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Antifeedant and toxicity of root extract of *Catharanthus roseus* (L.) G. Don on the tobacco leaf armyworm, *Spodoptera litura* (Fabricius)

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The effect of root extracts of *Catharanthus roseus* (L.) G. Don on the larval mortality, fecundity and fertility of *Spodoptera litura* (Fabricius) was investigated in the present study. The larval mortality was increased in root extract exposed *S. litura* as the concentration increased. The Pupal weight, fecundity and the hatching efficiency of egg were decreased as the concentration of the root extract increased. Thus, the phytochemicals present in the *C. roseus* has potential as botanical insecticide in alternative control strategies against *S. litura*.

Catharanthus roseus / *Spodoptera litura*

Due to the many problems associated with the use of acutely toxic, synthetic chemicals as insecticides, a search is underway to discover new, less damaging pest management tools (Isman, 1995). Botanical insecticides offer a more natural, `environmentally friendly' approach to pest control than do synthetic insecticides. Screening of plant extracts for deleterious effects on insects is one of the approaches used in the search for novel botanical insecticides (Arnason *et al*., 1993; Isman, 1995; Secoy and Smith, 1983). *Catharanthus roseus* (L.) G. Don, (Apocynaceae) commonly known as the tropical periwinkle, is a plant of medicinal importance due to its anticancer and antitumour activities which are attributed to the presence of the alkaloids vincristine and vinblastine in its leaves. The roots are used in various ways in traditional as well as folk medicine. Alkaloids present in the plants are also effective in leukaemia treatment, diabetes, hypertension and menorrhagia etc. (Atal and Kapur,1977). Little work has been done on the anti-insect properties of the root extract of *C. roseus* compared with the aerial portion (Deshpandey *et al.*, 1988). The tobacco cutworm, *Spodoptera litura* (Fabricius) is a serious and polyphagous insect, its reproductive capacity and migration ability over long distances has made it an economically important pest of many agricultural crops. It has been reported to attack on 112 plant species belonging to 44 families, of which 40 species are known from India (Mallikarjuna *et al*., 2004). In the present study, we aimed to examine the insecticidal activity of root extract of *C. roseus* on the antifeedant activity, larvicidal activity, pupal development and fecundity of *S. litura*.

Author contributions: A. Ganesh Kumar and C. Edward perform research work and K. Rajan critical evaluation and data analysis on this manuscript.

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Materials and Methods

Test insect

The eggs of *S. litura* were collected from castor fields in Soorankudi near Sattur, Virudhunagar district, Tamil Nadu, South India. The eggs were allowed to hatch out and the populations were maintained in laboratory conditions (temperature: 30 ± 2° C, RH: 75 ± 5 %; Photoperiod: 12 ± 1 hr.). The nymphal instars were maintained on fresh castor leaves (*Ricinus communis* L.) in the plastic troughs (15 x 30 cm).

Plant extraction

The roots of *C. roseus* were shade dried and powdered using electric blender. Twenty five grams of sieved powder of *C. roseus* were extracted by using Soxhlet apparatus for 8 hrs using acetone as solvent (Peach and Tracey, 1956). The residual extract was filtered and concentrated on a water bath. Then the residual extract was weighed and dissolved with little acetone and made up to 100ml using distilled water. Various concentration of root extract of *C. roseus* such as 1 %, 2 %, 3 %, 4 % and 5 % were prepared from the stock solution.

Toxicity

Freshly plucked castor leaves cleaned with distilled water and soaked in different concentrations of root extracts for 30 seconds and dried for 5 min. The newly hatched third instar larvae were fed with the castor leaves treated with each concentration. For control the larvae were fed with fresh castor leaves without any treatment. Six larvae per replication and ten replications were maintained for each concentration. Mortality data were recorded after 24 hr. The pupal weight was also measured using the electric balance.

Fecundity and hatching efficiency

After adult emergence, adults in the control and each concentration were allowed to mate in beakers containing 20 % glucose solution soaked in a cotton swap as food and castor leaves for egg laying. The number of eggs laid was recorded for each concentration with one pair. Ten replications were maintained for each concentration. The percentage of hatching efficiency was calculated using the following formula:

$$HE = \frac{\text{Number of eggs hatched out}}{\text{Number of eggs laid per adult}} X\ 100$$

All data collected from the experiments were analyzed statistically by analysis of variance (ANOVA) followed by mean comparison with Tukey's tests using the software OriginPro. 7.5.

