Management of Tobacco Stem Borer, *Scrobipalpa heliopa* in Virginia Tobacco

U Sreedhar

Central Tobacco Research Institute, Rajahmundry - 533 105, Andhra Pradesh, India.
E mail: usreedharctri@yahoo.com

Abstract

A field experiment was conducted for two seasons for management of tobacco stem borer, Scrobipalpa heliopa *in Virginia tobacco,* Nicotiana tabacum. *Rynaxypyr 25 SC @ 0.0075% and flubendiamide 480 SC @ 0.012% were highly effective followed by spinosad 45 SC @ 0.018% in protecting tobacco from stem borer infestation when sprayed in the seed beds ten days before pulling the seedlings and ten days after transplanting (DAT) in the main field. The grade index was also found to be higher with net returns of ` 93,496, ` 91,862 and ` 86,135 and the B:C ratio was 2.09, 2.07 and 2.00, respectively in the plots treated with rynaxypyr, flubendiamide and spinosad. Studies on persistent toxicity of the promising insecticides against tobacco stem borer on tobacco showed that the persistent toxicity index (PTI) was highest (1405.26) for rynaxypyr followed by flubendiamide (1379.16) and spinosad (1302.08). The order of relative persistent toxicity was rynaxypyr > flubendiamide > spinosad > emamectin benzoate > chlorpyrifos.*

Keywords: Tobacco, *Nicotiana tabacum, Scrobipalpa heliopa*, management, rynaxypyr, flubendiamide, spinosad

Introduction

Stem borer, *Scrobipalpa heliopa* Low. is one of the important insect pests of tobacco. It infests the crop both in the seed beds as well as planted crop. The larvae bore through the midrib into the stem, feed on the tissue obstructing water and nutrient supply. In the infested plants, a gall is formed at the base of the stem. The plants remain stunted and develop suckers resulting in uneven growth and reduction of yields. Also, the infestation of stemborer pre-disposes the tobacco plants to Fusarium wilt disease (*Fusarium oxysporum*) greatly increasing the losses. Control of the pest with conventional insecticides is rather difficult once the larva enters the stem. Endosulfan, quinalphos, monocrotophos and chlorpyrifos were recommended for control of the pest (Jagadish, 1979; Rao and Das, 1980; Rao, 1981; Sreedhar and Krishnamurthy, 2007). 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 (Sreedhar, 2011; Sreedhar, 2012). The guidance residue levels (GRLs) of the recommended insecticides have been revised to a lower level by CORESTA (CORESTA, 2008). Besides other adverse effects due to repeated application of insecticides, the problem of insecticide residues is the major cause of concern in tobacco. In order to circumvent the problems, there is a need to replace the conventional insecticides with selective insecticides effective at low dose in tobacco. Search for safer alternatives for pest management, which are less aggressive for the environment, has brought a significant development in identification and deployment of new insecticides, with possibilities of use in pest management and contributing to a safer and more efficient way of pest control. As the infestation occurs both in the seed beds as well as planted crop and the infestation is often carried over through seedlings to the main field, there is a need to find out promising insecticides and effective method of application.

Materials and methods

The experiment was laid out in randomized block design with three replications using cv. *Siri* of FCV tobacco with a plot size of 7 x 7 m for two seasons during 2008-2010. The seedlings were treated with insecticides *viz.*, Spinosad 45 SC @ 0.018%, flubendiamide 480 SC @ 0.012%, rynaxypyr 25 SC @ 0.0075%, emamectin benzoate 5 SG @ 0.001%, carbosulfan 25 EC @ 0.05%, profenofos 50 EC @ 0.15% and chlorpyrifos 20 EC @ 0.05% in the seed beds, ten days before pulling and the same were sprayed with the respective insecticides 10 days after planting (DAP). These treatments were compared with untreated tobacco plants in

(41.3%) and similarly the maximum avoidable yield loss of 30.7 per cent was registered in flubendiamide.

In urdbean, Sesha-Mahalakshmi *et al.,* (2012) recorded the highest seed yield of 270.8 kg/ ac in flubendiamide followed by thiodicarb (250.0 kg/ac), pyridalyl (229.2 kg/ac) and indoxacarb (216.7 kg/ac) during *Rabi* 2009-10. The efficacy of newer insecticides such as flubendiamide, emamectin benzoate, indoxacarb, chlorantraniliprole and thiodicarb against caterpillar pests has been reported earlier by many workers in different crops. Suhas *et al.* (1999) reported that application of indoxacarb was very effective in bringing down the pod damage (23.1 %) by *H. armigera* in pigeonpea. In the present study, flubendiamide along with chlorantraniliprole and indoxacarb @ 24, 30 and 75 g a.i./ ha, respectively were the most effective insecticides in reducing the damage caused by *M. vitrata* in greengram and also registered maximum yields.

