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Efficacy of Some Botanicals against Potato tuber moth, *Phthorimaea operculella* (Zeller, 1873)

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Abstract

Dried powders of five different plants, rhizomes of *Acorus calamus*, leaves of *Melia azedarach*, ripen berries of *Piper longum*, leaves of *Prunus persica* and ripen fruit of *Lindera neesiana* were tested as treatments for the control of potato tuber moth at laboratory. Three concentrations C_1 0.05%w/w, C_2 0.5%w/w and C_3 5%w/w were used in each treatment. The percentage mortality of adult PTM in each treatment was observed at every 24 hours of one week and compared with control. The effects of the treatment were also studied up to first generation constructing the life table. All the concentration of *L.neesiana* and *A. calamus* were found effective in PTM control. *L. neesaina* showed 66.7%, 70.0% and 83.3% and *A. calamus* 56.7%, 66.7% and 70% adult mortality, 168 hours after treatment in C_1, C_2 and C_3 concentrations. The effects of these two treatments persist for long periods, which causes high percentage mortality of larvae and less adult emergence in first generation.

Keywords:*Phthorimaea operculella, , Lindera neesiana, Acorus calamus*

Introduction

Potato tuber moth (PTM), *Phthorimaea operculella*, is one of the serious pest of potato (*Solanum tuberosum*, Solanaceae). It belongs to the family Gelechiidae of order Lepidoptera. It is cosmopolitan in distribution and in Nepal recorded from Kathmandu Valley, Banepa, Nala, Shankhu, Panchkahal, Trisuli some places of Dhading and Palung of Makawanpur and some field of Parawanipur (Hofmaster 1949, Joshi 1989 and 1994). Its larvae make great problem in storage. It bore making irregular tunnels, leaves excreta, behind and led to a considerable weight loss. In storage up to 90% weight loss and during PTM out break cent percentage tubers is infested (Joshi 1989 and Stoll 2000).

The problem raise from over use of organochlorine and other insecticides in potato cause resistance to moth, environmental contamination,increase health hazards to applicator, danger to consumers of high toxic residues in market products and arising production of costs (Schinus *et al.* 2000). Botanical pesticides are important component for modern pest management technology, because these are the safest, simplest and at the same time slow but effective measures of controlling most of the harmful pest including PTM.

According to the Neupane (2000), in Nepal 324 plant species are recognized as pesticidal properties. Many practices are continued to control PTM by various workers using many indigenous plants in various times. Kennedy (1984), Pradhan (1988),Rivera and Retamazo (2000), reported some plants and weeds like Muna (*Minthostachys* spp),Eucalyptus (*Eucalyptus globulus*), Chilca (*Baccharis* spp), Curry plants, Indian pivets, *Lantana camera*, Pangam leaves, *Chenopodium botrys*, *Mentha arvensis* and *Artemesi vulgaris* , *Lycopersicon hirsutum* etc are effective to control PTM.The present study

for the control of potato tuber moth using 5 plants, *Acorus calamus*, *Melia azedarach*, *Piper longum*, *Prunus persica*, and *Lindera neesiana* were undertaken practices based on local and traditional knowledge which are available in the localities.

Materials and Methods

The experimental insects were allowed to lay eggs in a black muslin cloth of breeding cage. The laid eggs were collected at every 24 hrs and kept in freeze at 10^0 C. After one week all the eggs were kept in four kg potatoes in a rearing cage made of wooden and mosquito net. The surrounding surfaces of potatoes were pricked by sterilized needle for the shake of hatch. The taken (Table 1) plants were placed in dry shady area for a few days and dried fine powder was prepared crushing in mortar. The collected white, round, woundless potatoes were washed in water, cleaned with muslin cloth and dried in hot sun areas. Before treatments it was placed in woven at 50^0 C in 24 hrs. The gape between woven and experimental design was 6 hrs. 500gm potatoes placed in each 48 transparent plastic bottles were used as experimental cages. Applications of each treatment were conducted in three separate concentrations and each concentration three replications. Thus in each three concentrations of the five treatments 45 replications and three controls (without using any treatments) were designed randomly.