Results and Discussion

The larval mortality was increased as the concentration of the root extract increased over the control (Table 1). The maximum mortality was observed in the concentration of 5 % as 76.67±21.34 % and in the control there was no mortality. This might be due to the presence of alkaloids like Ajamalicine, Serpentine and Reserpine. Similarly, Shah (1992a) reported that 11 to 100 % mortality in house-cricket adults with leaf and root extracts of *C. roseus* when applied topically. He also told that the root extracts are more toxic than leaf alkaloids. The insecticidal properties of *C. roseus* have been reported against *Amsacta moorei* Butler (Patel *et al*., 1990), *Dysdercus cingulatus* (Fabricius) (Rajendran and Gopalan, 1980), *Phthroimaea operculella* Zeller (Deshpande *et al*., 1990), *Spodoptera littoralis* Boisduval (Meisner *et al*., 1981) and *S. litura* (Deshpande *et al*., 1988).

The pupal weight decreased as 249.1±2.47, 248.0±2.32, 241.1±2.7, 236.6±2.46 and 233.4±2.01 mg in 1 %, 2 %, 3 %, 4 % and 5 %, respectively over control (253.6±4.29). This reduction may be due to the antifeedant activity of the extracts. Kumar and Sevarkodiyone (2009) reported the effect of *Annona squamosa* L. and *Lepidium sativum* L. on the pupal weight of *S. litura*. Similar observation was reported by Pathrose *et al*. (2007) as the pupal weight was increased higher in methanol extract from aerial parts of *Andrographis paniculata* (Burm f.) Wall. Ex Nees than the hexane extract. Elumalai *et al*. (2004) also reported that the hexane extract of *Acorus calamus* L. leaf showed highest and significant antifeedant activity (77.8%) followed by *Lobelia leschenaultiana* L. on *S. litura*. Gupta and Raghuraman (2004) reported the effect on pupal weight and pupal abnormalities when the larvae were fed with Neemazal and Neem Triguard. Wheeler *et al*. (2001) reported that when the concentration of crude extract of *Trichilia americana* (Sesse and Mocino) increased the weight of pupae of *S. litura* was decreased.

Table -1: Effect of root extracts of *Catharanthus roseus* on the larval mortality, pupal weight, fecundity and egg hatching efficiency of *S. litura* (n=10).

Parameters	Control	Concentration of root extracts of *C. roseus*				
		1%	2%	3%	4%	5%
Larval mortality (Mean % ±SD)	0a	26.67±15.27b	36.67±16.33bc	45.00±16.75bc	51.67±17.40c	76.67±21.34d
Pupal weight (mg) (Mean ± SD)	253.6±4.29a	249.1±2.47b	248.0±2.32bc	241.1±2.7d	236.6±2.46e	233.4±2.01ef
Fecundity (in numbers) (Mean ± SD)	510.8±16.44a	488.3±14.31b	449.8±13.65bc	429.3±7.29d	418.4±4.74de	381.0±11.37f
Egg hatching (Mean % ± SD)	99.80±0.61a	97.16±1.63a	92.22±2.90b	84.82±3.27c	73.64±2.97d	60.83±3.74e

Values followed by similar alphabets are statistically not significant at P=5 % level (Tukey test).

The fecundity was significantly different at P=0.05 level (Table 1). The fecundity was also decreased as the concentration of the root extract increased. This may be due to the antifeedant activity. Kumar and Sevarkodiyone (2009) reported *A. squamosa* and *L. sativum* reduced the fecundity of *S. litura*. Similarly, Sharma and Seth (2005) reported that the fecundity of *S. litura* was reduced in both azadirachtin alone and combined with gamma radiation.

The hatching efficiency of egg of *S. litura* was also affected significantly (P=0.05) due to the effect of different concentration of root extracts of experimental plants (Table 2). Kumar and Sevarkodiyone (2009) also reported *A. squamosa* and *L. sativum* reduced the hatching efficiency of eggs of *S. litura*. Similarly, Sharma and Seth (2005) reported that the fertility of *S. litura* was reduced after the treatment of azadirachtin than in control. Sundar *et al*. (2000) also reported that the lethal concentrations of azadirachtin based proprietary formulations affected egg hatchability in 50-60% of *S. litura*. Thus, the root extract of *C. roseus* affected the survival, fecundity and fertility of *S. litura*. Hence, the present study reveals that the further studies on the chemical components present in *C. roseus* needed to use this plant as biocontrol agent as botanical insecticide.

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References

Arnason JT, MacKinnon S, Durst A, Philogene BJR, Hasbun C, Sanchez P. 1993 Insecticides in tropical plants with non-neurotoxic modes of action. In: *Phytochemical Potential of Tropical Plants* (eds.) Downum, K.R., Romeo, J. and Stafford, H., Plenum Press, New York, pp. 107-131.

