The Andhra Agric. J 59(2): 249-252, 2012

Effect of Abamectin and Emamectin Benzoate on Larval Period, Feeding and Weight Gain of *Spodoptera litura* (Fab.)

G Venkateswari, P V Krishnayya, P Arjuna Rao and K V M Krishna Murthy
Department of Entomology, Agricultural College, Bapatla 522 101, Andhra Pradesh

ABSTRACT

Abamectin at 20-30 ppm and 800-1000 ppm, and emamectin benzoate at 0.6-1.2 ppm and 25-55 ppm significantly prolonged the larval periods *i.e.* 8.2-11.2 days in both leaf disc ingestion and topical methods of application against third instar larvae of *S. litura*. The mean feeding inhibition by abamectin against third instar larvae of *S. litura* in leaf disc ingestion method was between 6.19 to 50.81% (5 to 30 ppm) as against 2.33 to 40.33% (100 to 1000 ppm) in topical method. Whereas, for ememectin benzoate in leaf disc ingestion method it was between 6.73 to 67.00% (0.2 to 1.2 ppm) as against 5.06 to 48.68% (5 to 55ppm) in topical method. The mean reduction of larval weight for abamectin against third instar larvae of S. litura in leaf disc ingestion method was between 20.43 to 53.84% (5 to 30 ppm) as against 17.34 to 45.35% (100 to 1000 ppm) in topical method. Whereas for emamectin benzoate in leaf disc ingestion method it was between 25.98 to 50.95% (0.2 to 1.2 ppm) as against 20.34 to 49.46% (5 to 55 ppm) in topical method.

Key words : Abamectin, emamectin benzoate, *Spodoptera litura*

Over the last decade, much attention has been given to produce biological insectides either directly from the nature or through formulation process keeping in view of the unwanted effects of conventional insecticides. Avermectins are such novel class of naturally occurring macrocyclic lactones with potent nematicidal, acaricidal and insecticidal activites. These compounds are produced by fermentation of soil actinomycetes, *Streptomyces avermitilis* Burg MA- 4680 (NRRL 8165) (Lasota and Dybas, 1991). Abamectin (MK-936) and emamectin benzoate (MK- 244) are the commercially formulated products of avermectins containing a minimum of 80 per cent avermectin B_{1a} and maximum of 20 per cent avermectin $B_{1b.}$ Avermectin function as gamma amino butyric acid (GABA) agonist that stimulates GABA release from presynaptic inhibitory membranes (Kass *et al*., 1980) and also act as agonist for GABA – gated chloride channels in the insect nervous system (Albrecht and Sherman, 1987). In the present investigation, effect of avermectins on larval period, feeding and weight gain of polyphagous lepidopteran, *Spodoptera litura* Fab. as evaluated

MATERIAL AND METHODS

The test insect, tobacco caterpillar, *S. litura* was reared in the Department of Entomology, Agricultural College, Bapatla on the leaves of castor, *Ricinus communis* (L.) in the laboratory at room temperature (27^0 C $\pm$ 4) and 70% relative humidity by collecting the egg masses initially from the field. Third (6 day old, 30 mg) and final (10 day old, 450 mg) instar larvae were used to evaluate the effect of abamectin and emamectin benzoate on larval period, feeding and weight gain by leaf disc ingestion and by topical methods.

Required concentrations of both the test chemicals *i.e*., abamectin (Vertimec 1.8 EC) and emamectin benzoate (Proclaim 5 SG) of M/s Syngenta India Ltd, Mumbai, were prepared by following serial dilution technique using water as solvent.

Moderately tender castor leaf discs (50 cm^2) were smeared (1 ml) with different concentrations of test chemicals, air dried and were fed to third instar larvae of *S. litura*. After 24 h, fresh, clean and untreated leaf discs were provided to the larvae as food every day till their pupation.

