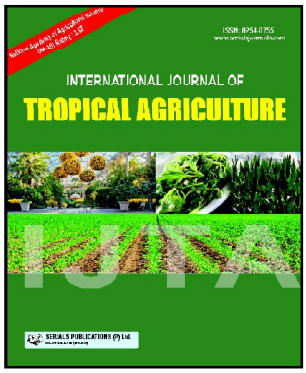

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Efficacy of Botanicals and their Impact on Natural Enemies of Pea Leaf Miner (*Chromatomyia horticola* G.) Under Climatic Conditions of Mid-hills of Himachal Pradesh

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Abstract: Pea leaf miner *(Chromatomyia horticola* Goureau) is a polyphagous pest which causes huge crop damage. Various broad spectrum synthetic insecticides had been used for its management but, there are many side effects. In the present study, efficacy of seven botanical extracts (*Artemisia brevifolia, Chromoleana adenophorum, Vitex nugundo, Azadirachta indica, Melia azedarach*, *Rumex nepalensis* and kinnow peel oil), cow urine two synthetic insecticides (lambda-cyhalothrin and acetamiprid) and one biopesticides (avermectin) was studied. The results revealed that application of lambda-cyhalothrin and avermectin treatment resulted in maximum reduction in leaflet infestation over control. The highest reduction in leaf minor population over control was recorded in avermectin followed by lambda-cyhalothrin. All the evaluated botanicals provided more than fifty per cent reduction in population of pea leaf miner over control, highest being in *A. india* and *M. azedarach*. Among botanicals, *A. indica* and *M. azedarach provided* maximum protection in leaflet infestation by pea leaf miner over control. The evaluated botanical resulted in more than thirty per cent reduction in leaflet infestation over control. The highest pararsitisation of *Diglyphus* sp. and *Opius* sp. was observed in *A. indica* being at par to other botanicals thereby revealing minimal influences of botanicals on the activity of pea leaf miner. The present study therefore, points on the comparable effect of two botanicals viz., *A. indica* and *M. azedarach* on pea leaf miner and therefore can be the safer alternatives for the pest control.

Key words: *Chromatomyia horticola,* botanicals, pea leaf miner, *Azadirachta indica*, *parasitoids.*

INTRODUCTION

Pea leaf miner *(Chromatomyia horticola* Goureau) is a polyphagous pest infesting many agriculturally important crops like vegetables and ornamental crops in both the temperate and tropical regions of the world (Spencer, 1973). The larvae cause damage by feeding within the leaves, construct mines in the leaves and consume leaf tissues. The damage, thus results in reduced photosynthetic area of leaves and hence lower yield of pea. The severe infestation can cause crop damage up to 90 per cent by restricting its flowering and pod formation (Atwal *et al*., 1969; Mavi and Singh, 1988; Tariq *et al*., 1991). In Himachal Pradesh, more than 20 per cent avoidable losses in pea grain yield have been reported beyond 40 per cent infestation (Mehta *et al*., 1994). Various broad spectrum synthetic insecticides had been used for the management of pea leaf miner (Dash, 1990; Khajuria and Sharma, 1995; Tsutomu, 2004; Singh and Saravanan, 2008). However, the obvious limitations and hazards associated with insecticidal applications in vegetables like objectionable pesticide residues, development of resistance to insecticides, pest resurgence, hazards to natural enemies, *etc*. restrict their use in pest control programmes.

The main strategy in plant protection scopes is to minimize the use of synthetic compounds and aims for environmental safety. Therefore, several efforts are being exerted to look for the alternative safer means for leaf miner control (Chanchal and Lal, 2009; Khedkar *et al*., 2012; Desai *et al*., 2013). One of these efforts is the development of botanical insecticides is a novel and safer alternative strategy. Botanical insecticides, which contain plant extracts as active components, are safer as well as environmental friendly. Their use is growing rapidly worldwide, and they are in demand for their value in IPM programs to enhance yields and quality. Botanical extracts of neem and tobacco are usually used as bio-pesticides; however, many other plants are under consideration for using as bio-pesticides (Gupta and Dixit, 2010). Over 2000 species of plants are known to have possessed insecticidal activities despite this only a few have been scientifically evaluated (Ojo, 1996). Therefore, keeping in view the economic importance of crop, insect infestation and hazards of chemical insecticides, the present field studies were oriented to evaluate the effectiveness of seven botanicals insecticides along with one biopesticide and two synthetic insecticides against pea leaf miner and their impact on natural enemies.