Atal CK, Kapur BM. 1977. *Cultivation and Utilization of Medicinal and Aromatic Plants*. Regional Research Laboratory, Jammu Tawai, pp. 138.

Deshpande SG, Joseph M, Sharma RN. 1988. Insect growth and development inhibition properties of *Catharanathus roseus*. *International Journal of Tropical Agricultural* 6(3-4):287-290.

Deshpande SG, Nagasampagi BA, Sharma RN. 1990. Synergistic oviposition deterrence activity of extracts of Glycosmis pentaphyllum (Rutaceae) and other plants for Phthorimaea operculella (zell) control. *Current Science*, 59(19): 932-933.

Elumalai K, Jeyasankar A, Raja N, Ignacimuthu S. 2004. Evaluation of certain plant extracts for deterrent activity against tobacco armyworm, *Spodoptera litura* (Fabricius). *Indian Journal of Ecology*, 31(1): 8-10.

Gupta GP, Raghuraman M. 2004. Utilization of biopesticides in cotton pest management. In: *Biopesticides for Sustainable Agriculture: Prospects and Constraints*, (ed.), Kaushik, N. CAB Abstracts, Teri Press, The Energy and Resources Institute.

Isman MB. 1995. Leads and prospects for the development of new botanical insecticides. In: Reviews in Pesticide Toxicology, (eds.), Roe, R.M. and Kuhr, R.J., Vol. 3, Toxicology Communications Inc., Raleigh, NC, U.S.A, pp. 1-20.

Kumar AG, Sevarkodiyone SP. 2009. Effect of seed extracts of *Annona squamosa* L. and *Lepidium sativum* L. on the pupal development and reproductive parameters of tobacco cutworm, *Spodoptera litura* (Fabricius). *Hexapoda*, 16(2): 132-135.

Mallikarjuna N, Kranthi KR, Jadhav DR, Kranthi S, Chandra S. 2004. Influence of foliar chemical compounds on the development of *Spodoptera litura* (Fab.) in inter-specific derivatives of groundnut. *Journal of Applied Entomology*, 128: 321-328.

Meisner J, Weissenberg M, Palevitch D, Aharonson N. 1981. Phagodeterrency Induced by Leaves and Leaf Extracts of*Catharanthus roseus* in the Larva of *Spodoptera littoralis*. *Journal of Economic Entomology*, 74(2): 131-135.

Patel JR, Jyani DB, Patel CC, Board PK. 1990. In: *Botanical Pesticides Integrated Pest Management* (eds.) Chari, M.S. and Ramaprasad, G., Indian Society of Tobacco Science, Rajahmundry, India, pp. 332–339.

Pathrose B, Srivastava C, Walia S. 2007. Insect growth regulatory activity of *Andrographis paniculata* (FA: Acanthaceae) extracts against tobacco caterpillar, *Spodoptera litura*. *Indian Journal of Entomology*, 69(1):17-21.

Peach K, Tracey MV. 1956. *Modern Methods of Plant Analysis*, Springer Verlag, Berlin. pp. 33.

Rajendran B, Gopalan M. 1980. Juvenile hormone like activity of certain plant extracts on *Dysdercus cingulatus* Fabricius (Heteroptera: Pyrrhocoridae). *Indian Journal of Agricultural Sciences*, 50: 781-784.

Secoy DM, Smith AE. 1983. Use of plants in control of agricultural and domestic pests. *Economic Botany*, 37:28-57.

Shah, SD. 1992a. Inhibitory action of *Catharanthus roseus* total leaf alkaloids extracts on fecundity of the house-cricket, *Gryllodes siqillatus* (Walker) (Orthoptera: Gryllidae). *Bioved*., 3(2):169-174.

Shah SMD. 1992a. Effect of plant extracts on the mortality of *Gryllodes siqillatus* (Orthoptera: Gryllidae). *Journal of Ecotoxicology and Environmental*, 2(1):27-30.

Sharma AK, Seth RK. 2005. Combined effect of gamma radiation and Azadirachtin on the growth and development of *Spodoptera litura* (Fabricius). *Current Science*, 89(6): 1027-1031.

Sundar MS, Krishnayya PV, Rao A. 2000. Evaluation of lethal concentrations of azadirachitin based proprietary formulation for larvicidal and ovicidal effect against *Spodoptera litura* (Fab.). *Journal of Entomological Research*, 24(2): 147-150.

Wheeler DA, Isman MB, Sanchez-Vindas PE, Arnason JT. 2001. Screening of Costa Rican *Trichilia* species for biological activity against the larvae of *Spodoptera litura* (Lepidoptera: Noctuidae). *Biochemical Systematics and Ecology*, 29: 347-358.