VOLUME II

Proceedings of the Second Biennial Conference of Ethiopian Horticultural Science Society

22 - 23 January 2009

Addis Ababa, Ethiopia

EHSS

Evaluation of Some Botanicals to Control Potato Tuber Moth *(Phothoromaea operculella)* at Bako, West Shoa, Ethiopia

Ahmed Ibrahim, Teshome Bogale and Tadesse Birhanu
Bako Agricultural Research Center, P.O. Box- 03, Bako, West Shoa, Ethiopia

ABSTRACT

*Potato tuber moth (***Phothoromaea operculella***) is one of the most noxious insect pests of potato tuber seed. The widely used chemical control metho d against the pest is found to be environmentally unsafe. Therefore, the present study was initiated to identify some safe botanicals that can be used in the IPM of potato tuber moth. The effects of* **Lantana camara, Eucalyptus globulus, Tagetus minuta,** *Pyretherum flowers and* **Azadiractha indica,** *were evaluated against potato tuber moth (PTM) damage including two checks (Diazinon 60% EC and untreated control) at Bako Agricultural Research Center in 2003/2004 and 2004/2005 cropping seasons. A total of 21 huts were constructed from locally available materials. Inside each store, 1m² bed storage sacks were constructed at 65 cm above the ground. Six hundred fifty potato tubers were stored on the bed in each hut (cottage) in two layers, one over the other. The treatments were arranged in a randomized complete block design (RCBD) with three replications. The botanicals in powder form and Diazinon 60% EC were applied at the rate of 50 gm/ bed and 3.5 ml/bed, respectively at two months interval. The treatments that showed promising effects were further advanced on a large bed (2 m x3 m) without replication. Data were collected for the number of potatoes infested and damaged by potato tuber moth, and number of potatoes damaged by some other causes. Evaluations were made at an interval of 15 days for seven consecutive months. The results were subjected to analysis of variance, which showed significant differences among the treatments. Number of potatoes infested and damaged by potato tuber moth was significantly (P<0.05) lower in* **Lantana camara, Eucalyptus globulus and Pyretherum** *flowers than the rest of the treatments. Percent of potatoes infested and damaged by PTM on the large bed were low for* **Lantana camara, Eucalyptus globules, Pyretherum** *flowers and Diazinon, while it was high for the other treatments. Percent of potatoes damaged by diseases and other causes/factors were significantly high in all treatments, but non-significant differences were observed amongst them. This study seems to indicate that* **Lantana camara, Eucalyptus globules and Pyretherum** *flowers can be used to protect seed potatoes from PTM damage in diffused light storage.*

KEY Words: Potato tuber, botanicals, Diazinon, potato tuber moth, seed potato

INTRODUCTION

Potato is one of the major tuber crops that grows in the highlands of western Ethiopia, particularly around Bako area and other similar agro-ecologies in the country. It serves as food and income security to farmers especially during seasonal food shortage and when grain is depleted from the store.

Improved seed that is free from insect damage is one of the packages used for higher yield production. However, there are multifarious farming systems constraints that are imminent and difficult that inflict great economic losses on potato tuber seeds in rustic storage system. Potato tuber moth (*Phothorimaea operculella*) is one of the noxious insect pests of potato tuber seeds in the storage.

Good postharvest handling is determinant and crucial factor for uniform sprout growth that is free from insect attack. Unless protected in the storage, storage losses due to storage pests are reported to vary from 30-70%, in India as high as 86% in Tunisia, Algeria and Turkey (Anonymous (1980). PTM infestation of tubers in the field is estimated to be 50% in Peru. It is also the most damaging pest of potato in Ethiopia, which could reach up to 91% in 90 days (Adahanom *et al.*,1985). In western parts of Ethiopia no research had been conducted to mitigate the problem except screening resistant genotype for PTM. The widely adopted method to control it, is chemical application. Currently, the problem associated with the use of chemicals is highly appreciated in terms of sustainability and effect on environment and also on non-target organism. Therefore, it is high time to see for alternatives that are effective, environmentally safe and economically feasible.

