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Repellent Efficacy of *Adhatoda vasica* , *Pongamia glabra* and *Momordica charantia* plant extract against *Spilarctia obliqua* Walker (Lepidoptera: Arctiidae)

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*(*A part of Ph.D. Thesis of the candidate)*

Abstract

In the present investigation alcoholic extract of leaves of *Adhaloda vasica* Nees, *Annona reticulata* Linn, *Momordica charantia* Linn, *Ocimum canam* Sims, *Pongamia glabra* Vent, *Solanum nigrum* Linn, *Withamnia somnifua* Deen, Bulb of *Allium salivum* Linn, Seeds of *Cleome monoplylla* Linn, Rhizome of *Curcuma domesticu*s Val., *Zingiber officinatis* Rose, Arial parts of *Lantana camara* Linn, Unripe fruits of *Piper nigram* Linn. were prepared under the laboratory conditions. For testing the repellent effect the mustard leaves were used as food against the third instars larvae of Bihar hairy caterpillar, *Spilarctia obliqua* Walk. After four hours of the release of larvae the data was collected on the number of larvae reached and repelled at each treated food. All the comparisons were made with control. It is evident from the results in the experiment of repellent test against larvae of *Spilarctia obliqua*. All the plant origin insecticide showed a good repellent property, when compared with the control. The repellent property was observed based on their minimum EC_{50} values as : Adhatoda vasica (0.0855) > *Pongamia glabra* (0.1465) > *Momordica charantia* (0.1620) >*Allium sativum* (0.1700) > *Lantana camara* (0.3202) > *Ocimum canum* (0.3905) > *Zingiber officinalis* (0.3906) > Solanum nigrum (0.6932) > Withamnia somnifera (0.8120) > Piper nigrum (0.8552) > *Cleome monophylla* (0.9450) > *Curcuma domesticus* (0.9530) > *Annona retuculata* (0.9531), *respectively.*

Keywords: *Spilarctia obliqua*, *Adhatoda vasica*, *Pongamia glabra*, mustard

INTRODUCTION

Indiscriminate use of synthetic chemical pesticides to ensure higher crop and vegetable yield have adversely affected both biological and physical environment, leading to the environmental pollution and rapid build-up of resistance and resurgence of insect pests and diseases (Mwangi *et al.* 1992,). The damage is caused due to high toxicity and non-biodegradable nature of the pesticides and due to the residues in soil, water and crops that affect human health.

Thus, efforts are needed to search new selective and biodegradable naturally occurring indigenous pesticides. These green pesticides and the continuing need for developing new crop protection tools, phytochemicals derived from various bio-active plant species offer a promising source of safer agrochemicals (Srivastava and Awasthi 1958). There are many botanical products that have been reported as anti-insect compounds (Dubey *et al.*,2004). These anti-insect compounds present in higher plants are the well-known factors to disease resistance. They are biodegradable and selective in toxicity (Srivastava and Awasthi 1958).

Various compounds isolated from plants have been studied for insecticidal activity globally (Dev and Koul, 1997) and majority of them are insect feeding deterrent (Deshpande and Tipnis 1977, Antonius and Hagazy 1987). More than 140 compounds, which are chemically diverse and structurally complex, have been isolated from the leaves, seed oil and bark of neem (Daniel and Smith 1991). Phytochemicals are often distasteful and toxic to many pests. They can modify feeding deterrence behaviour of an insect (Schmidt and Streloke, 1994).

Bihar hairy caterpillar, *Spilarctia obliqua* Walker (Lepidoptera: Noctuoidea: Arctiidae: Arctiinae) is a serious major polyphagous and feeds on almost all green vegetation.(Chandel *et al.*2004*).* Major hosts include groundnut, sunflower, cashew, castor, cucurbits, mulberry, pigeonpea, other pulses, millets, *Calotropis gigantea*, etc. and vegetables. (Golob and Webley 1980,Tandon et al. 2004). In the present study, efforts were made to explore the naturally available indigenous various plant extracts as antifeedant against *S. obliqua* affecting crop and vegetables.

