Pest Management in Horticultural Ecosystems
Vol. 26, No.2 pp 274-278 (2020)

RESEARCH NOTE

Management of leaf eating caterpillar, *Spodoptera litura* (Fab.) through bio-intensive components in cabbage

M. PUSHPALATHA, M. H. TATAGAR, VILAS D. GASTI, SUMANGALA KOULAGI and DILEEP KUMAR A. MASUTHI

Department of Entomology, Kittur Rani Channamma College of Horticulture, University of Horticultural Sciences, Arabhavi -591218, Karnataka, India

E-mail: pushpalatham143@gmail.com

ABSTRACT: A study on the management of leaf eating caterpillar, *Spodoptera litura* (Fab.) through bio-intensive components in cabbage was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India, during *rabi* 2019-20. Among the various bio-intensive components evaluated, novaluron 10% EC @ 1ml/l and *Nomuraea rileyi* 1×10^8 cfu/g @ 2g/l were found to be significantly more effective. Next best treatments in the order of efficacy were Neemazal 10,000 ppm @ 2ml/l, neem seed kernel extract (NSKE) 5% followed by chlorpyriphos 20 EC- Poison bait (RPP) and *Sl*NPV @ 500 LE. Spraying of novaluron 10% EC @ 1ml/l and *N. rileyi* (2×10^8 cfu/g) @ 2 g/l twice, 30 days after transplanting at 10 days interval recorded lowest *S. litura* larval incidence and highest cabbage yield of 28.56 and 26.63 t/ha and highest benefit: cost ratio of 2.81 and 2.67 respectively. Hence it can be recommend as effective and eco-friendly components for the management of *Spodoptera litura* in cabbage.

Keywords: Cabbage, *Spodoptera litura*, larvae, bio-intensive components, management

Cabbage, *Brassica oleracea* var. *capitata* is an important cole vegetable crops. It is the fifth most important vegetable crop after onion, potato, tomato and eggplant. In India, a total of 37 insect pests have been reported to feed on cabbage (Lal, 1975) from sowing till harvest. *Spodoptera litura* (Fab.) is one among those important insect pests which feed on cabbage. Various management strategies based on chemical pesticides without giving much importance on other natural products *viz.,* microbes, plant products *etc*. have been tried against lepidopteran pests of cabbage. But, increasing concern on environmental safety and global demand for pesticide residue-free food has evoked interest in pest control through bio-intensive components. Therefore, the present study is being undertaken to test the bio-efficacy of different bio-intensive components against *Spodoptera litura* (Fab.) on cabbage.The experiment was carried out in an area of 100×15 m^2. Twenty five day old seedlings of cabbage hybrid 'Saint' were transplanted in the plot size of 4.8 m^2 with a spacing of 45×30cm^2. Transplanting was done during 1st week of December and all the cultural practices except plant protection measures were taken time to time. Sex pheromone traps @ 10 per hectare were installed in order to monitor the pest incidence. There were totally 8 treatments and 3 replications with RCBD as statistical design. The treatments were applied as 2 sprays at 10 days interval after 30 days of planting. Observations were recorded on number of larvae per plant and per cent head damage from ten randomly selected cabbage plants from each plot one day before, one, three, five, seven and nine days after imposition of treatments to know the effect of treatments on mortality of *Spodoptera litura* larval population. The data were analysed statistically and necessary conclusions were drawn. Yield, net returns and cost: benefit ratio was recorded after harvest.

Treatment details:

T_1 - Spray of *Spodoptera litura* Nucleo Polyhedrosis Virus (500 LE/ha, 2 sprays, 1 month after planting at 10 days interval)

T_2 - Spray of entomopathogenic fungi (*Nomuraea rileyi* @ 2×10^8 cfu/g -2g/l, 2 sprays, 1 month after planting at 10 days interval)

T_3 - Spray of Bougainville leaf extract 5 per cent (2 sprays, 1 month after planting at 10 days interval)

T_4 - Spray of IGR's (Novaluron 10% EC @ 1 ml/l, 2 sprays, 1 month after planting at 10 days interval)

T_5 - Cabbage with castor as a trap crop

Table 1: Efficacy of different treatments against *Spodoptera litura* (Fab.) on cabbage during *rabi*-2019

