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Research Article

GROWTH REGULATING ACTION OF LEAF EXTRACT OF *CATARANTHUS ROSEUS* ON DEVELOPMENT OF *SPODOPTERA LITURA*

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ABSTRACT
Feeding deterrents or antifeedant chemicals are those chemicals which inhibit feeding of insect on a treated food material without necessarily killing or repelling them. Plants with ant feeding properties are increasingly being used against phytophagous insect pests for protection of crops. In the present study of growth regulating action of Leaf extract of *Catharanthus roseus on* development stages of Spodoptera *litura*. Results show that growth regulating effect of *C.roseus* was more profound when larvae were treated with the leaf extract by topical application method. Highest mortality of 44.16 percent was observed during development when 2nd instar larvae of *S.litura* were treated with 0.5% extract (compared to 13.35 percent in control). At the concentrations of 0.01, 0.05 and 0.1% total mortality recorded was 21.00, 24.99 and 36.66 percent respectively Total mortality caused during development was maximum of 44.16 percent when second instar larvae were treated with the leaf extract of C*atharanthus roseus* at 0.5%.

Keywords**:** *Spodoptera Litura, Plant Extract Growth Regulating Action, Leaf Extract, Catharanthus Roseus*

INTRODUCTION
Agricultural sector in India has long been recognized for its dependence on chemical Control for the management of biotic stresses (insect, diseases, and weeds). The increasing population often demands more and more food grain production. The crop yields in farms are generally low and there are wide gaps between the farmers' yields and the potential yields of several crops. Though reliable estimates on crop losses are limited, Oerke *et al.,* (1995) brought out about 42 % loss in global output.
Due to insect pests, diseases and weeds despite the use of plant protection options. The loss could have been up to 70% in the absence of plant protection. In India, the pre-harvest loss was up to 30% in cereals and pulses and it can be up to 50% in cotton and oil seeds crops (Dhaliwal and Arora, 1993). Annual Economic loss due to Helicoverpa alone was estimated at Rs. 2,000 crores despite the use of pesticides Worth Rs. 500 crores (Pawar, 1998).
India is basically an agriculture based country and more than 80% of Indian population depends on it. Agricultural productivity influences the Indian economy.
Insect pests are known to cause significant damage to crops. *Spodoptera litura* (Fabricius) the common cutworm is an economically important noctuid moth which is a polyphagous pest causing considerable economic loss to many vegetables and field crops the major ones being tobacco, cotton, rice, maize, cabbage, lettuce, tea etc. It is able to destroy a vegetable crop and particularly prefers vegetables within cabbage family.
Management of *Spodoptera litura* (Fabricius) population using synthetic insecticides has proved futile as it has developed resistance to several classes of insecticides. Moreover an increased awareness of potential dangers of synthetic pesticides as well as a permanent increase in pest resistance, resurgence, residual toxicity, and environment deterioration etc. during past three decades has led the scientists to examine the possibility of using less persistent, biodegradable, and economical and ecofriendly alternatives including plant-derived insecticides.
The tobacco cutworm can quickly spread throughout the crop if it has a suitable environment. *Spodoptera litura* has been reported to attack 112 plant species belonging to 44 families, of which 40 species are

known from India (Ramana *et al.,* 1988; Dhir *et al.,* 1992). *Spodoptera litura* has shown resistance against all the insecticidal groups (Murugan and Dhingra, 1995; Armes *et al.,* 1997; Kranthi *et al.,* 2002) including the newly synthesized lufenuron (Sudhakaran, 2002).

Plants are the storehouse of a wide array of bioactive chemicals that are used in defense against herbivores. These photochemical, which are mainly terrenes, alkaloids, steroids, phenolics, tannins etc can control pest due to their multiple modes of action. These compounds are deleterious to insects in multiple ways, such as through acute toxicity, affecting insect behavior, disrupting growth and development of insects and acting as repellents, anti-feedants and oviposition deterrents. The use of botanical pesticides for protecting crops from insect pests has assumed great importance in recent years. Numerous plant species have been reported to possess pest control properties but only a few of them have been successfully registered as an insecticide in recent years. The plant-derived insecticides show variable effect against different insect species. Thus in the present scenario, the finding of specific plant-derived pesticides is inevitable and is need of the hour.

Basker *et al.,* (2011) evaluated the bioefficacy of leaf extracts of two plants, *Blumea mollis* and *Hygrophila auriculata* against *Spodoptera litura* to assess their antifeedant, larvicidal and growth regulating action. Larvicidal activity of some plants was observed by Chauhan *et al.,* (2011) against *Spodoptera litura*.