MATERIALS AND METHODS

Experimental Material

The experiment on management of pea leaf miner was conducted in Pea variety Lincoln. Seven botanical extracts (*Artemisia brevifolia, Chromoleana adenophorum, Vitex nugundo, Azadirachta indica, Melia azedarach*, *Rumex nepalensis* and kinnow peel), cow urine, two synthetic insecticides (lambda-cyhalothrin and acetamiprid) and one biopesticides (avermectin) were selected to find out the most effective one for the control of pea leaf miner.

Preparation of Extracts

Leaves of *Artemisia brevifolia, Chromoleana adenophorum and Vitex nugundo;* drupes of *Azadirachta indica* and *Melia azedarach* and roots of *Rumex nepalensis* were used to make extracts. All the plant materials were collected locally and dried in shade for one month before extraction. One hundred gram each of dried plant part was crushed separately in a mortar with pestle to yield uniform size of powder. The crushed plant parts were put in a separate plastic container containing one litre of water. These were allowed to settle overnight and the aqueous suspension was filtered through double layer of muslin cloth. The final extract volume was made to one litre by adding water before spraying. The sticker and spreader were also mixed with the extracts at the time of spray applications. The aqueous extracts and other insecticides were applied as foliar application with the help of high volume knapsack sprayer to run-off. The concentration of different treatment is given in Table 1.

Table 1
Concentration of different treatments used against pea leaf miner.

Treatment	*Conc. (%)*
Acetamiprid	0.01
Artemisia brevifolia	10.0
Avermectin	0.05
Azadirachta indica	10.0
Cow urine	5.0
C. adenophorum	10.0
Kinnow peel oil	0.3
Lambda-cyhalothrin	0.08
Melia azedarach	10.0
Rumex nepalensis	10.0
Vitex nigundo	10.0

Experimental Procedure and Data Collection

Field evaluation on the efficacy of freshly prepared aqueous extracts along with kinnow peel oil, cow urine, lambda-cyhalothrin, acetamiprid and avermectin against pea leaf miner was carried out at experimental fields of Department of Entomology, Chaudhary Sarvan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur. Pea variety Lincoln was sown in plots of 3.2m × 3.0 m with three replications in Randomized Block Design under climatic conditions of mid-hills of Himachal Pradesh. Recommended package of practices, except insect-pest management was used to raise healthy plants. The experiments were initiated during first week of November. The spray was initiated with the build-up of pest population in the field during first week of March and subsequent treatments were employed after 10 days interval. A total of three spray of each treatment were administered.

Three samplings were made after 10 days of each spray. In each sampling, three randomly selected plants per replication were collected from plant and observations were recorded on number of infected leaflets per plant, total leaflets per plant, population of maggots and population of pupae.

Per cent leaflet infestation and per cent reduction in population of leaf miner and percent reduction in leaflet infestation over control was worked out as below:

Mean per cent leaflet infestation was worked out as:

$$= \frac{\text{Number of infested leaflets per plant}}{\text{Total leaflets per plant}} \times 100$$

From this calculation, per cent reduction in leaflet infestation over control was worked out as:

$$= \frac{\text{Leaflet infestation in control} - \text{Leaflet infestation in treatment}}{\text{Leaflet infestation in control}} \times 100$$

Similarly per cent reduction in population of leaf miner over control was worked out as:

$$= \frac{\text{Population of leaf miner in control} - \text{Population of leaf miner in treatment}}{\text{Population of leaf miner in control}} \times 100$$

Pea leaf samples were drawn from treated plots and brought to laboratory to record the emergence of parasitoids. The experiment was replicated thrice. The per cent parasitism was calculated by the following formula as adopted by Mills(1997) and Van Driesche (1983):

Per cent parasitism

$$= \frac{\text{No. of adult parasitoids emerged}}{\text{No. of host adult insects} + \text{No. of parasitoid adults}} \times 100$$

The data generated was subjected to pooled statistical analysis.

RESULTS AND DISCUSSION

The efficacy of insecticides against pea leaf miner was evaluated by imposing seven different botanical extracts, cow urine, kinnow peel oil, two synthetic

insecticides and one biopesticides. The results presented revealed that among all the treatments per cent reduction in leaflet infestation over control was highest in synthetic insecticides - lambda-cyhalothrin (50.95) followed by avermectin (45.48%). This was followed by *M. azedarach* (38.75%) and *A. indica* (38.23%) which resulted in more than 30 per cent reduction. The percent reduction in leaflet infestation over control was was lowest in cow urine.

