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Repellent effect of some plant extracts against *Pieris brassicae* (Linn)

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ABSTRACT

The aqueous extract of eight plant species, namely *Azadirachta indica,* A Juss, *Melia azedarach* L, *Lantana camara* L Moldenke, *Cannabis sativa* L, *Nerium indicum* Mill, *Eucalyptus* sp, *Ricinus communis* L and *Solanum nigrum* L were tested for repellent effects against *Pieris brassicae*. The ethanol extracts of potential plants were further tested for their biological activity against the test insect. The aqueous extracts of *A indica* and *M azedarach* resulted in statistically higher repellent effect repelling 2.2-50.4 and 4.4-52.6 per cent second instar larvae of *P brassicae* respectively. In case of ethanol extract also seed extracts of *A indica* and *M azedarach* were highly effective against *P brassicae* giving statistically higher repellent (15.1% and 13% respectively) effects as compared to other plant extracts. In general repellent effect was dose dependent and diminished with the passage of time.

Keywords: Repellent effect, *Pieris brassicae,* plant extracts

INTRODUCTION

Plants are composed of chemical substances of which some are not directly beneficial for the growth and development of the organism. These secondary compounds have usually been regarded as a part of the plants defense against plant-feeding insects and other herbivores (Rosenthal and Janzen 1979). The pesticidal properties of many plants have been known for a long time and natural pesticides based on plant extracts such as rotenone, nicotine and pyrethrum have been commonly used in pest control during the earlier half of the last century. It is well known that the use of persistent organochlorines like DDT and the acute toxic organo-phosphorous compounds has led to hazardous effects on environment and human beings. To the disadvantages of pesticide contamination of the environment and human health risks other aspects can be added. Misuse of non-selective chemicals can wipe out the natural enemies and induce problems with development of resistance. About 450 pest

species of insects and mites have now developed resistance to one or more major synthetic pesticides (Georghiou 1986).

In general plants with pesticidal properties can be exploited in three ways. By using as whole plant, powder or crude extracts in water or other solvents; as purified extracts, like rotenone and as a key to synthesize a chemical compound which then could be produced commercially. Today there is considerable interest among biochemists and botanists to screen plants for secondary chemical compounds which could be used for developing medicines and pesticides (Downum et al 1993). However it is an expensive and difficult process to isolate and identify the active ingredients and further to produce them in formulations which can be commercialized. Moreover natural pesticides are not uniform products but consist of different active ingredients which often vary in concentration from sample to sample. This makes toxicological tests difficult and costly to run (Latum and Gerrits 1991).

The cabbage white butterfly, *Pieris brassicae* L (Lepidoptera: Pieridae) is a serious pest of cauliflower and cabbage (Bhalla and Pawar 1977) causing damage to seedlings or to the plants at vegetative and flowering stages (Ali and Rizvi 2007, Hasan 2008, Rizvi et al 2009). It is an oligophagous pest with wide host range and is known to infest 83 species of food plants belonging to Cruciferae (Jainulabden and Prasad 2004). In India *P brassicae* is distributed along Himalayan region throughout the plain except the southern plain (Raqib 2004). It has been reported as a serious pest of cabbage, cauliflower, broccoli and brussels sprout in different parts of the world. It also attacks turnip, radish, sarson, toria etc. The young caterpillars feed gregariously on leaves (Jainulabden and Prasad 2004, Hasan 2008). All the parts like leaves, branches, pods and the seeds of the plants of cabbage and cauliflower are eaten by the larvae (Siraj 1999).

MATERIAL AND METHODS

Rearing of test insect

The stock culture of P *brassicae* was maintained under laboratory conditions. For this purpose egg clusters were collected on cole crops in the field and kept in Petri plates (10 cm diameter) on the filter papers. Newly hatched larvae were transferred to cabbage/cauliflower leaves with their petioles dipped in water in glass vials (14 cm x 4 cm) inside the wooden rearing cages (36 cm x 34 cm x 26 cm) with glass panes on three sides and the top and wire mesh on the front door. Fresh leaves were provided daily to the caterpillars till pupation.