Overall, the present study revealed that newer insecticides such as flubendiamide, chlorantraniliprole, and indoxacarb were very effective followed by emamectin benzoate, fipronil and thiodicarb against *M. vitrata* on greengram with reduced damage and enhanced seed yields.

Acknowledgements

The first author is grateful to the Department of Science and Technology for INSPIRE fellowship for the research work and also to ICAR.

References

Ashok Kumar C T and Shivaraju C 2009. Evaluation of newer insecticide molecules against pod borers of blackgram. *Karnataka Journal of Agricultural Sciences* **22 :** 521-523.

Atachi P and Djihou Z C 1994. Record of host plants of *Maruca testulalis* (Geyer) (Lepidoptera: Pyralidae) in the republic of Benin. *Entomological Society of Annatesdela France* **36 :** 169-174.

Bhosale B B, Nishantha K M D W P, Patinge N R and Kadam D R 2009. Comparative efficacy of microbial insecticide molecule E2Y45 against pod borer complex of pigeonpea. *Pestology* **33 :** 38-42.

Cook D R, Leonard B R and Gore J 2004. Field and laboratory performance of novel insecticides to armyworms (Lepidoptera: Noctuidae). *Florida Entomologist* **87 :** 433-439.

Gomez K A and Gomez A A 1984. *Statistical Procedures for Agricultural Research* (2nd ed.). John Wiley & Sons, New York. 680 pp.

Liao C T and Lin C S 2000. Occurrence of the legume pod borer, *Maruca testulalis* Geyer (Lepidoptera: Pyralidae) on cowpea *(Vigna unguiculata* Walp.) and its insecticides application trial. *Plant Protection Bulletin* 42 **:** 213-222.

Randhawa H S, Aulakh S S, Bhagat I and Chhina J S 2009. Efficacy of different insecticides against *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) on seed crop of berseem in Punjab. *Legume Research* **32 :** 145-148.

Sesha Mahalakshmi M, Rama Rao C V and Koteswara Rao Y 2012. Efficacy of certain newer insecticides against legume pod borer, *Maruca vitrata* in urdbean. *Indian Journal of Plant Protection* **40 :** 115-117.

Sharma H C 1998. Bionomics, host plant resistance and managament of the legume pod borer, *Maruca vitrata* - a review. *Crop Protection* 17 **:** 373-386.

Sontakke B K and Swain L K 2007. Bio-efficacy of emamectin benzoate against boll worm complex in cotton. *Annals of Plant Protection Sciences* **15 :** 1-3.

Sonune V R, Bharodia R K, Jethva D M, Rathod R T and Deshmukh S G 2010. Field efficacy of chemical insecticides against spotted pod borer, *Maruca vitrata* (Fabricius) infesting blackgram. *Legume Research* **33 :** 287-290.

Suhas Y, Sidde Gowda D K and Patil B V 1999. Efficacy of indoxacarb (Avaunt 15 SC) against pigeonpea pod borer *Helicoverpa armigera* (Hubner). *Pestology* **11 :** 60-64.

Received : 16-04-2013 Accepted : 21-01-2014

a replicated field experiment. Observations on stem borer infestation on tobacco were recorded periodically at 30, 40 and 50 days after planting. Yield characters *viz*., green leaf, cured leaf and bright 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 benefit: cost ratio.

The persistent residual toxicity of four new insecticides *viz.*, Spinosad 45 SC @ 0.018%, flubendiamide 480 SC @ 0.012%, rynaxypyr 25 SC @ 0.0075%, emamectin benzoate 5 SG @ 0.001% and chlorpyrifos 20 EC @ 0.05% was studied. The seedlings were treated with respective insecticides and the leaves were used to study the residual persistent toxicity from 0 days till there is no mortality in that particular treatment at 24 h interval. Ten first instar larvae (0 -12 h old) were released on each leaf and mortality was recorded after 24 h. All the five treatments were replicated thrice. The persistent residual toxicity was determined by slightly modifying the method suggested by Pradhan (1967) and as used by Sarup *et al*., (1970) subsequently.