MATERIALS AND METHODS

(A) Procurement of raw plant materials:

The plants parts used for extracts were surveyed, identified and collected mainly from wasteland and wild areas and some plants were collected from cultivated fields of the farmers. The investigations on the screening of various available indigenous naturally occurring thirteen plant extracts viz., leaves of *Adhaloda vasica* Nees, *Annona*

reticulata Linn, *Momordica charantia* Linn, *Ocimum canam* Sims, *Pongamia* glabra Vent, *Solanum nigr*um Linn, *Withamnia somnifua* Deen, Bulb of *Allium salivum* Linn, Seeds of *Cleome monoplylla* Linn, Rhizome of *Curcuma domesticus* Val., *Zingiber officinatis* Rose, Arial parts of *Lantana camara* Linn, Unripe fruits of *Piper nigram* Linn. were screened for their bioefficacy insecticidal against Bihar hairy caterpillar, *Spilarctia obliqua* Walk. in laboratory. For carrying out the present studies only thirteen selected botanical soxhlet extractives were assessed for their repellent bioefficacy under laboratory conditions.

(B) Preparation of powder and their Extraction:

Fresh collected thirteen green plant parts (leaves, Flowers and seeds, rhizomes etc) were washed with distilled water and kept in the laboratory for 7 days for air drying followed by one day sun drying before making powder. Electric grinder was used to have coarse powder then these were passed through a 60-mesh sieve to get fine powder. Powders were kept in polythene bags at room temperature and properly sealed to prevent quality loss. For the extraction, Soxhlet Apparatus was used; about 20g powder of each category of powder were extracted with 300 ml of different solvents (n-hexane, acetone, methanol, petroleum ether and distilled water). Extraction of each category of powder were done in about 12 hrs. After soxhlet extraction, the material was run on rotary evaporator (Pellerin,1992). The extracts were concentrated on rotary evaporator by removing the excess solvent under vacuum. After evaporation of solvent with rotary evaporator the remaining extracted material was kept on water bath for removing remaining solvent from the extracts. The extracts were stored at 4°C prior to application.

(C) Preparation of Stock Solution and Insecticidal Formulations:

For stock solution, 50ml. extract in each case was taken into reagent bottles and 50ml. benzene was added in it to dissolve the constituents of the materials. The mouth of the bottles were stopper with airtight corks after which, these bottles containing the solutions were kept in refrigerator.Three concentrations (0.5,1.0, 2.0 percent) were used for experiments on insecticidal and repellent tests in the laboratory conditions. However, only three concentrations (0.5,1.0 and 2.0 percent)were used for insecticidal test in the laboratory and contact test in the field experiment. The different concentrations of the herbal extracts were prepared from the stock solution using benzene as solvent and Triton X-100 as emulsifier. The level of solvent and emulsifier were kept constant.

(D) Apparatus used for experiment:

Small plastic jars (capacity 50 ml) were used for the experiment, there was one set of two jars joined by clear plastic pipe of 1cm diameter at an angle of 180 degree for each replication. One jar of each set was provided with 10 g of grains given the name 'A' while the other jar was kept empty and given the name **'**B**'**. In jar 'A**'**, the grains treated with extracts were placed, while the jar B remained empty. The jars used for experiment were disinfected with alcohol.

(E) Experimental Protocol:

In the present investigation alcoholic extract of leaves of *Adhaloda vasica* Nees, *Annona reticulata* Linn, *Momordica charantia* Linn, *Ocimum canam* Sims, *Pongamia glabra* Vent, *Solanum nigrum* Linn, *Withamnia somnifua* Deen, Bulb of *Allium salivum* Linn, Seeds of *Cleome monoplylla* Linn, Rhizome of *Curcuma domesticus* Val., *Zingiber officinatis* Rose, Arial parts of *Lantana camara* Linn, Unripe fruits of *Piper nigram* Linn. were prepared with the help of the soxhlet apparatus under the laboratory conditions. For testing the repellent effect the mustard leaves were used as food against the larvae of Bihar hairy caterpillar, *Spilarctia obliqua* Walk. The leaf pieces fastened under clip and left under electric fan for about thirty minutes, so as to complete dry up the extract. The treated foods were kept in jar (23cm x 10cm) on moist filter paper. Then third instars, 24 hours starved larvae were released in each jar. In each set of extract and one control was introduced, where the leaves pieces were dipped in Benzene + emulsified water only. After four hours of the release of larvae the data was collected on the number of larvae reached and repelled at each treated food. Three replication of treatment were made.