One day old pupae were collected from the walls of the rearing cages and were sexed as suggested by Chandra and Lal (1975). The pupae of both the sexes were

kept separately in glass jars (10 cm x 14.5 cm) on pieces of filter paper. In each jar resting place was provided to the newly hatched adults for normal expansion of wings. The adults were provided with sugar solution (10%) soaked in cotton swabs and some shoots of cabbage/ cauliflower. The biological activity of different plant extracts was studied during February 2006 - May 2006 against this pest.

Processing of plant material: The samples containing leaves, stems, seeds or flowers, as the case may be, of the selected plant material were air-dried for 6-7 days and then dried in oven at 30^0C for 24 hours.

Extraction of plant material: The plant material was extracted by two methods viz simple extraction method and Soxhlet extraction.

Repellent effect

Repellent effects of different plant extracts were tested against the second instar larvae of the test insect *P brassicae*. Fresh leaves of castor and cabbage/ cauliflower were dipped in the desired concentrations of plant extracts, dried in shade and placed in Petri plates having filter paper at the base. For each treatment ten second instar larvae were kept on the treated leaves. The larvae which were repelled to the walls of the Petri plates were considered as repelled. These observations were recorded after 2, 4 and 6 hours. The repellency was calculated in terms of percentages and the data were subjected to Abbott's correction.

Statistical analysis

The data emanating from the above experiments were subjected to statistical analysis through Completely Randomized Design (CRD) and the significance of each treatment was calculated by comparing with control as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Repellent effects of aqueous and ethanol extracts of test plants were evaluated by releasing the second instar larvae of test insects in Petri plates having leaves dip-treated in plant extracts. The observations were recorded after 2, 4 and 6 hours of release and number of larvae repelled over control was recorded.

Maximum repellency of 52.6 per cent was recorded in case of *M azedarach* at 10 per cent concentration which was at par with 35.0 per cent larvae repelled at 1 per cent of the same plant extract (Table 1). Similar was the case of *A indica* where statistically similar repellency was recorded from 1 to 10 per cent. Repellent effect of *N indicum* leaf extract was at par with that of leaf extract of *Eucalyptus* sp and *C sativa* (repelling 2.2-39.4% and 0-39.4% larvae respectively). The repellent effects of *L camara* (repelling 0-32.9% larvae) and *S nigrum* (repelling 2.2-32.9%

Table 1. Repellent effect of aqueous extracts of plants against second instar larvae of *Pieris brassicae*, the larvae fed on treated leaves of castor for 24 hours

