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EFFECT OF INSECTICIDES ON ENDOLARVAL PARASITOID *Snellenius maculipennis* (SZEPLIGATE) OF CASTOR SEMILOOPER *Achaejanata* L.

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ABSTRACT

Snellenius maculipennis (Szepligate) is an important hymenopteran endo larval parasitoid of castor semilooper *Achaea janata* L. Nine insecticides (acephate 75 SP, profenophos 50 EC, novaluron 10 EC, thiodiocarb 75WP, emamectin benzoate 5 SG, lufenuron 5.4 EC, flubendiamide 480 SC, chlorantraniliprole 18.5 SC, lambda cyhalothrin 5 EC) were tested for their safety against cocoon stages of *S. maculipennis* under laboratory condition. Among all insecticides tested, acephate 75 SP was detrimental to *S. maculipennis* with least adult emergence of (26.67%) followed by profenophos 50 EC (33.33%) and thiodicarb 75 WP (33.33%). Emamectin benzoate 5 EC and flubendiamide 480 SC were highly safer to the parasitoid by recording 93.33 per cent of adult emergence. Adult longevity was short ranged between 1-1.33 days in acephate 75 SP, thiodicarb 75 WP and profenophos 50 EC treatments. Adult longevity of *S. maculipennis* was relatively longer in emamectin benzoate 5 EC (3.83 days) and flubendiamide 480 EC (3.67 days) treatments.

KEY WORDS: *Snellenius maculipennis, Achaea janata* and castor.

INTRODUCTION

Castor, *Ricinus communis* L. is an important non-edible oilseed crop and one of the most important commercial crop of the country. Castor oil and its derivatives, besides being used in medicine, are also used in a wide range of sectors including agriculture, textile industry, paper industry, plastics engineering, rubber and pharmaceuticals (DOR, 2003).

Castor semilooper *A. janata* is one of major defoliators and completely devour the green foliage, leaving only the veins and enforce the farmers to re-sow the crop. It causes yield reduction to the extent of 20 to 23% (Gaikwad and Bilapate, 1992). *A. janata* is regulated by an hymenopteran endolarval parasitoid *Snellenius* (=*Microplitis*) *maculipennis* (Szepligate) (Hymenoptera: Braconidae) which is cosmopolitan in distribution (Gaikwad and Bilapate, 1989). Under field conditions, it is capable of parasitising up to 77.31per cent of the semilooper larvae (Rai and Jayaramaiah, 1978).

Indiscriminate use of pesticides leads to development of insecticide resistance in insects, toxic effects on natural enemies, pest resurgence and pesticide residues on food. And causes environmental pollution (Metcalf and Luckmann, 1982). These negative externalities, though cannot be eliminated altogether, their intensity can be minimized through development, dissemination and promotion of alternative technologies such as integrated pest management as well as good agronomic practices rather relaying solely on chemical pesticides.

One of the important components of integrated pest management is the use biocontrol agents. This has many advantages over the traditional chemical control (Scholler and Flinn, 2000). The natural enemies are self-perpetuating, effective on a long term, and economical. Generally, parasitoids are host specific and parasitise the host in a density dependent manner (Annecke and Moran, 1982), and it is an effective way to reduce the frequency of pesticide applications and also reduced environmental pollution (Talekar and Yang, 1990).

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Selective insecticides could play a role in conserving the wide diversity of natural enemies. Several insecticides that are widely used to suppress various pests can disrupt the effectiveness of these beneficial agents. It is less clear to what degree insecticides are disruptive with other non-target organisms. Improved understanding of pest-natural enemy-insecticide interactions will assist in formulating more effective Integrated Pest Management strategies.Therefore, there is a need to use selective pesticides along with the biocontrol agents (Halappa, 2011*)*.

Pupae can also be easily contaminated by direct contact with insecticide droplets during the spray. Testing the susceptibility of pupae to pesticides is important because this stage can function as reservoir of the natural enemy to the pest population in the crops (Medina *et al*., 2001), and because in many natural enemies the pupal stage has been found to be less sensitive to pesticides than the other stages (Consoli *et al*., 1998 and Medina *et al*., 2001).

MATERIAL AND METHODS:

MAINTENANCE OF NUCLEUS CULTURE OF PARASITOID, *SNELLENIUS MACULIPENNIS* (SZEPLIGATE).

