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Effect of Leaf Extracts of Medicinal Plants on Feeding, Larval Growth and Defecation of Woolly-Bear Caterpillar, *Pericallia ricini* (F.) (Arctidae : Lepidoptera) on Castor Bean

M. Jamal Mohamed* and A. Abdul Kareem[1]
*Post Graduate and Research Department of Zoology
C. Abdul Hakeem College, Melvisharam- 632 509
[1]Former Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore - 641 003

The present study indicates that leaf powder extract of *Vinca rosea* L. 5.0 and 2.5 per cent were highly effective in reducing the food consumption, larval body weight and faecal matter voided by *Pericallia ricini* under laboratory conditions. Caterpillars consumed very less amount of castor leaves treated with *V. rosea* leaf powder extracts 2.5 and 5.0 per cent (i.e. 0.444 and 0.263g, respectively) compared to untreated control. The consumption was 0.483g per four caterpillars in the castor leaves treated with neem leaf powder extract 5.0 per cent. Larvae fed by *V. rosea* 5.0 per cent, neem leaf powder 5.0 per cent and *V. rosea* leaf powder 2 .50 per cent treated leaves voided 0.430, 0.497 and 0.627 g of faecal matter per four caterpillars, respectively. Larval body weight was decreased to 80.63 per cent in *V. rosea* 5.0 per cent over untreated check. It was followed by *V. rosea* 2.5 per cent and neem 5.0 per cent and registered 71.26 per cent decrease in body weight over the untreated check. The extracts of *V. rosea* exhibited feeding inhibition or gustatory repellency or impairment in food assimilation and imbalance in enzyme activity.

Key words: *Pericallia ricini*, food consumption, body weight, faecal matter, *Vinea rosea,* neem.

There is accelerated research for more environmentally and toxicologically safe, more selective and effective pesticides. The increasing incidence of pesticide resistance in insects is also fueling the need for new pesticides. Thus, natural compounds have increasingly become the focus for the management of insect pests.

Thousands of secondary products of plants have been identified and there are estimates that hundreds of thousands of these compounds exist. There is growing evidence that most of these compounds are involved in the interaction of plants with other species-primarily the defense of the plant from plant pests. Thus, these secondary compounds represent a large reservoir of chemical pool with biological activity. Unlike compounds synthesized in the laboratory, secondary compounds from plants are virtually guaranteed to have biological activity and that activity is highly and likely to function in protecting the plant from a herbivore, Despite the relatively small amount of previous effort in development of plant-derived compounds as pesticides, they have made a large impact in the area of insecticides.

Castor, *Ricinus communis* L. is a non-edible oil seed crop mostly grown as intercrop in groundnut under rainfed condition. The woolly bear, *Pericallia ricini* (F.) is one of the important defoliating pests of the crop. Use of synthetic insecticides may be uneconomical and hence studies have been made at the Department of Zoology, C. Abdul Hakeem College, Melvisharam to manage the pest by using the plant derivatives. Leaf powder extracts of *Azadirachta indica* A. Juss. (Meliaceae), *Datura metal* L. (Solanaceae), *Calotropis gigantea* L.R.Br (Asclepiadaceae) and *Vinca rosea* Linn, (Apocynaceae.) were tested for their activity against *P. ricini.*

*Corresponding author

Materials and Methods

Rearing of Pericallia ricini

P. ricini was reared on castor leaves under laboratory condition using the field collected larvae. They were reared upto pupation and this pupae were kept in the cages (45x45x45 cm) for adult emergence. Five pairs of healthy adults were released into plastic buckets (7 lit.) for oviposition where fresh castor leaves with petiole immersed in 100ml conical flasks to maintain turgidity of leaves were provided in the buckets as ovipositional substrate. Buckets were covered with black cloth. Every morning, moths were collected from emergence cages and allowed for oviposition. Adult feed consisting of ten per cent sucrose fortified with vitamins (ABDEC®), 0.03 per cent was provided in feeding dispensers in the

emergence cages and oviposition buckets. They were replaced daily with fresh preparation. Deformed and illformed adults were disposed off in 10 per cent formaldehyde solution. After ten days of oviposition, the moths were discarded and the oviposited leaves were sterilized with 10 per cent formaldehyde solution for use in next batch. The cycle was repeated for continuous maintenance of culture.

