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Perception of Ethiopian Mango Farmers on The Pest Status and Current Management Practices for The Control of The White Mango Scale, Aulacaspis Tubercularis (Homoptera: Diaspididae)

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Abstract

White Mango Scale (WMS), Aulacaspis tubercularis Newstead (Hemiptera: Diaspididae), was occurred in Ethiopia in 2010. It was introduced from Asia (India) through infected mango seedlings. Currently, the insect problems increase to different parts of Ethiopia. This survey was initiated with the objectives of gathering perception of mango growing farmers on mango WMS insect status and its management methods. Semi-structured questionnaires were administered to mango growing farmers selected at random, with majority being members of the banana and mango producers. The survey result shows that white mango scale insect is present at all the studied area, and all the interviewed farmers responded that their mango tree was faced with some insect problem, and some farmers started to manage this insect by cultural and chemical methods. From the interviewed mango growers, 57.3% were knowledge on white mango scale insect, and they thought it causes high amount of yield loss. Sixty percent of the respondents use one or combination of control methods of the pest. A further systematic study is needed to implement informed management system to control this emerging mango pest.

Keywords: White Mango Scale, Management, Knowledge, Pest, Damage

Introduction

Improved fruit production has been one of the focus areas of Ethiopia. Production area of fruit crops is estimated at 15, 373.04ha (CSA, 2017/18). Mango ranks third in area of production next to banana and avocado. In production, it ranks 2nd next to banana. In 2017, fresh mango production level was estimated to be 1049.82 tons (CSA, 2017/18). Like many other fruits produced in the country, productivity of mango is very low due to unavailability of quality planting materials, poor agronomic practices, damage by local and invasive pests and poor postharvest handling leading to huge post-harvest losses. White mango scale, *Aulacaspis tubercularis* Newstead (Homoptera: Diaspididae) is one of the invasive scale insect and causes serious damage on mango plant. It is a tiny armoured scale which feeds on plant through sap-sucking. It poses severe damage to mango plantation. White mango scale insect is a serious pest that injures mangoes by feeding on the plant sap through leaves, branches and fruits, causing defoliation, drying up of young twigs, poor blossoming and so affecting the commercial value of fruits and their export potential especially to late cultivars where it causes conspicuous pink blemishes around the feeding sites of the scales. In nurseries, severe early stage infestation retards growth. Young trees are particularly vulnerable to excessive leaf loss and death of twigs, during hot dry weather. The heavily infested premature fruits dropping and the mature fruits became small in size with lacking of juice. *A. tubercularis* is a tropical species that may have originated in Asia. Yellowing of leaves, dieback and total death of young mango trees are some of the damages caused by this insect pest (Abo-Shanab, 2012). Mango fruits infested by white mango scale (WMS) ultimately develop pink blemish, and as a result acceptability of the fruit is highly affected (USDA, 2006; El-Metwally *et al*., 2011). White mango scales are distributed in a wide range of climates (Watson, 2007). It is a tropical species that may have originated in Asia (Borchsenius, 1966) and white mango scale has been firstly reported in India on mangoes (Ben-Dov *et al*., 2006). It has been spread by the transport of infested plant material and it is now widespread in many mango growing countries, including the United State of America (Florida), northern part of South America (Brazil, Colombia, Jamaica, the Caribbean) the

east and west coasts of Africa (Egypt, Ghana, South Africa, Kenya), Asia (India, China, Iraq, Indonesia, Japan, Pakistani), Italy and Australia. Infestation of white mango scale in Ethiopia, as a new insect pest on mango, was reported in 2010 from an orchard owned by Green Focus Ethiopia Ltd located at Loko Village, Gida Ayana District in East Wollega Administrative Zone of Oromia National Regional State, western Ethiopia (Temesgen, 2014). In 2001 and 2002, a private farm called Green Focus Ethiopia Ltd introduced a new cultivar called Alphanso from India and was planted at Lako in Guto Gida Woreda of East Wollega zone of Oromia region, western Ethiopia. A study made in western Ethiopia confirmed that the variety introduced was highly infested with a new insect pest called white mango scale (Mohammed *et al.,* 2012). Currently this insect is distributed all over Ethiopian regions according to the Ethiopian broadcast report. The current study was focus on perception and management components on mango white scale insect based on the following above information's.

