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Effect of Fungicides on Growth and Development of *Spodoptera litura*

Kuldeep Srivastava[2*], Sonika Sharma[1], Devinder Sharma[1], Ramesh Kumar[2]
[1]Division of Entomology, S K Univ. of Agri. Sciences and Tech., Chatha, Jammu, India
[2]ICAR-National Research Centre on Litchi, Muzaffarpur, Bihar, India

[*]**Address for Correspondence:** Dr. Kuldeep Srivastava, Senior Scientist, ICAR- National Research Centre on Litchi, Muzaffarpur, Bihar, India

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ABSTRACT- The present investigation on the impact of fungicides on the growth and development of *Spodoptera litura* was carried out in the laboratory of the Department of Entomology, SKUAST- Jammu, during the year 2012-13. Base-line toxicity of two fungicides *viz*., mancozeb and ridomil MZ were evaluated against *S. litura* in the laboratory. The results showed that fungicides significantly influenced the growth and development of *S. litura*. The larval development duration was significantly shorter and it was an average (14.61±0.30), (16.28±0.66) days, when treated with ridomil, and mancozeb respectively. The results show that fungicides can serve a practical tool to reduce the *S.litura* and may assume a greater role in integrated programs showed to manage insect pests and pathogens.

Key-word: Bioassay, Fungicides, Growth and development, *Spodoptera litura*,

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INTRODUCTION

Spodoptera litura Fabricius commonly known as tobacco caterpillar is a polyphagous pest and cause considerable damage to soybean, cotton and vegetables [1-3]. Use of insecticides for controlling this pest is on the rise and it has the ability to develop resistance to many insecticides [4,5]. Further, various pesticides viz., herbicides, fungicides have been reported to have detrimental effects on different aspects of a life cycle of the *S. litura* [6,7].

In addition, to understand the influence of fungicides on expression of resistance in plants against insects, it is also essential to complete a database on the direct and indirect effect of fungicides on insect pests [6]. Therefore, it is essential to know the role of fungicides on the developmental profile of *S. litura*. Such observations will help to understand the shifts in insect pest population on a crop influenced by these fungicides. Information on this interesting area of pest management is scanty.

Therefore, keeping the things in view, the present study was contemplated to explore the possibilities of fungicides against tobacco caterpillar, *S. litura* to reduce pesticide load

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MATERIALS AND METHODS

The larvae and egg patches of *S. litura* was collected from castor plant and reared in laboratory at the Department of Entomology, SKUAST- Jammu, J&K, India. The bioassays were kept at a temperature of 26±2°C, 60-70±5% relative humidity and 16:8 (Light: Dark) photoperiod. These laboratory-reared larvae were used for bioassays and the cultures were maintained throughout the study period. Castor leaves were collected from unsprayed plants, washed and air-dried and made 5 cm diameter leaf discs with the help of a leaf cutter. A stock solution of each tested fungicide was made from the available formulation and different concentrations were prepared. The leaf disc was dipped in each concentration for 20 seconds [7,8] and allowed to dry at ambient temperature for about 15–20 min in a fume hood. Air- dried leaf discs were then placed in individual plastic petri dishes (5 cm diameter) containing moistened filter paper. Each treatment (concentration) including controls were replicated three times. Ten larvae of *S. litura* (2nd instar), of uniform age, were exposed to different concentrations. The larvae were fed on treated leaves for 48 hrs, thereafter fresh leaves were provided *ad libitum*. Observations were recorded in larval period, pupal period, adult emergence, for all test chemicals. From these observations, growth index and success index were also calculated [9].

