*Asian J. of Bio Sci. (2007) Vol. 2 No. 1 : (25-30)*

# Ovicidal and ovipositional deterrent botanicals against *Leucinodes orbonalis* Guenee (Pyraustidae : Lepidoptera)

P. YASODHA[1]* AND N. NATARAJAN[2]
[1] Department of Plant Molecular Biology and Biotechnology, Centre for Plant Protection Studies, T.N.A.U., COIMBATORE (T.N.) INDIA
[2] Department of Agril. Entomology, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA

(Accepted : February, 2007)

Laboratory experiments were carried out inorder to test the oviposition deterrency and ovicidal action of certain wild *Solanum* spp., kernels of *Azadirachta indica* and dried powder of *Acorus calamus* against *Leucinodes orbonalis* females and its eggs. Maximum oviposition deterrency is expressed in the form of minimum oviposition index (OI). At highest concentration of 5 per cent as aqueous extract, NSKE + *A. calamus* was found to have minimum oviposition index of 0.22, indicating the strong oviposition deterrent effect. Considering wild *Solanum* spp, *S. mauritianum* exhibited strong deterrency only at 5 % concentration. Methanol extracts of NSKE + *A. calamus* as observed in the aqueous extract showed maximum oviposition deterrency with the least OI (0.14). Among wild *Solanum* spp., the strong deterrancy was exhibited by 0.2 per cent methanol extract of *S. viarum* and *S. lasiocarpum*. Hence, organic solvents of various tested botanicals exhibited more deterrency effect than the aqueous extract. The maximum ovicidal action (62.60%) was achieved with NSKE +*A. calamus* combination while the minimum was by *S. trilobatum* (25.61%).

Key words : Botanicals, Oviposition deterrancy, Ovicidal nature, *L. orbonalis.*

## INTRODUCTION

Considering the vegetable production in the global scenario, India occupies the second after China. The average productivity of eggplant in India has been estimated to be 130.8 q / ha. Out of several factors to cause low productivity, the insect pest attack to the crop is one of the vital constraints. *Leucinodes orbonalis* is the most important and destructive pest of eggplant. The pest starts damaging eggplant a few weeks after transplantation.

Upto 70 per cent loss is caused to the crop by this pest. Lack of resistant varieties as well as efficient biological control measures forced the farmers for using toxic chemicals for its control. Of late, there has been reduced effectiveness of several chemical in controlling this pest. This situation is further aggravated owing to indiscriminate as well as frequent use of tank mix of highly toxic pesticides irrespective of safe waiting period, chemical group and monoculture of the crop in the same area over years.

The management of this pest after hatching is very difficult, therefore, in the present study, management of eggs and laying of eggs by adults are targeted by using botanicals.

## MATERIALS AND METHODS

Laboratory experiment with aqueous and solvent extracts of the leaves of wild *Solanum* spp. (*Solanum pubescence, S. seaforthianum* Dunal, *S. macrocarpum* L, *S. torvum* Sw., *S. nigrum* L., *S. trilobatum* L., *S. erianthum* Don, *S. incanum* L., *S. viarum* Dunal., *S. robustum* Ripperger., *S. mauritianum* Scop., *S. lasiocarpum* Dunal., *S. elagnifolium* Cav., *S.xanthocarpum* Schrad.), kernel of *Azadirachta indica* and dried powder of *Acorus calamus* L. were tested against *Leucinodes orbonalis* eggs and its females.

Aqueous extract was prepared with leaves (15 g) of each plant species were homogenized in 100 ml of water using the mixer and allowed to settle at room temperature in a flask. After 30 minutes, the extract was filtered through muslin cloth and filter paper. In the case of neem seed kernel extract NSKE, 15 g of kernel powder was soaked in 100 ml of hot distilled water overnight and homogenized and filtered. Filtrate of both wild *Solanum* and neem kernel was made up to 500 ml and refrigerated for further use. In the case of *A. calamus*, 50 g of dust was soaked in 100 ml of distilled water for an hour and filtered. The test concentrations of 2, 3 and 5 per cent of wild *Solanum* spp, *A. indica*, and *A. calamus*

* Author for Correspondence

were prepared and tested for oviposition deterrency against *L. orbonalis*.

