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Insecticidal Activity of *Lantana Camara* on Maize Weevils (*Sitophilus Zeamais* Motsch.)

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***Abstract* – Laboratory experiment was conducted in order to evaluate the toxicity potential of parts of *Lantana camara* (leaf, flower and mixture of leaf and flower) powder at a rate of 5 gm per 100 gm of maize grain (W: W) as a possible control of maize weevils (*Sitophilus zeamais* Motsch.). The study was conducted at Wolaita Sodo University Plant Sciences laboratory using CRD with three replications twice. Maize variety used for the experiment was BH540 and Malathion 5% dust and untreated check were included for comparison. The experiment revealed that all *Lantana camara* parts used in the experiments as a treatment caused high adult weevils mortality and reduce F1 progeny emergence. Comparatively lantana leaf powder showed better performance in its insecticidal activity against maize weevils (*S. zeamais*).**

***Keywords* – BH540, *Lantana Camara,* Malathion Dust, *Sitophilus Zeamais*.**

I. Introduction

Maize is widely produced in all parts of Ethiopia. It is one of the major cereal crops grown for its food and feed values. Its productivity (1.98 tons ha^{-1}) is leading all cereals in the country (CSA, 2010), but compared to the world's average production (3.7 tons ha-1) and to that of developing countries (2.5 tons ha^{-1}) is still low. In the study area, Wolaita, it is the major grain crop which occupies 42% of the land covered by grain crops and its production is very low which is 16 qt/ha while the national yield average is 21qt ha^{-1} (SNNPRS, 2009).

Insect pests cause significant loss of maize in the developing world reducing the 4.9 t/ha world average grain yield production to 1.5 t/ha average in Sub Saharan Africa (Ali *et al.*, 2007). An annual average of 20-30% of this is then lost through damage by insect pests in storage.

Among serious problems facing maize production, arthropods pests are the key factors contributing to low yield. Stored grain insect pests are the major constraints to maize storage in Ethiopia. More than 30 species of arthropods are recorded on stored maize in Ethiopia (Abraham, 1991). Maize weevil (*Sitophilus zeamais* Motsch.) is one of the major insect pests of stored maize in Ethiopia. The infestation commences in the field but most damage occurs during storage (Demissie *et al.*, 2008).

Synthetic insecticides may play a significant role in reducing storage losses due to insect pests (Tapondjou *et al.*, 2002). However, their current applications for the control of storage insect pests is limited because of resistance development by the pest, consumers concern, widespread environmental hazards and increasing costs of application (Bekele, 2002). For these reasons, attention was directed towards the development of alternative chemicals such as botanical pesticides (Shaaya *et al.*, 1997).

A number of plants have been evaluated for their insecticidal properties against various insect pests (Cosimi *et al.*, 2009). Many efforts have been made to screen plants with better botanical insecticides which can be used as an alternative to synthetic insecticide (Emana *et al.*, 2003). It was reported that when mixed with stored-grains, leaf, bark, seed powder, or essential oil extracts of plants reduce oviposition rate, suppress progeny production and toxic to adults which ultimately results in low infestation and yield losses (Tapondjou *et al.*, 2002). Thus, the current study was aimed at evaluating the insecticidal activities and effectiveness of *Lantana camara*, which is locally available in Ethiopia, for the control of Maize Weevils (*Sitophilus zeamais* Motsch.).

II. Material and Methods

Experimental Site Description

The experiment was conducted in Wolaita Sodo University, Plant Sciences Department Laboratory. Wolaita Sodo University is located in the Southern Nation Nationalities and People regional state (SNNP), Wolaita Zone. The average annual rainfall 1200 mm and mean temperature of the area is 21- 23 ^{0}C and the altitude of the area is 1800 masl.

Collection & Preparation of Lantana camara

Leaves and flower of *lantana camara* were collected from Wolaita Sodo University Campus and shade dried according to Wambua *et al.* (2011) protocol. The dried leaves and flowers of the plant were finely grounded using manual mortar and pestle as described by Mbah (2003) and the powder form of each plant part was used for the experiments.