The stock culture of *S. maculipennis* was maintained at Insectary, Department of Entomology, S.V. Agricultural College, Tirupati at 25 ± 2°C, 75 ± 5% RH. Initially, parasitised larvae of *A. janata* with cocoons were collected from college farm and Regional Agricultural Research Station, Tirupati and were kept in Petri plates of 15 cm diameter. Adults emerging from these cocoons were confined into oviposition cages (32 cm × 30 cm × 30 cm) for mating. Honey solution mixed with proteinex powder dipped in cotton swab was provided as adult food.

Second instar larvae of *A. janata* were released on local castor variety leaves and were exposed to adults of *S. maculipennis* for oviposition in oviposition cages. The cut end of petioles of castor leaves were dipped in water in a conical flask containing ten per cent sugar solution. After exposing the larvae for 24 to 48 hrs to the adult parasitoids, the parasitised larvae were collected and reared separately in plastic troughs of 20 cm diameter and provided with castor leaves till cocoon formation. After formation of the cocoon from parasitised larvae, parasitised larvae with cocoons still attached to its body were kept in Petri plates for further rearing as described above.

The parasitoids were reared and multiplied for two generations to obtain sufficient number of parasitoid cocoons before using them for the experiment. Cocoons of *S. maculipennis* from this nucleus culture were used for the experiment.

The concentration of 1µl, 2µl, 3µl, 4µl, and 5µl of insecticide solution on cocoons of *S. maculipennis* to determine amount of insecticide required to wet the cocoon completely and it was observed that 5µl of insecticide solution wet the cocoon completely and hence a topical application of 5µl of insecticide solution has been selected as standard quantity to be applied on to the cocoons using micropipette (Range: 0.5-10µl; Company: Microlit India).

Ten numbers of parasitoid cocoons (< 24 hrs old) were placed in Petri plates on leaf discs and 5µl of the insecticide solution of the desired concentration (doses as mentioned in Table 1.) were applied on cocoons by topical application with the help of micropipette (Range: 0.5-10µl; Company: Microlit India). After application of insecticides, cocoons were allowed to dry. There were three replications with ten cocoons in each replication. Adults emerged from insecticide treated cocoons were released into plastic boxes (8.5 cm x 4.5 cm x 2.5 cm) and were provided with five per cent sugar solution dipped in cotton swab as food material for the emerging adult. Data was recorded on cocoon duration, number of adult parasitoids emerged number of deformed adults, and adult longevity. The data was subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS, 16.2).

RESULTS AND DISCUSSION

The order of toxicity of various insecticides against the cocoons of *S. maculipennis* based on field recommended doses was as follows: acephate > profenophos > thiodicarb > novaluron > lufenuron > chlorantraniprole > lambda cyhalothrin > flubendiamide > emamectin benzoate (Table 2).

Cocoon duration

Cocoon duration of *S. maculipennis* in different treatments ranged from 5.13 to 6.93 days. Longest cocoon duration were observed when cocoons were

Table 1. Insecticides used in bioassay on the cocoons of *S. maculipennis*

S. No.	Insecticide	Trade name	Dose (ml or g/l)
1	Acephate 75 SP	Orkem	1.5 g L^{-1}
2	Profenophos 50 EC	Profigan	2.0 ml L^{-1}
3	Novaluron 10 EC	Rimon	1.0 ml L^{-1}
4	Thiodiocarb 75WP	Larvin	1.5 g L^{-1}
5	Emamectin benzoate 5 SG	On a top	0.5g L^{-1}
6	Lufenuron 5.4 EC	Cigna	1.0 ml L^{-1}
7	Flubendiamide 480 SC	Fame	0.2 ml L^{-1}
8	Chlorantraniliprole 18.5 SC	Coragen	0.3 ml L^{-1}
9	Lambda cyhalothrin 5 EC	Leokem	1.0 ml L^{-1}
10	Control		-

topically treated with acephate (6.93 days) followed by thiodicarb (6.30 days) which were significantly different with each other. Shortest cocoon duration were observed in flubendiamide (5.13 days) followed by emamectin benzoate (5.17 days) which were on par with each other. However, the least cocoon duration (4.33 days) was recorded in untreated check.

Negligible effect of pesticides on pupal duration might be primarily attributed to the cocoon making behavior of the parasitoids and method of bioassay. In case of our test parasitoids (*S. maculipennis*), pupae are adequately protected by silken cocoon spun by them and thus, minimizes the entry of pesticides into the developing pupae. Negligible mortality during the pupal stage in this study also indicates the little contact of pesticides to the parasitoid pupae inside the cocoon due to self-protection by their cocoon. Haseeb and Amano (2002) reported that emamectin benzoate, a relative of avermectin, had no harmful impact on the cocoon stage when applied against the cocoons of *Cotesia plutellae* recording remarkably low mortality (2.43 %) in cocoon stage.