In the present study, second instar larvae of *Spodoptera litura* were treated with sublethal doses of leaf extracts of *Catharanthus roseus* by Topical treatment methods. The parameters observed were mortality in larvae and pupae, duration of larval and pupal stages and adult emergence.

MATERIALS AND METHODS

A. Experimental Insect

Spodoptera litura (Fabricius) (Lepidoptera: Noctuidae) commonly called tobacco caterpillar or cutworm was selected for the proposed investigation. *Spodoptera litura* is a polyphagus pest of large host range including tobacco, cotton, cabbage, groundnut, maize, jute, lettuce etc.

For laboratory rearing the egg masses of *Spodoptera litura* were procured from Agricultural Research Station, Durgapura, Jaipur. Rearing was done at the temperature of 27 ± 2^0C , 75 ± 5% RH and 10: 14 hrs of Light: Dark period. The eggs were surface sterilized with 0.02% sodium hypochloride solution, dried and allowed to hatch.

B. Experimental Plant Material

Extraction of Leaves

Fresh leaves of the plant, *Catharanthus roseus* was plucked and chopped into small pieces and allowed to dry naturally in the shade.

Thereafter the dried leaves were powdered in domestic hand grinder to get 40 mesh powders. Leaves of plants were extracted by Soxhlet-extraction method. Acetone was used as solvent. 30 gms. Of 40 mesh leaf powder was extracted with 300 ml of solvent for 8 hours over a mantle heater at 50ºC. The extract was filtered through Whatman filter paper no.1 and concentrated on a water bath. Concentrated extract was weighed on electronic balance and it represented 6% of the total dry weight of powdered leaves. The dried extracts were stored in refrigerator.

RESULTS AND DISCUSSION

Results

Second instar larvae of *Spodoptera litura* were treated with sublethal doses of leaf extracts of *Catharanthus roseus* by topical application methods. The parameters observed were mortality in larvae and pupae, duration of larval and pupal stages and adult emergence. Growth indices and relative growth indices on treatment with the plant extracts were calculated. Observations were taken till the adult emergence from the treated larvae.

Topical Application Method

Mortality: Results show that growth regulating effect of *C.roseus* was more profound when larvae were treated with the leaf extract by topical application method. Highest mortality of 44.16 percent was

observed during development when 2nd instar larvae of *S.litura* were treated with 0.5% extract (compared to 13.35 percent in control). At the concentrations of 0.01, 0.05 and 0.1% total mortality recorded was 21.00, 24.99 and 36.66 percent respectively (Table 1).

Larval mortality was maximum of 24.16 percent at 0.5% extract. 8.33, 10.83 and 20.50 percent mortality was observed at the concentrations of 0.01, 0.05 and 0.1% respectively. In control experiment mortality during larval period was 6.15 percent.

Prepupal stage showed high susceptibility as was evident by high mortality during this stage. 20.00 percent mortality was reported in pre-pupa when larvae were treated with 0.5% extract. At 0.01, 0.05 and 0.1% concentrations mortality was 6.66, 8.33 and 14.16 percent respectively. In control experiment pre-pupal mortality was 3.00 percent. Mid-pupal mortality was observed only at the concentrations of 0.01 and 0.05% where it was 3.33 percent (2.15 percent in control). Pupal mortality was 2.50 percent at 0.01 and 0.05% extract.

Mortality in newly emerged adult was only 0.16 percent at the lowest concentration of 0.01%. At other concentrations adult mortality was not reported.

Larval and Pupal Periods: Prolongation in developmental period was greater when 2nd instar larvae were treated with *C.roseus* leaf extract by topical application method. Developmental period showed maximum prolongation to 41.51 days at the 0.5% extract (18.39 days in control). At 0.01, 0.05 and 0.1% extract treated larvae completed their development in 24.16, 27.06 and 32.06 days respectively (Table 2).

Prolongation in larval period was upto 27.50 days at the concentration of 0.5%. At 0.01, 0.05 and 0.1% extract treated larvae completed their development in 14.73, 16.78 and 21.83 days respectively. In control experiment larval period was reported as 11.59 days.

Pupal period showed maximum prolongation to 14.35 days when larvae were treated at 0.5% extract (6.80 days in control). At 0.01, 0.05 and 0.1% concentration pupal period was increased to 9.43, 10.28 and 11.50 days respectively.