Materials and methods

Field surveys

A field survey was conducted between October 2018 and August 2019 to establish the perception of mango farmers on the pest status and current management options for the control of white mango scale, *Aulacaspis tubercularis* in Ethiopia. Semi-structured questionnaires were administered to farmers selected at random, with majority being members of the banana and mango Producers. The study was conducted in four districts of Wolaita zone namely, Bolloso sore, Bolloso Bombe, Humbo, and Kindo koyisha district of Wolaita zone. Seventy-five (75) farmers were selected for the study, with each selected farmer having a farm size of at least, 2 ha. The stratified random sampling procedure was adopted for the study so that, each mango producing village in the selected district represented a stratum (sampling unit). Farmers were selected at random from each of the sampling units. Criteria for selection included, the farmer being in mango production for at least four years and have more than 30 mango tree. This is because the level of awareness of mango insect and disease problems is high during this period.

Questions in the questionnaire were premised on finding information on pest problems commonly encountered by farmers in mango fruit production as well as finding the major and minor pests. Questions were also asked relating to the awareness on mango white scale insect, the time of its introduction, and the nature of the damage caused by mango white scale. Farmers were also asked to rate the effect of mango white scale on fruit production relative to other arthropod pests commonly encountered in the mango agro-ecosystem. Question relating to knowledge of the economic significance of the pest with regards to it being a quarantine pest and the losses it could cause in the mango industry were asked in the questionnaires. They were requested to indicate whether mango white scale was an exotic, endemic, and/ or occasional pest. The concluding aspect of the questionnaire dealt with matters relating to management options adopted by farmers.

Data analysis

All data gathered from the field survey (questionnaire) were analyzed using descriptive statistics (percentages).

RESULTS

Perception of mango farmers on the pest status of mango white scale insect

Results from the survey questionnaire indicated that all the respondents (100%) have encountered some pest problem at a point in their career as mango producers. Several arthropod and pathogen species were listed by the respondents as being pests in mango agro-ecosystems in Ethiopia. The arthropod pests and pathogens mentioned by the farmers fell under two categories namely; major and minor pests (Table 1). Farmers categorized pests as being major mostly based on the length of time they spend dealing with them on their farms over the production period and the extent of intervention required in terms of monetary values. Few 8 (10.7%) of the farmers were of the opinion that scale insects and fruit fly were of major concern in the mango

agro ecosystem. The majority of the respondents 50 (66.7%) indicated that anthracnose (fungal disease) were of major economic importance causing damage that can lead to the production of unmarketable fruits. The second in order of significance as a major pest was 43 respondents (57.3%) were the white mango scale. This proportion of farmers believed that the white mango scale insect caused a lot of problems leading to yield reduction in the mango production. They were fully aware of white mango scale being pest of economic significance. Few farmers mentioned termites (2.1%) and ants (32.2%) as pests of major economic importance that required some attention during and even after the production cycle. Arthropod pests indicated as minor pests by the respondents during the survey included fruit flies (2.9%), grasshoppers (5.1%), mites (3.7%) and ants (32.2%).

Table 1: Pests encountered by farmers on mango farms

Name of Insect	Percentage (%) (n = 75)
(a) **Major**	
Scale insects	57.3
Anthracnose	66.7
Mango white scale	73.0
Fruit flies	75.0
Termites	1.9
Ants	21.2
(b) **Minor**	
Fruit flies	1.9
Grasshoppers	5.8
Mites	7.7
Ants	32.8

Nature of damage caused by mango white scale

The perceptions of farmers on the nature of damage caused by the white mango scale also vary greatly. About 13.3% of them cited fruit damage as one of the damage caused by the white mango scale. Some 40.0% of the farmers believed that the white mango scale insect pierced the stylet in to the leaf and sucked sap, which causes drying of the leaf. Others (20.0%) indicated that the insect damages the fruit, and this led to premature dropping of the fruit, while 8.0% of the farmers indicated that the insect present and damage the leaf as well as the stem of the branch. Few farmers (2.7%) responded that white mango scale insect causes flower dropping which decreases production of their mango plant. The total loss in yield is the direct effect of the presence of mango

white fly in the mango agro-ecosystem to some respondents (12.0 %) because the scale insect caused partial destruction of the leaf, leading to complete loss of yield in the absence of some intervention measures to control it.