Treatment No.	Treatment	Dosage	I Spray		II Spray		Mean		Cabbage head yield (t/ha)	Increase in yield over UTC (%)	B:C ratio
			No. larvae/ plant	Reduction in in larvae over UTC (%)	No. larvae/ plant	Reduction in larvae over UTC (%)	No. larvae/ plant	Reduction in larvae over UTC (%)			
T_1	*Sl*NPV (1×10^9 POB)	500 LE/ha	0.76 (1.12) [ab]	49	0.49 (0.99) [b]	75.9	0.62 (1.05) [ab]	64.80	21.05	47.62	2.06
T_2	*Nomuraea rileyi* (2×10^8 cfu/g)	2 g/l	0.65 (1.07) [a]	56.38	0.32 (0.90) [b]	84.3	0.48 (0.98) [a]	72.80	26.63	58.60	2.67
T_3	Bougainvillea leaf extract (5%)	50 ml/l	0.82 (1.14) [ab]	44.97	0.53 (1.01) [bc]	73.9	0.67 (1.08) [ab]	61.94	19.6.9	44.00	1.98
T_4	Novaluron (10% EC)	1 ml/l	0.53 (1.01) [a]	64.5	0.07 (0.75) [a]	96.5	0.43 (0.96) [a]	75.60	28.56	61.40	2.81
T_5	Castor as a trap crop	5 kg seeds/ ha	0.94 (1.2) [b]	36.92	1.06 (1.24) [d]	47.8	1.003 (1.22) [bc]	43.10	15.69	29.75	1.57
T_6	Neemazal (1% EC) (10000 ppm)	2 ml/l	0.73 (1.10) [a]	51.01	0.39 (0.94) [b]	80.8	0.56 (1.02) [a]	68.20	23.50	53.08	2.21
T_7	NSKE (5%) followed by Chlorpyriphos (20 EC) - Poison Bait	50 ml/l and 125 ml/ha	0.74 (1.11) [ab]	50.34	0.47 (0.98) [b]	76.9	0.60 (1.04) [ab]	65.91	22.02	49.94	2.19
T_8	Control	-	1.49 (1.41) [c]	-	2.03 (1.59) [e]	-	1.76 (1.50) [d]	-	11.02	-	-
S. Em ±			0.03	-	0.02	-	0.02	-		-	
CD at 5%			**0.10**	-	**0.07**	-	**0.06**	-		-	
CV (%)			**7.92**		**7.61**		**7.76**	-		-	

UTC: Untreated control * Figures in the parentheses are square root transformed values

*Figures with same alphabetical super scripts are statistically non-significant

T_6 - Spray of Neem-based plant products (Neemazal 10,000 ppm @ 2 ml/l- 2 sprays, 1 month after planting at 10 days interval)

T_7 - Recommended plant protection (NSKE 5% for early instars- 1 spray, Poison bait- 25Kg Rice + 2Kg Jaggery + 125 ml Chlorpyrifos 20EC + 5 litre of water one application for late instars)

T_8 – Control

To prepare leaf extract, fresh leaves of the *Bougainvillea glabra* were collected and brought to the laboratory and washed thoroughly 3-4 times with tap water. Then they were shade dried and powdered by using mixer without adding water. To get 5 per cent extract, 5g of powdered leaves was dissolved in 100 ml of distilled water. The solution is allowed to settle down for 24 hours and then heated at 60^0C in a water bath for 45 minutes. It was shaken and sieved with the help of filter paper and then used (Aihetasham *et al*., 2017). NSKE was prepared as method suggested by Ajit (2011).

In the present investigation**,** treatment T_4 - Novaluron 10% EC @ 1 ml/l was found to be highly effective in reducing the larval load with 75.60 per cent reduction in larvae followed by T_2 - *Nomuraea rileyi* @ 2×10^8 cfu/g - 2g/l with 72.80 per cent of reduction in larval population over untreated control on the cabbage crop. The next best treatments in the order of efficacy were T_6 - Neemazal 10,000 ppm @ 2 ml/l with 68.20 per cent larval reduction, T_7 - Recommended plant protection (NSKE 5% for early instars- 1 spray, Poison bait- 25Kg Rice + 2Kg Jaggery + 125 ml Chlorpyrifos 20EC + 5 litre of water one application for late instars) with 65.91 per cent larval reduction and T_1 - Spray of *Spodoptera litura* Nucleo Polyhedrosis Virus (500 LE/ha) with 64.80 percent reduction in larvae over untreated control. Least efficacy was found in the treatments T_5 – Cabbage with castor as a trap crop with 43.10 per cent reduction in larvae which was succeeded by T_3 - Spray of Bougainville leaf extract 5 per cent with 61.64 per cent reduction in larvae over untreated control. Highest larvae were noticed in untreated controlled plot (1.76 larvae/plant).