Table 1: Effect of Leaf extract of *Catharanthus roseus* on development of *Spodoptera litura* following a Topical treatment on early second instar larvae

Doses %	Percent Larval (II,III,IV, V ,VI instar) Mortality Mean ± SE	Percent Pre-pupal (shrunken stage) Mortality Mean ± SE	Percent Mid-pupal (Larval-Pupal intermediate) Mortality Mean ± SE	Percent Pupal Mortality Mean ± SE	Percent Adult Mortality Mean ± SE	Percent Total Mortality Mean ± SE
0.01	8.33 ± 0.33	6.66 ± 0.32	3.33 ± 0.33	2.50 ± 0.25	0.16 ± 0.05	21.00 ±0.66
0.05	10.83 ± 0.38	8.33 ± 0.05	3.33 ± 0.15	2.50 ± 0.22	NIL	24.99 ± 0.43
0.1	20.50 ± 0.63	14.16 ± 0.16	NIL	NIL	NIL	36.66 ± 1.00
0.5	24.16 ± 0.66	20.00 ± 0.33	NIL	NIL	NIL	44.16 ± 1.25
Control	6.15 ± 0.33	3.00 ± 0.25	2.15 ± 0.15	2.05 ± 0.25	NIL	13.35 ± 0.85
F-Value	86.5	207.6	-	-	-	253.21
CV at 5%	3.34	2.98	-	-	-	3.34

30 larvae treated at each concentration

$$GI = \frac{\text{No. surviving as adult}}{\text{No. of larvae treated}} \qquad RGI = \frac{\text{GI Treated}}{\text{GI control}}$$

Adult Emergence: Maximum reduction (38.34%) in adult emergence was observed at 0.5% extract. In control experiment reduction in adult emergence was 8.00 percent. At 0.01, 0.05 and 0.1% extract percent reduction in adult emergence was 12.00, 26.00 and 28.34 percent respectively (Table 2).

Discussion

Results obtained in the present investigation show that leaf and seed extracts of C*atharanthus roseus* possess strong growth regulatory properties against *Spodoptera litura.* Total mortality caused during development was maximum of 44.16 percent when second instar larvae were treated with the leaf extract of C*atharanthus roseus* at 0.5%.

Strong insect growth regulating (IGR) activity of *C.roseus* observed in the present investigation against *Spodoptera litura* is supported by the study of Deshpanday *et al.,* (1988) who reported growth inhibitory property of an acetone extract of *Catharanthus roseus*. Singh *et al.,* (2003) reported that treatment with □-amyrin acetate isolated from *C.roseus* produced 52.63 to 57.80% mortality in *Spodoptera litura*. The bioefficacy of *C.roseus* leaf extract at 5% was reported against *Amsacta moorei* by Patel *et al.,* (1990), and high larval mortality compared to *A.indica* was reported after 24 hours of treatment.

Table 2: Growth regulating action of Leaf extract of *Catharanthus roseus* on development of *Spodoptera litura* following Topical treatment

Doses %	Average Larval Period (II to VI instar) Mean±SE	Average Pupal Period (Pre-pupa to Adult emergence) Mean±SE	Average Development Period (II instar to Adult) (b) Mean±SE	Percent Adult Emergence (a) Mean ±SE	Percent reduction in Adult Emergence Mean±SE	Growth Index a/b
0.01	14.73±1.12	9.43±0.45	24.16±1.17	88.00±2.00	12.00±2.00	3.64
0.05	16.78±1.06	10.28±0.25	27.06±1.24	74.00±3.46	26.00±3.45	2.73
0.1	21.83±1.60	11.50±0.50	32.06±0.95	71.66±2.88	28.34±2.88	2.23
0.5	27.50±1.00	14.35±0.60	41.51±0.56	61.66±2.88	38.34±2.88	1.48
Control	11.59±0.99	6.80±1.25	18.39±1.02	92.00±0.95	8.00±1.35	5
F-Value	87.05	231.28	188.57	142.4	287.17	-
CV at 5 %	3.34	3.34	3.34	3.34	3.34	-

Growth regulating property of *Catharanthus roseus* have been reported earlier and Fitt (1989) reported that α-amyrin acetate found in the n-hexane fraction of acetone extract of *C.roseus* is a natural resource of IGR against *Spodoptera litura* F. and *Helicoverpa armigera*. In the present investigation treatment of second instar larvae greatly retarded the larval and pupal growth which is evident by an abnormal prolongation of larval and pupal durations. The treated larvae showed several malformations which occurred in dose-dependant manner. At higher concentrations (0.1 and 0.5 %) larvae died before transformation to pupae. Larvae that reached pupal stage belonged to the lowest concentration of 0.01 and 0.05 %. Adults emerged from treated larvae showed many deformaties.

In the present study when second instar larvae of *S.litura* were treated with *C.roseus* leaf extract, a significant fall in the emergence of adults was observed and average developmental period was prolonged. Results obtained are in conformation to the observations by Singh (2003) who reported a

maximum IGR activity of 84.2% when *Heliothis armigera* larvae were treated with α-amyrin acetate isolated from *C.roseus.*

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