Rearing of weevils for the experiments

To have similar aged weevils (*S. zeamais*) supply for the experiments, local variety of maize seeds were stored in a refrigerator at - 4°C after cleaning all visible damaged seeds for a month to eliminate potential field infestation. Three kg of seeds were then transferred to plastic bags and kept at room temperature for three weeks. Unsexed *S. zeamais* were collected from infested maize seeds and cultured on clean local maize seeds in jars with the proportion of 100 weevils per 0.5 kg of seeds. The jars were covered with muslin cloth and fixed with rubber band to allow aeration and to prevent escape of weevils and were kept at room temperature. A week after oviposition, all parent weevils were removed from each jar and were placed on another set of seeds kept at the same conditions. These procedures were repeated until sufficient numbers of laboratory-reared weevils of known age obtained (Tefera *et al*., 2010; Fikremariam *et al*., 2009).

Treatments and Experimental Design

Lantana leaf powder, flower powder and their mixture at a rate of 5g was added separately into 100 g of maize seeds variety BH540 and mixed thoroughly to ensure even distribution and kept a week before introduction of the weevils in jars. Thirty randomly selected newly emerged adult were introduced into each jars containing the seeds. The jars were covered with muslin cloth and fixed with rubber band to allow aeration and to prevent escape of weevils. Then they were kept at room temperature. The experiment was conducted in Completely Randomized Design (CRD) and five treatments each was replicated three times. Untreated but inoculated maize was used as a control and Malathion was used as standard check.

Data Collection

- *Parent adult mortality* which was recorded at 7, 14, 21, 28 and 35 days after treatment application, dead insects were removed and counted. After five weeks infestation, the remaining adult weevils were removed and the numbers of live and dead insects were counted.
- *F1 progeny* were checked and counted until 45 days with an interval of 5 days.
- *Seed weight loss* which was taken 35 days after treatment application. One hundred seeds were taken from each replication of the treatment and weighted using sensitive balance. To obtain the seed weight loss, the seed weight after 35days was subtracted from the initial average seed weight before weevils' introduction (Gwinner *et al.* 1996).
- *Percent grain damage* was calculated by converting the proportion of damaged seeds from the total of each replication of the treatment at the end of the experiment. It was computed according to Dobie (1991) as follows:

$$\text{Weight loss (\%)} = \left(\frac{(UNd - DNu)}{U(Nd + Nu)}\right) \times 100$$

Where:

U – Weight of undamaged grains
D – Weight of insect-damaged grains
Nu – Number of undamaged grains
Nd – Number of insect-damaged grains

Data Analysis

All the parameters were statistically analyzed using the General Linear Model of Statistical Analysis System software (SAS soft ware, 2003). Effects were considered significant if P values were < 0.05. Significant differences among treatment means were tested using LSD (Least Significant Difference) test at 5 % level of significance.

III. Results and Discussions

Effect of L. camara on Parent Adult Weevil Mortality

Observation made at different days after treatment application showed that the tested botanical had different response on the control of *S. zeamais* (Table 1). During the first observation (7 days after treatment application (DAT), all parts of the tested botanical showed no significance over untreated check.

Application of *L. camara* flower and mixture of leaf and flower powder caused relatively higher (11.67%) adult mortality whereas 100% adult mortality was recorded from maize seeds treated with Malathion 5% dust.

A week after the first observation (14 DAT), application of lantana flower and lantana leaf caused 21.67% adult mortality while the mixture caused 13.33% which were highly significant compared with the untreated check (0%) and similar trend of treatment effect was observed in the next consecutive observations.

The effectiveness of different botanicals against *S. zeamais* was reported by many researchers. The observed increase in adult mortality with time was in agreement with reports of Ahmed and Ahmed (1992). Adane and Abraham (1995) also reported as lantana showed insecticidal activity against maize weevils by causing high adult mortality compared to the untreated control.

