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**SHORT NOTE**

# EFFECT OF SUB LETHAL DOSES OF SOME SYNTHETIC PYRETHROIDS IN COMBINATION WITH PLANT OILS ON *Spodoptera litura* Fab.

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Tobacco caterpillar, *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae) is one of the economically important polyphagous pests and is known to damage more than 50 crops including tobacco, cole crops, castor, cotton, sunflower, chilli, etc. (Shankar Murthy *et al*., 2006). Several synthetic pesticides have been tested and recommended to control *S. litura*, which have caused serious concern among the scientists and ecologists, due to their adverse impacts like health hazard, resistance build up, residue problem, environmental pollution etc. It was the first lepidopteran pest to develop insecticide resistance in India, when Srivastava and Joshi (1965) reported the failure of HCH to check this pest on cauliflower with seven fold resistance. The frequent application of higher dose of same insecticides has led to the development of insect resistance involving alteration at the site of action, increased detoxication and metabolism (Bloomquist, 1993). In the southern states of India, *S. litura* was reported to have developed resistance virtually to all commonly used insecticides such as cypermethrin, fenvalerate, endosulfan, quinalphos and monocrotophos (Armes *et al*., 1997). Hence it is important to find ways to address the problem of insecticide resistance and synergists are one of the options. It has already been established that mixed formulations provide less toxic residue, prevent development of insect resistance, and reduce the pollution of agro-ecosystem (Dhingra *et al*., 1998). The introduction of less hazardous, safe and biodegradable synergists of natural origin could be of great help, as the tests conducted over the years have shown that synergists increase the efficacy of insecticides in terms of toxicity toward insect pests and not towards mammals (Metcalf, 1992). Plant oils are reported to have synergistic properties as the chemical structure of plant oils is similar to the insecticide synergist piperonyl butoxide which has played a greater role in reducing population of pyrethroid resistante insects (Collin, 1950). Hence the present investigations were carried out to evaluate the effect of sub lethal doses of three synthetic pyrethroids in combination with plant oils on growth, development and survival of *S. litura*.

Effect of sub lethal concentrations of three synthetic pyrethroids *viz.*, cypermethrin, lambdacyhalothrin and alphamethrin in combination with plant oils *viz., karanja* and jatropha oil was studied under laboratory conditions against eight day old larvae of *S. litura* using larval dip method. Concentrations of pyrethroid and oil combinations were decided based on the preliminary experiment of $LC_{50}$ determination. The sub lethal concentrations chosen were $LC_{30}$ value of respective treatments, *viz*., cypermethrin + *karanja* (0.002%), lambdacyhalothrin + *karanja* (0.005%), alphamethrin + *karanja* (0.0.02%), cypermethrin + jatropha (0.001%), lambdacyhalothrin + jatropha (0.001%), alphamethrin + jatropha (0.01%), cypermethrin (0.025%), lambdacyhalothrin (0.020%), alphamethrin (0.018%). Teepol (1%) was used as spreading and sticking agent to the oil solution (Rao *et al*., 2007). While in case of synthetic pyrethroids, water alone was used as solvent. In each treatment (n=30), larvae of *S. litura* were dipped into the respective concentration of insecticides for 18-20 seconds. The treated larvae were transferred to the clean plastic boxes (22 x 14 x 8cm) lined with an inner layer of moist filter paper containing untreated castor leaves as food. The observations on weight gain, mortality (%), pupal weight (g), pupation (%), and adult emergence (%) were recorded. The data obtained were subjected to statistical analysis by using CRD programme.

All the treatments used in the present investigation affected the growth and development parameters of *S. litura*. The combination of synthetic pyrethroids and plant oils caused more pronounced effect than individual treatments of synthetic pyrethroids, plant oils and teepol (Table 1). The duration of larval period has increased significantly over control (12.81days) in all the treatments except in plant oils and teepol. However larval period was prolonged more in case of combinations. For example, maximum larval period of 14.1days was observed in lambdacyhalothrin + jatropha oil combination, whereas lambdacyhalothrin and jatropha oil alone extended it up to 13.84 and 13.08days, respectively. The weight of pupae was reduced (5.68 to 20.73 %) in all the treatments over control (0.299g). The combinations of synthetic pyrethroids and plant oils caused higher reduction in the weight of pupae than synthetic pyrethroids, plant oils and teepol alone. For instance, cypermethrin, lambdacyhalothrin and alphamethrin when mixed with *karanja* oil, reduced pupal weight by 20.73, 16.72 and 14.04 per cent, respectively. Whereas they caused weight reduction of 8.36, 5.68 and 5.68 per cent, respectively when used alone. *Karanja* and jatropha oil when used alone caused a reduction of pupal weight by 1.33 and 5.35 per cent, respectively. This indicated an additive effect of plant oils to the synthetic pyrethroids in reducing the growth of this insect.