The use of natural plant products is found to be promising against PTM. The use of extracts of wild coastal "tomiz" (*Plucheachinyoyo*) has shown great potential to controlling "Polill" (*Phthorimaea operculella*) in stored potato, a plague that inflicts great economic damage to Anden farmers (Luis, 2001) . On the other hand, the use of *eucalyptus spp*, Muna (*Minthostachis spp*) and *Lantana camara* has been reported by International Potato Center (CIP) as being capable of controlling pest attack in stored potato (Luis, 2001). At present, environmentally friendly biological options exist, which are based on natural crop production approaches that make use of diversity in nature itself. One of that natural crop protection approaches is the use of plants, which are having insecticidal properties. Hence, the objective of the study was to evaluate potential botanicals for the control of PTM.

MATERIALS AND METHODS

The experiment was conducted at Bako Agricultural Research Center (BARC). The Center is located 9° 6'N latitude and 37°09'E longitude, 260 km west of Addis Ababa, at an altitude of 1650 m.a.s.l. The area is characterized by warm and humid climate. The annual average rainfall and relative humidity during the study period were 1341 mm and 60.11%, respectively. The average minimum and maximum atmospheric temperatures of the area during the study period were 12.58°C and 27.21°C, respectively.

Eucalyptus globulus, *Tagetus minuta*, *Pyrethrum* flowers and *Azadiractha indica* were evaluated against potato tuber moth with Diazinon 60% EC and untreated treatments as the two checks (Table 1) for two cropping seasons (2003/2004 and 2004/2005) at Bako Agricultural Research Center. The treatments were arranged in randomized complete block design (RCBD) with three replications. A total of twenty-one huts (cottages) were

constructed from locally available materials. Inside each cottage a bed ($1m^2$ area) was constructed at 65 cm above the ground. Menagesha, a released variety was multiplied at the Research Center. The botanicals were obtained from the vicinity and *Pyrethrum* flower was obtained from Kulumsa Agricultural Research Center. Six hundred fifty potato tubers were stored on the bed of each cottage. The botanicals were dried under shade and ground into fine powder using mortal and pestle. Leaf and/or flower powder of the botanicals and the chemical were applied at the rate of 50 gm/bed and 3.5ml / bed, respectively at two-month interval. The treatments that showed promising results were transferred on large beds (2m x 3m) without replication. One hundred fifty gm powder was applied on each bed at an interval of two months for 7 consecutive months. Data were collected for number of damaged potatoes by PTM and by some other factors. Affected tubers were counted at 15 days interval during the experiment period. Data were subjected to SAS version 6.12 software. Mean separations were done using SNMK range test.

Table 1. List of botanicals evaluated in 2003/2004 and 2004/2005 cropping seasons

Scientific name	Plant parts used
Lantana camara	Leaf powder
Eucalyptus globulus.	Leaf powder
Tagetus minuta	Leaf powder
Pyretherum flowers	Flower powder
Azadirachta indica	Diazinon 60% EC
Diazinon 60 % EC	-
Untreated check	-

RESULTS AND DISCUSSION

Combined effects of different botanicals on percent of potatoes infested and damaged by PTM, and percent of potatoes damaged by diseases are shown in Table 2. Percent of potatoes infested and damaged by potato tuber moth were significantly lower in *Lantana camara, Eucalyptus globules* and *Pyretherum flowers* than the other treatments. Percent of potatoes damaged by disease and other factors were significantly high in all of the treatments and no-significant differences were recorded among them (Table 2). Similar results were observed in 2004/05 cropping seasons (Table 4).

Percent of potatoes infested by PTM were significantly ($P<0.05$) lower in *Eucalyptus spp, Lantana camara* and Diazinon 60% EC but significantly high in the other treatments (Table 3). Percent of damaged potatoes by PTM were significantly high in *Lantana camara, Tagetus minuta, Azadrachta indica* and the control but were significantly ($P<0.05$) lower in the other treatments (Table 3). Low percent of potatoes infested and damaged by PTM were observed in *Lantana camara, Eucalyptus globules, Pyretherum flowers* and Diazinon 60% EC. However, high percent damage was observed on the untreated control (Tables 5 and 6).