Table 1: Effect of L. camara on maize adult weevil mortality at Wolaita Sodo, Ethiopia

Treatment	Maize weevil mortality after treatment application (%)				
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT
L. camara flower	11.67 b	21.67 b	33.3 b	45.0 b	51.67 b
L. camara leaf	8.33 b	21.67 b	21.67 b	33.3 bc	40.0 bc
Mixture (flower and leaf)	11.67 b	11.67 b	16.67 bc	20 c	38.33 bc
Untreated	00 b	00 b	00 c	00 c	11.67 d
Malathion 5% dust	100 a	100 a	100 a	100 a	100 a
LSD (0.05)	23.54	20.67	22.93	23.9	26.86
CV (%)	27.5	25.03	25.48	29.09	28.34

Effect of L. camara on Emergence of F1 Progeny

There were no significant differences among the tested lantana parts in affecting F1 progeny emergence (Table 2). Higher numbers of F1 progeny were emerged from maize seeds treated with the powder mixture of the tested plant parts (4.0). Whereas, comparatively small numbers of F1 progenies were emerged from maize seeds treated with lantana leaf powder (3.33%). All botanicals showed high significant difference over untreated control (13.33). There was no progeny emergence from maize seeds treated with Malathion 5% dust.

This study clearly indicated that powder of lantana plant parts reduced the emergence of F1 progenies besides to causing high adult mortality. A 75% F1 progeny reduction was reported by Ogendo *et al.* (2004) using plant powder of *L. camara* and *Tephrosia vogeli* compared with synthetic insecticide. Furthermore, Tigist (2004) suggested that natural pesticides could have direct or delayed insecticidal effects. The delayed effect operates indirectly by inhibiting reproduction and development that can be evaluated after a complete cycle of development of the pest.

Seed weight loss and Seed damage percentage

Among botanicals used in this experiment the lowest

Table 2: Effect of *L. camara* on average F1 progeny emergence of maize weevil at Wolaita Sodo, Ethiopia

Treatment	Average F1 progeny emerged (no)
L. camara flower	3.67 b
L. camara leaf	3.33 b
Mixture (flower and leaf)	4.00 b
Untreated	13.33 a
Malathion 5% dust	0.00 b
LSD (0.05)	5.77
CV (%)	25.34

Means followed by the same letter are not significantly different percentage of seed weight loss was recorded from seed treated with mixture of lantana leaf and flower compared to the untreated check. The remaining treatments also showed lower grain weight loss than the untreated control. The lowest percentage of seed damage (5%) was recorded from seeds treated with mixture of lantana leaf and flower while the highest (13.3%) was recorded from lantana leaf (Table 3). In the present study the percentage of seed weight loss is to some extent directly related to the percentage of grain damaged. McFarlane (1969) indicated that in cereal grains like maize the percentage of weight loss is directly related to the percentage of damage grain but not constantly related.

Table 3: Effect of L. camara on seed weight loss and percentage of seed damage of maize seed infested with maize weevil at Wolaita Sodo, Ethiopia

Treatment	Seed weight loss (%)	Seed damage (%)
L. camara flower	13.96 b	6.67 b
L. camara leaf	16.18 ab	13.33 a
Mixture (flower and leaf)	9.78 c	5.00 b
Untreated	18.79 a	12.33 a
Malathion 5% dust	0.70 c	1.67 c
LSD (0.05)	2.83	2.86
CV (%)	13.08	21.22

Means followed by the same letter are not significantly different

IV. Summary and Conclusion

The protection of stored products by the use of plant materials is a common practice among small holder farmers in Africa. In the recent years research efforts have focused on the use of natural products derived from plants as alternatives to the conventional synthetic insecticides for protection of stored products. Botanicals which have insecticidal activity are often considered by farmers as weed plants but farmers lack awareness about the role of them in controlling insect and pest. Moreover, these botanicals don't have effect on the environment and are inexpensive.

In this study, powder of *Lantana camara* leaf, flowers and their mixture were tested against maize weevil. All the tested parts of Lantana showed insecticidal activities with varying degree and were significantly different from the untreated check. This evaluation study indicated that the use of lantana parts powder is better than nothing (untreated) to control maize weevil in storage. Although the study showed the potential of lantana in controlling maize weevil, further research is needed to determine the effective dose and methods of application.

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AUTHOR'S PROFILE

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My major field of M.Sc. Thesis Research was Management of root-knot nematode (*Meloidogyne incognita*) with botanicals in tomato (*Lycopersicon esculentum).* Presently, I am a Ph.D. student at Haramaya University, Ethiopia.
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