Regarding yield and economics, highest yield was recorded from T_4 - Novaluron 10% EC @ 1 ml/l (285.64 q/ha) followed by T_2 - *Nomuraea rileyi* @ 2×10^8 cfu/g - 2g/l (266.32 q/ha). The next best treatments were T_6 - Neemazal 10,000 ppm @ 2 ml/l (235 q/ha), T_7 - Recommended plant protection (NSKE 5% for early instars- 1 spray, Poison bait- 25Kg Rice + 2Kg Jaggery + 125 ml Chlorpyrifos 20EC + 5 litre of water one application for late instars) (220.25 q/ha) and T_1 - Spray of *Spodoptera litura* Nucleo Polyhedrosis Virus (500 LE/ha) (210.50 q/ha). Lowest yield recorded from the untreated controlled plot (110.25 q/ha). Moderate yield was recorded from T_3 - Spray of Bougainville leaf extract 5 per cent (196.90 q/ha) and T_5 – cabbage with castor as a trap crop (156.94 q/ha). Highest net returns were recorded from T_4 - Novaluron 10% EC @ 1 ml/l (2.81) followed by T_2 - *Nomuraea rileyi* @ 2×10^8 cfu/g - 2g/l (2.67).

In the present investigation, Novaluron 10% EC @ 1 ml/l and *Nomuraea rileyi* @ 2×10^8 cfu/g were found highly effective against *Spodoptera litura* on cabbage when compared to other insecticides.

The superiority of Novaluron over other treatments was mainly because of varied mode of action like interfering with chitin biosynthesis (Hajjar and Casida, 1978; Gijswijt *et al*. 1979), production of imperfect cuticle (Mulder *et al*. 1975; Hammock and Quistad, 1981). It also affects the hormonal balance in insect thereby result in physiological disturbances such as, inhibition of DNA synthesis (Deloach *et al.* 1981), alteration in carbohydrates (Ishaaya and Ascher, 1977), cuticular lipids (Salama *et al.* 1976) and increase in phenyl oxidase (Deul *et al.* 1978). The results were in line with Barrania (2012) recorded 62.5 per cent and 97.5 per cent of larval mortality of *Spodoptera littoralis* after 3 days of treatment with Novaluron (Roxy 10% EC) in the year 2011 and 2012 respectively. Similar findings were recorded by Paliwal (2000), Murthy and Ram (2002), Arora *et al.* (2003) and Mahmoudvand *et al.* (2011) when they evaluated Novaluron against *Spodoptera litura*.

The result of *Nomuraea rileyi* was mainly because of its high virulence and better performance due to favourable environmental conditions like low temperature and high humidity and easy infection through cuticle by adhesion of conidia to insect cuticle (Boucias *et al*. 1982) facilitated the effective control of *Spodoptera litura.* Devi *et al.* (2002) reported higher mortality of *Spodoptera litura* when they applied *Nomuraea rileyi* on 3rd instar larvae of *Spodoptera litura* when the temperature was between 22.5^0C to 27.5^0C and with the critical humidity of ≥ 65 per cent. The results were in line with Devi *et al*. (2003) reported 79 per cent and 63.3 per cent mortality of *S. litura* and *H. armigera* by HaNR-coim and HaNR-Bang isolates of *N. rileyi* respectively. Shanthakumar *et al*. (2010) reported that *Nomuraea rileyi* influenced weight and length of pupa and duration of pupation and had 96.7 per cent of malformed adults under laboratory condition.

The study revealed that among various bio-intensive components evaluated against *S. litura* on cabbage, Novaluron (10% EC) @ 1 ml/lit and *Nomuraea rileyi*

(2×10^8 cfu/g) @ 2 g/l registered their superiority over rest of the treatments with lowest percent head damage of 20.00% and 30.00% respectively. Highest yield was recorded from Novaluron 10% EC @ 1 ml/l (285.64 q/ha) followed by *Nomuraea rileyi* 2×10^8 cfu/g @ 2g/l (266.32 q/ha) with the B:C ratio of 2.81 and 2.67 respectively. So, they can be suggested that spraying of Novaluron (10% EC) @ 1 ml/l and *Nomuraea rileyi* (2×10^8 cfu/g) @ 2 g/l twice, 30 days after transplanting at 10 days interval as effective and eco-friendly bio-intensive components for integrated management of *S. litura* in cabbage.

ACKNOWLWDGEMENT

The authors are highly thankful to the department of Entomology, Kittur Rani Channamma College Horticulture, Arabhavi, UHS, Bagalkot for providing necessary facilities.

REFERENCES

Aihetasham, A., Rasib, K. Z., Hasan, S. R. and Bodlah, I. 2017. Effect of *Carica papaya, Helianthus annus* and *Bougainvillea glabra* aqueous extracts against termite, *Heterotermes indicola* (Isoptera: Rhinotermitidae). *Punjab University Journal of Zoology*, **32**(1): 51-56.

Ajith. 2011. *Agri-info zone blog*.

Arora, R. K., Kalra, U. K. and Rohilla, H. R. 2003. Toxicity of some new and conventional insecticides to diamond back moth, *Plutella xylostella*. *Indian Journal of Entomology*, **65**(1): 43-48.