The results of the study have shown that *Eucalyptus spp. Pyretherum* flowers and *Lantana camara* showed promising results

against PTM damage and comparable results were observed with Diazinon 60% EC (Table 2). These findings agree with the research results reported by International Potato Center (IPC), and Palecios and Cisnerose (1997). The use of some plant materials such as *Lantana camara* as being capable of controlling pest attack in stored potato has ben reported by Luis (2001). From such results, it appears that those efficient botanicals may posses antifedant, repellent and insecticidal effects or the combination of these effects for they reduce the damage level caused by insect pests. According to the work of Stool (1996) and the International Potato Center, it was possible to control PTM by storing potatoes on the bed of *Eucalyptus spp.* leaves. On the other hand, some plants and weeds like Muna (*Minthosstachys spp*), Eucalyptus (*Eucalyptus globules*), Chilca (*Baccharis spp*), Curry plants, *Indian pivets*, *Lantana camara*, *Mentha arvensis* and *Artemesi vulgaris*, *Lycopersicon hirsutum* etc., are effective to control PTM (Kennedy,1984; Pradhan,1998). Therefore, *Eucalyptus spp.* *Pyretherum* flowers and *Lantana camara* can effectively protect the potato seed tubers from PTM and can be used by farmers.

Table. 2. Effects of different botanicals on percent potato infested and damaged by PTM and diseases and other factors at Bako (combined over 2003/04 and 2004/05 cropping seasons)

Treatments	Percent of potatoes infested by PTM	Percent of potatoes damaged by PTM	Percent of potatoes damaged by diseases & other factors
Lantana camara	0.97 ± 0.26 c	2.82 ± 0.87 c	1.03 ± 0.24 *
Eucalyptus globulus	1.13 ± 0.28 c	1.87 ± 0.25 c	1.20 ± 0.19
Tagetus minuta	5.48 ± 0.29 a	7.87 ± 0.91 a	1.13 ± 0.19
Pyretherum flowers	1.84 ± 0.23 c	2.48 ± 0.188c	1.41 ± 0.14
Azadirachta indica	4.10 ± 0.36 b	4.99 ± 0.34 b	0.97 ± 0.12
Chemical	0.95 ± 0.16 c	1.51 ± 0.37 c	1.20 ± 0.24
Control	5.87 ± 0.64 a	8.26 ± 1.08 a	1.18 ± 0.22
CV% (0.05)	**23.61**	**27.71**	**26.46**

** All treatment effects were non-significant at 5% level of probability (SNKRT)*

Means followed by common letters within the same column are not significantly different from each other at 5% probability level (SNKRT)

Table. 3. Percent of potatoes infested and damaged by PTM, diseases and other factors at Bako (2003/204 cropping season).

Treatments	Percent of potatoes infested by PTM	Percent of potatoes damaged by PTM	Percent of potatoes damaged by diseases & other factors
Lantana camara	1.43 ± 0.34 c	4.31 ± 1.23 ab	0.56 ± 0.18 *
Eucalyptus globulus	1.69 ± 0.27 c	2.36 ± 0.20 b	0.87 ± 0.13
Tagetus minuta	5.84 ± 0.35 b	6.61 ± 1.07 a	0.77 ± 0.09
Pyretherum flowers	2.10 ± 0.40 c	2.72 ± 0.20 b	1.13 ± 0.05
Azadiractha indica	4.71 ± 0.34 b	5.59 ± 0.34 a	0.82 ± 0.10
Chemical	1.18 ± 0.13 c	1.89 ± 0.67 b	0.77 ± 0.31
Control	6.61 ± 0.87 a	5.89 ± 0.48 a	0.72 ± 0.13
CV% (0.05)	**19.59**	**29.67**	**18.29**

**-ditto-*

Means followed by common letters within the same column are not significantly different from each other at 5% probability level (SNKRT)

Table. 4. Percent of potatoes infested and damaged by PTM diseases and other factors at Bako (2004/2005 cropping season).

