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DEVELOPMENT AND EVALUATION OF PEST MANAGEMENT MODULES IN BURLEY TOBACCO

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Field experiments conducted for two seasons indicated that IPM module proved to be effective in minimizing the insect pest damage, sustained the natural enemy activity and economically beneficial. Infestation of stem borer (*Scrobipalpa heliopa*), tobacco caterpillar (*Spodoptera litura*), budworm (*Helicoverpa armigera*), aphid (*Myzus nicotianae*) and leaf curl virus disease transmitted by whitefly (*Bemesia tabaci*) was least in IPM plot followed by chemical control plot. Mean cured leaf yield in IPM plot was 1673 kg/ha as against 1583 kg/ha in chemical control plot and 1374 kg/ha in biological control plot. Economics of different modules showed that the net returns were Rs. 40,996/ha with a CB ratio of 1: 1.89 in IPM module, as against Rs. 36,116 and 1:1.78 in chemical control module and Rs. 24,948/ha and 1:1.54 inbio-control module respectively.

Key words: Burley tobacco, IPM,Yield

INTRODUCTION

Burley tobacco (*Nicotiana tabacum* L.) is cultivated in area of about 12,000 ha with a production of about 13 million kg in Andhra Pradesh. Burley tobacco is mainly cultivated by resource poor small and marginal farmers. Insect pests are one of the major limiting factors in production of burley tobacco. Indiscriminate use of chemical pesticides to manage the insect pests bring various undesirable effects on the agro-ecosystem and environment besides jeopardizing the export prospects of burley tobacco due to increased residues in the leaf. Earlier studies proved the effectiveness of IPM modules and bio control modules in tobacco (Rao *et al.*, 1994; Chari *et al.*, 1995, 1996; Sitaramaiah *et al.*, 2002). Hence, studies were undertaken to evaluate different modules *viz.*, IPM, biological control and chemical control modules for management of insect pests in burley tobacco.

MATERIALS AND METHODS

A field experiment comprising of three modules *viz.*, IPM, biological control and chemical control for management of insect pests in burley tobacco was laid out at burley tobacco research centre, Jeddangi, Andhra Pradesh using cv. Banket A1 of burley tobacco with a plot size 0.3 ha for each module for two seasons during 2007-2008. Three modules *viz.*, IPM, biological control and chemical control were tested. The components of IPM were cultural, biological and need based application of selective insecticides. Sorghum was grown as border crop around tobacco in IPM plot. Imidacloprid 0.005% was sprayed at 25 DAP to manage leaf curl in IPM plot and chlorpyrifos 0.05% was sprayed to mange stem borer. To manage *S. litura* one spray of SlNPV was given. For management of budworm, handpicking and application of HaNPV was undertaken. In biological control plot, two sprays each of NSKS 0.5%, Sl NPV @ 1.5×10^{12} PIBs/ha and HaNPV @1.5×10^{12} PIBs/ha were carried out. Five insecticide sprays were given in chemical control plot with imidacloprid 0.005%; chlorpyrifos 0.05% and acephate 0.075% at 20, 30, 40, 50 and 60 DAP. Observations were recorded on pest infestation and yield in all the three plots. Observations on the activity of natural enemies was recorded on border crop sorghum and tobacco

RESULTS AND DISCUSSION

Pest infestation in different management modules

During 2007, the results showed that the infestation of insect pests was more in biological control plot as compared to IPM and chemical control plots. Stem borer infestation ranged from 6.60 - 14.20% in biological control, 4.40 - 6.80%

in IPM and 4.20 - 8.20 % in chemical control plot. It was significantly less in IPM and chemical control plots than that of biocontrol plots at all the observations (Table 1). Leaf curl infected plants were 4.60 -10.20% in biological control, 1.00 – 5.00% in IPM and 0.80 - 5.80% in chemical control plot. The infestation of tobacco leaf eating caterpillar, *S. litura* in IPM plot ranged from 1.20