Similarly, to test organic solvent extracts (hexane, ethyl acetate and methnol) with 15 g leaves of each plant species soaking in 100 ml of organic solvents separately for 30 minutes and homogenizing with a mixer. The extract was filtered through filter paper. In the case of NSKE and *A. calamus,* 15 g of kernel powder was soaked in the 100 ml of organic solvents for overnight, homogenized in a mixer and filtered, while *A. calamus*, 10 g of dust was soaked in 100 ml of organic solvents for an hour and filtered. The solvent in the respective filtrates was evaporated in water bath at $60^0$C to get thick mass / crude extract. These crude extracts were refrigerated for further use. The test concentrations of 0.1, 0.15 and 0.2 per cent of *A. indica*, *Acorus calamus* and wild *Solanum* spp. were prepared as and when required.

Oviposition deterrency was tested in rearing cages (40 cm l x 40 cm b x 40 cm h). Fresh and clean CO 2 brinjal (30 days old) plants were sprayed by the hand atomiser at various concentrations of aqueous and organic solvent extracts of botanicals (as mentioned above) and allowed to air dry at room temperature for 30 min. The treated plants were kept at 15 cm apart from the untreated plants inside the rearing cages. A single pair of *L. orbonalis* was released for egg laying on plants with 10 per cent honey as adult feed. The observations were made on the number of eggs laid on the treated plants, untreated plants, and the walls of the glass cage at 24 h intervals for ten days. From these observations, the oviposition index was calculated by using the following formula suggested by Bajpai and Sehgal (2003) for *H. armigera.*

$$\text{O.I.} = \frac{\text{No. of eggs laid on treated surface}}{\text{No. of eggs laid on untreated surface}}$$

Treatment effect was graded based on the Oviposition Index (OI) value as given below OI = >1- Preferred for egg laying; OI=1- No effect; OI = >0.6 to <1.0- Weak oviposition deterrent effect; OI=>0.3 to 0.6- Moderately deterrent; OI==0.3- Strong oviposition deterrency; OI= Nil- Not selected for egg laying.

For testing the ovicidal action, a pair of laboratory reared, *L. orbonalis* adults were released for egg laying on clean CO 2 brinjal plant (30 days old plant) kept inside the rearing cages (60 cm l, 60 cm b and 60cm ht). After 24 h, the plants were examined for number of eggs laid and were sprayed with varied test concentrations of solvent extract of botanicals using hand atomizer. After air-drying, the sprayed plants were kept inside the rearing cages and were observed for the number of eggs hatched after four days.

Data were analysed using 2 factor and 3 factor completely randomised design. Data on number and weight of various life stages of host was transformed into square root values v (x+0.5). The number of eggs laid on the muslin cloth and walls of the cage in the choice chamber experiments were considered as a treatment choice in CRD statistical analysis.

## Results and Discussion

*Oviposition deterrancy :*

Aqueous and organic solvent extracts of leaves of wild *Solanum* spp., neem seed kernel extract (NSKE) and *Acorus calamus* powder were tested for oviposition deterrancy action. Oviposition index was arrived based on the number eggs laid on the treated surface with respect to the untreated.

*Aqueous extract :*

On an average of all the tested aqueous concentrations, maximum oviposition deterrency expressed in the form of minimum oviposition index (OI) of 0.24 was exhibited by NSKE + *A. calamus* combination, and the minimum deterrency was by *S. torvum* (1.04 OI) and *S. trilobatum* (1.03 OI). NSKE and *A. calamus* when applied individually, the O.I was significantly lower than their combination. Among these two NSKE performed better than *A. calamus*. Of the wild *Solanum* species, *S. mauritianum* had OI of 0.3, which was at par with *A. calamus*. At highest concentration, NSKE (5%) + *A. calamus* was found to have minimum oviposition index of 0.22, indicating the strong oviposition deterrent effect, when *S. torvum* had the maximum oviposition index of 1.12 exhibiting least oviposition deterrancy. The NSKE and *A. calamus* combination were found to have strong oviposition deterrency at all concentration where as, *S. mauritianum* showed strong deterrency only at 5 % concentration (Table 1). The O.I of NSKE + *A. calamus* at 2 and 3 per cent was at par with each other with an oviposition index of 0.25, falling under the category of strong deterrancy.