Results and discussion

Results showed that during 2008-09 season, at 30 DAP the infestation in control (untreated) plot was significantly high (25.6%) as compared to treatments (Table 1). The infestation was least in rynaxypyr and flubendimide (3.3%) which was on par with spinosad (3.6%), emamectin benzoate (5.6%) and carbosulfan (6.7%). Similar trend was observed at 40 DAP. At 50 DAP a maximum infestation of 35.6 % was recorded in control (untreated) plots. The infestation remained least in rynaxypyr and flubendiamide (3.3%) however; it was on par with spinosad (4.4%) and emamectin benzoate (7.8%). Among the treatments chlorpyrifos recorded highest infestation (15.6%). During 2009-10 season at 30 DAP the infestation was least in rynaxypyr (2.2%) followed by flubendiamide (3.3%), which was on par with spinosad and emamectin benzoate (4.4%). At 50 DAP a maximum infestation of 36.7 % was recorded in control (untreated) plots. The infestation remained least in rynaxypyr (3.3%) followed by flubendiamide (4.44%) and remained on par with spinosad and emamectin benzoate (5.6%). Among the treatments chlorpyriphos recorded the highest infestation (14.4%) followed by profenofos (13.3%) and both were on par with carbosulfan (12.2%).

Combined analysis of two seasons data showed at 30 DAP the infestation in control (untreated) plot was significantly high (30.6 %) as compared to all the treatments. The infestation was least in rynaxypyr (2.8%) followed by flubendiamide (3.3%), which was on par with spinosad and emamectin benzoate (4.0 & 5.0%). Chlorpyrifos recorded highest (10.6%) infestation among the treatments and was found to be on par with that of and profenofos (9.4%). Similar trend was observed at 40 DAP. At 50 DAP a maximum infestation of 36.1 % was recorded in control (untreated) plots. The infestation remained least in rynaxypyr (3.3%) followed by flubendiamide (3.3%) and remained on par with spinosad (4.0%). Emamectin benzoate (4.5%), while remaining on par with spinosad and carbosulfan was inferior to rynaxypyr. Among the treatments chlorpyrifos recorded the highest infestation (10.6%) followed by profenofos (9.4%) and both were on par with carbosulfan (7.8%).

Yield parameters and economics

Pooled analysis of two seasons data revealed that all the treatments recorded significantly higher green leaf yield than control (9448 kg/ha). The plots treated with rynaxypyr recorded highest cured leaf yield (2007 kg/ha) and was on par with the yield in the plots treated with flubendiamide (1967 kg/ha) and spinosad (1920 kg/ha). Among the treatments chlorpyrifos recorded the lowest yield (1588) kg/ha which was on par with carbosulfan (1645 kg/ha) and profenofos (1617 kg/ha). The bright leaf yield in rynaxypyr, flubendiamide, and spinosad was on par with each other. The grade index was also highest in rynaxypyr (1433 kg/ha) and it was on par with that of flubendiamide (1420 kg/ha) and spinosad (1379 kg/ha). Among the treatments chlorpyrifos recorded lowest grade index (1130 kg/ha). Perusal of Table 2 shows that the net returns and benefit: cost ratio was highest for the treatments of rynaxypyr and flubendiamide (₹ 93,496 & ₹ 91,862 and 2.09 & 2.07 respectively) followed by spinosad (₹ 86,135 and 2.00).

Persistent toxicity studies

From the PT values the superior persistence of the new insecticides over chlorpyrifos is evident. Treatment of rynaxypyr and flubendiamide resulted in cent per cent mortality up to 18 days after treatment (DAT) and their toxicity was very high (80.8 & 78.6 %) up to 12 DAT. These insecticides recorded 100 per cent mortality up to 8 DAT where as spinosad and emamectin benzoate recorded 100 % mortality up to 6 DAT. The PT values were higher for emamectin benzoate and spinosad followed by flubendiamide and rynaxypyr. However, the persistent toxicity index (PTI) was highest (1405.3) for rynaxypyr followed by flubendiamide (1379.2) due to their higher persistency for a longer period than others. The lowest PTI (703.4) was observed in chlorpyrifos treatment. The order of relative persistent toxicity was rynaxypyr > flubendiamide > spinosad > emamectin benzoate > chlorpyrifos.