Table 1: Pest infestation in different management modules in burley tobacco

	Tobacco plants infested (%)									
	Stem borer		Leaf curl		Budworm		Aphid		Caterpillar	
Module	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**
30 DAP										
IPM	4.40	4.00	1.00	0.8	0.20	0.40	–	–	–	–
Bio-control	6.60	6.40	4.60	2.8	1.80	1.60	–	–	–	–
Chemical control	4.20	4.20	0.80	0.6	0.40	0.60	–	–	–	–
Students 't' value for comparison of means										
M1& M2	1.96*	1.03*	2.76*	1.94*	4.82	2.30	–	–	–	–
M1&M3	0.20	0.41	0.22	0.25	0.22	0.20	–	–	–	–
M2&M3	1.39*	2.22	2.47*	1.54*	1.43	1.93	–	–	–	–
40 DAP										
IPM	6.20	4.40	2.40	1.40	2.00	2.40	–	–	1.20	1.40
Bio-control	10.20	8.00	6.20	4.20	8.20	5.80	–	–	3.80	3.60
Chemical control	5.60	4.80	2.00	1.00	2.40	2.80	–	–	0.66	0.80
Students 't' value for comparison of means										
M1& M2	2.75*	1.32*	1.41*	1.01*	4.26*	1.79*	–	–	1.78*	1.20*
M1&M3	0.10	0.60	0.49	0.06*	0.02	0.40	–	–	0.02*	0.70
M2&M3	2.43*	2.17*	3.69*	1.37*	1.84*	0.50*	–	–	2.16*	1.99*
50 DAP										
IPM	6.80	5.20	4.00	2.20	5.00	5.20	0.50	0.60	5.80	4.60
Bio-control	12.00	10.20	8.60	6.00	16.80	10.60	2.60	1.80	10.40	8.20
Chemical control	8.00	6.60	4.20	2.00	6.80	6.00	0.28	0.40	6.20	5.80
Students 't' value for comparison of means										
M1& M2	1.07*	1.86*	4.04*	1.11*	3.05*	1.43*	1.66*	1.99*	3.68*	1.83*
M1&M3	9.64	3.12	0.24	0.44	3.46	0.02	0.32	0.20	0.05*	4.59
M2&M3	2.16*	1.94*	1.84*	1.22*	4.80*	2.53*	1.32*	2.80*	2.55*	1.48*
60 DAP										
IPM	6.80	5.80	5.00	2.80	6.20	6.00	1.60	2.00	6.40	6.60
Bio-control	14.20	10.80	10.20	8.20	20.20	12.20	4.80	4.60	14.60	10.80
Chemical control	8.20	6.80	5.80	3.00	7.00	6.80	2.00	2.40	8.00	8.20
Students 't' value for comparison of means										
M1& M2	4.73*	1.11*	1.44*	1.84*	3.22*	2.75*	1.02*	1.81*	7.30*	3.30*
M1&M3	1.15*	2.09	0.04	0.44	0.05	0.90	0.12*	0.59	3.33	2.95
M2&M3	2.67*	1.09*	1.48*	1.05*	1.36*	1.29*	1.34*	2.60	5.10*	3.51