All the botanicals resulted in more than 50 per cent (mean) reduction in population of leaf miner over control. The extracts of *A. indica* and *M. azedarach* resulted in highest reduction in population over control (being 59.50 and 59.46 per cent, respectively) followed by *C. adenophorum* (58.86%). The findings are in close proximity to reports of Desai *et al.* (2013) and Singh and Saravanan (2008) in terms of neem formulations.

Application of avermectin and lambda-cyhalothrin resulted in more than seventy per cent reduction in population of leaf miner over control. This may be due to the fact that the active ingredient in insecticides is more environmentally stable than any known botanical insecticide.

Two parasitoids namely, *Diglyphus* sp. (Eulophidae: Hymenoptera) and *Opius* sp. (Bracinidae: Hymenoptera) were found to be associated with pea leaf miner. These parasitoids were also found to parasitize *C. horticola* in pea at Pantnagar (Yadav and Patel, 2015). The per cent parasitisation in the non-chemical treatments varied between 15.31-20.04 per cent while it varied between 2.09-6.61 per cent in synthetic insecticide treatment revealing minimal influences of botanicals on the activity of pea leaf miner. The highest parasitisation was observed in *A. indica* (19.05 %) being at par to other botanicals. Yadav and Patel (2015) also advocated that there is a need to understand the natural enemy complex of this pest to promote natural biological control as well as to avoid the use of harmful pesticides in pea ecosystem at the time when they are actively involved in reducing the population of this pest. The present study is thus, helpful in adoption of safer alternatives in the form of botanicals in their

Table 2
Field efficacy of plant extracts and some insecticides in reducing infestation by *C. horticola* (pooled for 2004-2006)

		% Reduction in population over control				*% Reduction in leaflet infestation over control*		
Treatment	*Conc. (%)*	*2004*	*2005*	*2006*	*Mean*	*2005*	*2006*	*Mean*
Acetamiprid	0.01	–	–	52.04	52.04	–	36.92	36.92
Artemisia brevifolia	10.0	79.19	35.26	37.78	50.74	42.25	27.36	34.81
Avermectin	0.05	93.45	50.87	–	72.16	45.48	–	45.48
Azadirachta indica	10.0	83.21	50.58	44.71	59.50	42.39	34.06	38.23
Cow urine	5.0	79.07	33.82	25.33	46.07	34.11	20.87	27.49
C. adenophorum	10.0	81.56	40.17	54.85	58.86	35.91	28.89	32.40
Kinnow peel oil	0.3	73.36	45.09	49.39	55.95	29.14	22.70	25.92
Lambda-cyhalothrin	0.08	93.29	63.01	58.76	71.69	52.71	49.19	50.95
Melia azedarach	10.0	82.31	43.93	52.15	59.46	44.48	33.01	38.75
Rumex nepalensis	10.0	75.53	32.37	47.14	51.68	41.27	31.63	36.45
Vitex nigundo	10.0	81.85	35.55	54.96	57.45	33.71	21.35	27.53

–Not evaluated

Table 3
Effect of insecticides on the parasitisation of *C. horticola*

Treatment	*Conc. (%)*	*Per cent parasitization*
Artemisia brevifolia	10.0	15.04(4.00)
Azadirachta indica	10.0	19.05(4.48)
C. adenophorum	10.0	17.73(4.33)
Melia azedarach	10.0	18.94(4.46)
Rumex nepalensis	10.0	15.88(4.11)
Vitex nigundo	10.0	15.82(4.10)
Kinnow peel oil	0.3	15.31(4.04)
Cow urine	5.0	20.04(4.59)
Avermectin	0.05	2.09(1.76)
Lambda-cyhalothrin	0.08	4.54(2.34)
Acetamiprid	0.01	6.61(2.76)
Untreated check	Water	20.73(4.66)
CD(P = 0.05)		0.43

potential use in management programs of pea leaf miner.

Different commercial insecticides including botanicals have been tested for the control of leaf miner by various workers (Dash, 1990; Mehta *et al.,* 1995 and Khajuria and Sharma, 1995). These products differ in their formulation and concentration of active ingredients. In the present study *A. indica* and *M. azedarach* had a comparable effect on pea leaf miner and therefore can be the safer alternatives to the synthetic insecticides.

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