Management of tobacco caterpillar, *Spodoptera litura* in Virginia tobacco with insecticide baits

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Abstract

*A replicated field experiment was conducted for three seasons in flue cured Virginia (FCV) tobacco (*Nicotiana tabacum*) cv. Kanchan for management of tobacco leaf eating caterpillar,* Spodoptera litura. *Baits prepared with emamectin benzoate 5 SG, Sl NPV,* Bacillus thuringiensis *var.* kurstaki *and IGRs novaluron 10 EC and lufenuron 5 EC were evaluated in comparison with chlorpyriphos 20 EC bait for management of the pest. Tobacco plants infested, mean number of leaves damaged and per cent leaf area damaged were found to be least in emamectin benzoate bait treated plots followed by novaluron and lufenuron bait treated plots. Highest cured leaf yield (1982 kg/ha) was recorded in emamectin benzoate bait treated plots followed by that in novaluron treated plots (1931 kg/ha), which was on par with that of lufenuron bait treated plots (1812 kg/ha). The net returns (₹ 77,878/ha) and incremental cost benefit ratio (ICBR) (1:20.47) was highest for emamectin benzoate bait treatment followed by novaluron (₹ 71,433/ ha and 1:14.70), chlorpyriphos (₹ 54,039 and 1: 14.79) and lufenuron (₹ 58,332 and 1:11.56) bait treatments. Data on infestation, leaf damage and yield parameters, net returns and economics showed that baits prepared with emamectin benzoate 5 SG @ 11 g a.i /ha and IGRs novaluron 10 EC @ 50 g a.i./ha and lufenuron 5 EC @ 30 g a.i./ha were quite promising and can be used in place of chlorpyriphos 20 EC @ 200 g a.i./ ha bait in FCV tobacco field crop.*

Keywords: Tobacco, *Nicotiana tabacum, Spodoptera litura*, baits, emamectin benzoate, lufenuron, novaluron

Introduction

Tobacco caterpillar, *Spodoptera litura* Fab. is the key pest of tobacco, infests the crop both in seed beds as well as planted crop. The caterpillars feed voraciously along the veins of leaves and in case of severe infestation only veins are left on the plant causing significant yield loss. It was reported to cause up to 20 per cent yield loss under normal conditions. The hot and humid weather that prevail in coastal Andhra Pradesh is congenial for rapid multiplication of the pest; under congenial conditions, the pest causes severe damage to the tobacco crop. Management of the pest with foliar sprays of insecticides under outbreak situations, cyclonic weather conditions and in grown up crop is a problem. Under such situations insecticide baits have been recommended for management of the pest in tobacco (Ramaprasad *et al.*, 1989; Sitaramaiah *et al.*, 2001). Insecticides in bait formulations were reported to provide effective control of boll worm and *S. litura* (Abdul Kareem and Viswanathan, 1980; Viswanadham *et al.*, 1986). Studies conducted in the laboratory and nursery have revealed that chlorpyriphos, monocrotophos, endosulfan and carbaryl mixed with rice bran and jaggery bait in 8:2 ratios was effective in controlling 4th and 5th instar larvae of *S. litura* (Ramaprasad *et al.*, 1986). Application of endosulfan or fenvalerate or chlorpyriphos or monocrotophos or quinolphos in bait form at 1/3rd of their recommended dose by mixing with rice bran and jaggery in 4:1 ratio was recommended for effective and economical control of late instar larvae of *S. litura* in tobacco nurseries (Ramaprasad *et al.*, 1989). Muniz and Garifalo (1980) found that the effectiveness of *Bacillus thuringiensis* bait was comparable with foliar spray of chemical insecticides against *Heliothis virescens*. Feeding stimulants based baits often reduce insecticide use and increase the efficacy of the insecticide or entomopathogen used. However, the baits with chemical insecticides *viz.*, chlorpyriphos, monocrotophos and carbaryl are not eco-friendly and pose a hazard when used indiscriminately. The registered insecticides that provide adequate control of the pest continued to decrease and also there is a ban on some of these insecticides on tobacco. The guidance residue levels (GRLs) of the recommended insecticides have been revised to a lower level by CORESTA (CORESTA, 2013). Besides other adverse effects due to repeated application of insecticides, the problem of insecticide residues is a major cause of concern in tobacco. Hence, there is a need to search for alternative eco-friendly baits for management of the pest in tobacco.

