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

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Abstrac: *Lantana camara, Eucalyptus globulus*, *Tagetus minuta,* Pyretherum flowers and *Azadiractha indica,* were evaluated against potato tuber moth damage including two checks (Diazinon 60% EC and untreated check) at Bako Agricultural Research Center in 2003/2004 and 2004/2005 cropping seasons. A total of twenty-one huts were constructed from locally available materials. Inside each store, $1m^2$ bed storage sacks were constructed 65 cm above the ground. Six hundred and fifty (650) numbers of potato tubers were stored on the bed of each hut in two layers one over the other. The treatments were arranged in a randomized complete block design with three replications. Plant powder and Diazinon 60% EC were applied at the rate of 50 g/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 x 3 m) without replication. Data was collected for the number of potatoes infested and damaged by potato tuber moth, and number of potatoes damaged by some factors other than potato tuber moth. Evaluations were made at an interval of fifteen days for seven consecutive months. Analysis of variance showed that there were 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 other treatments. Percent of potatoes infested and damaged by potato tuber moth on a large bed were lower for *Lantana camara*, *Eucalyptus globules, Pyretherum flowers* and Diazinon , while higher for the other treatments. Percent of potatoes damaged by diseases and other factors were significantly high in all treatments and non-significant differences were observed among them. From this study it can be conclude that *Lantana camara, Eucalyptus globules* and *Pyretherum flowers* could be used to protect seed potatoes from potato tuber moth damage in diffused light storage.

Keywords: Seed Potato; Potato Tuber Moth; Botanicals

1. Introduction

Potato is one of the major tuber crops that is grown in the high lands of western Ethiopia, particularly around Bako area. It serves as food and income security to farmers especially during seasonal food shortage and when grain is depleted from store.

Improved seed is one of the packages to be used to get high yield and must be free from insect attack. But there are multifarious farming systems constraints that are imminent and plague that inflict great economic losses on potato tuber seeds in a rustic storage system. Potato tuber moth is the bottleneck that may cause damage to seed tuber under storage.

Good postharvest handling is an important and crucial factor for uniform sprout growth free from insect attack. Unless protected in the storage, potato tuber moth, PTM (*Phothoromaea operculella)* is one of the noxious insect pests of potato tuber seeds in the storage. According to Anonymous (1980), storage losses due to storage pests are reported to vary from 30-70% in India, and as high as 86% in Tunisia, Algeria and Turkey. Infestation of tubers in the field is estimated to be 50% in Peru. According to Adhanom *et al.* (1985), potato tuber moth is the most damaging pest of potato, which could reach up to 91% in 90 days in Ethiopia (Adahanom, 1985). In western parts of Ethiopia research to mitigate the problem is only limited to screening resistant genotypes for potato tuber moth. The widely adopted method to control potato tuber moth is chemical application. Currently, the problem associated with the use of chemicals is recognized in terms of its sustainability and effect on environment and on non-target organisms. Therefore, it is important to search for alternatives that are effective, environmentally safe and economically feasible.

The use of natural plant products is found to be promising against potato tuber moth. Use of extracts of wild coastal "tonuz" (*Plucheachinyoyo*) has shown great potential to control "Polill" (*Phthorimaea operculella*) in stored potato (Luis, 2001; Solomon, 1985). Similarly, 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; Tindal, 1983). At present, environmentally friendly biological options exist. These options based on use of botanicals and natural diversity needs to be addressed for their application and effectiveness. One of the natural crop protection approaches is the use of plant, which are having insecticidal properties. Hence, the objective of this study was to evaluate potential botanicals for the control of potato tuber moth.

2. Material and Methods

The experiment is conducted at Bako Agricultural Research Center that is located 9° 6`N latitude and 37° 09` E longitude, 260 km west of Addis Ababa, at an altitude of 1650 masl 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 (12.58 °C) and maximum (27.21 °C) atmospheric temperatures of the area during the study period were recorded.