*Organic solvent extracts :*

Organic solvent extracts of NSKE + *A. calamus* as observed in the aqueous extract showed maximum oviposition deterrancy with the least of 0.14 O.I. while the minimum with *S. trilobatum* (0.74). In general, organic solvents of various tested botanicals exhibited more deterrancy effect than the aqueous extract. There is no botanical extracted with organic solvents showed more than 0.76 O.I (*S. trilobatum*). This indicated that the

Table 1 : *Effect of aqueous extracts of botanicals on the oviposition behaviour of L. orbonalis*

| S.No. | Botanicals | Oviposition Index | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | | Aqueous extract | | | | | | |
| | | 2% | Class | 3% | Class | 5% | Class | |
| 1. | *S. pubescence* | 0.81 | WD | 0.81 | WD | 0.69 | WD | $0.77^{k}$ |
| 2. | *S. seaforthianum* | 0.83 | WD | 0.73 | WD | 0.70 | WD | $0.75^{jk}$ |
| 3. | *S. macrocarpum* | 0.71 | WD | 0.70 | WD | 0.67 | WD | $0.69^{j}$ |
| 4. | *S. torvum* | 1.12 | PO | 1.10 | PO | 0.92 | WD | $1.04^{l}$ |
| 5. | *S. trilobatum* | 1.09 | PO | 1.04 | PO | 0.98 | WD | $1.03^{l}$ |
| 6. | *S. erianthum* | 0.81 | WD | 0.76 | WD | 0.72 | WD | $0.76^{jk}$ |
| 7. | *S. incanum* | 0.57 | MD | 0.51 | MD | 0.48 | MD | $0.51^{g}$ |
| 8. | *S. viarum* | 0.39 | MD | 0.39 | MD | 0.32 | MD | $0.36^{e}$ |
| 9. | *S. robustum* | 0.36 | MD | 0.36 | MD | 0.32 | MD | $0.34^{d}$ |
| 10. | *S. mauritianum* | 0.31 | MD | 0.32 | MD | 0.29 | SD | $0.30^{c}$ |
| 11. | *S. lasiocarpum* | 0.32 | MD | 0.32 | MD | 0.30 | SD | $0.31^{c}$ |
| 12. | *S. elagnifolium* | 0.42 | MD | 0.47 | MD | 0.47 | MD | $0.45^{f}$ |
| 13. | *S. xanthocarpum* | 0.67 | WD | 0.64 | WD | 0.60 | MD | $0.63^{h}$ |
| 14. | NSKE | 0.27 | SD | 0.27 | SD | 0.24 | SD | $0.26^{b}$ |
| 15. | *A. calamus* | 0.33 | MD | 0.33 | MD | 0.31 | WD | $0.32^{c}$ |
| 16. | NSKE + *A. calamus* (50 + 50%) | 0.25 | SD | 0.25 | SD | 0.22 | SD | $0.24^{a}$ |
| | Mean | 0.57 | | 0.56 | | 0.51 | | 0.55 |

CD :
Concentration (C ) = 0.0377
Treatments (T ) = 0.0871
C x T = 0.1510
Each value is a mean of 5 replications
Means followed by common alphabets are not significantly different at 5% level by LSD
SD-Strong Oviposition Deterrancy; MD-Moderately Deterrant;
WD-Weak Oviposition Deterrant; NE; No Effect; PO-Preferred for egg laying

extract could effect atleast weak deterrancy against aqueous extract of *S. trilobatum* and *S. torvum* which fell under no effect class. NSKE and *A. calamus* when used alone also showed good deterrancy effect falling under the class of strong deterrancy. In contrast to aqueous extract, *A. calamus* was found to have better oviposition deterrancy than NSKE. Of the three tested concentrations of the botanicals, combination of NSKE and *A. calamus* with the highest concentration of 0.2 effected maximum deterrancy compared to 0.1 and 0.15 concentrations (Table 2).

Among the wild *Solanum* species, the least O.I was expressed by *S. viarum* and *S. lasiocarpum* and was followed by *S. robustum* and *S. mauritianum* falling under the class of strong oviposition deterrence. However, the *S. incanum* only at highest concentration of 0.2 with methanol exhibited O.I of 0.29 and got grouped under the class of strong deterrancy.