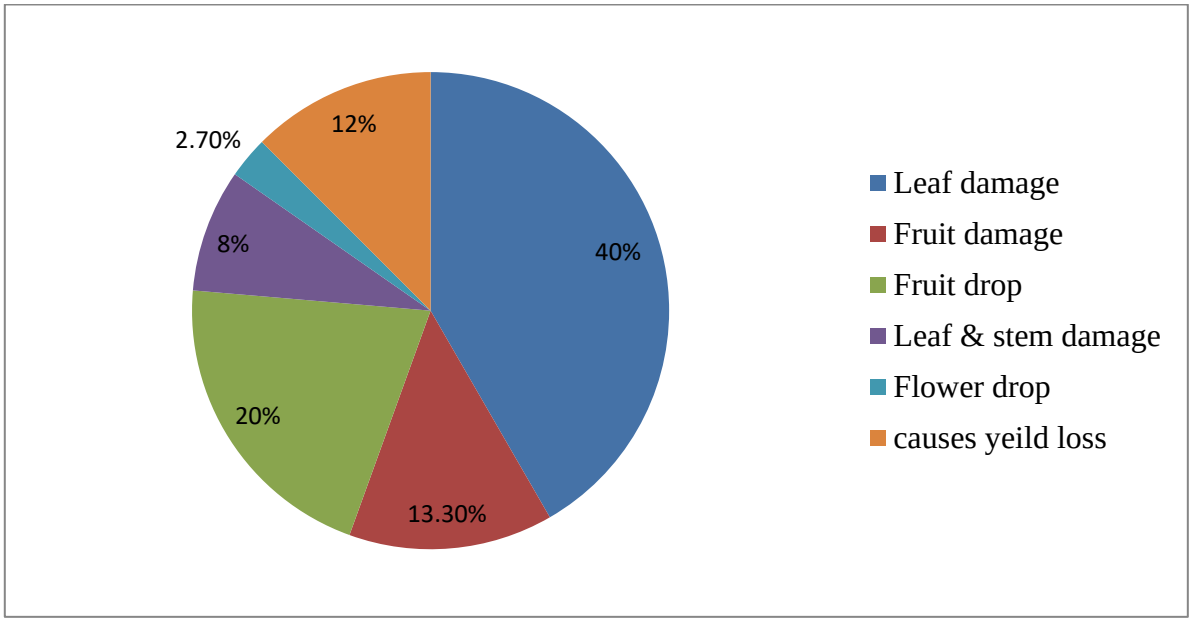

Figure 1 Perception of mango farmer on the nature of damage caused by the *white mango scale* in the study area (n=75).

Effects of mango white scale on fruit production

Generally, the majority of the farmers (57.3%) are of the opinion that, the white mango scale insect causes very severe damage to the mango industry second to anthracnose disease. This implies that mango producers in Ethiopia are aware that, the newly introduced white mango scale can cause serious damage to their crops with detrimental consequences to their earnings. On the rating of the white mango scale relative to other pests in the mango agro-ecosystem, 55.0 % of the respondents indicated that the scale was more damaging to their tree. Thus, mango farmers are aware of the threat posed by the white mango scale insect to the mango industry.

Pest status of mango white scale insect

Responding to the question on the pest status of the white mango scale insect, 2.3% of the respondents believed that the pest was an endemic one, i.e. it has been in the system since they started the mango production. On the other hand 48.5% of the farmers said, it was an exotic pest that found itself into the country's landscape some five years ago. Similarly, some 64.6% of the respondents firmly believed that it was an occasional pest occurring only when prolonged dry season occurred. Some groups of the respondent, 32.7% emphasized that the insect distributed to new area in great speed.

Some management strategies adopted by Ethiopian farmers to control mango white scale

Some of the respondents (60%) have used one control measure or the other to reduce the effects of mango white scale insect in their attempt to produce mango fruit that will meet there. Two control strategies namely chemical and cultural were dominant among all the respondents. Some 21.5% of the farmers apply chemicals as either a single control strategy or alongside one or more other control measure(s). Similarly, (76.9%) of the farmers adopted cultural control measures e. g. pruning and field sanitation to control white mango scale. All the respondents were ignorant of any deliberate use of resistant varieties for the management of the white mango scale in Ethiopia. They generally believed that no variety of mango was in any way resistant to the attack

of the pest, and hence the use of host-plant resistance as means of controlling would be ineffective for all practical commercial purposes.