Per cent adult emergence

The per cent adult emergence of *S. maculipennis* in different treatments ranged from 26.67 to 93.33 per cent. Emamectin benzoate (93.33%) and flubendiamide (93.33%) were safer to the parasitoid by recording maximum per cent of adult emergence, and are on par with each other. While chlorantraniprole (60.00%) and lambda cyhalothrin (60.00%) were the next best treatments recording more than 50% parasitoid emergence. Acephate was detrimental to *S. maculipennis* which recorded least adult emergence of 26.67 per cent and was significantly inferior to all other treatments. The highest adult emergence of 100 per cent was recorded in untreated check. Similar results were repoted by Shi *et al*. (2004) that avermectins

were slightly toxic to cocoons of the parasitoid, *Cotesia plutellae*, however the chemical did not reduced adult emergence. Our results are on par with the findings of Halappa (2011) who reported that novaluron and emamectin benzoate were safer to parasitoid *Cotesia plutellae* by recording 93.33 and 90.00 per cent adult emergence respectively.

Adult longivity

Adult longevity of *S. maculipennis* in different treatments ranged from 1 to 3.83 days. No malformed adults were observed in any treatments. Shortest adult longevity was observed in acephate (1 day) followed by thiodicarb (1.17 days) and profenophos (1.33 days) treatments which were significantly not different with each other. Longest adult longevity of *S. maculipennis* was observed in treatment emamectin benzoate (3.83 days) followed by flubendiamide (3.67 days) which were on par with each other. In control adult longevity was 4 days (Table 2.).

Shi *et al.* (2004) reported that the longevity of adults of *Cotesia plutellae* emerging from the fipronil treated cocoons was shortened. Schneider *et al*. (2003) reported that spinosad (broad spectrum insecticide) was the most deleterious insecticide at field recommended concentration, where 95% of *Hyposoter didymator* adults were dead only 2 days after emergence. Firake *et al*. (2017) reported that longevity of emerging adults of *Hyposoter ebeninus*, *Cotesia glomerata* and *Pteromalus puparum* from spinosad treated cocoons was significantly reduced.

Once the adults of *S. maculipennis* emerged from the emamectin benzoate - treated pupae, the chances of being affected by the insecticide residue from cocoon seemed relatively small because of its less half life period of 1 to 4 days (Toxnet Toxicology Data Sheet) and hence recorded highest adult emergence of 93.33% and longest adult longevity of 3.83 days. Where as in case of acephate which have half-life of 3 to 6 days (Bouchard and Lavy, 1982 and Chuanjiang *et al*., 2010) showed least adult emergence of 26.67% and reduced longevity of surviving parasitoids (1 day) which might be due to the incidental ingestion during emergence (by gnawing the treated cocoon) or by contact of treated cocoons after emergence (Firake *et al*., 2017). Flubendiamide which have half-life period of 5.5 days (Flubendiamide in the products Belt 480 SC Insecticide & Belt 240 W) was also less affected by the insecticide residue from cocoon at the time of emergence and hence recorded highest adult emergence of 93.33% and longest adult longevity of 3.67 days.

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Table 2. Evaluation of safety of insecticides against the cocoons of endolarval Parasitoid *S. maculipennis* of castor semilooper *A. janata*.

S. No.	Treatments	Cocoon duration (days)	Adult emerged (%)	Adult longevity (days)
1	Acephate 75 SP	6.93[d]	26.67[a] (30.79)	1.00[a]
2	Profenophos 50 EC	6.13[c]	33.33[ab] (35.01)	1.33[a]
3	Novaluron 10 EC	5.50[b]	40.00[ab] (39.23)	2.17[b]
4	Thiodiocarb 75WP	6.30[c]	33.33[ab] (35.01)	1.17[a]
5	Emamectin benzoate 5 SG	5.17[b]	93.33[c] (81.15)	3.83[c]
6	Lufenuron 5.4 EC	5.44[b]	50.00[ab] (45.00)	2.22[b]
7	Flubendiamide 480 SC	5.13[b]	93.33[c] (81.15)	3.67[c]
8	Chlorantraniliprole 18.5 SC	5.39[b]	60.00[b] (50.77)	2.5[b]
9	Lambda cyhalothrin 5 EC	5.33[b]	60.00[b] (51.15)	2.55[b]
10	Control	4.33[a]	100.00[c] (90.00)	4.00[c]
11	LSD at 0.01	0.61	25.09 (20.92)	0.70
	CV%	4.72	18.31	12.35

Values followed by same letter are not significantly different at 0.01 level and the values in parenthesis are transformed values.

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