### *Ovicidal action*

The maximum ovicidal action (62.60%) was achieved with NSKE + *A. calamus* combination while the minimum ovicidal action was with by *S. trilobatum* (25.61%). *S. mauritianum* had 59.03 per cent of ovicidal action and found at par with *S. lasiocarpum*, *S. pubescence*, *S. seaforthianum* and *S. xanthocarpum* were found to have same level of ovicidal action of 31.99 per cent (Table 3).

On comparison of solvents, the hexane effected a maximum mean ovicidal action of 49.93 per cent than ethyl acetate (42.18 %) and methanol (38.72%). Highest

Table 2 : Effect of organic solvent extracts of botanicals on oviposition behaviour of *L. orbonalis* under controlled condition

| S. No | Treatments | Oviposition Index | | | | | | | | | | | | Grand mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hexane | | | Mean | Ethyl acetate | | | Mean | Methanol | | | Mean | |
| | | 0.1% | 0.15% | 0.2% | | 0.1% | 0.15% | 0.2% | | 0.1% | 0.15% | 0.2% | | |
| 1. | *S. pubescence* | 0.56 | 0.52 | 0.50 | 0.52 | 0.65 | 0.61 | 0.60 | 0.62 | 0.53 | 0.47 | 0.48 | 0.49 | $0.54^{h}$ |
| 2. | *S. seaforthianum* | 0.55 | 0.52 | 0.50 | 0.52 | 0.64 | 0.61 | 0.59 | 0.61 | 0.52 | 0.49 | 0.48 | 0.49 | $0.54^{k}$ |
| 3. | *S. macrocarpum* | 0.54 | 0.51 | 0.48 | 0.51 | 0.63 | 0.60 | 0.57 | 0.60 | 0.51 | 0.48 | 0.46 | 0.48 | $0.53^{I}$ |
| 4. | *S. torvum* | 0.81 | 0.69 | 0.69 | 0.73 | 0.90 | 0.78 | 0.78 | 0.82 | 0.78 | 0.66 | 0.67 | 0.70 | $0.75^{k}$ |
| 5. | *S. trilobatum* | 0.79 | 0.74 | 0.71 | 0.74 | 0.88 | 0.83 | 0.80 | 0.83 | 0.76 | 0.71 | 0.69 | 0.72 | $0.76^{k}$ |
| 6. | *S. erianthum* | 0.53 | 0.48 | 0.41 | 0.47 | 0.62 | 0.55 | 0.50 | 0.55 | 0.50 | 0.45 | 0.38 | 0.44 | $0.49^{g}$ |
| 7. | *S. incanum* | 0.43 | 0.36 | 0.30 | 0.36 | 0.52 | 0.43 | 0.39 | 0.44 | 0.40 | 0.33 | 0.29 | 0.33 | $0.38^{f}$ |
| 8. | *S. viarum* | 0.31 | 0.26 | 0.20 | 0.25 | 0.40 | 0.33 | 0.29 | 0.34 | 0.28 | 0.23 | 0.18 | 0.23 | $0.27^{d}$ |
| 9. | *S. robustum* | 0.42 | 0.37 | 0.30 | 0.36 | 0.51 | 0.44 | 0.39 | 0.44 | 0.39 | 0.34 | 0.28 | 0.24 | $0.28^{e}$ |
| 10. | *S. mauritianum* | 0.31 | 0.27 | 0.22 | 0.26 | 0.40 | 0.34 | 0.31 | 0.35 | 0.28 | 0.24 | 0.20 | 0.24 | $0.28^{e}$ |
| 11. | *S. lasiocarpum* | 0./30 | 0.25 | 0.21 | 0.25 | 0.39 | 0.32 | 0.30 | 0.33 | 0.27 | 0.22 | 0.18 | 0.22 | $0.27^{d}$ |
| 12. | *S. elaegnifolium* | 0.55 | 0.42 | 0.41 | 0.46 | 0.64 | 0.51 | 0.49 | 0.54 | 0.52 | 0.39 | 0.39 | 0.43 | $0.48^{g}$ |
| 13. | *S. xanthocarpum* | 0.76 | 0.61 | 0.50 | 0.62 | 0.80 | 0.70 | 0.59 | 0.69 | 0.73 | 0.58 | 0.49 | 0.60 | $0.64^{j}$ |
| 14. | *NSKE* | 0.30 | 0.23 | 0.19 | 0.24 | 0.30 | 0.29 | 0.28 | 0.29 | 0.27 | 0.20 | 0.17 | 0.21 | $0.24^{c}$ |
| 15. | *A. calamus* | 0.21 | 0.19 | 0.14 | 0.18 | 0.30 | 0.28 | 0.21 | 0.26 | 0.18 | 0.16 | 0.12 | 0.15 | $0.19^{b}$ |
| 16. | *NSKE + A. calamus* (50% + 50%) | 0.15 | 0.13 | 0.09 | 0.11 | 0.28 | 0.20 | 0.20 | 0.22 | 0.12 | 0.11 | 0.08 | 0.10 | $0.14^{a}$ |
| | *Mean* | 0.4700 | 0.4081 | 0.3656 | 0.415 | 0.5538 | 0.4888 | 0.4556 | 0.4994 | 0.4400 | 0.3769 | 0.3469 | 0.3879 | 0.4340 |