RESULTS AND DISCUSSION

Mancozeb

Data presented in Table 1 revealed that the fungicide has a significant effect on the growth and development parameters of *S. litura*. Overall development of larva significantly prolonged when treated with higher concentrations. Data obtained in Table (1) illustrate that there was a significant prolongation ($p<0.001$) for all larval stages, the maximum prolongation (20.33±0.0.33 days) being recorded at 2000 ppm till pupation comparing with 12.33±0.33 days for control larvae. The pupation duration and pupation percentage ranged from 8.36±0.27 (62.5 ppm) to 12.76±0.12 (2000 ppm) days and 30.00±11.54 to 66.66±3.33 percent, respectively. Growth and success indices also revealed the toxic effect of this compound on an insect with the increase in concentration. The growth and success indices ranged from 3.05±0.15 (62.5ppm) to 0.91±0.35 (2000ppm) days and 0.62±0.09 to 0.47± 0.08 per cent, respectively. Singh and Bhattacharya [6] also observed that mancozeb at concentration of 0.125% to 0.132% resulted in 62.50 to 92.50% survival of *S. litura* larvae. The larval periods, as well as its mortality increased with increase in the level of mancozeb in the diet. A significant reduction in pupation percentage and adult emergence was recorded when larvae were reared on diets fortified with 0.0625% of manoczeb. A field dose of 0.25% resulted in 5.00% pupation and adult emergence.

Adamski and Ziemnicki [10] tested ethylene bis-dithiocarbamate fungicide mancozeb on larvae and imago of *Spodoptera exigua* and observed decreased survival, disturbances, and malformations in development, changes in the activity of tested enzymes.

Guven and Goven [11] tested different pesticides on *C. carnea* in the laboratory, including three fungicides and found that fenarimol, mancozeb+metalaxyl, and micronized sulphur showed 45%, 28% and 16% death rate, respectively. Adamski *et al*. [12] observed that mancozeb causes multilevel alterations, within various tissues and systems. The observed malformations are similar to those caused by fenitrothion and carbaryl (carbamate insecticide) in *Spodoptera exigua* and *Tenebrio molitor* fat body [13]. Therefore, they seem to be rather universal, caused by a chemical imbalance within cells, not the direct action of pesticides on target tissues and cells. The above mentioned changes are similar to those reported by Sakr et a*l*. [14] for mice exposed to mancozeb. These authors reported irregularities of nuclear structure, that led to apoptosis, loss of glycogen, dilated ER. Such changes obviously slow down the activity of cells. Therefore, the activity of a fat body may be decreased. If decreased weight of the fat body, reported from *S. exigua* [10] is a universal phenomenon, the activity of fat body and its effect on insect's development would be drastically decreased.

Table 1: Effect of mancozeb on the developmental behavior of larvae of *Spodoptera litura*

Conc. (ppm)	2nd instar	3rd instar	4th instar	5th instar	6th instar	Total larval period (days)	Pupal period (days)	Pupation (%)	Adult emergence (%)	Growth index (G.I.)	Success index (S.I.)
Control	3.00± 3.00a	2.00±0.0 0a	2.67± 0.33a	2.00±0 .00a	2.66±0 .33a	12.33± 0.33a	7.33±0.3 3a	90.00±5.7 7c	90.00±5.77 c	4.56±0. 23d	1.00±0.00c
62.5	3.00±. 00ab	2.00±0.0 0a	2.66± 0.33a	2.66±0 .33a	3.00±0 .00a	13.33± 0.33ab	8.36±0.2 7b	66.66±3.3 3b	66.66±3.33 b	3.05±0. 15c	0.62±0.09a b
125	2.66±0 .33a	2.66±0.3 3ab	3.00± 0.00a	2.33±0 .33ab	3.66±0 .33b	14.33± 0.33b	8.66±0.2 8b	60.00±5.7 7b	60.00±5.77 b	2.72±0. 27c	0.55±0.04a
250	4.00±0 .00bc	3.00±0.0 0b	3.00± 0.33a	2.66±0 .33ab	3.66±0 .33b	16.33± 0.33c	9.26±0.6 3b	46.66±6.6 6ab	46.66±6.66 ab	1.85±0. 26b	0.80±0.04b
500	5.00±0 .57c	3.00±0.0 0b	3.66± 0.33a	2.66±0 .33ab	3.66±0 .33ab	18.00± 1.15cd	10.70±0. 20c	46.66±3.3 3ab	46.66±3.33 ab	1.63±0. 16ab	0.62±0.04a b
1000	4.66±0 .66c	4.00±0.5 7bc	3.00± 0.00a	3.66±0 .33bc	4.33±0 .33bc	19.33± 0.88de	11.13±0. 18c	33.33±3.3 3a	33.33±3.33 a	1.09±0. 14a	0.54±0.04a
2000	4.33±0 .33	3.33±0.3 3c	3.66± 0.33a	4.00±0 .33c	5.00±0 .57c	20.33± 0.33e	12.76±0. 12d	30.00±11. 54a	30.00±11.5 4a	0.91±0. 35a	0.47±0.08a