Larval mortality on the first day after treatment (DAT) was significantly high in all the treatments except plant oils and teepol over control. Cypermethrin, lambdacyhalothrin and alphamethrin caused mortality of 20, 20 and 25 per cent, respectively. These synthetic pyrethroids when mixed with *karanja* and jatropha oil caused an increased mortality of 30, 25 and 25 per cent and 30, 25 and 25 per cent, respectively. Terminal larval mortality was 40, 40 and 35 per cent due to cypermethrin, lambdacyhalothrin and alphamethrin, respectively. When these synthetic pyrethroids were mixed with *karanja* and jatropha oils, the mortality ranged from 45-55 per cent The per cent pupation was also reduced significantly by all the treatments over control (100%) except jatropha and *karanja* oil (85% each) and teepol (90%). The lowest per cent pupation of (45%) was observed in pyrethroid and oil combinations *viz*., cypermethrin + jatropha, lambdacyhalothrin + *karanja* and alphamethrin + *karanja* oil combinations caused, whereas cypermethrin, lambdacyhalothrin and alphamethrin caused 60, 60 and 65per cent, respectively. Adult emergence calculated on the basis of pupal population was lower in synthetic pyrethroids and plant oil combinations than when used alone, but these values were statistically *at par* with control (100%). Maximum reduction in adult emergence was caused by lambdacyhalothrin + *karanja* oil combination (81.0%).

From the present study it is clear that the sub lethal doses of synthetic pyrethroids when mixed with plant oils, affected the growth,

**Table 1. Effect of insecticide and plant oil combinations on growth, development and survival of *S. litura***

| Treatment | Conc. (%) | Larval period (days) | Pupal weight (g) | Pupation (%)* | Adult emergence over pupal population (%)* | Larval mortality 1DAT (%)* | Larval mortality 2 DAT (%)* | Terminal larval mortality (%)* |
|---|---|---|---|---|---|---|---|---|
| Cypermethrin+ Karanja oil | 0.002 | 14.04 | 0.237 | 50.0 | 90.0 | 30.0 (33.03) | 50.0 (44.99) | 50.0 (44.99) |
| Lambdacyhalothrin+ Karanja oil | 0.005 | 13.90 | 0.249 | 45.0 | 81.0 | 25.0 (29.69) | 55.0 (47.90) | 55.0 (47.90) |
| Alphamethrin+ Karanja oil | 0.02 | 14.04 | 0.257 | 45.0 | 90.0 | 25.0 (29.69) | 50.0 (44.99) | 55.0 (47.90) |
| Cypermethrin+ jatropha oil | 0.001 | 13.9 | 0.246 | 45.0 | 90.0 | 30.0 (33.03) | 55.0 (47.90) | 55.0 (47.90) |
| Lambdacyhalothrin+ jatropha oil | 0.001 | 14.10 | 0.256 | 55.0 | 90.0 | 25.0 (29.69) | 45.0 (42.09) | 45.0 (42.09) |
| Alphamethrin+ jatropha oil | 0.01 | 13.7 | 0.254 | 50.0 | 100.0 | 25.0 (29.69) | 45.0 (42.09) | 50.0 (44.99) |
| Cypermethrin | 0.025 | 13.56 | 0.274 | 60.0 | 93.3 | 20.0 (29.92) | 35 (36.24) | 40.0 (39.15) |
| Lambdacyhalothrin | 0.020 | 13.84 | 0.282 | 60.0 | 93.3 | 20.0 (29.92) | 30.0 (33.03) | 40.0 (39.15) |
| Alphamethrin | 0.018 | 13.70 | 0.282 | 65.0 | 86.6 | 25.0 (29.69) | 35.0 (36.24) | 35.0 (36.23) |
| Karanja oil | 1.0 | 13.24 | 0.295 | 85.0 | 93.3 | 15.0 (22.59) | 15.0 (22.59) | 15.0 (22.59) |
| Jatropha oil | 1.0 | 13.08 | 0.283 | 85.0 | 93.3 | 10.0 (18.38) | 15.0 (22.59) | 15.0 (22.59) |
| Teepol | 1.0 | 12.94 | 0.283 | 90.0 | 100.0 | 10.0 (18.38) | 10.0 (18.38) | 10.0 (18.38) |
| Control | - | 12.81 | 0.29 | 100.0 | 100.0 | 0.0 (0.00) | 0.0 (0.00) | 0.0 (0.00) |
| Sem± | - | 0.184 | 0.006 | 5.80 | 9.27 | 6.50 (3.08) | 5.00 (2.58) | 5.5 (2.73) |
| CD *(p=0.05)* | - | 0.522 | 0.0185 | 16.46 | 26.31 | 8.94 | 7.51 | 7.90 |