*** Significant P=0.05**

M1= IPM, M2= Bio-control, M3= Chemical Control; DAP= Days after plantin

- 6.40% whereas it was 80 - 14.60% in biological control and 0.66- 8.00% in chemical control plot. Budworm infestation was the lowest in IPM plot (0.20 – 6.20%) and the highest in biological control plot (1.80 - 20.80%) whereas it was 0.40 -7.0% in chemical control. It was significantly less in IPM and chemical control plots compared to bio-control plot at 40, 50 & 60 DAP. During 2008 also the infestation of insect pests was more in biological control plot as compared to IPM and chemical control plots. Stem borer infestation ranged from 6.40 -10.80% in biological control, 4.0 - 5.80% in IPM and 4.20 - 6.80% in chemical control plot which was significantly less than that of bio-control plot. Leaf curl incidence was 2.80 - 8.20% in biological control, 0.80 - 2.20% in IPM and 0.60 - 3.0% chemical control plot. The infestation of *S. litura* in IPM plot ranged from 1.40 - 6.60% whereas it was 3.60- 10.80% in biological control and 0.80 - 8.20% in chemical control plot. Significant differences were observed between the three modules at 40 and 50 DAP, whereas significantly higher incidence of *S. litura* was observed in biocontrol plot at 60 DAP as compared to IPM and chemical control plots. Budworm infestation was the lowest in IPM plot (0.40 – 6.0%) and the highest in biological control plot (1.60 - 12.20 %) whereas it was 0.60 - 6.80% in chemical control. The pest infestation in IPM and chemical control module were on a par and significantly less than that in biological control plots. Effectiveness of IPM in various crops has been well established (Singh *et al.*, 2003; Bhosle *et al.*, 2007; Gundannavar *et al.*, 2010). The components of biological control apparently could not provide adequate protection probably due to low persistency of the components *viz.*,NSKS, SlNPV and HaNPV. Bell (1991) attributed higher damage in NPV treated fileds due to longer incubation periods of the NPV which allows the larvae to inflict considerable damage to the plant. In case of IPM, the sorghum barrier crop not only prevented the infestation of the pests but also harboured many natural enemies which limited the pest activity on burley tobacco. Effectiveness of intercrops/barrier crops in altering the micro climate and minimizing the pest incidence has been extensively reported (Lawson and Jackai, 1987; Mensah, 1997; Khorsheduzzaman *et al.*, 1997; Fereres, 2000)

Natural enemy activity

The activity of natural enemies in IPM plot was relatively high as compared to chemical control plot due to rational use of selective insecticides and use of sorghum barrier crop which harbored the natural enemies and apparently moved to the main crop. The population of spiders though the highest in biocontrol plots (2.40 – 6.50/ plant) during both the years, it was on a par with IPM plots at 40, 50 & 60 DAP in 2007 and at all the observations in 2008 (Table 2). Coccinellids were recorded only in biocontrol and IPM plots from 40 DAP. The highest coccinellids were recorded in biocontrol plots (0.80 – 8.20/plant) followed by IPM plot, which were on a par with each other at all the observations during both the years. The population of coccinellids and syrphids was nil in chemical control plots at all the observations during both the seasons. Significantly higher syrphids were recorded in bio-control plots (0.60 – 4.00/plant) as compared to IPM plots (0.50 – 2.40/plant). On sorghum border crop around IPM plot, more coccinellids (0.6 -12.60 & 0.5 -12.80/plant) were recorded as compared to other predators during 2007 & 2008 seasons, respectively (Table 3). Among others, spiders were predominant (4.00-8.00 & 4.60 -6.80) followed by syrphids (1.80 -5.20 & 0.60 -4.80) and wasps (0.20- 1.60 & 0.60- 2.20). *Harpactor* sp., chrysopids, mantids, damsel flies and pentatomid bugs were the other predators recorded. Among the treatments the activity of natural enemies was more in biological control plot followed by IPM plot and it was least in chemical control plots. The natural enemies were more in biological control plot due to the use of bio-pesticides and also due to increased incidence of the pests as most of the natural enemies are density dependent. The role of habitat management, a form of conservation biological control, is an ecologically based approach aimed at favoring natural enemies and enhancing biological control in agricultural systems (Picket, 1998; Landis, 2000). Also the IPM plots conserve natural enemies due to less application of insecticides (Bhosle *et al.*, 2007).