Fungicide Ridomil MZ

The insecticidal activity of ridomil MZ was directly proportional to the concentration of the fungicide (Table 2). This fungicide did not affect the growth and development of *S. litura* larvae except at higher concentrations. The larval duration and its mortality increased with increase in the level of fungicide. The result revealed that larval duration was significantly prolonged for all larval stages, the maximum prolongation (17.00±0.57 days) being recorded at 200 ppm till pupation comparing with 13.33±0.33 days for control larvae. A significant reduction in pupal duration and the pupal percentage was recorded when larvae reared at 200 ppm as compared with other treatments. No significant difference in the pupal duration was observed at a concentration of 31.25, 62.50, and 125 ppm. Significantly increased pupal duration (15.33±0.33 days) was recorded at 1000 ppm as compared with those recorded at lower concentrations including control (9.66± 0.33).

A significant decrease in pupal percentage (10.00±5.77%) at 1000 ppm compared with control (86.66±3.33%) was recorded. The increase in fungicide concentration showed the marked decrease in adult emergence indicating a significant correlation between adult emergence (%) and concentration. The adult emergence ranged from 6.66±3.33 to 53.33±3.33 percent at 1000 and 31.25 ppm concentration. At all the concentrations, adult emergence occurred in all those insects pupated. The growth and success indices indicated that diets fortified with fungicides have some detrimental effect on the growth and development of *S. litura*. Nasreen *et al*. [15] assessed the toxicity level of some fungicides against *Chrysoperla carnea* (Stephens) larvae and reported that Ridomil caused 4.44% mortality of 1st and 3rd instars larvae after 24 and 72 hrs. The lowest pupation rate (89.32 %), adult emergence, the longevity of adults and fecundity was recorded in ridomil treated larvae.

Table 2: Effect of ridomil MZ on the developmental behavior of different instar of *S. litura*

Conc. (ppm)	2nd instar	3rd instar	4th instar	5th instar	6th instar	Larval period (days)	Pupal period (days)	Pupation (%)	Adult emergence (%)	Growth index (G.I)	Success index (S.I.)
Control	3.00± 0.00a	2.33±0 .33ab	2.33±0 .33	2.67±0 .33ab	3.00±0 .00b	13.33±0 .33a	9.66±0. 33a	86.66±3.3 3c	86.66±3.33d	3.76±0. 14d	1.00±0. 00c
31.25	2.67± 0.33a	2.67±0 .33ab	2.67±0 .33a	2.67±0 .33ab	3.00±0 .00b	14.33±0 .33ab	10.00±0 .57ab	53.33±3.3 3b	53.33±3.33c	2.18±0. 10c	0.63±0. 09ab
62.5	3.33± 0.33a	2.33±0 .33ab	2.33±2 .67a	3.00±0 .00b	2.33±0 .33a	13.67±0 .67a	10.33±0 .33ab	33.33±6.6 6ab	30.00±5.77b	1.25±0. 25b	0.49±0. 04a
125	3.67± 0.33a	2.00±0 .00a	2.67±0 .33a	3.33±0 .33b	2.67±0 .33b	14.00±0 .57a	10.66±0 .66ab	26.66±8.8 1ab	23.33±3.33b	1.02±0. 23b	0.70±0. 03b
250	3.33± 0.33a	3.00±0 .57ab	3.33±0 .67a	2.00±0 .00a	2.67±0 .33b	14.33±0 .33ab	11.33±0 .33b	23.33±3.3 3ab	23.33±3.33	0.73±0. 39ab	0.57±0. 01ab
500	3.33± 0.33a	3.33±0 .33b	3.67±0 .33a	3.00±0 .00b	2.33±0 .33a	15.67±0 .33bc	13.00±0 .57c	23.33±3.3 3ab	16.66±8.81a	0.67±0. 21ab	0.67±0. 05b
1000	5.00± 0.57b	2.67±0 .33ab	3.67±0 .33a	2.67±0 .33ab	3.33±0 .33b	17.00±0 .57c	15.33±0 .33d	10.00±5.7 7a	6.66±3.33	0.20±0. 10a	0.49±0. 04a

CONCLUSIONS

It may be concluded that fungicides can serve a practical tool to reduce the *S.litura* and may assume a greater role in more highly integrated programs to manage insect pests and pathogens. Information based on these results would help in formulating IPM programs for the management of insect pests and pathogens.