Table 1. Effect of abamectin on larval period, feeding inhibition and larval weight in third instar larvae of *S. litura*

Leaf disc ingestion method				Topical method			
Abamectin concentration (ppm)	Larval period (Days)	Per cent feeding inhibition over untreated check	Per cent reduction in larval weight over untreated check	Abamectin concentration (ppm)	Larval period (Days)	Per cent feeding inhibition over untreated check	Per cent reduction in larval weight over untreated check
5	7.4^{d}	6.2 (14.4)^{f}	20.4 (26.9)^{f}	100	7.4^{c}	2.3 (8.8)^{f}	17.3 (24.6)^{f}
10	7.6^{cd}	13.7 (21.7)^{e}	29.5 (32.9)^{e}	200	7.6^{c}	11.0 (19.4)^{e}	27.0 (31.3)^{e}
15	7.8^{cd}	29.4 (32.8)^{d}	33.6 (35.4)^{d}	400	7.6^{c}	19.7 (26.3)^{d}	34.4 (35.9)^{d}
20	8.2^{c}	39.3 (38.8)^{c}	38.8 (38.5)^{c}	600	8.0^{bc}	25.3 (30.2)^{c}	38.0 (38.1)^{c}
25	9.0^{b}	47.7 (43.7)^{b}	44.4 (41.8)^{b}	800	8.6^{b}	28.6 (32.3)^{b}	41.1 (39.9)^{b}
30	10.6^{a}	50.8 (51.3)^{a}	53.8 (48.0)^{a}	1000	10.4^{a}	40.3 (39.4)^{a}	45.4 (42.3)^{a}
Untreated check	7.2^{d}	—	—	Untreated check	7.4^{c}	—	—
F test	Sig.	(0.1)	Sig.	F test	Sig.	Sig.	Sig.
SEM ±	(0.4)	(0.3)	(0.1)	SEM ±	(0.4)	(0.2)	(0.1)
CD (P = 0.05)	(0.7)	(0.1)	(0.2)	CD (P = 0.05)	(0.8)	(0.4)	(0.3)

Sig: Significant **DAT:** Days after treatment

Note: Values in parenthesis are angular transformed values, in each column values with same alphabets are not significant

Different concentrations of the test chemicals were applied (1µ1 larva^{-1}) using micro-syringe on the dorsal thoracic region of the third instar larvae. Care was taken to air dry the micro droplet applied before releasing the larvae on the leaf discs.

Total time required for the larvae to enter into pupal stage after treatment was recorded and expressed in days as larval period.

The live larval weights were recorded on one, three and five days after treatment using electronic mono-pan balance and were expressed as mean per cent reduction over untreated check by using the formula,

$$\frac{\text{Mean weight gain in untreated check} - \text{Mean weight gain in treatment}}{\text{Mean weight gain in untreated check}} \times 100$$

Feeding inhibition of larvae, in terms of left over area of leaf disc three days after treatment was calculated over untreated check using leaf area meter. Per cent feeding inhibition over untreated check was calculated by using the formula,

$$\frac{\text{Mean leaf area consumed in untreated check} - \text{Mean leaf area consumed in treatment}}{\text{Mean leaf area consumed in untreated check}} \times 100$$

Five replications were maintained for each test concentration with 20 larvae per replication. The data pertaining to per cent reduction in larval weights over untreated check and larval feeding inhibition were subjected to angular transformation. The data were analyzed by ANOVA technique (Gomez and Gomez, 1984).

Table 2. Effect of emamectin benzoate on larval period, feeding inhibition and larval weight in third instar larvae of *S. litura*

Leaf disc ingestion method				Topical method			
Emamectin benzoate concentration (ppm)	Larval period (Days)	Per cent feeding inhibition over untreated check	Per cent reduction in larval weight over untreated check	Emamectin benzoate concentration (ppm)	Larval period (Days)	Per cent feeding inhibition over untreated check	Per cent reduction in larval weight over untreated check
0.2	7.4[e]	6.7 (15.0)[f]	26.0 (29.3)[f]	5	7.4[d]	5.1 (13.0)[f]	20.3 (26.8)[f]
0.4	7.6[e]	15.9 (23.5)[e]	31.9 (34.8)[e]	15	7.8[d]	12.6 (20.8)[e]	28.3 (32.2)[e]
0.6	8.4[d]	39.3 (38.8)[d]	38.1 (38.1)[d]	25	8.6[c]	19.7 (26.3)[d]	36.2 (37.0)[d]
0.8	9.2[c]	49.7 (44.8)[c]	41.6 (40.2)[c]	35	9.2[c]	25.4 (30.3)[c]	40.7 (39.6)[c]
1.0	10.4[b]	58.6 (50.0)[b]	47.4 (43.5)[b]	45	10.4[b]	35.6 (36.3)[b]	46.0 (42.7)[b]
1.2	11.2[a]	67.0 (54.9)[a]	51.0 (45.5)[a]	55	11.2[a]	48.7 (44.2)[a]	49.5 (44.7)[a]
Untreated check	7.4[e]	—	—	Untreated check	7.4[d]	—	—
F test	Sig.	Sig.	Sig.	F test	Sig.	Sig.	Sig.
SEM ±	(0.3)	(0.1)	(0.1)	SEM ±	(0.3)	(0.1)	(0.1)
CD (P = 0.05)	(0.7)	(0.3)	(0.3)	CD (P = 0.05)	(0.67)	(0.2)	(0.3)

