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Assessment of *Oecophylla longinoda* (Hymenoptera: Formicidae) in the Control of Mango Seed Weevil *(Sternochetus mangiferae)* in Mkuranga District Tanzania

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Abstract
Mango seed weevil *S. mangiferae* (Fabricius) (Coleoptera:Curculionidae), is one of the most important quarantined pest in commercial mango crop grown by small and medium growers in Tanzania. Though the damaged caused by mango seed weevil is pulp damage and mango seed which is used for propagation materials. The heavy use of broad spectrum insecticides in mango production has resulted in increased production costs, environmental pollution, disputes among neighbors and the reduction in natural enemies of insect pests and pollinators.
Random fruit collection of 300 fruits during the mango season was carried out from weaver ant orchard and non weaver ant orchard to assess the effect of weaver ant on the management of mango seed weevil. Fruits were sampled at an interval of 30 days 60days and 90 days near to ripening stage. Foraged fruits with weaver ants were the only fruits collected for the assessment of the effect of weaver ant on the management of mango seed weevil.
The African weaver ant colonization of mango trees ranged from 60% to 80%. An overall mean percentage infested mango fruits sampled at different stages of development to maturity stage were significantly different ($p = 0.0001$). The results from this study conclude that African weaver ant were able to control mango seed weevil and should be considered as a suitable component of Integrated Pest Management (IPM) for mango seed weevil in mango growing areas in Tanzania.
Keywords: mango seed weevil, African Weaver Ant (AWA) Integrated Pest Management (IPM)

1. Introduction

The mango seed weevil (*Sternochetus mangiferae*) is one of major pests of mangoes in mango growing areas in Tanzania and also neighboring countries in East Africa. The larva, which is the damaging stage of the pest, enters the fruit through burrowing the flesh into the seeds, where they feed on until pupation, destroying the mango seed (Pena *et al*., 1998). Mango seed weevil stay near to their plant as they are short flying insect (Gove *et al*., 2007) Early infestation of mango fruits leads to premature fruit fall. If the attacks occur at a later stage, fruit infestation is very difficult to detect, since there are no external signs of infestation.
Weevils exit from the fruit seed after it has fallen on the ground, no significant yield loss has been reported due mango seed weevil infestation. When the adult emerges, it tunnels through the flesh into the open, leaving a hole in the fruit skin. In late-maturing varieties, it causes post-harvest damage to the pulp as the tunnel turns hard making the fruit unmarketable. This hole also serves as an entry point for secondary fungal infection. Mango seed weevil is one of quarantine pest, probably its greatest significance as a pest is to interfere with the export of fruit because of quarantine restrictions imposed by importing countries and the market requirement for blemish-free fruit. This is particularly troublesome in the case of the mango seed weevil because, in many instances, weevil attack remains undetected in the field, and is first noticed in storage or in transit.
Weevil feeding reduces the germination capacity of seeds. Damage is entirely on the seed which is important for propagation of rootstock. There is evidence suggests that weevils spread into clean areas through the movement of infested fruit for propagation and consumption.
There is therefore a need to introduce Integrated Pest Management (IPM) for the control of mango seed weevil. IPM is mostly suitable for small mango growers with the aim to increase sustainable food security. Weaver ant *O longinoda* is suitable biological control agents in coconut as well as in cashew orchards (Seguni, 1997; Stoll, 2000; Peng & Christian 2005; Olotu *et al*., 2012). Similar approach can be applied in management of mango seed weevil in mango orchards.

Objective
(1) The effect of weaver ant in the control of mango seed weevil in mango orchard

2. Materials and Methods

2.1 Geographical position and climatic features

The district is located at 6°S and 8°S and 37°E and 40°E. The area receives an amount of rainfall ranging from 800mm to 1000mm per year. The rainfall is divided into two regimes namely long and short rain season. The short rain season commences from October to December and the long rain season commence from April to June. The average annual temperature in the district is 25.2 °C.

2.2 Experimental site

A mango orchard of 1.5ha planted with 150 trees was selected at Mkuranga district to undertake on farm studies on mango seed weevil infestation between weaver ant colonized and non weaver ant colonized mango orchard. Common varieties in this orchard include Apple, Kent and Keith. Trees were about 10-12 years old and fully bearing, planted at approximately 8-10 meters within and between rows.

2.3 Colonization of weaver ant (O. *longinoda)*

Regular surveys of weaver ants from mango orchard were carried out to determine colonization level per tree during the study period. Number of nests and level of foraging were estimated from tree crown and tree branches. The selected mango orchards for the weaver ant were the same as a control mango orchard.

2.4 Mango fruit collection

During sampling 100 mango fruits were harvested randomly from weaver ant trees at different development stages *ie* early stage 30 days, middle or green stage 60 days and 90 days at fully ripen stage. Fruits were picked from colonized trees packed, well labeled and transported to the laboratory for further studies. Similar sampling method was applied for the untreated control.