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Eucalyptus globulus, *Tagetus minuta, Pyretherum flowers* and *Azaddiractha indica* were evaluated against potato tuber moth with two checks (Diazinon 60% EC and untreated check) for two years (2003/2004 and 2004/2005) at Bako Agricultural Research Center. The treatments were arranged in randomized complete block design with three replications. A total of twenty-one huts (cottages) were constructed from locally available materials and inside each cottage the bed (1 m^2 area) was constructed 65 cm above the ground. An improved potato variety Menagesha was multiplied at Bako Agricultural Research Center. The botanicals were obtained from the vicinity and Pyrethrum flower was obtained from Kulumsa Research Center. Potato tubers (#650) were stored on the bed of each cottage. The botanicals were dried under shade and grinded in to fine powder using mortal and pestle. Leaf and/or flower powder of the botanicals and chemical were applied at the rate of 50 g/bed and 3.5 ml /bed, respectively, at two-month interval. The treatments that showed promising effects were advanced on large beds (2 m x 3 m) without replication and 150 g powder was used for each at an interval of two months. Data was collected on number of potatoes damaged by potato tuber moth and number of potatoes damaged by some factors other than potato tuber moth. Affected tubers were counted at fifteen days intervals for seven consecutive months during each experimental period. Data was subjected to SAS version 6.12 software. Mean separations were done using SNMK range test.

Table 1. List of botanicals evaluated against potato tuber moth in 2003/2004 and 2004/2005 cropping seasons at Bako, western Ethiopia.

Common name	Scientific name	Plant parts used
Lantana camara	Lantana Camara	Leaf powder
Eucalyptus Globulus.	*Eucalyptus Globulus.*	Leaf powder
Tagetus minuta	*Tagetus minuta*	Leaf powder
Pyretherum flowers	*Chrysanthemum spp*	Flower power
Neem	*Azadrachta indica*	Leaf powder
Diazinon 60% EC		Diazinon 60% EC
Control (Untreated check)		

3. Results and Discussion

Combined effects of different botanicals on percent of potatoes infested and damaged by potato tuber moth, and percent of potatoes damaged by diseases are indicated in Table 2. Percent of potatoes infested and damaged by potato tuber moth were significantly lower in *Lantana camara, Eucalyptus globules* and *Pyretherum flowers* treated huts than the other treatments. Percent of potatoes damaged by diseases such as Helminthosporium solani [*H. atrovirens syn. Spondylocladium atrovirens*), Soft rotting bacteria (*Erwinia carotovora)*, *Common scab (Streptomyces scabies)* were significantly high in all of the treatments and no-significant differences were recorded among them (Table 2). Similar results were observed in 2004/2005 experimental results (Table 4).

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

The results of the study have shown that *Eucalyptus spp, pyretherum* flowers and *Lantana camara* had potential effect 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, and Palecios and Cisnerose, (1997) that reported the use of some plant materials such as *Lantana camara* as being capable of controlling pest attack in stored potato (Luis, 2001). From such results, it appears that those efficient botanicals may possess antifedant, repellent, insecticidal effects or the combination of these effects that reduce the damage level caused by insect pests. According to the work of Gabby (1996) and the International Potato Center, it was possible to control PTM by storing potatoes on the bed of *Eucalyptus spp*. leaves (Luis, 2001). Some plants and weeds such as Muna (*Minthosstachys spp*), Eucalyptus (*Eucalyptus globules*), Chilca (*Baccharis spp*), *Curry plants*, *Indian pivets*, *lantana camara, Mentha arvensis* and *Artemesi vulgaris*, and *Lycopersiconhirsutum* were reported to offer effective control of PTM (Kennedy, 1984). Therefore, *Eucalyptus spp, pyretherum* flowers and *Lantana camara* can effectively protect seed potato tubers from potato tuber moth and can be used by farmers.

Table 2. Effects of different botanicals on infested and damaged potatoes by potato tuber moth (PTM), and damaged by diseases and other factors at Bako (combined ANOVA of 2003/2004 and 2004/2005 cropping seasons).