From the experimental results based on the pest infestation on tobacco, yield data and persistent toxicity studies, it can be inferred that with sequential spraying of rynaxypyr 25 SC @ 0.0075% or flubendiamide 480 SC @ 0.012% or

Table 1. Management of *Scrobipalpa heliopa* in tobacco using newer insecticides

Treatment	Per cent tobacco plants infested					
	30 DAP		40 DAP		50 DAP	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Spinosad 45 SC @ 0.018%	3.6 (10.5)	4.4(12.0)	4.4(12.0)	5.6(13.5)	4.4(12.0)	5.6(13.5)
Flubendiamide 480 SC @ 0.012%	3.3 (8.5)	3.3(10.5)	3.3(8.5)	4.4(12.0)	3.3(8.5)	4.4(12.0)
Rynaxypyr 25 SC@ 0.0075 %	3.3(8.5)	2.2(7.2)	3.3(8.5)	3.3(10.5)	3.3(8.5)	3.3(10.5)
Emamectin benzoate 5 SG @0.001%	5.6(13.2)	4.4(12.0)	7.8 (16.2)	5.6(13.5)	7.8(16.1)	5.6(13.5)
Chlorpyrifos 20 EC @ 0.05%	10.0(18.3)	11.1(19.4)	12.2(20.2)	12.2(20.4)	15.6(23.0)	14.4(22.3)
Carbosulfan 25 EC @ 0.05%	6.7(14.6)	8.9(17.1)	7.8(16.2)	11.1(19.2)	8.9(17.3)	12.2(20.3)
Profenofos 50 EC @ 0.15%	8.9(17.3)	10.0(18.3)	10.0(18.4)	12.2(20.2)	13.3(21.4)	13.3(21.4)
Control (un treated)	25.6(30.2)	26.7(31.0)	33.3(35.1)	32.2(34.5)	35.6(36.5)	36.7(37.2)
SEm ±	2.9	2.0	2.9	1.9	2.8	1.3
CD (p= 0.05)	8.7	6.2	8.8	5.8	8.6	3.8

Figures in parentheses are arc sine transformed values

Table 2. Management of stem borer in FCV tobacco- Mean Yield (kg/ha) and Economics -Pooled data of two seasons (2008-10)

Treatment	Green leaf	Cured leaf	Bright leaf	Grade index	Economics		
					Gross Return (₹/ha)	Net Return (₹/ha)	Benefit:Cost ratio
Spinosad 45 SC @ 0.018%	12928	1920	868	1379	172375	86135	2.00
Flubendiamide 480 SC @ 0.012 %	13202	1967	893	1420	177500	91862	2.07
Rynaxypyr 25 SC@ 0.0075%	13377	2007	913	1433	179125	93496	2.09
Emamectin benzoate 5 SG 0.001%	12345	1785	823	1297	162125	75479	1.89
Chlorpyrifos 20 EC @ 0.05%	11493	1588	705	1130	141250	56140	1.65
Carbosulfan 25 EC @ 0.05%	11665	1645	754	1167	145875	61630	1.73
Profenofos 50 EC @ 0.15%	11550	1617	730	1160	145000	59720	1.70
Control (un treated)	9448	1495	627	995	124375	39375	1.46
SEm ±	350	51	27	39	-	-	-
CD (p= 0.05)	1012	147	78	114			

spinosad 45 SC @ 0.018% ten days before pulling and ten days after transplanting in the main field stemborer, *S.heliopa* can be effectively managed in FCV tobacco. Chlorpyrifos (Rao and Das, 1980) and profenofos (Venkateswarlu *et al.*, 2007) were found effective against stem borer in the past. The guidance residue levels of both the insecticides were very low *viz.,* Chlorpyrifos 0.5 ppm, profenofos 0.1 ppm (CORESTA, 2008), which will result in residues in the cured leaf. Besides that, ineffectiveness of these insecticides was often reported by the farmers. In the present study profenophos and chlorpyrifos were inferior to the new insecticides rynaxypyr, flubendiamide, spinosad and emamectin benzoate in protecting tobacco from stem borer infestation. Effectiveness of rynaxypyr, flubendiamide and spinosad against lepidopterous borers was reported in various crops (Tohnishi *et al.*, 2005; Ebbinghaus *et al.*, 2007; Sharma and Sinha, 2009; Latif *et al.*, 2009, 2010; Ameta *et al.*, 2011; Chakraborti and Sarkar, 2011). Based on the stemborer infestation in the field, tobacco yield and economics, the present studies indicate that rynaxypyr 25

Table 3. Persistent residual toxicity of insecticides on FCV tobacco seedlings against tobacco stem borer, *S. heliopa*

Treatment	Per cent mortality (Days after treatment) Up to 2 days	4	6	8	10	12	14	16	18	20	(P)	(PT)	(PTI)	(ORE)
Spinosad 45 SC @ 0.018%	100	100	100	96.8	90.0	70.2	42.2	14.6	0	-	16	81.4	1302.1	3
Flubendiamide 480 SC @ 0.012%	100	100	100	100	97.8	78.6	46.8	16.4	3.2	0	18	76.6	1379.2	2
Rynaxypyr 25 SC @ 0.0075%	100	100	100	100	98.6	80.8	52.6	20.2	6.6	0	18	78.1	1405.3	1
Emamectin benzoate 5 SG100@ 0.001%	100	100	100	94.2	80.8	60.4	38.6	10.0	0	-	16	78.4	1254.4	4
Chlorpyrifos 20 EC @ 0.05%	100	90.2	76.6	36.4	14.8	6.2	0	-	-	-	12	58.6	703.4	5