Plant extract	Part used	Per cent larvae repelled over check at indicated concentration and post treatment time*												Mean
		2 hours				4 hours				6 hours				
		10%	5%	2.5%	1%	10%	5%	2.5%	1%	10%	5%	2.5%	1%	
A indica	Seed	50.4	41.6	35.0	39.4	28.6	10.9	11.0	2.2	8.8	13.1	13.1	4.4	21.5
		(45.2)	(40.2)	(36.4)	(38.9)	(31.9)	(19.3)	(17.1)	(3.9)	(13.3)	(18.9)	(16.4)	(7.7)	(24.3)
M azedarach	Seed	52.6	41.6	39.4	35.0	19.7	10.9	8.8	8.8	19.7	19.7	17.5	4.4	23.2
		(46.5)	(40.2)	(38.9)	(36.2)	(23.5)	(15.0)	(13.3)	(13.3)	(25.4)	(20.9)	(21.6)	(7.7)	(25.2)
L camara	Leaf	32.9	30.7	28.5	13.1	15.3	0.0	6.6	8.8	8.8	17.5	2.2	6.6	14.2
		(34.9)	(33.5)	(31.8)	(18.9)	(20.3)	(0.0)	(11.6)	(15.4)	(13.3)	(17.9)	(3.9)	(11.6)	(17.7)
N indicum	Leaf	48.2	35.0	39.4	19.7	6.6	8.8	6.6	8.8	2.2	6.6	4.4	4.4	15.9
		(43.9)	(34.8)	(38.9)	(23.5)	(11.6)	(13.3)	(11.6)	(9.4)	(3.9)	(9.4)	(5.6)	(7.7)	(17.8)
S nigrum	Leaf	32.9	19.7	21.9	6.6	13.1	13.1	8.8	8.8	4.4	4.4	6.6	2.2	11.9
		(34.7)	(25.9)	(27.6)	(9.5)	(18.9)	(18.9)	(13.3)	(15.4)	(7.7)	(7.7)	(11.6)	(3.9)	(16.3)
Eucalyptus sp	Leaf	39.4	28.5	35.0	21.9	8.8	10.9	8.8	6.6	2.2	2.2	4.4	6.6	14.9
		(38.4)	(32.0)	(35.7)	(27.6)	(15.4)	(15.0)	(10.9)	(9.4)	(3.9)	(3.9)	(7.7)	(9.4)	(17.5)
R communis	Leaf	39.4	35.0	26.3	17.5	8.8	6.6	8.8	0.0	4.4	2.2	8.8	6.6	13.7
		(38.9)	36.4)	(30.9)	(24.5)	(13.3)	(11.6)	(15.4)	(0.0)	(5.6)	(3.9)	(13.3)	(9.4)	(16.9)
C sativa	Leaf	39.4	37.2	24.1	13.1	4.4	4.4	4.3	6.6	2.2	0.0	2.2	4.4	11.9
		(38.9)	(37.6)	(29.0)	(18.9)	(7.7)	(7.7)	(7.7)	(11.6)	(3.9)	(0.0)	(3.9)	(7.7)	(14.5)
Mean		41.9	33.7	31.2	20.8	13.1	8.2	7.9	6.3	6.6	8.2	7.4	4.9	
		(40.3)	(35.0)	(33.6)	(24.7)	(17.8)	(12.6)	(12.6)	(9.8)	(9.6)	(1.3)	(10.5)	(8.1)	

*Mean of five replications

Figures in parentheses are arc sin transformed values

$CD_{0.05}$ Concentration x Time x Extract: 12.6

Table 1a. Extract x Concentration

Plant extract	Part used	Mean per cent larvae repelled over control at indicated concentration*				Mean
		10%	5%	2.5%	1%	
A indica	Seed	23.2 (26.6)	16.5 (21.4)	15.9 (22.8)	8.6 (12.9)	16.1 (20.9)
M azedarach	Seed	25.3 (28.3)	18.9 (20.7)	15.0 (18.8)	11.4 (13.3)	17.6 (20.3)
L camara	Leaf	12.9 (17.7)	12.2 (17.2)	11.7 (14.4)	5.9 (9.0)	10.7 (14.6)
N indicum	Leaf	15.9 (18.5)	12.5 (16.2)	13.6 (17.8)	7.8 (14.2)	12.5 (16.7)
S nigrum	Leaf	12.5 (16.5)	9.4 (15.0)	9.4 (15.0)	5.0 (7.7)	9.1 (13.6)
Eucalyptus sp	Leaf	12.8 (15.6)	10.7 (14.5)	11.8 (16.0)	10.7 (14.8)	11.5 (15.2)
C sativa	Leaf	10.9 (13.8)	9.9 (12.3)	8.2 (11.9)	5.3 (8.4)	8.6 (11.6)
Mean		16.2 (19.6)	12.9 (16.8)	12.2 (16.7)	7.8 (11.5)	

*Mean of five replications
Figures in parentheses are arc sine transformed values
$CD_{0.05}$ Extract: 2.6 Concentration: 2.0 Extract x Concentration: 5.4