2.5 Fruit incubation and dissection

Mangoes from weaver ant orchard were incubated separately after being weighed into 10litre transparent food containers with 0.5Kg sterilized sand for two weeks period before dissection. At the top of the containers were covered with muslin cloth in the laboratory to protect outside entry or any escape from the rearing containers. Dissections of the fruits followed by opening of the seed were carried out to detect presence or absence of mango seed weevil. The infested fruits due to mango seed weevil were calculated using the following formula

Di = (ni x 100)/N,

Where Di = Percentage fruit infested,

n = number of fruits infested,

N= Total number of fruits dissected (Vayssières *et al*., 2009).

3. Data analysis

The collected information were subjected to one way ANOVA ("GraphPad Software, InStat guide to choosing and interpreting statistical tests, 1998, GraphPad Software, Inc., San Diego California USA, www.graphpad.com") and mean separation were carried out using Tukey kramer method at P=0.05. Where possible the data set were transformed to normalize the data before analysis.

4. Results

4.1 Infested fruits from weaver ant mango orchard

A total of 300 mango fruits were dissected and infested fruit percentage at different stages of development to maturity were significantly different ($p = 0.0001$). During early development (30 days) of mango fruits none of the samples were observed with presence of mango seed weevil Figure 1. At mid maturity stage the number of fruits infested was 7% of the total fruits dissected. After 90 days infestation level was 2% near to ripening stage (Figure 1).

4.2 Colonization of weaver ant (*O. longinoda*) from different mango trees

During early development of the fruits 150 nests were recorded from 55 trees, mid maturity 250 nests were recorded from 83 trees and during ripening stage 250 nests were recorded from 55 trees. The results showed that the t-test comparison between trees and weaver ant nests there was significant differences ($P<0.011$) Figure 2).

5. Discussion

5.1 Infested fruits from non weaver ant mango orchard

During the study period it showed that mango seed weevil requires mango to complete their life cycle. Female lay eggs on the fruit surface of young fruits and they burrow down into the seed to feed on during development stage in contrast with (Balock and Kozuma, 1964).The high number of trees colonized by weaver ant showed its potential on management of mango seed weevil in agreement with (Olotu *et al*., 2012).These observation were similar to other studies carried out in coconut pest *pseudotheraptus wayi*) a sucking pest of young nut-lets (Seguni, 1997).

5.2 Colonization of weaver ant (O. *longinoda)*

Low number of mango seeds infested by mango seed weevil in the AWA colonized mango trees it demonstrate

the ability of AWA to control various insect pests in mango orchards (Olotu *et al.,* 2012). The high number of weaver ant during mid and full ripening stage was due to presence of high number of Homoptera in agreement with other studies Way, (1954b). Many Homopteran insects are ant tended and this mutual association makes AWA to benefit from honeydews secreted by them and by doing so they protect Homopterans from natural enemies (Way 1963). The weaver ant population fluctuations between sampling dates makes them to be one of the most important group of beneficial insects in the ecosystems (Wang *et al*., 2000). During the study period no mango seed weevil were encountered during early development of mango fruits in contrast with Steiner and Morashita, (1951).

Mango orchard colonized with weaver ants were effectively protected from mango seed weevil infestation than non foraged trees thus call for conservation of natural enemies in mango growing areas in Tanzania in agreement with Peng and Christian (2007). Furthermore, mango seed weevil does not affect yield of mango directly. Its importance as a pest in mango production is its restriction imposed by mango importing countries.

5.3 Conclusion

Weaver ants are natural predators, and their use is encouraged for managing insect pests in organic mango fruit production. Mango orchards foraged with weaver ants were effectively controlled from mango seed weevil. It is recommended to introduce weaver ants in non weaver ant mango orchards aiming to reduce mango pests including mango seed weevil. Fluctuations of weaver ants were due to climatic factors *ie* intense sun and competition with inimical ants. Use of ant bait is recommended to reduce population of inimical ants.