Eggs were collected from castor leaves using camel hairbrush and surface sterilized with 10 per cent formaldehyde solution for five minutes. Afterwards, eggs were washed in running water for 20 min, air-dried in shade at room temperature (27-32°C) and sterile clear plastic polypots (6x7cm) which were maintained in another sterile humidifying chamber for eclosion at 25 1 C. Larvae hatched out on third and fourth day. The neonate larvae were placed on clean castor leaves (water washed) with its petiole immersed in 100 ml conical flask (to maintain turgidity). Fresh leaves were provided and maintained at a temperature of 28± 10C, a relative humidity of 65± 5 per cent, a photoperiod of L10:D14 hours. When larvae reach the second instar, ten larvae were retained in each bucket. When the larvae reached the third instar, they were used for the experiment.

Full-grown larvae were allowed to pupate in the sterilized sand bed kept in boxes. Healthy pupae were selected, washed twice in running water followed by immersion in 0.5 per cent sodium hypochlorite for 30 seconds. Later, the pupae were rinsed in sterile water and rolled over filter paper to remove water. The surface sterilized pupae were kept in adult emergence cages (45x45x45 cm).

Preparation of leaf extracts

Fresh leaves of *A. indica*, *D. metal, C. gigantea* and *V. rosea* were collected from the field, washed with water to remove dusts, shade dried and powdered in the pulverizer (FRITSCH Pulverisette - 14) using 0.01mm sieve. Leaf powders were used for the preparation of 10 per cent stock solutions with distilled water (10 g per 100 ml of water). This extract was first filtered through a clean, sterilized muslin cloth and then through filter paper. From this fresh stock, solutions of 1.25, 2.5 and 5.0 per cent concentrations were prepared and were immediately used for experiments.

Table 1. Effect of botanical leaf powder extracts on feeding and faecal matter excretion by *P. ricini* larvae

Treatment and Dose	Leaf consumption per 4 caterpillars			Faecal matter voided per 4 caterpillars		
	*Mean leaf consumption (g)	Decrease in feeding over control (g)	% decrease over control	*Mean wt. of faecal matter voided (g)	Decrease in faecal matter voided over control (g)	% decrease over control
Vinca rosea leaf extract – 1.25%	0.923^{bcd}	1.390	60.10	0.931^{c}	1.062	53.29
Vinca rosea leaf extract – 2.5%	0.444^{a}	1.869	80.80	0.627^{bc}	1.366	68.54
Vinca rosea leaf extract – 5.0%	0.263^{a}	2.050	88.63	0.430^{a}	1.563	78.42
Neem leaf extract- 1.25%	0.866^{bc}	1.447	62.56	0.843^{c}	1.150	57.70
Neem leaf extract - 2.5%	0.826^{bc}	1.487	64.29	0.763^{c}	1.167	58.55
Neem leaf extract - 5.0%	0.483^{ab}	1.830	79.12	0.497^{ab}	1.496	75.06
Datura leaf extract– 1.25%	1.323^{cde}	0.990	42.80	1.573^{d}	0.420	21.07
Datura leaf extract – 2.5%	1.257^{cd}	1.056	45.40	1.257^{d}	0.736	36.93
Datura leaf extract – 5.0%	0.867^{bc}	1.446	62.52	0.860^{c}	1.133	56.85
Calotropis leaf extract - 1.25%	1.527^{e}	0.786	33.98	1.417^{d}	0.576	28.90
Calotropis leaf extract – 2.5%	1.403^{de}	0.910	39.34	1.250^{d}	0.743	37.28
Calotropis leaf extract – 5.0%	0.933^{bcd}	1.380	59.66	0.873^{c}	1.120	56.20
Control (water treatment)	2.313^{f}	-	-	1.993^{e}	-	-

*Mean of three replications. In a column means followed by the same letter are significantly not different by DMRT at p=0.05.