| | Solvents (S) | Concentration (C) | Treatment (T) | S x C | C x T | S x T | S x C x T |
|---|---|---|---|---|---|---|---|
| CD : | 0.00221 | 0.0021 | 0.00510 | 0.00383 | 0.00884 | 0.00884 | 0.01531 |

Each value is a mean of five replications. Means followed by common alphabets are not significantly different at 5% level by LSD

concentration of 0.2 per cent of NSKE + *A. calamus* effected a maximum ovicidal action of 70.5 per cent while the minimum (19.00%) by *S. trilobatum at* 0.10 per cent. No mortality of eggs was observed in control.

Oviposition deterrency of aqueous extracts of botanicals decreased as the concentration of extract decreased. Five per cent extract of NSKE, NSKE + *A. calamus* and *S. mauritianum* exhibited strong deterrency against *L. orbonalis* females. The finding is in agreement with Kumar (1996) who reported ovipositional deterrency effect of Neemark on *L. orbonalis* and Chakraborti (2001) proving the application of fresh neem cake in nursery @ 3 kg/m$^2$ during land preparation fresh neem cake @ 1 kg/ha once in 30 days after transplantation strongly deterred the oviposition of *L. orbonalis*. NSKE at 2 and 3 per cent resulted with strong deterrency against *L. orbonalis*. Bajpai and Sehgal (2003) also observed similar effects on *H. armigera*, while Joshi and Sitaramaiah (1979) on *S. litura* with 2 per cent. Effect of 5 per cent aqueous extract of NSKE (Bajpai and Sehgal, 2003) resulted in strong deterrency with oviposition index of 0.30 against *H. armigera* females.

Reason for the high oviposition deterrency of NSKE in aqueous medium than in solvent may be due to its high solubility is aqueous condition. Similarly, among the wild *Solanum* spp., the *S.mauritianum* might have deterrant principles with high solubility in aqueous medium. Strong oviposition deterrency was exhibited by 0.2 per cent methanol extract of *A. calamus* and NSKE combination. Cosidering separately, *A. calamus* effected very strong deterrency than NSKE which may be due to its high solubility in organic solvents.

NSKE also found to be strongly deterrent against *L. orbonalis* females with all the three solvents at three different concentrations tested. Methanol extract of neem seed kernel repelling females of *Crocidolomia binotalis* Zell. (Fagoone, 1981) and *H. armigera* (Bajpai and Sehgal, 2003) and methanol and hexane extracts on *S. litura* (Ayyangar and Rao, 1990) in treated area for five and four days, respectively are in support of this finding.

Table 3 : Effect of organic solvent extracts of botanicals against *L. orbonalis* eggs under controlled condition