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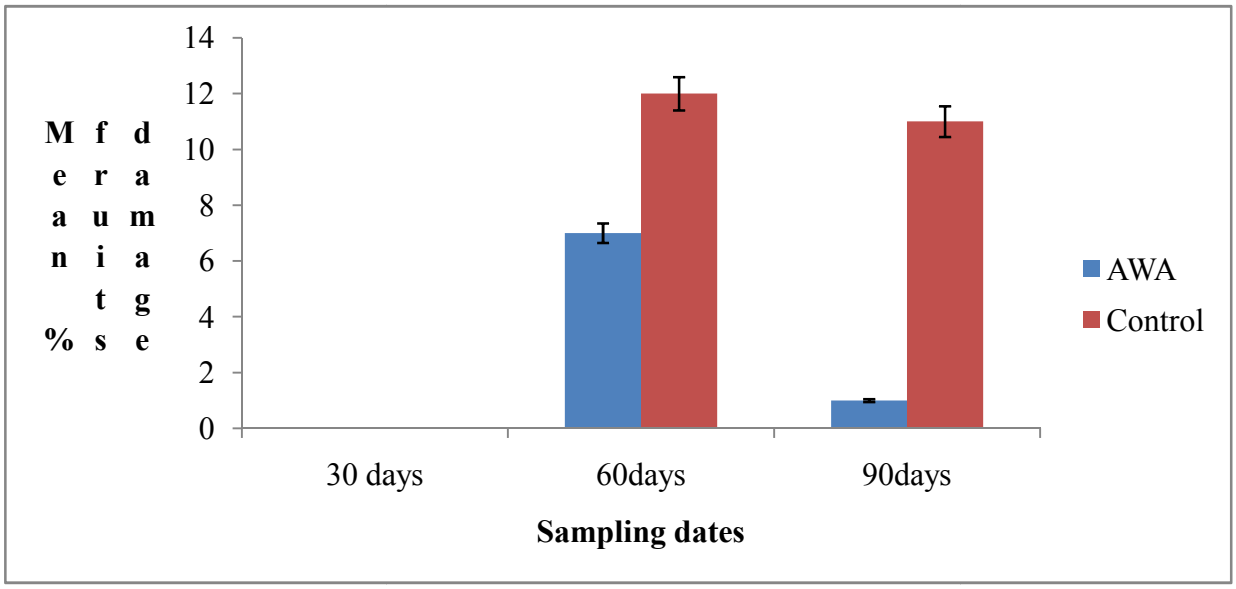
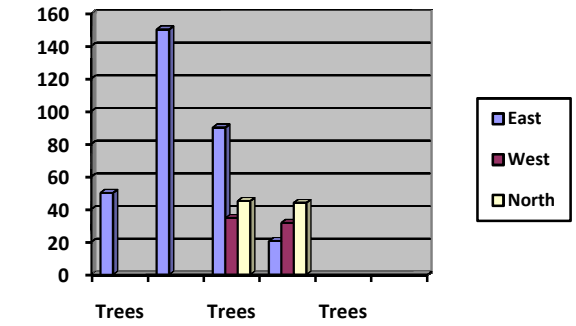


Figure 1: Mango fruits infested by mango seed weevil from weaver ant mango orchard



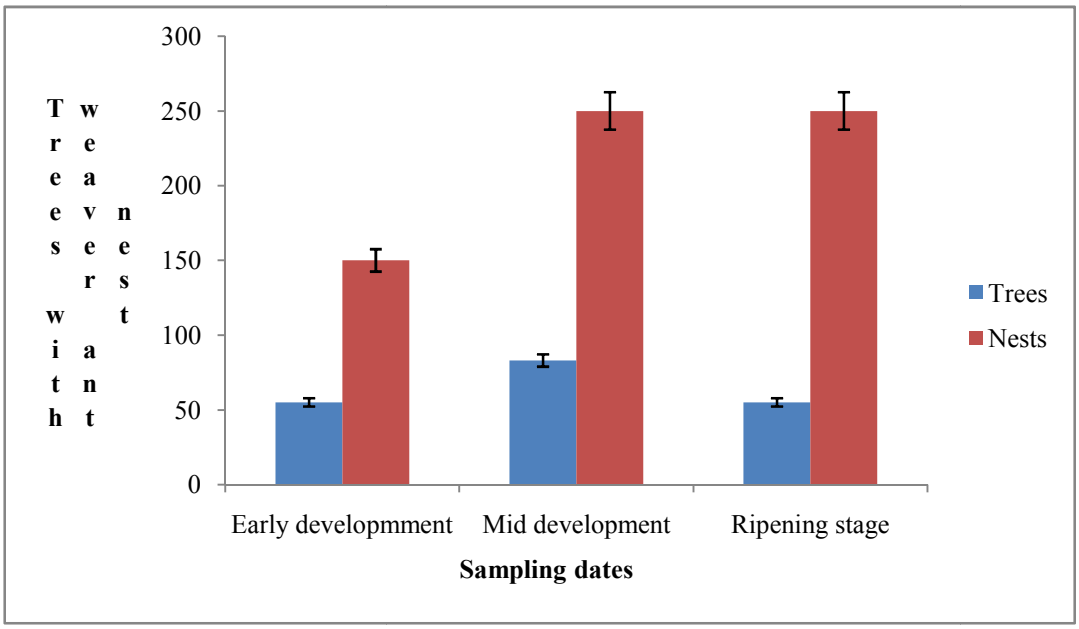


Figure 2: Number of nests recorded from weaver ant trees

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