Journal of Biological Control, 27(4): 343–349, 2013

Research Note

Effect of botanicals and microbial pesticides for management of wax moth (*Galleria mellonella* L.) under stored condition

S. P. BHOPALE, G. NARASA REDDY, S. R. SHINDE and M. B. CHOPADE

Department of Apiculture, Department of Agricultural Entomology, College of Agriculture, UAS, GKVK, Bangalore 560 065, India.
**Corresponding author E-mail* : sangramsinhbhopale@gmail.com

ABSTRACT: Different larval instars of *Galleria mellonela* were subjected to botanicals and microbial pesticides *viz*., dried neem leaf, neem oil 3 per cent, *Bt* kurstaki (Halt), *Bt* local strain-1 and *Bt* (Halt.) local strain-2, pongamia oil 3 per cent and NSKE 5 per cent. Among these *Bt kurstaki* and pongamia oil gave maximum larval mortality (93.33%) in both the cases. In case of *Bt* local strain-1&2, neem oil and NSKE 5 per cent gave intermediate comb protection and larval mortality.

KEY WORDS: Botanicals, microbial pesticides, *Galleria mellonella*, management

(Article chronicle: Received: 07-12-2013; Revised: 14-12-2013; Accepted: 18-12-2013)

Honey bees are highly valued resource-insects around the World, prized for their honey, wax production and pollination of many important crops. Five species of honey bees are found all over the India *viz*., *Apis florea, A. cerana, A. dorsata, A. mellifera* and *Tetragonula iridipennis*. However, only *A. cerana* and *A. mellifera* are reared in hives. Managed honey bee populations are affected by many factors including diseases, parasites, pesticides, environment and socio-economic factors. These factors can act alone or in combination with each other (Vanengelsdorp and Meixner, 2010) in contributing to the loss of colonies and consequently the associated economic benefits. Despite prosperity, potentiality and wider scope of beekeeping for development, the above factors hinder the beekeeping in India. Among the several bee enemies, the greater wax moth, *Galleria mellonella* L., causes the highest loss to the bee keeping industry. There are different methods used for the management of *G. mellonella* and use of botanicals and microbial pesticides for control of the *G. mellonella* is promising as they are safe to bees and other economically important non-target organisms.

Neem oil, pongamia oil and dried neem leaf were tested under laboratory conditions for their efficiency against the wax moth larvae. The neem oil and neem seed kernal extract (NSKE) – 5 per cent were obtained from Department of Entomology and pongamia oil from Biofuel unit, Department of Forestry and Environmental Science, UAS, GKVK, Bangalore. Neem leaves were harvested from the tree at botanical garden at GKVK and dried thoroughly under shade for a few days. Microbial pesticides like *Bacillus thuringiensis kurstaki* (Halt) was obtained from Biostat company Hyderabad and *Bt* local strain 1 & 2 were isolated in the laboratory.

Preparation of oil suspension and neem leaf powder

The oil suspensions were prepared by mixing 3 ml of neem oil, 1 ml of Teepol in 96 ml of water. The suspension was stirred properly and used for treating the combs. The fine powder of dried neem leaf was obtained by powdering the dried leaf using pestle and mortar. The leaf powder was used in the treatment of comb.

Preparation of *Bt* formulation

The isolated bacterial cultures (*Bt* local strain 1&2) grown at 30°C in 100 ml of luria broth for 5-6 days were used for the study. Sporulated culture was centrifuged and the supernatant was discarded. The crystals obtained were diluted with water and mixed with 1–2.5 gm of the talc powder. Neutral p^H was maintained by adding 15 gm calcium carbonate/ kg of formulation. To the neutralised formulations, 6 per cent glycerol and CMC (10 gm/kg product) were added and mixed thoroughly and air dried (Ninfa and Ross-garcia, 2009).