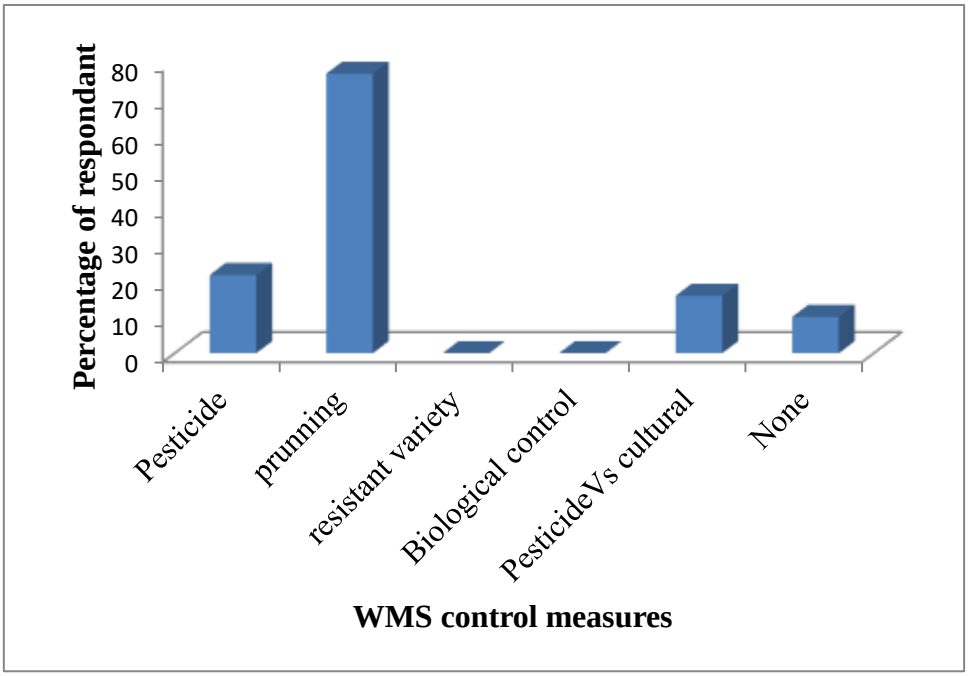

Figure 2 Percentages of mango growers using different control measures

Discussion

Farmer Perceptions of pest status and Management option for white mango scale control

The results of the survey indicated that mango farmers rank mango white scale among the major pests of mango in Southern Ethiopia (Table 1). This is an indication that Ethiopian mango farmers are already aware of the potential damage of the mango-infesting arthropods. This confirms Temesgen (2014), Tsegaye *et al.,* 2017 and Ofgaa Djirata *et al*., 2016 undertaken survey on the distribution and severity of white mango scale at Ethiopia (east and west wellega, Bench maji) and central and eastern Kenya respectively and reported that at all studied area, mango tree was affected by white mango scale insect and it causes severe damage to mango plant. Thus, white mango scale insect caused damage by sucking the sap and during this time it transmits viral disease to the mango plant. They reported the severity status and it was more of mild with few high and very high statuses. Duressa TF (2018) studied newly emerged insect pests in Ethiopia and their damage on crop and reported that white mango scale was introduced recently and causing 95% loss in mango production.

In case of farmer's knowledge about the insect, all of the respondents were familiar with white mango scale. This knowledge could have been gained as a result of curiosity on the part of the farmers trying to know the type of the problem occurred on their mango tree and they see most often or through contact with extension workers, plant protection laboratory, University researchers and district expertise. In essence, this is a clear indication that some farmers are already aware of this insect in Ethiopia in spite of its recent introduction. It was introduced to Ethiopia in 2010 through introduction of infested mango seedling by Indian investors who have mango farm at western parts of Ethiopia. The knowledge of the presence of white mango scale in mango farms in Ethiopia has the implication of aiding in developing solutions to minimize the menace of the pest and/or farmers accepting new innovations in tackling this pest. It also has the advantage of prompting farmers to collaborate with researchers in developing on-farm environmentally friendly strategies to reduce the losses caused by the pest. On the effect of white mango scale on fruit production, 43 (57.3%) of respondents were of the opinion that white mango scale was more damaging than other arthropod pests associated with mango in

Ethiopia. Several strategies are being adopted by farmers for the control of white mango scale insect in Ethiopia. These strategies include the use of insecticides (21.5%) and cultural control measures (76.9%). While, 56.5% of the respondents uses a combination of insecticide and cultural practices (pruning) to reduce the menace of white mango scale. Pruning is one of the agronomic practices for managing white mango scale by creating good aeration and penetration of sun light to lower canopy because of most of the times the insect settle underside of the tree canopy. On the contrary, pruning increase the number of male colonies and decreases the number of female colonies (Bautista-Rosales, 2013). It was evident that farmers adopt multiple strategies to minimize losses due to white mango scale in an IPM fashion. Ofgaa Djirata *et al*., 2016 reported that about 66.67% of mango growers knew the presence of the insect of which 14% did not consider it as pest in Kenya. About 57.33% of the respondents attempted to control white mango scale by the use of pesticides and other methods, of which 13.95% said, could control it as planned. Gashawbeza Ayalew *et al*., 2015 screened different insecticides to control white mango scale insect and reported that after five-time application, the insect population in control treatment is ten-fold higher than chemical treated treatment. Two to three-time sprays does not give significant difference than control one. Abo-Shanab (2012) tested some summer/light mineral oils and reported that super masrona is statistically different than the other tested oils (CAPL2® and Diver®) to manage white mango scale insect. There is the need therefore, to carefully study how these practices are carried out by farmers and improvement made upon them where necessary to enhance their effectiveness in white mango scale insect suppression.