The mouth of cages were covered by muslin cloth and tied with rubber. In the side of mouth there kept a small hole from which five pair second day virgin adults form rearing cage introduced through a test tube and used for experimental purpose in each replications and controls. The mouths were plugged by a piece of cotton. Pure water and 40% gulcose soaked cotton were placed over the mouth of each test cages and replaced at every 24 hrs. The experiment was conducted from June 26, 2001 to August 30, 2001. Average mortality of adult PTMs were observed 24 hrs of treatment and continued in every 24 hrs up to one week. The percentage mortality was calculated as-

%Mortality = (mean mortality in three replication by/number of insect taken)×100

Adult mortality observed in groups of the active treatment was corrected for control mortality using the equation (Abott 1925).

MC= [(T-C)/ (100-C)] ×100

Where, MC= Mortality coefficient,

C=% mortality in control,

T= percentage mortality in treatments

With the help of life table of PTMs in different treatments in different concentrations, effects on various life stage was recorded as (Price 1975).

x= age interval

lx= no of alive at beginning of x

dx= no of dying during x

100qx= dx as percentage of lx.

Results and Discussion

Percentage mortality of adult PTMs were found to high in *L. neesiana* and *A. calmus* as compared to other treatments. As the concentrations and time increased the value gradually increase (Table-2). The average percentage mortality of adult PTMs using L. *neesiana* were 13.3%, 16.7% and 23.3% and in *A.calamus* were 6.7%, 13.3% and 20% at C_1, C_2 and C_3 concentrations after 24 hrs of treatment. After 168 hrs of treatment it reached 66.7%, 70.0% and 83.3% in *L. neesiana* and 56.7%, 66.7% and 70% in *A.calamus* at the same concentration (Table-3). *Melia azedarach* and *Piper longum* showed slightly greater then the value of

control. The value showed high percentage mortality has competing with the control (Table-4). Mortality coefficient values of all the treatments in all the three concentrations are less than the value of control except *L. neesiana* and *A. calmus* whereas *Prunus persica* showed more or less same value with control. The effects of treatment T_1 and T_5 persistence for long period, which caused 46.7% and 46.36% larval mortality and only average 12.6 and 6.0 newly adult, emerged in first generation.

Table 1. Experimental plants and concentrations used in the study

S.N	Treatments	Plants	Parts	Concentration in 500gm Potato		
				C1	C2	C3
1.	T1	*Acorus calamus*	Rhizomes	0.025	0.25	2.50
2.	T2	*Melia azedarach Linn.*	Leaves	0.025	0.25	2.50
3.	T3	*Piper longum Linn.*	Berries	0.025	0.25	2.50
4.	T4	*Prunus persica Linn.*	Leaves	0.025	0.25	2.50
5.	T5	*Lindera neesiana Benth*	Fruits	0.025	0.25	2.50
			w/w	0.05%	0.5%	5.0%

Table 2. Average percentage mortality of adult PTMs with respect to different treatments in different concentrations.

Treatments	After 24 hrs			After 96 hrs			After 168 hrs		
	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3
1. *Acorus calamus*	6.7	13.3	20.0	30.0	36.7	50.0	6.7	66.7	70.0
2. *Melia azedarach*	0.0	3.3	6.7	16.7	20.0	23.3	36.7	40.0	46.7
3. *Piper longum*	3.3	6.7	6.7	23.3	26.7	33.0	40.0	46.7	50.0
4. *Prunus persica*	0.0	0.0	0.0	16.7	23.3	26.7	30.0	36.7	40.0
5. *Lindera neesiana*	13.3	16.7	23.3	36.7	40.0	56.7	66.7	70.0	83.3
6. Control		0.0		13.3				30.0	