Castor leaf discs of 9.5 cm were weighed and dipped in various concentrations of the extract for 30 seconds, shade dried and placed over moist filter paper in the Petri dishes. Twelve hours prestarved four third instar larvae were weighed and released in each Petri dish for feeding. The experiment was replicated thrice. After 48 hours of the experiment, weight of the leaf consumed, faecal matter and increase or decrease in larval body weight in each treatment were recorded. The data collected in laboratory studies were transformed to square root transformation and subjected to statistical analysis adopting completely randomized design. The mean values of treatments were then separated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Effect of botanical leaf powder extract treated castor leaves on Pericallia ricini larval food consumption

Pericallia ricini caterpillars consumed less amount of castor leaves treated with Vinca rosea leaf powder extract 2.5 and 5.0 per cent compared to untreated control. The mean leaf consumption by four caterpillars in these treatments was 0.444g and 0.263 g in 2.5 and 5.0 per cent, respectively. These two treatments were significantly different from other

Table 2. Effect of botanical leaf powder treated castor leaves on larval body weight of *P. ricini*

Treatment and Dose	Mean larval body weight (g) 4 caterpillars	Decrease in larval body weight over control (g)	% decrease over control
Vinca rosea leaf extract – 1.25%	0.760[c]	0.830	52.20
Vinca rosea leaf extract – 2.5%	0.457[ab]	1.133	71.26
Vinca rosea leaf extract – 5.0%	0.308[a]	1.282	80.63
Neem leaf extract- 1.25%	0.690[bc]	0.900	56.60
Neem leaf extract - 2.5%	0.637[bc]	0.953	59.94
Neem Neem leaf extract - 5.0%	0.457[ab]	1.133	71.26
Datura leaf extract– 1.25%	0.900[c]	0.690	43.30
Datura leaf extract – 2.5%	0.760[bc]	0.830	52.20
Datura leaf extract – 5.0%	0.703[bc]	0.887	55.79
Calotropis leaf extract - 1.25%	0.910[c]	0.680	42.77
Calotropis leaf extract – 2.5%	0.893[c]	0.697	43.84
Calotropis leaf extract – 5.0%	0.800[c]	0.790	44.03
Control (water treatment)	1.590[d]	-	-

*Mean of three replications. In a column means followed by the same letter are significantly not different by DMRT at p=0.05.

treatments. The consumption was 0.483g per four caterpillars in the castor leaves treated with neem leaf powder extract 5.0 per cent.

Consumption in neem leaf powder treatment was equal to that of *V. rosea* leaf powder treatment (i.e. 2.5 and 5.0 per cent). Larvae consumed 2.313 g untreated castor leaves. In Datura 1.25, 2.5 and 5.0 per cent, the larvae consumed 1.323, 1.257 and 0.867 g of castor leaves, respectively. The decrease in castor leaf consumption by four caterpillars was in *V. rosea* leaf powder extracts were 88.63, 80.80 and 79.12 per cent over control, respectively. Botanicals recorded less consumption. These treatments were significantly superior over control (Table 1).

Effect of botanicals on faecal matter voided by P. ricini larvae

The larvae fed with *V. rosea* 5.0 per cent voided 0.430 g of faecal matter per four caterpillars. It was significantly less than other treatments. In the neem leaf powder 5.0 per cent, the larvae recorded 0.497 g of faecal matter per four caterpillars and it was followed by *V.rosea* leaf powder 2.5 per cent treated castor leaves which registered 0.627 g of faecal matter per four caterpillars (Table 1).

