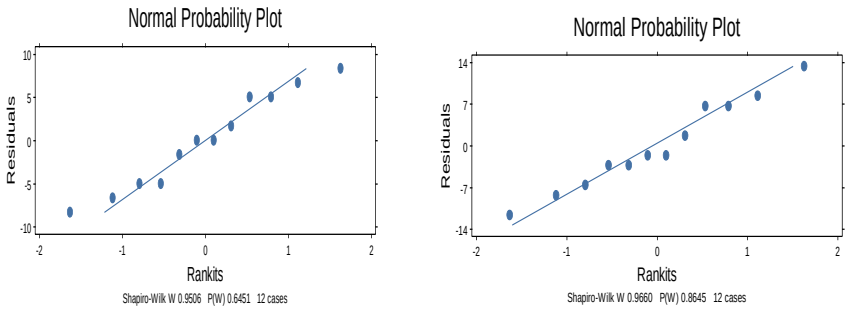

Fig3. .*Normality probability plot*

Combined

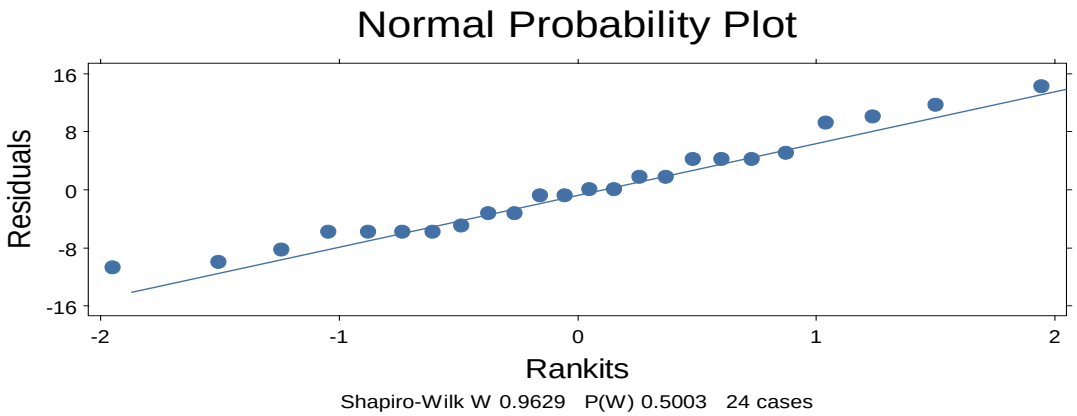

Fig4. *Normality probability plot*

Table1. *Significance of mean square value for incidence and severity of anthracnose for 4 treatments (Year1)*

Source	DF	DI (%)	DS (%)
Treatment	3	0.00000^{ns}	1474.31***
Error	8	0.00000	41.67
CV (%)		0.00	10.99

****, ns, DF, DI, DS =significant at p<0.05, not significant, degree of freedom, disease incidence, disease severity*

Table2. *Significance of mean square value for incidence and severity of anthracnose for 4 treatments (Year2)*

Source	DF	DI (%)	DS (%)
Treatment	3	0.00000^{ns}	1213.19***
Error	8	0.00000	77.08
CV (%)		0.00	14.94

****, ns, DF, DI, DS =significant at p<0.05, not significant, degree of freedom, disease incidence, diseaseseverity*

Table3. *Significance of mean square value for incidence and severity of anthracnose for 4 treatments (Combined).*

Source	DF	DI (%)	DS (%)
Treatment	3	0.00000^{ns}	2645.83***
Error	8	0.00000	53.75
CV (%)		0.00	12.48

****, ns, DF, DI, DS =significant at p<0.05, not significant, degree of freedom, disease incidence, diseaseseverity*

Table4. *Mean values of Disease severity of anthracnose for 4 treatments (Year1).*

Treatments	Disease Severity (%)
T1: hot water treatment	30.000 C
T2: tap water	71.667A
T3:chemical treatment	53.333 B
T4:control(untreated)	80.000 A
LSD	12.154

Note: *Means with the same letter are not significantly different from each other*

Table5. *Mean values of Disease severity of anthracnose for 4 treatments (Year2).*

Treatments	Disease Severity (%)
T1: hot water treatment	36.667B
T2: tap water	68.333A
T3:chemical treatment	48.333B
T4:control(untreated)	81.667A
LSD	16.531

Note: *Means with the same letter are not significantly different from each other*

Table6. *Mean values of Disease severity of anthracnose for 4 treatments (combined).*

Treatments	Disease Severity (%)
T1: hot water treatment	33.333D
T2: tap water	70.000B
T3:chemical treatment	50.833C
T4:control(untreated)	80.833A
LSD	8.8295

Note: *Means with the same letter are not significantly different from each other*

LSD= least significance Difference at 0.05 probability level. The analysis of variance showed that the tested treatments were significantly different (P<0.05) in severity of Anthracnose but, they were not significantly different in their incidence (Table 6). Severity ranged from 33.33 to 80.833%. The most effective treatments in managing of anthracnose were hot water treatment and chemical treatment, with scores of 33.33% and 50.833% respectively;this finding was similar to Esguerra et al., 2004 findings. Treating mango fruits with tap water (cultural practice) and the control one(Untreated) were not effective in managing of mango anthracnose with the score of 68.33.00% and 81.667% of severity respectively (Table 5).

CONCLUSION

Integrated control has always been studied as a viable option to bring about a more complete disease control strategy (De Villiers and Korsten, 1994, Korsten et al., 1991, Korsten et al., 1992, Korsten et al., 1993 and Serfontein et al., 2002).Hot water treatment and chemical treatment were effective in managing mango anthracnose from the tested management methods with score 33.33% and 50.833% respectively compared to the other tested management method. Therefore, dissemination of these methods alone and together to the farmers will be vital to increase production and productivity of mango in the studied area.

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