Average temperature 25±1.5 ^{0} C & relative humidity 95%

Table 3. Mortality coefficient of adult PTM for different treatments

Treatments	After 24 hrs			After 168 hrs		
	C_1	C_2	C_3	C_1	C_2	C_3
1. *Acorus calamus*	6.7	13.3	20.0	38.14	52.4	7.14
2. *Melia azedarach*	0.0	3.3	6.7	9.57	14.28	23.85
3. *Piper longum*	3.3	6.7	6.7	14.28	23.85	28.57
4. *Prunus persica*	0.0	0.0	0.0	0.0	9.57	14.28
5. *Lindera neesiana*	13.3	16.7	23.3	52.42	57.14	76.14
6. Control		0.0%			30.0%	

Annual report (1995-96) reported that the rhizome of *A.calamus* is very effective to control *Sitophilus zeamis* 2 gm, 1gm and 0.5 gm /100gm of maize grain were showed 100% mortality in 8th and 10th days respectively. No adults were emerged after three days of observation.Anonymous (1999) described that leaves of *M. azederach* caused 54%, 62% and 75% mean mortality of *Callosobruchus chinensis* at the rate of 0.5%, 1.0% and 2.0% (w/w) in the 12th day. But in this experiment *M. azederach* did not showed effective results. It showed only 36.7%, 40.0% and46.7% adult mortality at C_1, C_2 and C_3 concentrations in 168 hrs after treatment.

Ewete *et al.* (2000) mentioned that *Piper longum* consists of piperine caused, toxicity and inhibitions to larval growth and development at high mortality to larval stage of *Ostrini nubialis*. The value of adult PTM mortality by using *P. longum* was slightly higher than M. *azedarach* in 168 hrs after treatments (Table-2).

Chopra *et al.* (1965) mentioned that the leaves of *Prunus persica* have insecticidal properties. After 24 hrs of treatment, in all the concentrations of *P. persica* showed 0.0% adult PTM mortality and after 168 hrs of treatment the value raised 30.0%, 36.7% and 40.0%, which showed less than control in mortality coefficient (Table-3).Duwadi *et. al*. (1993) mentioned that dried seed powder mixture of 0.5kg *L. neesiana* and 1kg Prickly ash control, *Dorylus orientalis* in 6 m^2 area.

Thus it is concluded that *L. neesiana* and *A. calamus* are the best alternative of the chemical pesticides and recommended to use 5% w/w weekly for the control of Potato tuber moth in storage potatoes.

Table 4. Effects on life table of PTM with respect to two effective treatments T1 and T5

T_1	**C_1**			**C_2**			**C_3**		
x	lx	dx	100qx	lx	dx	100qx	lx	dx	100qx
Eggs	54.0	11.7	21.6	48.3	10.7	22.1	34.3	8.0	23.3
Larvae	42.3	14.0	33.0	37.6	13.6	36.1	26.3	12.3	46.7
Pupae	28.3	2.3	8.1	24.0	2.0	8.3	14.0	1.4	10.0
Adults	26.0	3.0	11.5	22.0	2.6	11.8	2.6	1.6	12.6
T_5	**C_1**			**C_2**			**C_3**		
x	lx	dx	100qx	lx	dx	100qx	lx	dx	100qx
Eggs	51.3	12.0	23.3	43.3	11.0	25.3	18.6	6.3	33.8
Larvae	39.3	13.3	33.8	32.3	13.0	40.2	12.3	5.7	46.3
Pupae	26.0	2.0	7.6	19.3	1.7	8.8	6.6	0.6	9.0
Adults	24.0	2.0	8.3	17.6	1.6	9.0	6.0	0.6	10.0
Control	**C_1**			**C_2**			**C_3**		
x	lx			dx			100qx		
Eggs	130.3			20.3			15.5		
Larvae	110.0			20.7			18.7		
Pupae	89.3			6.3			7.0		
Adults	83.0			7.3			8.7		

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