Barrania, A. A. 2012. Antifeedant, growth inhibitory and toxicity effects of Chlorantraniliprole, Thiamethoxam and Novaluron against the cotton leaf worm, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) in cotton fields. *Egyptian Journal of Agricultural Research*, **91**(3): 903-911.

Boucias, D. G., Schoborg, E. A. and Allen, G. E. 1982. The relative susceptibility of six noctuid species to infection by *Nomuraea rileyi* isolated from *Anticarsia gemmatalis*. *Journal of Invertebrate Pathololgy*, **39**: 238-240.

Deloach, J. R., Meola, S. M., Mayer, R. T. and Thompson, J. M. 1981. Inhibition of DNA synthesis by diflubenzuron in pupae of the stable fly *Stomoxys calcitrans* L. *Pesticides and Biochemistry and Physiology*, **15**: 172-180.

Deul, D. H., Dejong, B. J. and Kortnbach, J. A. M. 1978. Inhibition of chitin synthesis by two 1 - (2, 6 - Disubstituted Benzoyl) - 3 - phenylurea insecticides II. *Pesticides and Biochemistry and Physiology*, **8**: 98-105.

Devi, V. P. S., Prasad, Y. G. and Chowdary, A. 2002. Effect of drying and formulation of conidia on virulence of the entomo-fungal pathogen *Nomuraea rileyi* (F.) Samson. *Journal of Biological Control*, **16**(1): 43-48.

Devi, P. S. V., Prasad, Y. G., Chowdary, A. D., Rao, M. L. and Balakrishnan, K. 2003. Identification of virulent isolates of the entomopathogenic fungus *Nomuraea rileyi* (Farlow) Samson for the management of *Helicoverpa armigera* and *Spodoptera litura*. *Mycopathologia*, **156**: 365-373.

Gijswijt, M. J., Deul, D. H. and Dejong, B. J. 1979. Inhibition of chitin synthesis by benzyl phenyl urea insecticides: III Similarity in action in *Pieris brassicae* (L.) with Polyxin D. *Pesticides Biochemistry and Physiolology*, **12**: 87-94.

Hajjar, N. P. and Casida, J. E. 1978. Insecticidal benzoylphenyl Ureas: Structure- Activity relationships as chitin synthesis inhibitors. *Science*, **200**(4349): 1499-1500.

Hammock, C. D. and Quistad, G. B. 1981. Metabolism and mode of action of juvenile hormone, juvenoids and other insect growth regulators. *In: "Progress in Pesticide Biochemistry" (Hutson, D. H. and Roberts, T. R., eds.)*, **1**:1-85.

Mahmoudvand, M. Sheikhi, G. A. and Habib, A. 2011. Ovicidal effect of some insecticides on the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). *Chilean Journal of Agricultural Research*, **71**(2): 202-205.

Ishaaya, I. and Ascher, K. R. S. 1977. Effect of diflubenzuron on growth and carbohydrate hydrolases of *Tribolium casteneum*. *Phytoparasitica*, **5**: 149-158.

Lal, O. P. 1975. A compendium of insect pest of vegetables in India. *Bulletin of Entomology*, 31-36.

Mulder, R., Wellinga, K. and Daalen, V. J. J. 1975. A new class of insecticides. *Natur wissen schaften*, **62**: 531-531.

Murthy, K. S. and Ram, G. M. 2002. Studies on efficacy of a new chitin synthesis inhibitor Rimon (Novaluron 10% EC) on American bollworm, *Helicoverpa armigera* Hubn. attacking cotton. In: *Resources Management in Plant Protection during Twenty First Century*, Hyderabad, India, **2**: 165-168.

Paliwal, S. 2000. Phytotoxicity and bio-efficacy of Spinosad, a biopesticide against major insect pests of cauliflower (*Brassica oleracea* var. *botrytis* L.). *M. Sc. (Agri.) Thesis,* MPAUT, Udaipur, pp. 84.

Salama, H. S., Motagally, Z. A. and Skatulla, U. 1976. On the mode of action of Dimilin as a moulting inhibitor in some lepidoptera insect. *Journal of Applied Entomology*, **80**: 396-407.

Shanthakumar, S. P., Murali, P. D., Malarvannan, S., Prabavathy. V. R. and Nair, S. 2010. Laboratory evaluation on the potential of entomopathogenic fungi, *Nomuraea rileyi* against tobacco caterpillar, *Spodoptera litura* Fabricius (Noctuidae: Lepidoptera) and its safety to *Trichogramma* sp. *Journal of Biopesticides,* **3**(1 Special Issue): 132 – 137.

MS Received: 03 October 2020
MS Accepted: 27 November 2020