P = Period of persistency; PT = Mean persistent toxicity; PTI = Persistent toxicity index; ORE = Order of relative toxicity

SC @ 0.0075 %, flubendiamide 480 SC @ 0.012% and spinosad 45 SC @ 0.018% can be deployed for management of stem borer, *S. heliopa* in flue cured tobacco by foliar application twice (10 days before pulling the seedlings in the nursery and 10 days after transplanting tobacco in the main field).

References

Ameta O P, Sharma U S and Jeengar K L 2011. Efficacy of flubendiamide 480 SC against podborers, *Helicoverpa armigera* (Hubner) and *Maruca testulalis* (L.) in pigeon pea. *Indian Journal of Entomology* **73 :** 191-195.

Chakraborti S and Sarkar P K 2011. Management of *Leucinodes orbanalis* Guenee on egg plants during rainy season in India. *Journal of Plant Protection Research* **51 :** 325-328.

CORESTA 2008. The concept and implementation of agrochemical guidance residue levels. Guide No.1. *CORESTA*. France. 10 pp.

Ebbinghaus D, Schnorbach H J and Elbert A 2007. Field Development of Flubendiamide (Belt®, Fame®, Fenos®, Amoli®) – a New Insecticide for the Control of Lepidopterous Pests. 2007. *Bayer Crop Science Journal* **2 :** 219-246.

Jagadish A 1979. Control of *Spodoptera litura* and *Scrobipalpa heliopa* in nursery tobacco. *International Journal of Pest Management* **25 :** 16-18.

Latif M A, Rahman M M, Alam M Z and Hossain M M 2009. Evaluation of flubendiamide as an IPM component for the management of brinjal shoot and fruit borer, *Leucinodes orbanalis* Guenee. *Munis Entomology and Zoology* **4 :** 257-267.

Latif M A, Rahman M M and Alam M Z 2010. Efficacy of Nine Insecticides against Shoot and Fruit Borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) in Eggplant. *Journal of Pest Science* **83 :** 391-397.

Pradhan S 1967. Startegy of integrated pest control. *Indian Journal of Entomology* **29 :** 105-122.

Rao K N 1981. Tobacco stem borer and its control. *Indian Tobacco Journal* **13 :** 8-9.

Rao K N and Das V S R 1980. Persistent residual toxicity of the recommended insecticides to the first instar larvae of tobacco stem borer (*Scrobipalpa heliopa* Low). *Tobacco Research* **6 :** 108-111.

Sarup P, Singh D S, Amarpuri S and Rattan Lal 1970. Persisitent relative residual toxicity of some important pesticides to adults of sugarcane leaf hopper, *Pyrilla perpusilla*. Walker (Lopophidae: Homoptera). *Indian Journal of Entomology* **32 :** 256-267.

Sharma R K and Sinha S R 2009. Management of shoot and fruit borer, *Leucinodes orbonalis* Guen. through border cropping and insecticides in brinjal. *Indian Journal of Entomology* **71 :** 130-132.

Sreedhar U 2011. IPM and agrochemical management in tobacco. Souvenir XIV National Symposium on tobacco -Emerging trends in tobacco Science. Indian Society of Tobacco Science, Rajahmundry. Pp 89-92.

Sreedhar U 2012. Management of insect pests of tobacco. In: ed: Ramesh Arora, Balwinder Singh and Ashok Dhawan. Theory and practice of Integrated Pest Management. 529 pp. Scientific Publishers, New Delhi, India.

Sreedhar U and Krishna Murthy V 2007. Safe use of crop protection agents in tobacco. Central Tobacco Research Institute, Rajahmundry, India. 26 pp.

Tohnishi M, Nakao H, Furuya T, Seo A, Kodama H, Tsubata K, Fujioka S, Hirooka T and Nishimatsu T 2005. Flubendiamide, a novel insecticide highly active against Lepidopterous insect pests. *Journal of Pesticide Science* **30 :** 354-360.

Venkateswarlu P, Sreedhar U, Sitaramaiah S and Nageswararao S 2007. Evaluation of method of application of certain insecticides against stem borer, *Scrobipalpa heliopa* in tobacco. *Tobacco Research* **33 :** 79-80.

Received : 05-09-2013 Accepted : 13-01-2014