The decrease in faecal matter voided was very high in *V. rosea* 5.0 per cent and it was 78.42 per cent over control. It was followed by neem 5.0 per cent (75.06 %) and *V. rosea* 2.5 per cent (68.54%). The order of decrease in faecal matter voided in other treatments over untreated check was neem 5.0 per cent (58.55%), neem 1.25 per cent (57.70%), Datura 5.0 per cent (56.85%), Calotropis 5.0 per cent (56.20),% *V. rosea* 1.25 per cent (53.29%), Calotropis 2.5 per cent (37.28%), Datura 2.5 per cent (36.93%), Calotropis 1.25 per cent (28.90%) and Datura 1.25 per cent (21.07%).

Effect of botanical leaf powder extracts on P. ricini larval body weight

The larval body weight had decreased in *V. rosea* leaf powder extract 5.0 per cent and it was 0.308 g per four caterpillars. *V.rosea* 2.5 per cent and neem 5.0 per cent leaf powder treated castor leaves recorded less larval weight of 0.457 g when compared to control where there was an increase to the extent of 1.590 g. *Datura* 1.25 per cent, *Calotropis* 1.25, 2.5 and 5.0 per cent recorded less than 50 per cent reduction in larval body weight (Table 2).

The present study indicates that leaf powder extract of *V. rosea* 5.0 and 2.5 per cent are highly effective in reducing the food consumption, larval body weight and faecal matter voided by *P. ricini* larvae under laboratory conditions. Patil and Gaud (2003) reported that methanolic extracts of *V. rosea* had potent IGR activity against third instar larvae of Helicoverpa armigera. *V. rosea* is rich in alkaloids such as vincristine, vincaleukoblastine, ajmalicine, raubacine and reserpine (Kumar *et al.,* 2004).

The extracts of *V. rosea* caused feeding inhibition, gustatory repellency, impairment in food assimilation and imbalance in enzyme activity that would have caused malfunctioning of digestive system and that would have resulted in oozing of internal body contents (Nelson Jeyarajan *et al.,* 2006). The present investigation with water extracts also resulted in reduced feeding, which might be due to interference resulting in reduced growth.

The results indicated that neem leaf powder extract 5.0 per cent reduced the food consumption, larval body weight and defaecation next to *V. rosea* leaf powder products. Schmutterer (1990) reported that neem affected metamorphosis including insect growth regulation, adult fertility, toxicity and behaviour, owing to antifeedant and oviposition deterrent

effects. It contains two major triterpenoids (azadirachtin and salannin), that have antifeedant, repellent and growth regulatory properties (Warthen *et al.,* 1978; Reed *et al.,* 1982.)

Biochemical interferences that were caused in the digestive system might have led to reduced food consumption by the *P. ricini* larvae. Simmonds *et al.* (1995) reported that when azadirachtin and its analogues significantly reduced food intake and insect growth of the Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd).The activity of the midgut enzymes (protease, phosphatase, amylase and invertase) was reduced by 18± 40 per cent (Ayyangar and Rao, 1989). Hence, such kind of influence would have resulted in reduced food consumption and consequently the faecal pellets voided.

Neem leaf powder would also inhibit the normal growth and development of *P.ricini* by affecting growth hormone systems (Koul, 1987). Ayyangar and Rao (1991) revealed that azadirachtin reduced the body weight of *S.litura* larvae because of reduction in storage proteins in the haemolymph of larvae. Singh (1996) reported that rearing of neonate larvae of *S. litura* on plants treated with Neemolin (1%) led to a considerable reduction in percentage larval weight, survival and pupation, pupal weight and malformation in adults. Similarly giganticine, a novel nonprotein amino acid, isolated from a methanol extract of the root bark of *C. gigantea* (collected from India) exhibited significant antifeedant activity against nymphs of the desert locust *Schistocerca gregaria* (Pari *et al.,* 1998).

Plants like *C. gigantea* and *D.metal* have medicinal properties and they have been in use in traditional or ayurvedic medicine for long time. Though they had not caused mortality of caterpillars, it is imperative from the experiment that they had altered the larval physiological system.It is surmised that plant origin insecticides are considered to be safe to natural enemies and free from any residue problem on crop and environment. Considering the overall performance, *V. rosea* and neem leaf extract can be utilized in the management of *P. ricini* after confirming their efficacy under field conditions.

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