Treatments	Percent of potatoes infested by potato tuber moths	Percent of potato damaged by potato tuber moth	Percent of potatoes damaged by diseases and other factors
Lantana camara	0.51 ± 0.13	1.33 ± 0.22	1.49 ± 0.18 *
Eucalyptus globulus	0.56 ± 0.13	1.38 ± 0.18	1.54 ± 1.54
Tagetus minuta	5.13 ± 0.40	9.12 ± 1.20	1.49 ± 1.49
Pyretherum flowers	1.59 ± 0.18	3.23 ± 1.12 t	1.69 ± 1.69
Azadiractha indica	3.49 ± 0.41	4.41 ± 0.36	1.13 ± 1.13
Diazinon 60% EC	0.72 ± 0.22	1.13 ± 0.34	1.64 ± 1.64
Control	5.12 ± 0.85	10.61 ± 0.23	1.64 ± 1.64
CV% (0.0%)	**29.11**	**25.82**	**21.36**

* - *ditto-*

Means with common letters within the same column are not significantly different from each other at 5% probability level (SNKRT)

Table. 5 Effects of different botanicals on percent of potatoes infested and damaged by PTM, diseases and other factors at Bako, Legaya (2005/206 cropping season).

Treatments	Percent of potatoes infested by potato tuber moths	Percent of potatoes damaged by potato tuber moth	Percent of potat damaged by diseases and others factors	Yield advantage over the check
Lantana camara	7.01	2.41	0.56	**16.49**
Eucalyptus globulus	6.14	2.88	0.44	**16.02**
Pyretherum flowers	4.85	1.99	0.35	**16.91**
Diazinon 60% EC	9.11	3.97	0.48	**14.93**
Control	**56.00**	**18.90**	**0.58**	

Table. 6 Effects of different botanicals on percent of potatoes infested and damaged by PTM, diseases and other factors at Bako Sirec (2005/206 cropping season).

Treatments	Percent of potatoes infested by potato tuber moths	Percent of potat damaged by potato tuber moth	Percent of potat damaged by diseases and other factors	Yield advantage over the check
Lantana camara	4.57	1.89	0.24	**14.98**
Eucalyptus globulus	7.24	4.58	0.18	**12.59**
Pyrethorum flowers	3.45	2.45	0.28	**14.42**
Chemical	8.75	1.24	0.34	**15.63**
Control	**38.45**	**16.87**	**0.41**	

ACKNOWLEDGMENTS

Acknowledgment is due to the field assistants and supervisors of Crop Protection Research Division of Bako Agricultural Research Center for their immeasurable and wholehearted efforts they made in managing the field. Special thanks also go to Teshome Bogale and Tadesse Birhanu for their keen interest they showed in collecting the data. The kind cooperation of the staff of BARC is sincere acknowledged

REFERENCES

Adhanom Negasi, Tsedeke abate and Emana Getu, 1985. Research on insect pest of root and tuber crops in Ethiopia, Tsedeke A (ed) pro. First Ethiopian crop protection symposium, Addis Ababa, Ethiopia.

Anonymous, 1980. Annual report of international potato center (CIP) Lima, Peru, p57-60.

Gabby Stool, 1996. Natural crop protection based on local farm resource in the tropics. An information center with in the net work for sustainable agriculture in the third wold Countries, Germany, p118-124.

Kennedy, G.M. 1984. 2-Tridecanone, tomatoes and heliothis zea potential incompatibility of plants and antibiotics with insecticidal control. *Entomol.Exp.Appl.*35:305

Luis Gomero Oscrio, 2001. Plants protecting other plants. Alternative methods to pest resistant. Magazine on low external inputs and sustainable agriculture. Action network on pesticides and thier alternative in latine America. V-17, n-4, p,23-24

Palecios M and F. Cisnerose,1997. International potatoes center. Integrated pest management for the potato tuber moth in pilot units in the Anden Region and Dominica Republic Lima Peru.

Solomon Yilma. 1985. Review of potato research in Ethiopia. First Ethiopian Horticultural work shop. p.294. Institute of Agricultural Research (IAR), Addis Ababa Ethiopia.

Tindal H.D 1983. Potato preparation for market and storage. Vegetable in tropics. Hong kong, p375-76.