***** Figures in parentheses are angular transformed values. DAT= days after treatment development and survival of *S.litura* more severely, than synthetic pyrethroids alone. We have not come across any direct reference in integration of sub lethal dose of synthetic pyrethroids with plant oils. The present attempt is therefore new in this regard and the results are encouraging. Abdul *et al*. (1997) studied the effect of sub lethal doses of cypermethrin and deltamethrin on *S. littoralis* and found that sub lethal doses caused a gradual decrease in larval survival, larval weight gain, rate of pupation, pupal weight and adult emergence. Deleterious effects were slightly higher with deltamethrin as compared with cypermethrin. The sub lethal doses of synthetic pyrethroids are known to influence feeding, growth and development of insects adversely. The present study concludes that addition of plant oils (*karanja* and jatropha at 1%, emulsified with teepol 1%) to synthetic pyrethroids enhanced the toxicity against *S. litura*. This strategy could be helpful in sustainable control of *S. litura* and thereby reducing the insecticide load in the crop ecosystem.

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## REFERENCES

Abdul, G., Jepson, P. C. and Ghaffar, A. 1997. Effect of sublethal doses of cypermethrin and deltamethrin on the growth and development of *Spodoptera littoralis. Pakistan Journal of Zoology,* **29**: 81-86.

Armes, N. J., Wightman, J. A., Yadav, D. R. and Rao, G. V. R. 1997. Status of insecticide resistance *in Spodoptera litura* in Andhra Pradesh, India. *Pesticide Science,* **50**: 240-248.

Bloomquist, J. R. 1993. Ion channels as targets for insecticides. *Annual Review of Entomology,* **41**: 163-190.

Collins, P. J. 1990. A new resistance to pyrethroids in *Tribolium castaneum. Pesticide Science*, **28**: 101-115.

Dhingra, S., Seema, Dureja, S. P. and Sudhakar, K. 1998. Effect of neem oil on the toxicity of different synthetic pyrethroids in mixed formulation against *Bagrada cruciferarum* (Kirk). *Journal of Entomological Research*, **22**: 153-156.

Metcalf, R. J. 1992. The synergistic activity of various selected chemicals to the insecticides carbofuran and malathion against brine shrimp larvae. B. Sc. (Hons) Thesis. Department of Agriculture and Environmental Sciences, University of Newcastle. pp. 53.

Rao, K. P., Krishnaih, K. R. and Sudhakar, K. 2007. Evaluation of toxicity of insecticides without and with vegetable oil on a phytophagous pest, *Helicoverpa armigera*. *Indian Journal of Entomology*, **69**: 105-107.

Shankara Murthy M., Thippaiah M. and Kitturmmath, M. S. 2006. Effect of neem formulations on larvae of tobacco cutworm, *Spodoptera litura* (Fab.). *Insect Environment,* **12**: 84-85.

Srivastava, B. K. and Joshi, H. C. 1965. Occurrence of resistance to BHC in *Prodenia litura* Fab. (Lepidoptera : Noctuidae). *Indian Journal of Entomology*, **27**: 102-104.