| S. No. | Treatments | % Ovicidal action | | | | | | | | | | | | Grand mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hexane | | | Mean | Ethyl acetate | | | Mean | Methanol | | | Mean | |
| | | 0.1% | 0.15% | 0.2% | | 0.1% | 0.15% | 0.2% | | 0.1% | 0.15% | 0.2% | | |
| 1. | *S. pubescence* | 40.00 | 32.90 | 34.81 | 35.90 | 29.00 | 30.10 | 33.16 | 30.75 | 26.00 | 30.00 | 32.00 | 29.33 | 31.99 |
| | | (39.23) | (35.00) | (36.15) | (36.79) | (32.58) | (33.27) | (35.15) | (33.67) | (30.65) | (33.21) | (34.44) | (32.77) | (34.41)$^{j}$ |
| 2. | *S. seaforthianum* | 40.00 | 32.80 | 35.00 | 35.93 | 29.00 | 30.30 | 33.63 | 30.97 | 25.00 | 30.00 | 32.00 | 29.00 | 31.97 |
| | | (39.23) | (34.93) | (36.27) | (36.81) | (32.58) | (33.29) | (35.44) | (33.80) | (29.99) | (33.21) | (34.44) | (32.55) | (34.39)$^{j}$ |
| 3. | *S. macrocarpum* | 45.48 | 40.89 | 43.51 | 43.29 | 41.00 | 42.91 | 42.60 | 42.17 | 37.00 | 43.00 | 43.00 | 41.00 | 42.15 |
| | | (42.40) | (39.75) | (41.27) | (41.14) | (39.81) | (40.92) | (40.74) | (40.49) | (31.46) | (40.97) | (40.97) | (39.80) | (40.49)$^{g}$ |
| 4. | *S. torvum* | 35.48 | 27.91 | 30.40 | 31.26 | 20.00 | 24.00 | 28.91 | 24.30 | 20.00 | 23.00 | 23.00 | 22.00 | 25.85 |
| | | (36.55) | (31.76) | (33.46) | (33.97) | (26.56) | (29.33) | (32.52) | (29.47) | (26.56) | (28.65) | (28.65) | (27.96) | (30.46)$^{k}$ |
| 5. | *S. trilobatum* | 36.42 | 27.71 | 30.10 | 31.41 | 20.00 | 24.20 | 29.12 | 24.44 | 19.00 | 22.00 | 22.00 | 21.00 | 25.61 |
| | | (37.12) | (31.76) | (33.27) | (34.07) | (26.56) | (29.33) | (32.65) | (29.58) | (25.84) | (27.97) | (27.97) | (27.28) | (30.31)$^{k}$ |
| 6. | *S. erianthum* | 45.55 | 41.00 | 42.81 | 43.12 | 40.00 | 42.21 | 42.94 | 41.71 | 37.00 | 40.20 | 40.20 | 39.13 | 41.32 |
| | | (42.44) | (39.81) | (40.37) | (41.04) | (39.23) | (40.51) | (40.94) | (40.23) | (37.46) | (39.34) | (39.34) | (38.72) | (39.99)$^{h}$ |
| 7. | *S. incanum* | 59.88 | 58.10 | 63.40 | 60.46 | 52.00 | 56.00 | 56.80 | 54.93 | 45.00 | 48.00 | 49.31 | 47.43 | 54.27 |
| | | (50.69) | (49.66) | (52.77) | (45.38) | (46.72) | (48.44) | (48.90) | (41.74) | (42.13) | (43.85) | (44.70) | (38.11) | (46.74)$^{e}$ |
| 8. | *S. viarum* | 65.60 | 64.12 | 48.61 | 59.44 | 56.00 | 60.72 | 66.90 | 61.20 | 43.00 | 46.00 | 52.71 | 47.23 | 55.96 |
| | | (54.08) | (53.20) | (48.10) | (50.49) | (47.67) | (51.19) | (54.87) | (51.50) | (40.97) | (42.70) | (46.55) | (43.41) | (48.47)$^{d}$ |