Materials and methods

A replicated field experiment was conducted for three seasons (2009-12) in planted flue cured Virginia tobacco cv. *Kanchan* at CTRI Research Farm, Jeelugumilli, West Godavari District of Andhra Pradesh. The experiment was laid out in randomized block design with 6 treatments and an untreated control with a plot size of 6 × 6 m. Baits were prepared with the test insecticide + rice bran @ 68 kg/ha + jaggery @ 17 kg/ha + water 34 l/ha and applied in the leaf axils of the plant at 60 days after planting (DAP) in tobacco. The insecticides used in the bait were lufenuron 5 EC @ 30 g a.i./ha, novaluron 10 EC @ 50 g a.i./ha, emamectin benzoate 5 SG @ 11 g a.i./ha, Sl NPV @ 1. 5 × 10^{12} PIBs/ha + boric acid (H_3BO_3) 1%, *Bacillus thuringiensis* var. *kurstaki* (*Btk*) 1 kg + potassium carbonate (K_2CO_3) @ 375 g/ha and compared with chlorpyriphos 20 EC @ 200 g a.i./ha bait.

Observations on per cent plants infested, mean number of leaves damaged per plant and per cent leaf area damaged were recorded at 4 and 10 days after treatment (DAT). Yield characters *viz*., green leaf, cured leaf were recorded and grade index was calculated and subjected to analysis of variance. Economics of inputs and output was worked out to obtain the net returns and the incremental cost: benefit ratio (ICBR).

Results and discussion

Pooled analysis of three seasons data (Table 1) showed that the infestation was least (10.6%) in the plots treated with emamectin benzoate bait at 4 days after treatment (DAT) followed by novaluron bait treated plots (12.3%), which was on par with lufenuron bait treated plots (13.6%). All these three treatments were significantly superior to chlorpyriphos bait treated plots (16.4%). Among the treatments, *Btk* bait treated plots recorded highest (24%) damage, which was on par with that in Sl NPV (22.8%) treated plots as well as that of untreated control plots (25.8%). At 10 DAT, emamectin benzoate bait treated plots continued to be the least infested (10.6%) followed by novoluron bait treated plots (12.3%) both of which were superior to all other treatments except novaluron bait that was found to be on par with lufenuron bait treated plots. As regards to the mean number of leaves damaged per plant, all the treatments recorded significantly less number of leaves damaged as compared to control both at 4 (5.5 leaves/plant) and 10 (6.3 leaves/plant) DAT. Emamectin benzoate bait treated plots recorded least number (1.5 and 1.6) of leaves damaged at 4 and 10 DAT. It remained on par with novaluron bait treated plots (2.0 and 2.2) at 4 and 10 DAT and was significantly superior to all the treatments. Chlorpyriphos bait treated plots recorded 2.4 and 2.6 leaves damaged per plant at 4 and 10 DAT, respectively, and remained on par with that of novaluron and lufenuron bait treated plots. The leaf area damaged was also least in emamectin benzoate bait treated plots both at 4 and 10 DAT (8.4% and 9.6%) which was significantly superior to all the treatments except that of chlorpyriphos bait treated plots (9.7% and 10.6%). Novaluron (10.4% and 12.0%) and lufenuron (11.0% and 13.1%) bait treated plots were found to be on par with chlorpyriphos bait treated plots both at 4 and 10 DAT. Among the treatments, the plots treated with Sl NPV (16.7% and 20.1%) and *Btk* (17.2% and 20.7%) baits recorded the highest leaf area damaged though they recorded significantly less leaf area damaged

Table 1. Tobacco caterpillar infestation in Virginia tobacco, pooled data 2009-12