Treatment of combs

The undamaged combs were cut into rectangular pieces each weighing 10 gm. The comb pieces were treated with prepared oil suspension and NSKE 5 per cent by giving a soaking spray using a hand sprayer. After spraying the comb with above products, the combs were allowed to dry at room temperature. Neem leaf powder was dusted on the cut comb @ 2.5 g/10 g of comb. All the formulations of *Bt* were prepared @ 2.5 gm in 500 ml of water and tested against greater wax moth larvae. Each treated comb was inoculated with larvae of second, third, fourth @ 5/ piece separately and placed in the ventilated plastic box of size (21 x 8 cm). The control consisted of combs applied with water spray. Ten days after larval release, combs were observed for the wax moth damage. The final weight of comb, number of cells damaged and larval mortality were also recorded (Cantwell and Shieh, 1981). Each treatment was replicated thrice.

There were no significant differences among the treatments with respect to mean larval mortality. The mean larval mortality was highest in *Bt kurstaki* (Halt) (93.33%), pongamia oil (93.33%), *Bt* local strain-1 (86.66%), NSKE 5% (75%), neem oil 3% (73.33%), *Bt* local strain-2 (66.66%) and dried neem leaf (66.66%), respectively. This findings are in conformity with that of Verma (1995) who reported highest mortality (98.72) of wax moth in honey bee colonies sprayed with a suspension of Dipel (10%) and protected the combs for 5.5 months from wax moth infestation. Wax combs sprayed with Certan recorded less damage by *G. mellonella* up to three months in storage (McKillinf and Brown, 1991) (Table 1).

The minimum cell damage in the comb was observed with pongamia oil treatment and *Bt kurstaki*, *Bt* local strain-1, NSKE 5% and neem oil treatments were on par with each other with respect to cell damage. The cell damage in all the treatments was significantly lesser than in the control. Our findings are in agreement with that of Hanumanthaswamy (2000) who reported the effect of different plant products on second and sixth instar larvae of *G. mellonella*.

Effect of botanicals and microbial pesticides on third instar larvae of wax moth

There were significant differences among the treatments with respect to mean per cent mortality. The mean larval mortality was highest in *Bt kurstaki* (Halt) (93.33%), *Bt* local starin-1 (80%), pongamia oil (80%), neem oil (70%), *Bt* local strain-2 (60%) and dried Neem leaf (53.33%), respectively.

Among the products, lowest cell damage was observed in *Bt kurstaki* (Halt) which was on par with that of pongamia oil, *Bt* local starin-1 and neem oil (12 to 20 per cent cell damage). Dried neem leaf and *Bt* local strain-2 performed poorly with 32.22 to 37 per cent cell damage respectively. These findings are in accordance with that of Morrison and Perron (1963) and Virakthmath *et al*. (2005) who concluded that the toxicity of Bt depends upon larval age, temperature and crystal content of the bacterial preparation. Burges and Bailey (1968), who reported that crystals are more important than spores in the mixture against the GWM larvae. The reduction in comb weight was highest at 6.8 gm in control treatment which was significantly higher than loss of comb weight in all other treatments (Table 2).

Table 1. Effect of botanicals and microbial pesticides on second instar larvae of *Galleria mellonella*

Treatment on the comb	Av. final wt of comb (gm)	Wt. reduction of comb (gm)	Larval mortality (%)	cell damaged in the comb (%)
Dried neem leaf	9.00	1.00	66.66	10.00
Neem oil 3%	9.10	0.90	73.33	7.00
Pongamia oil 3%	9.80	0.20	93.33	0.66
N.S.K.E 5%	9.20	0.80	75.00	6.30
Bt kurstaki (Halt)	9.80	0.20	93.33	0.66
Bt local strain – 1	9.50	0.50	86.66	4.50
Bt local strain – 2	9.00	1.00	66.66	10.00
Control	7.30	2.70	0	17.25
SEm±	–	0.11	8.01	0.53
C.D (P = 0.01)	–	0.47	32.04	2.12

- C.D – Critical difference SEm – Standard error mean

Table 2. Effect of botanicals and microbial pesticides on third and fourth instar larvae of *Galleria mellonella*