Sig: Significant **DAT:** Days after treatment

Note: Values in parenthesis are angular transformed values, in each column values with same alphabets are not significant

RESULTS AND DISCUSSION

In both the methods of application, with increase in test concentrations of abamectin, larval period of treated larvae increased from 7.4 to 10.6 days in leaf disc ingestion method (5 to 30 ppm) compared to 7.4 to 10.4 days in topical method (100 to 1000 ppm). Significantly prolonged larval periods were recorded *i.e.,* 8.2, 9.0 and 10.6 days at 20, 25 and 30 ppm in leaf disc ingestion method were also significantly different from each other. Whereas the larval periods of 7.4, 7.6 and 7.8 days corresponding to 5, 10 and 15 ppm were on par with each other and untreated check (7.2 days). Similarly in topical method the larval periods were 8.6 and 10.4 days corresponding to 800 and 1000 ppm, whereas the variation in larval period from 7.4 to 8.0 days corresponding to 100 to 600 ppm was significant and were on par with untreated check (7.4 days) (Table 1)

Similarly for emamectin benzoate in both the methods, with increase in test concentrations larval period of treated larvae increased from 7.4 to 11.2 days. Significantly prolonged larval periods were recorded *i.e.* 8.4, 9.2, 10.4 and 11.2 days at 0.6, 0.8, 1.0 and 1.2 ppm in leaf disc ingestion method and 8.6, 9.2, 10.4 and 11.2 days at 25, 35, 45 and 55 ppm in topical method. Whereas the larval periods of 7.4 and 7.6 days corresponding to 0.2 and 0.4 ppm in leaf disc ingestion method and 7.4 and 7.8 days corresponding to 5 to 15 ppm in topical method were on par with untreated check (7.4 days) (Table 2)

Prolongation of larval period might be due to decreased feeding. Reed *et al.* (1985) reported prolonged larval period of >40 days compared to 27 to 30 days of normal period in codling moth, *Cydia pomonella* (L.) with abamectin 0.16 and 0.32 ppm through artificial diet. Though avermecrtins do not exhibit rapid knock down effect on insects, paralysis is rapid and damage to crops by insect feeding is minimal because feeding ceases shortly after ingestion. Avermectins are taken up by arthropods

via. contact and ingestion, later is considered to be the primary route to accumulate a lethal dose (Jansson and Dybas, 1998)

With regard to feeding inhibition of *S. litura* larvae compared to untreated check, the mean feeding inhibition by abamectin ranged between from 6.2 to 50.8% (5 to 30 ppm) in leaf disc ingestion method and between 2.3 to 40.3% (100 to 1000 ppm) in topical method and were significantly different from each other (Table 1).

In the similar line, abamectin at a topical dose of 0.025 µg, feeding of soybean looper, *Pseudoplusia includes* (Walker) on normal and resistant soybean foliage was reduced by 66.0 and 59.0 per cent, respectively (Beach and Todd, 1985). Pienkowski and Mehring (1983) also noted that abamectin reduced the feeding of larvae of the alfalfa weevil, *Hyper postica* (Gyllenha) on alfalfa.

Residues of abamectin were reported to have resulted in significant antifeedant effects immediately following its application and reduced leaf area consumption in *S. exigua* at zero days of post-treatment (Trumble *et al*., 1987).