	Per cent plants infested		Mean no. of leaves damaged/plant		Per cent leaf area damaged	
Treatment	4 DAT	10 DAT	4 DAT	10 DAT	4 DAT	10 DAT
Lufenuron bait	13.6 (17.2)	13.6 (17.2)	2.2	2.4	11.0 (11.4)	13.1 (16.0)
Novaluron bait	12.3 (14.1)	12.3 (14.1)	2.0	2.2	10.4 (10.3)	12.0 (13.6)
Emamectin benzoate bait	10.6 (10.8)	10.6 (10.8)	1.5	1.6	8.4 (6.9)	9.6 (8.8)
Sl NPV + H_3BO_3 bait	22.8 (43.3)	26.1 (53.4)	4.5	5.5	16.7 (25.0)	20.1 (34.8)
Btk + K_2CO_3 bait	24.0 (46.9)	27.4 (57.5)	4.3	4.7	17.2 (26.5)	20.7 (36.8)
Chlorpyriphos bait	16.4 (24.2)	16.7 (25.0)	2.4	2.6	9.7 (9.1)	10.6 (10.7)
Control (untreated)	25.8 (52.4)	25.9 (53.0)	5.5	6.3	19.9 (34.2)	25.7 (52.2)
CD (P=0.05)	2.32	2.31	0.6	0.6	1.7	1.8

Figures in parentheses are arcsine transformed values

Table 2. Management of *S. litura* in FCV tobacco; mean yield (kg/ha) and economics, pooled data 2009-12

Treatment	Green leaf (kg/ha)	Cured leaf (kg/ha)	Grade index	Economics	
				Net returns (₹/ha)	Benefit: Cost ratio
Lufenuron bait	11832	1812	1080	58,332	1:11.56
Novaluron bait	12545	1931	1112	71,433	1:14.70
Emamectin benzoate bait	12913	1982	1147	77,878	1:20.47
Sl NPV + H_3BO_3 bait	10605	1506	938	25,594	1:4.46
Btk + K_2CO_3 bait	10382	1471	901	21,520	1:2.78
Chlorpyriphos bait	11594	1763	1038	54,039	1:14.79
Control (untreated)	9777	1370	777	13,297	-
CD (P= 0.05)	793	119	78	-	-

as compared to control (19.9% and 25.7% at 4 and 10 DAT, respectively). Effectiveness of insecticides baits against *S. litura* and other lepidopterous pests has been reported in tobacco as well as other crops (Viswanadham *et al.*, 1986; Ramaprasad *et al.*, 1989; Hiremath, 1993; Sitaramaiah *et al.*, 2001; Renju *et al.*, 2009). Similarly, use of feeding stimulants to enhance the effectiveness of insect growth regulators and bio insecticides proved effective in earlier studies (Andrews *et al.*, 1975; Bell and Kanavel, 1975; Chandler, 1993; Mona *et al.*, 2004). The less effectiveness of biopesticide baits may be due to high temperatures (32-34 °C) prevailing during the experimental period.

Yield parameters and economics

Pooled analysis of cured leaf yield data (Table 2) showed that the highest (1982 kg/ha) cured leaf yield was recorded in emamectin benzoate bait treated plots followed by that in novaluron bait treated plots (1931), which was on par with that of lufenuron bait treated plots. Chlorpyriphos bait treated plots recorded 1763 kg/ha yield, which was on par with that in lufenuron bait treated plots. The lowest cured leaf yield was recorded in *Btk* bait treated plot (1471 kg/ha) which was on par with that in Sl NPV bait treated plot; however, both the treatment recorded significantly higher cured leaf yield as compared to that in control plots (1370 kg/ha). The grade index was the highest (1147) in the emamectin benzoate bait treatment followed by novaluran (1112) and lufenuron (1080) bait treatments and all of them were on par with each other. Only emamectin benzoate bait treated plots recorded significantly higher grade index as compared to chlorpyriphos bait treated plots which recorded a grade index of 1038, which was significantly higher than Sl NPV and *Btk* bait treatments. The net returns and incremental cost benefit ratio (ICBR) was the highest (₹77,878/ha; 1:20.47) for emamectin benzoate bait followed by novaluron (₹71,433/ha; 1:14.70), chlorpyriphos (₹ 54,039; 1: 14.79) and lufenuron (₹58,332; 1:11.56) baits.

Considering the results obtained on the effectiveness of different treatments in terms of infestation, leaf damage, yield parameters and economics, it can be inferred that insecticide baits prepared with emamectin benzoate 5 SG @ 11 g a.i./ha and IGRs novaluron 10 EC @ 50 g a.i./ha and lufenuron 5 EC @ 30 g a.i./ha proved effective and can be used in place of chlorpyriphos 20 EC @ 200 g a.i./ha bait in tobacco field crop under outbreak situations and cyclonic weather conditions when insecticide sprays prove ineffective.

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