Yield parameters

The green leaf yields in IPM, chemical control and biological control plots during 2007 were

Table 2: Natural enemy population in different management modules in burley tobacco

	Mean numbers/plant									
	Spiders		Coccinellids		Syrphids		Wasps		Others	
Module	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
30 DAP										
IPM	1.90	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40
Bio-control	2.40	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.80
Chemical control	1.20	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
SEm±	**0.16**	**0.21**	-	-	-	-	-	-	**0.05**	**0.08**
CD (P=0.05)	**0.51**	**0.68**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.18**	**0.21**
40 DAP										
IPM	2.60	2.80	0.80	0.70	0.60	0.50	0.00	0.00	1.40	1.20
Bio-control	3.20	3.00	1.00	0.80	1.00	0.60	0.00	0.00	1.50	1.40
Chemical control	1.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.40
SEm±	**0.30**	**0.60**	**0.24**	**0.13**	**0.08**	**0.16**	-	-	**0.29**	**0.32**
CD (P=0.05)	**0.94**	**1.20**	**0.76**	**0.40**	**0.26**	**0.46**	**N.S**	**N.S**	**0.86**	**0.92**
50 DAP										
IPM	3.50	3.50	4.40	4.00	1.40	1.60	0.00	0.00	1.60	1.50
Bio-control	4.80	4.00	6.40	6.60	3.20	3.80	0.00	0.00	1.60	1.80
Chemical control	1.80	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.20
SEm±	**0.40**	**0.59**	**0.72**	**0.69**	**0.49**	**0.39**	-	-	-	**0.59**
CD (P=0.05)	**1.28**	**1.80**	**2.20**	**2.12**	**1.50**	**1.24**	**N.S**	**N.S**	**0.62**	**1.20**
60 DAP										
IPM	3.90	4.00	6.50	6.20	2.40	2.20	0.40	0.20	2.20	2.00
Bio-control	6.50	5.80	8.20	8.00	3.90	4.00	0.60	0.40	2.80	2.50
Chemical control	2.20	1.80	0.00	0.00	0.00	0.00	0.40	0.00	0.60	0.40
SEm±	**0.47**	**0.70**	**0.61**	**0.63**	**0.54**	**0.60**	-	-	**0.27**	**0.21**
CD (P=0.05)	**1.46**	**2.10**	**1.86**	**1.94**	**1.60**	**1.84**	**N.S**	**N.S**	**0.84**	**0.66**

Table 3: Natural enemy population on border crop sorghum in IPM module

	Mean numbers/plant									
	Spiders		Coccinellids		Syrphids		Wasps		Others	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
30 DAP	4.00	4.60	0.60	0.50	0.00	0.60	0.00	0.60	1.40	1.60
40 DAP	4.80	5.60	2.60	4.00	1.80	2.20	0.20	1.00	2.00	2.60
50 DAP	5.80	6.80	8.40	10.00	4.60	3.60	1.40	2.20	2.66	3.00
60 DAP	8.00	6.00	12.60	12.80	5.20	4.80	1.60	1.60	6.00	4.86

12790, 10500 and 9306 kg/ha and the cured leaf yields were 1695, 1625 and 1410 kg/ha, respectively. During 2008, green leaf yields in IPM, chemical control and biological control plots were 12450, 11100 and 8920 kg/ha and the cured leaf yields were 1650, 1540 and 1338 kg/ha, respectively (Table 4). Economics of different modules showed that the net returns were Rs 40,996 with a CB ratio of 1:1.89 in IPM module as against Rs.36,116 and 1:1.78 in chemical control module and Rs.24,948 and 1:1.54 in biocontrol module, respectively. Effectiveness of IPM and its favourable economics over other methods have been reported in various crops including tobacco (Rao *et al.*, 1994; Chari *et al.*, 1995, 1996; Singh *et al.*, 2005; Amutha and Manisegaran, 2007; Birthal *et al.*, 2007; Yambathnal *et al.*, 2011). Based on the results it can be inferred that, the IPM module proved to be effective in minimizing insect pest damage, enhanced the natural enemy activity and proved economically beneficial in burley tobacco.

Table 4: Evaluation of trap crops against budworm in FCV tobacco- mean yield (kg/ha)

	Green leaf		Cured leaf	
Module	**2007**	**2008**	**2007**	**2008**
IPM	12790	12450	1695	1650
Bio-Control	9306	8920	1410	1338
Chemical Control	10500	11100	1625	1540
SEm±	**396**	**268**	**21**	**17**
CD (P=0.05)	**1170**	**812**	**60**	**48**

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