| 9. | *S. robustum* | 59.32 | 57.90 | 64.67 | 60.63 | 52.00 | 56.70 | 57.90 | 55.53 | 40.00 | 43.00 | 49.00 | 44.00 | 53.38 |
| | | (50.37) | (49.54) | (53.53) | (51.15) | (46.14) | (48.85) | (49.54) | (48.18) | (39.23) | (40.97) | (44.42) | (41.54) | (46.95)$^{f}$ |
| 10. | *S. mauritianum* | 64.70 | 66.71 | 69.90 | 67.10 | 57.00 | 60.20 | 67.50 | 61.56 | 45.00 | 48.00 | 52.31 | 48.43 | 59.03 |
| | | (53.54) | (54.76) | (56.72) | (55.01) | (46.14) | (50.88) | (55.24) | (51.71) | (42.13) | (43.85) | (46.52) | (44.10) | (50.27)$^{c}$ |
| 11. | *S. lasiocarpum* | 63.80 | 66.99 | 69.81 | 66.87 | 56.00 | 60.00 | 66.80 | 60.93 | 45.00 | 48.00 | 54.00 | 49.00 | 58.93 |
| | | (53.01) | (54.93) | (56.67) | (54.87) | (48.44) | (50.76) | (54.81) | (51.34) | (42.13) | (43.85) | (47.29) | (44.42) | (50.21)$^{c}$ |
| 12. | *S. elagnifolium* | 45.36 | 40.91 | 42.41 | 42.89 | 40.01 | 42.14 | 42.14 | 41.43 | 37.00 | 40.70 | 40.01 | 39.23 | 41.18 |
| | | (42.33) | (39.76) | (40.63) | (40.91) | (39.23) | (40.47) | (40.47) | (40.06) | (37.46) | (39.64) | (39.23) | (38.78) | (39.92)$^{h}$ |
| 13. | *S. xanthocarpum* | 40.00 | 32.20 | 35.20 | 35.80 | 30.21 | 30.20 | 33.40 | 31.27 | 28.00 | 30.00 | 32.00 | 30.00 | 32.35 |
| | | (39.23) | (34.57) | (36.39) | (36.73) | (33.34) | (33.33) | (35.32) | (33.99) | (31.94) | (33.21) | (34.44) | (33.20) | (34.64)$^{j}$ |
| 14. | *NSKE* | 69.00 | 68.00 | 74.00 | 70.33 | 59.00 | 59.00 | 68.00 | 62.00 | 46.00 | 49.00 | 60.00 | 51.66 | 61.33 |
| | | (56.16) | (55.55) | (59.34) | (59.34) | (49.99) | (50.18) | (55.55) | (51.97) | (41.70) | (44.42) | (50.76) | (49.96) | (51.65)$^{b}$ |
| 15. | *A. calamus* | 40.90 | 42.90 | 43.00 | 41.97 | 29.00 | 31.00 | 33.00 | 31.00 | 25.00 | 25.00 | 36.00 | 28.66 | 33.87 |
| | | (39.75) | (40.91) | (40.97) | (41.51) | (32.58) | (33.83) | (36.27) | (33.82) | (29.99) | (29.99) | (38.86) | (32.29) | (35.86)$^{i}$ |
| 16. | NSKE + *A. calamus* | 71.00 | 70.00 | 76.50 | 72.50 | 59.90 | 61.00 | 68.00 | 62.96 | 47.00 | 49.00 | 61.00 | 52.33 | 62.60 |
| | (50% + 50%) | (57.54) | (56.78) | (61.00) | (58.40) | (50.70) | (51.35) | (55.55) | (52.53) | (43.28) | (44.42) | (51.35) | (46.35) | (52.43)$^{a}$ |
| | *Control* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) | (0.57) |
| | *Mean* | 48.38 | 45.35 | 47.30 | 46.99 | 39.40 | 41.80 | 45.34 | 42.18 | 33.23 | 36.17 | 39.91 | 36.43 | 44.49 |
| | | (51.34) | (48.19) | (50.25) | (43.27) | (41.88) | (44.41) | (48.17) | (44.82) | (35.31) | (38.43) | (42.40) | (38.72) | (41.87) |