Treatment	Infested potatoes (%)	Damaged potatoes (%)	Potatoes damaged by diseases (%)
Lantana camara	0.97±0.26c	2.82±0.87c	1.03±0.24a
Eucalyptus globulus	1.13±0.28c	1.87±0.25c	1.20±0.19a
Tagetus minuta	5.48±0.29a	7.87±0.91a	1.13±0.19a
Pyretherum flowers	1.84±0.23c	2.48±0.188c	1.41±0.14a
Azadirachta indica	4.10±0.36b	4.99±0.34b	0.97±0.12a
Diazinon 60% EC	0.95±0.16c	1.51±0.37c	1.20±0.24a
Control	5.87±0.64a	8.26±1.08a	1.18±0.22a
CV%	23.61	27.71	26.46

Different letters within the same column are significantly different from each other at 5% probability level (SNK range test)

Table 3. Mean potatoes infested and damaged by potato tuber moth (PTM), and damaged by diseases and other factors at Bako (2003/2004 cropping season).

Treatment	Infested potatoes (%)	Damaged potatoes (%)	Potatoes damaged by diseases (%)
Lantana camara	1.43±0.34c	4.31±1.23ab	0.56±0.18a
Eucalyptus globulus	1.69±0.27c	2.36±0.20b	0.87±0.13a
Tagetus minuta	5.84±0.35b	6.61±1.07a	0.77±0.09a
Pyretherum flowers	2.10±0.40c	2.72±0.20b	1.13±0.05a
Azadiractha indica	4.71±0.34b	5.59±0.34a	0.82±0.10a
Diazinon 60% EC	1.18±0.13c	1.89±0.67b	0.77±0.31a
Control	6.61±0.87a	5.89±0.48a	0.72±0.13a
CV%	19.59	29.67	18.29

Different letters within the same column are significantly different from each other at 5% probability level (SNKRT)

Table 4. Mean potatoes infested and damaged by potato tuber moth (PTM), and damaged by diseases and other factors at Bako (2004/2005 cropping season).

Treatment	Infested potato (%)	Damaged potatoes (%)	Potatoes damaged by diseases (%)
Lantana camara	0.51±0.13c	1.33±0.22c	1.49±0.18a
Eucalyptus globulus	0.56±0.13c	1.38±0.18c	1.54±1.54a
Tagetus minuta	5.13±0.40a	9.12±1.20a	1.49±1.49a
Pyretherum flowers	1.59±0.18c	3.23±1.12bc	1.69±1.69a
Azadiractha indica	3.49±0.41b	4.41±0.36b	1.13±1.13a
Diazinon 60% EC	0.72±0.22c	1.13±0.34c	1.64±1.64a
Control	5.12±0.85a	10.61±0.23a	1.64±1.64a
CV%	29.11	25.82	21.36

Different letters within the same column are significantly different from each other at 5% probability level (SNKRT)

Table 5. Effects of different botanicals on potatoes infested and damaged by potato tuber moth, and damaged by diseases and other factors at Bako, Legaya on large bed with out replication (2005/2006 cropping season).

Treatments	Potatoes infested (%)	Potatoes damaged (%)	Potatoes damaged by diseases (%)	Yield advantage over the control (%)
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 potato tuber moth, and damaged by diseases and other factors at Bako Siree on large bed with out replication (2005/2006 cropping season).

Treatments	Potatoes infested (%)	Potatoes damaged (%)	Potatoes damaged by diseases (%)	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
Pyretherum flowers	3.45	2.45	0.28	14.42
Diazinon 60% EC	8.75	1.24	0.34	15.63
Control	38.45	16.87	0.41	

4. Conclusions

The over all study showed that application of *Eucalyptus spp, pyretherum* flowers and *Lantana camara* leaf powder at the rate of 50 g per 650 potato tubers can be used as a component of integrated pest management by farmers around Bako area in western Ethiopia to tackle the problem of potato tuber moth.

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