RESULT AND DISCUSSION

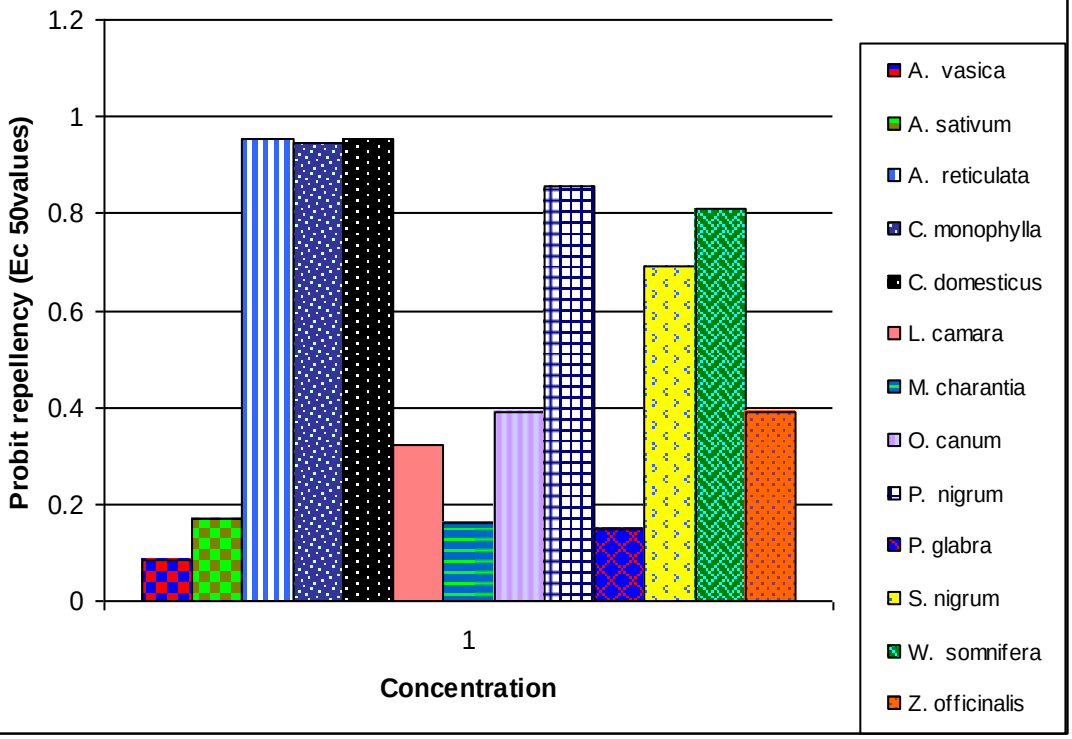
It is evident from the results in the experiment of repellent test against larvae of Spilarctia obliqua. All the plant origin insecticide showed a good repellent property, when compared with the control. *The repellent property was observed based on their* EC_{50} *values as : Allium sativum* > Lantana camara > *Zingiber officinalis* > *Curcuma domesticus* > *Ocimum canum* > *Adhatoda vasica* > *Pongamia glabra* > *Solanum nigrum* > *Withamnia somnifera* > *Piper nigrum* > *Momordica charantia* > *Cleome monophylla* > *Annona retuculata*, respectively.

Table 1: Log conc./Probit repellency Regression Column of Bihar hairy caterpillar, *Spilarctia obliqua* Walk.