| | Solvents (S) | Concentration (C ) | Treatment (T) | S x C | C x T | S x T | S x C x T |
|---|---|---|---|---|---|---|---|
| CD (P=0.05) | 0.57550 | 0.57550 | 1.329 | 0.996 | 2.302 | 2.302 | 3.142 |

Each value is a mean of five replications.

Schmutterer (1990) and Mehto *et al.* (1980) observed that application of formulated neem products, NSKE and neem oil on plant parts was known to repel the female moths, *C. binotalis*, *S. furgiperda* and *H. armigera* for oviposition. Ovipositional deterrent effect of Neemark on *E. vittella* (Sojitra and Patel, 1992; Patel *et al.*, 1995) of Neemazal-F (0.1%) *L. orbonalis* Guen. (Kumar, 1996) and Achook, Granim, Neemark, Nimbecidine, Neemol and NSKE on citrus leaf miner, *Phyllocnistis citrella* Stainton (Patel and Patel, 2000) were reported.

The ovipositional deterrency effect of neem seed kernel solution and Neemark on *E. vittella* and *S. litura* was experimentally proved by Sojitra and Patel (1992) and Patel and Patel (1998), respectively. Considering the wild *Solanum* spp., the strong deterrancy was exhibited by 0.2 per cent methanol extract of *S. viarum* and *S. lasiocarpum* followed by *S. robustum* and *S. mauritianum*. Maximum ovicidal action of 76.5 per cent was exhibited by 0.2 per cent hexane extract of NSKE and *A. calamus* combination against *L. orbonalis* eggs. Fly species (Stark, 1990) and *Plutella xylostella* L. (Friend, 1998) failed to eclose when the larvae were treated with 10.00 per cent neem kernel extracts. There was no survival of larvae hatched from egg laid on Solanum spp. and in case of survived larvae gained minimum weight per larva.

Considering wild *Solanum* spp. the *S. mauritianum* had maximum ovicidal action on eggs of *L. orbonalis*. Not much work on ovicidal action of wild *Solanum* spp. was carried out earlier. Potential of wild Solanum spp. for the management of *L. orbonalis* is to be explored.

## REFERENCES

**Ayyangar, G.S.G. and Rao, P.J. (1999).** Neem (*Azadirachta indica* A. JUSS) extracts as repellent and ovipositional deterrents to *Spodoptera litura* (Fade.). *Indian J. Ent.*, **50 :** 121-124.

**Bajpai, J.K. and Sehgal, S. (2003).** Effect of botanicals on oviposition behaviour of *Helicoverpa armigera* moths at Pantnagar, India. *Indian J. Entomol.*, **65 :** 427-433.

**Chakraborti, S. (2001).** A biorational approach for the management of brinjal fruit and shoot borer, *Leucinodes orbonalis* Guen. *J. Entomol. Res.*, **25 :** 73-76.

**Fagoone, 1 (1981).** Behavioral response of *Crocidolomia binotalis* Zeller. to neem. *Proc. 1st Int. Neem. Conf., Rottach. Egern*.pp. 109-120.

**Friend, J.A. (1998).** Twenty years of horticultural research with neem against diamond backmoth *plutella xylostella* L. (Family: Yponomeutidae).syn: *Plutella maculipenis* (after Steets 1975). *Pestology*, **22 :** 33-40.

**Joshi, B.G. and Sitaramaiah, S. (1979).** Neem kernal as an ovipositional repellant for *Spodoptera litura* (F.) moths. *Phytoparasitica*, **7 :** 199-202.

**Kumar, S.P. (1996).** *Ecofriendly pest management in brinjal*. Unpub. M.Sc.(Ag.) Thesis, Tamil Nadu Agric. Univ., Coimbatore, India. 148p.

**Mehto, D.N., Singh, K.M. and Singh, S.R.N. (1980).** Dispersion of *Leucinodes orbonalis* during different season. *Indian J. Entomol.*, **42 :** 539-540.

**Patel, G.P. and Patel, J.R. (2000).** Evaluation of neem based formulation as oviposition deterrent against *Phyllocnistis citrella* Stainton on kagzi lime. *Pestology*, **24 :** 23-24.

**Patel, K.B. and Patel, J.R. (1998).** Oviposition deterrent of botanical materials on tobacco leaf eating caterpillar, *Spodoptera litura* Fab. *Indian J. Agric. Sci*., **68 :** 48-49.

**Patel, M.M., Patel, C.B. and Patel, M.B. (1995).** Screening of brinjal varieties against insects pests. *Gujarat Agric. Univ., J.*, **20 :** 98-102.

**Schmutterrer, H. (1990).** Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. *Ann. Rev. Entomol*., **35 :** 271-297.

**Sojithra, I.R. and Patel, J.R. (1992).** Effect of plant extract on ovipositional behaviour of spotted bollworm, *E. vitella* infesting okra *Hibiscus esculenthus). Indian J. Agric. Sci.*, **62 :** 848-849.

**Stark, J.D. (1990).** Azadirachtin : Effects on metamorphosis, longevity aqnd reproduction of three tephritid fly species (Diptera; Tephriridae). *J. Econ. Entomol.*, **83 :** 2168-2174.