Mango is one of the most important tropical fruit crops grown worldwide. Its demand and cultivation is also on the increase worldwide. It is targeted as the next major fruit crop in Ethiopia to banana that has the potential production at different parts of the country. Mango production is also aimed at increasing the food security of the nation by providing suitable fruit that is rich in many of the nutrients required for the proper nourishment of the body. One of the major constraints to the production of this important crop is the attack by arthropod pests, among which the white mango scale insect is most destructive.

Conclusion

The results reported in this study confirmed presence of white mango scale (*Aulacaspis tubercularis*) in the Wolaita district, Ethiopia, and application of few management options against the pest. A study towards integrated management of the pest based on understanding the ecology of the pest including geographic distribution and population dynamics, need to be conducted. Insecticide screening program should focus on those that are less harmful to the environment and pest's natural enemies.

Recommendations

Public advocacy campaigns should be organized by Minster of Agriculture, Research institutes, University, and NGO's to increase farmer's awareness of white mango scale insect and its effects on mango production. There is the need to study different control measures to manage this exotic insect before covering all mango growing area of the country. It is also important to study the natural enemies which manage this insect in its original country and introduce to newly introduced areas because it is difficult to manage the pest with chemical insecticides.

References

1. Abo-Shanab ASH. 2012. Suppression of white mango scale, *Aulacaspis tubercularis* (*Hemiptera: Diaspididae*) on mango trees in El-Beheira Governorate, Egypt. Egypt. Acad. J. Biol. Sci. 5(3):43-50

2. Borchsenius, N. S., 1966. A catalogue of the armoured scale insects (Diaspidoidea) of the World. In Russian.) Nauka, Moscow, Leningrad, Russia. 449 pp.
3. Central Statics Agency. 2017/18. The Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey 2017/18 (2010 E.C.) Volume I. Report on Area and Production of Major Crops.

4. Duressa TF. 2018. Newly Emerging Insect Pests and Diseases as a Challenge for Growth and Development of Ethiopia: The Case of Western Oromiya. J Agri Sci Food Res 2018, 9:1
5. El-Metwally, M. M., Moussa, S.F.M. and Ghanim, N.M. 2011. Studies on the population fluctuations and distribution of the white mango scale insect, *Aulacaspis tubercularis* Newstead within the canopy of the mango trees in eastern of Delta region at the north of Egypt. *Egyptian Academic Journal of Biological Sciences* 4:123-130.

6. Gashawbeza Ayalew, Abiy Fekadu, and Birhanu Sisay. 2015. Appearance and chemical control of white mango scale, *Aulacaspis tubercularis, in central rift valley.Sci. Technol. Arts Res. J., April-June 2015, 4(2): 59-63*

7. Mohammed D, Belay HG, Lemma A, Konjit F, Seyoum HM, Teshome B. 2012. White mango scale: Anew insect pests of mango in western Ethiopia. Proceedings of the inaugural and third Ethiopian Horticultural Society Conference. Addis Ababa Ethiopia pp. 257-267.

8. Ofgaa Djirata, Emana Getu, and Kahuthia-Gathu R. 2016. The trend in Mango Production and Potential Threat from Emerging White Mango Scale, Aulacaspis tubercularis (Homoptera: Diaspididae) in Central and Eastern Kenya. Journal of Natural Sciences Research. (6)7: pp. 87-94.
9. P. U. Bautista-Rosales, J. A. Ragazzo-Sánchez, M. Calderón-Santoyo, E. Cortéz-Mondaca, and R. Servín-Villegas. 2013. *Aulacaspis tubercularis1* Newstead in Mango Orchards of Nayarit, Mexico, and Relationship with Environmental and Agronomic Factors. Bio-One**.** VOL. 38, NO. 2.

10. Temesgen F., 2014. White Mango Scale, *Aulacaspis tubercularis,* Distribution, and Severity Status in East and West Wollega Zones, Western Ethiopia. Sci. Technol. Arts Res. J. 3(3): 01-10.

11. Tsegaye Babege, Bewuketu Haile, and Awalom Hailu. 2017. Survey on distribution and significance of White Mango scale (*Aulacaspis tubercularis)* in Bench-Maji Zone, Southwest Ethiopia

12. USDA, United States Department of Agriculture. 2006. Importation of Fresh Mango Fruit (*Mangifera indica*L.) from India into the Continental United States: a Qualitative, Pathway-Initiated Pest Risk Assessment. Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory, Raleigh.90pp.