Plant Extracts	**H***	**X^2**	**Regression Equation**	**EC_{50}**	**Fiducial Limit**	**Relative EC_{50}**
Adhatoda vasica	3	2.834	1.05X + 2.80	0.0855	M_1=2.3060 M_2=1.8719	I
Allium sativum	3	1.93	1.41X + 3.26	0.1700	M_1=1.4512 M_2=0.2168	IV
Annona reticulata	3	1.0880	1.25X + 2.42	0.9531	M_1=2.0267 M_2=1.8325	XII
Cleome monophylla	3	1.080	1.25X + 2.42	0.9450	M_1=2.0267 M_2=1.9235	XI
Curcuma domesticus	3	1.0880	1.25X + 2.42	0.9530	M_1=2.0267 M_2=1.8325	XIII
Lantana camara	3	0.32	0.87X + 4.94	0.3202	M_1=2.0694 M_2=0.1366	V
Momordica charantia	3	0.24	0.66X + 3.753	0.1620	M_1=1.9255 M_2=0.0344	III
Ocimum canum	3	1.95	0.92X + 4.37	0.3905	M_1=1.1588 M_2=0.0148	VI
Piper nigrum	3	4.601	1.101X + 2.89	0.8552	M_1=2.1173 M_2=1.7484	X
Pongamia glabra	3	1.492	1.08X + 2.65	0.1465	M_1=2.3362 M_2=1.9781	II
Solanum nigrum	3	0.123	1.22X + 2.74	0.6932	M_1=2.0266 M_2=1.6557	VIII
Withamnia somnifera	3	4.601	1.10X + 2.89	0.8120	M_1=2.1173 M_2=1.7484	IX
Zingiber officinalis	3	1.95	0.92X + 4.37	0.3906	M_1=1.1588 M_2=0.0148	VII

In case of X^2 was found non significant heterogeneous at P=0.05, Y=Probit repellency, X=Log Concentration X $10^{'}$ D.F.=Degree of Freedom, $E.C._{50}$=Concentration Calculated at given 50% repellency

Fig:1. Log conc./Probit Repellency Regression column of *Spilarctia obliqua* Walker



The EC_{50} values of the above regarding relative repellency in the following descending order are: 0.0855 > 0.1465 > 0.1620 > 0.1700 > 0.3202 > 0.3705 > 0.3905 > 0.6360 > 0.6932 > 0.8120 > 0.8558 > 0.9450 > 0.9530 respectively, where as Annona reticulata was taken as a unit.

In the support of the above findings various botanical products and their extractives works as repellent and has been reported by several researchers against various crop pests as Yothers and Carlson 1944, Dethier, 1947, Turowski 1963. Roomi and Ariquiddin,1977, Meisner et al. 1981, Sighamony *et al*. 1984, Krishnarajah et al. 1985, Ahmed and Eapen 1986, Pandey et al., 1986, Saraswathi and Rao 1987, Jilani *et al*.(1988), Jilani and Saxena 1990, Daniel and Smith,1991, Weaver *et al*.(1991), Mehta and Sandhu, 1992, Tripathi *et al* 2000, Won-Sik *et al*. 2002).

Pandey *et al*. (1976) studied the powder of sweat flag (rhizomes), *kaner* (drupes), *Adhatoda* and *Sadabahar (leaves)*, petroleum ether extract of garlic, onion and *neem* oil for their repellent effects against *Callosobruchus chinensis* infesting gram seeds. Among them, garlic, *Allium sativum* extract acted as feeding deterrent and protected stored grain for upto 135 days. Only 1.65 per cent of seeds were damaged during

this time, as compared with 95.56 per cent of the controls. Meisner *et al.* (1981) observed phagodeterrency of leaves extract of *Catharanthus roseus* on *Spodoptera littoralis*. Feeding inhibition was higher in fresh leaves then alkaloid fraction against *C. roseus* at 0.125 per cent, which exhibited high feeding inhibitory activity. He further tested the *neem* extract and *solannin* against *S. littoralis* and *E. insulana* larvae and observed significant repellent activity. Bekele *et al.* (1996) *Ocimum suave* leaves oil showed repellent properties against *S. zeamais.* Abe and Matsuda (2000) reported the repellent efficacy of *Momordica charantia* leave extracts against certain cucurbitaceous beetle species.

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