Table 1b. Time x Concentration

Time (hours)	Mean per cent larvae repelled over control at indicated concentration*				Mean
	10%	5%	2.5%	1%	
2	33.3 (35.1)	27.4 (30.5)	25.0 (29.6)	14.1 (18.6)	25.0 (28.4)
4	10.9 (16.6)	6.5 (11.7)	6.1 (10.9)	5.7 (9.5)	7.3 (12.2)
6	4.4 (7.1)	4.8 (8.1)	5.6 (9.6)	3.6 (6.4)	4.6 (7.8)
Mean	16.2 (19.6)	12.9 (16.8)	12.2 (16.7)	7.8 (11.5)	

*Mean of five replications
Figures in parentheses are arc sine transformed values
$CD_{0.05}$ Time: 1.7 Concentration: 2.0 Time x Concentration: 3.7

larvae) leaf extracts though were at par with each other these were lower than that of *Eucalyptus* sp and *C sativa*. The data contained in Table 1a indicate that maximum repellent effect was observed in case of *M azedarach* repelling 23.2 per cent larvae which was at par with 21.5 per cent repelled by *A indica* and minimum was in case of *C sativa* and *S nigrum* repelling 11.9 per cent larvae. The repellent effect decreased with the concentration in this case also. Table 1b shows that maximum repellency was recorded after 2 hours and minimum after 6 hours repelling 31.9 and 6.8 per cent larvae respectively.

In the present study it was found that in the first 2 hours maximum number of larvae of *P brassicae* were repelled by *M azedarach* (52.6%) at 10 per cent concentration over control (Table 1). In the plant x concentration interaction studies it was found that *M azedarach* and *A indica* repelled maximum number of *P brassicae* larvae (30.7 and 29.2% respectively) at 10 per cent concentration (Table 1a). The repellency effect decreased with the increase in the treatment time in both the cases ie from 31.9 per cent larvae repelled after 2 hours to 6.8 per cent larvae repelled after 6 hours (Table 1b).The repellent effect of *L camara* and *Eucalyptus globulus* against *Phthorimaea operculella* (Zeller) has also been reported by Lal (1988) and of *A indica* and *N indicum* against *Amarasca bigutulla bigutulla* Ishida by Patel and Patel (1996). Similarly Khan and Marwat

Table 1c. Extract x Time

Plant extract	Part used	Mean per cent larvae repelled over control at indicated concentration*			Mean
		2	4	6	
A indica	Seed	29.7 (32.6)	10.6 (15.5)	7.9 (14.8)	16.1 (20.9)
M azedarach	Seed	32.8 (32.1)	8.8 (13.3)	11.4 (15.5)	17.6 (20.3)
L camara	Leaf	20.7 (25.6)	8.9 (14.6)	2.5 (3.5)	10.7 (14.6)
N indicum	Leaf	28.6 (31.8)	5.5 (11.1)	3.3 (7.0)	12.5 (16.7)
S nigrum	Leaf	16.0 (21.2)	8.9 (14.6)	2.4 (4.9)	9.1 (13.6)
Eucalyptus sp	Leaf	26.0 (30.4)	4.7 (8.7)	3.8 (6.6)	11.5 (15.2)
C sativa	Leaf	20.7 (25.4)	4.1 (7.3)	0.9 (2.2)	8.5 (11.6)
Mean		25.0 (28.4)	7.3 (12.2)	4.6 (7.8)	

*Mean of five replications

Figures in parentheses are arc sine transformed values

CD ($P_{0.05}$) Extract: 2.6 Time: 1.7 Extract x Time: 4.6

(2003) studied the repellent effect with neem seed and Kanair bark respectively. The repellent effect of *R communis* was evaluated by Haq Tooba et al (2005) against *Tribolium casteanum* (Herbst) who found 78-86 per cent repellency against the pest.

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