	Third Instar				Fourth Instar			
Treatment on the comb	Av. final wt of comb (gm)	Wt. reduction of comb (gm)	Larval mortality (%)	Cell damage in the comb (%)	Av. final wt of comb (gm)	Wt. reduction of comb (gm)	Larval mortality (%)	Cell damaged in the comb (%)
Dried neem leaf	6.4	3.6	53.33	37	4.70	5.30	46.66	54.00
Neem oil 3%	8.0	2.0	70	20	5.70	4.30	60.00	43.00
Pongamia oil 3%	8.4	1.6	80	16	5.20	4.80	53.33	47.00
N.S.K.E 5%	7.5	2.5	66.66	25	3.50	6.50	39.66	65.00
Bt kurstaki (Halt)	9.20	0.80	93.33	12.00	5.90	4.10	73.33	41.00
Bt local strain – 1	8.40	1.60	80.00	16.00	3.70	6.30	40.00	63.00
Bt local strain – 2	6.70	3.30	60.00	32.33	2.90	7.10	33.33	71.00
Control	3.2	6.8	0	72.66	1.00	9.00	0.00	90.00
SEm±	0.12	0.14	5.81	3.18	0.10	0.05	12.06	1.53
C.D ($P = 0.05$)	0.49	0.58	23.24	12.75	0.41	0.23	48.27	6.15

- C.D- Critical difference SEm- Standard error mean

Effect of botanicals and microbial pesticides on fourth instar larvae of wax moth

Mean per cent mortality of wax moth larvae showed significant differences among the treatments. The mean larval mortality was highest in *Bt kurstaki* (Halt) (73.33%), neem oil (60%), pongamia oil (53.33%), dried neem leaf (46.66%), *Bt* local strain-1 (40%), NSKE 5% (39.66%) and *Bt* local strain-2 (33.33%) respectively (Table 1). The cell damage in the comb was significantly second lowest in the *Bt kurstaki* (Halt) treatment and was on par with treatment of neem oil and pongamia oil. The comb damage under control was 90 per cent which was significantly higher than the damage recorded under all the treatments. The loss in comb weight under *Bt kurstaki* (Halt) and neem oil was 4.1 and 4.3, respectively.

REFERENCES

Anonymous, 2009. Food and agriculture organization of the united nations (FAO), FAOSTAT. <http://faostat.fao.org>.

Burges HD, Bailey L. 1968. Control of greater wax moth and lesser wax moth with *Bacillus thuringiensis*. *J Inv Pathol*. **11**: 184–195.

Cantwel GE, Shieh TA. 1981. Certan- A new bacterial insecticide against greater wax moth, *Galleria mellonella* L. *Am Bee J.* **121**: 424–426, 430–431.

Crane E. 1980. *A Book of Honey*. International Bee Research Association, Oxford University Press, Oxford, 1st edn, pp. 198.

Hanumanthaswamy BC. 2000. Natural enemies of honey bees with special reference to bio ecology and management of greater wax moth, *Galleria mellonella* L (Lepidoptera: Pyralidae). Ph.D. Thesis, University of Agricultural Sciences, Bangalore, India.

McKillup, Brown DG. 1991. Evaluation of formulations of *Bacillus thuringiensis* against greater wax moth in stored honey combs. *Aus J Exp Agri.* **31**(5): 709–711.

Morrison DL. 1948. The wax moth and its control. *Agri Gaz N S W*. **59**(7): 375–379.

Ninfa M, Ross-Garcia, 2009. Biopesticide production from *Bacillus thuringiensis*: An environmentally friendly alternative. *Recent Patents on Biotechnology* **3**: 28–36.

Vanengelsdorp D., Meixner MD. 2010. A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. *J Inv Pathol.***103**: 580–595.

Verma SK. 1995. Studies on the control of greater wax moth, *Galleria mellonella* in *Apis cerana* colonies with biological insecticide, Dipel. *Indian Bee J*. **57**: 121–123.

Viraktamath S, Basalingappa S, Lingappa S. 2005. Efficiency of commercial formulations of *Bacillus thuringiensis* against the larvae of the greater wax moth, *Galleria mellonella*. *Indian Bee J*. **67**: 72–77.