In case of emamectin benzoate, the overall mean feeding inhibition values over untreated check were in the range of 6.7 to 67.0% (0.2 to 1.2 ppm) in leaf disc ingestion method and 5.1 to 48.7% (5 to 55 ppm) in topical method were significantly different from each other (Table 2).

It is the characteristic feature of lepidopteran larvae to attain a critical weight by voracious feeding particularly in the final instar for successful pupation. The larvae store enough food reserves and energy required for the metabolism and metamorphosis in the inactive stage of pupa (Chapman, 1968).

In case of abamectin by leaf disc ingestion method, the mean values of reduction of larval weights over untreated check were ranged between 20.4 to 53.8% (5 to 30 ppm) as against 17.3 to 45.4% (100 to 1000 ppm) in topical method (Table 1).

The present observations were in agreement with Abro *et al.* (1993) who reported that sub lethal effects of abamectin (1.8 ng ml^{-1}) on *P. xylostella* reduced the weight gain of fourth instar larvae.

In case of emamectin benzoate by leaf disc ingestion method, the mean values of reduction of larval weight over untreated check ranged between 26.0 to 51.0% (0.2 to 1.2ppm) as against 20.3 to 49.5% (5 to 55 ppm) in topical method (Table 2).

Thus the effect of avermectins on larval duration, feeding inhibition and weight reduction indicate their insect growth regulatory effects besides their direct lethal effect on lepidopteran larvae and prove them as one of the ecofriendly groups of pesticides to include in IPM modules.

LITERATURE CITED

Abro G H, Corbitt T S, Christie P T and Wright D J 1993. Sublethal effects of abamectin of *Plutella xylostella* (L.) and *Spodoptera litura* (F.) larvae. *Crop Protection,* 21(1): 39-44.

Albrecht C P and Sherman M 1987. Lethal and sublethal effects of avermectin B_1 on three fruit fly species (Diptera:Tephritidae). *Journal of Econonic Entomology,* 80: 344-347.

Beach R M and Todd J W 1985. Toxicity of avermectin to larva and adult soybean looper (Lepidoptera: Noctuidae) and influence on larva feeding and adult fertility and fecundity. *Journal of Economic Entomology*, 78: 1125-1128.

Chapman R F 1968. Digestion and Absorption. In: *The Insects*: *Structure and Function*. The English Language Book Society, Hodder and Stoughton Ltd., Kent. Pp 78-79.

Gomez K A and Gomez A A 1984. Single - Factor experiments In: *Statistical Procedures for Agricultural Research*. John Wiley & Sons, New York. Pp 20-29.

Jansson R K and Dybas R A 1998. Avermectins: Biochemical mode of action, biological activity and agricultural importance. In: *Insecticides with novel Mode of action – Mechanisms and Applications*. Ishaaya I and Deghede D (eds.). Springer-Verlag, Berlin, Heidelberg, New York, Pp 1553-1570.

Kass I S, Wang C C, Walrond J P and Stretton A O W 1980. Avermectin B_{1a} a paralyzing anthelmintic that affects interneurons and inhibitory motor neurons in *Ascaris*. *Proceedings of Natural Academy of Sciences*, USA 77: 6211-15.

Lasota J A and Dybas R A 1991. Avermectins a novel class of compounds : Implications for the use in arthropod pest control. *Annual* Review of Entomology 36: 91117.

Pienkowski R L and Mehring P R 1983. Influence of avermectin B_1 and carbofuran on feeding by alfalfa weevil larvae (Coleoptera: Curculionidae). *Journal of Economic Entomology*, 76: 1167-69.

Reed O K, Tromley N J and Reed G L 1985. Activity of avermectin B1 against codling moth (Lepidoptera: Olethreutidae). *Journal of Economic Entomology*, 78: 1067-1071

Trumble J T, Moar W J, Babu J R and Dybas R 1987. Laboratory bioassays of the acute and antifeedant effects of avermectin B_1 and a related analogue on *Spodoptera exigua* (Hubner). *Journal of Agricultural Entomology*, 4(1): 21-28.

(Received on 20.06.2011 and revised on 02.08.2011)