REFERENCES

[1] Kuldeep, Ram S. Toxicity of diflubenzuron against *Spodoptera litura* Fab. and *Spilarctia obliqua* Walk. Indian J.l Entomol., 2004; 66: 354-56.

[2] Srivastava K, Rahman SMA, Ram S. Insect Growth Regulators (IGRs): a novel tool to regulate soybean defoliators. J. Res.SKUAST-J., 2007; 6: 242-48.

[3] Srivastava, K., Rahman, Sk. Md. A. and Ram, S. Toxicity of lufenuron against *Spodoptera litura* Fab. and *Spilarctia obliqua* Walk. Ann. Pl. Protec. Sci., 2007; 15: 253-54.

[4] Kuldeep, Rahman SK, Md A, Ram S. Effect of sublethal doses of lufenuron against *Spodoptera litura* Fab. and *Spilarctia obliqua* Walk.. Indian J. Entomol., 2004; 66: 287-92.

[5] Srivastava K, Rahman SK, Md. A, Ram S. Evaluation of Insect Growth Regulators against Soybean Defoliators. Ann. Pl. Protec. Sci., 2007; 15: 294-298.

[6] Singh H , Bhattacharya AK. Effect of fungicides on *Spodoptera litura*. Ann. Pl. Protec. Sci., 2004; 12: 51-54.

[7] Srivastava K, Sharma S, Sharma D, Ahmad H. Ganai SA. Base line toxicity of fungicides and insecticides to *spodoptera litura* (fab.). Bangladesh J. Bot., 2016; 45: 39-45.

[8] Rahman SK, Md A, Ram S. Effect of sublethal doses of diflubenzuron against *Spodoptera litura* Fab. and *Spilarctia obliqua* Walk. Ann. Pl. Protec. Sci., 2005; 13: 44-47.

[9] Chenchaiah KC, Bhattacharya AK. Mass Rearing of *Spodoptera litura* on artificial diet. Ann. Pl. Protec. Sci., 2005; 13: 76-80.

[10] Adamski Z, Ziemnicki K. Side-effects of mancozeb on *Spodoptera exigua* (Hubn.) larvae. J. Appl. Entomol., 2004; 128: 212-17.

[11] Guven B, Goven MA. Side effects of pesticides used in cotton and vineyard areas of Aegean Region on the green lacewing, Chrysoperla carnea (Stephen) (Neuroptera: Chrysopidae) in the laboratory. In: Proceedings of IOBC/WPRS Working Group *"Pesticides and Beneficial Organisms*" at Avignon (France), 2002. IOBC/WPRS Bull., 2003; 26(5): 21-24.

[12] Adamski Z, Bloszyk J, Piosik K, Tomczak K. Effects of diflubenzuron and mancozeb on soil micro arthropods: a long-term study. Biol. Lett., 2009; 46(1): 03–13.

[13] Mehlhorn H, Mencke N, Hansen O. Effects of imidacloprid on adult and larval stages of the flea Ctenocephalides felis after in vivo and *in vitro* application: a light-and Electron-microscopy study. Parasitol. Res., 1999; 85: 625–37

[14] Sakr SA, Mahran HA , Abo-Elyazid SM. Effect of DBB on mancozeb fungicide induced ultrastructural and biochemical changes in the liver of albino mice. In: Proceedings of 9th Conference on Environ. Sci. Technol., 2005; pp. 809-16.

[15] Nasreen A, Cheema GM, Iqbal M. Relative Toxicity of Different Fungicides against Larvae of Green Lacewing, *Chrysoperla carnea* (Chrysopidae: Neuroptera). South Pacific Stud., 2005; 26(1): 07-13.

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