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Management of bud worm (*Helicoverpa armigera*) in Virginia tobacco (*Nicotiana tabacum*) through pest diversionary approach*

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Bud worm (*Helicoverpa armigera* Hub.) is one of the major insect pests of tobacco. It infests the crop during the grand growth period, feeds voraciously on the apical bud and bud leaves, adversely affecting the growth of the plant resulting in considerable yield loss. In Virginia tobacco, *Nicotiana tabacum* L. the loss in green leaf and cured leaf was recorded to be 2 891 and 426 kg/ha, respectively (Sreedhar *et al*. 2005). Besides other adverse effects due to sole dependence on insecticides, the problem of insecticide residues is the major cause of concern in tobacco. Trap cropping is a useful strategy to manage the insect pests, as it can be integrated with other cultural, biological and chemical control methods. Marigold, *Tagetes erecta* L. and rustica tobacco, *Nicotiana rustica* L. planted in perimeter pattern (all around the plot) or as strips in east-west direction were found effective as trap crops for management of budworm, *H. armigera* in FCV tobacco (Sreedhar *et al.* 2007, Sreedhar, 2011). Benefits of trap crop can be greatly improved through various manipulations including a skill full combination with bio-pesticides. Hence, a field experiment was conducted for two seasons, integrating trap crop and bio-pesticide, neem, Azadirachta *indica* A. Juss seed kernel extract (NSKE) to develop an eco-friendly IPM strategy for management of budworm, *H.armigera* in Virginia tobacco.

The experiment was laid out in randomized block design with three replications using cv. *Hema* of FCV tobacco with a plot size of 7 m × 7 m for two seasons during 2006–08. Trap crops, viz. marigold (flowers with single whorl ray florets-sw), marigold with multi whorl ray florets (mw) and rustica tobacco were planted around Virginia tobacco plots. Virginia tobacco was sprayed with NSKE @ 0.5% at 30 and 40 days after planting. These treatments were compared with tobacco plots without trap crop but sprayed with NSKE 0.5% and tobacco plots without trap crop and without NSKE spray in a replicated field experiment. Observations on budworm infestation on tobacco, population of budworm on trap crops, population of natural enemies on trap crops as well as tobacco were recorded periodically. Yield characters, viz green leaf, cured leaf and bright leaf were recorded, and grade index was calculated and subjected to analysis of variance.

The infestation of *H.armigera* was least (2.7%) in tobacco with marigold-sw + NSKE followed by tobacco with rustica tobacco + NSKE (3.0) which were on par with marigold – mw + NSKE (4.3%) at 40, 50 and 60 days after planting during 2006–07 season (Table 1). Similar trend was observed at 50 and 60 DAP. The infestation (12.7–16.3%) in tobacco plots sprayed with NSKE without trap crop was significantly higher than all other treatments and was found to be on a par with control (15.7–18.0%) in all the observations. The infestation of *H.armigera* was least (2.7%) in tobacco with rustica tobacco + NSKE, followed by tobacco with marigold-sw + NSKE (3.00%) which were on par with marigold –mw + NSKE at 40 days after planting during 2007–08 season. Similar trend was observed at 50 DAP. The infestation in tobacco plots sprayed with NSKE without trap crop was significantly higher (12.0–16.7%) than all other treatments and was found to be at par with control (14.7–18.3%) in all the observations. A Significant reduction in budworm infestation was observed in tobacco plots with trap crops + NSKE spray as compared to plots with trap crop and without NSKE spray during both the seasons.

Virginia tobacco plots with rustica tobacco as trap crop + NSKE spray on Virginia tobacco recorded the highest number of eggs than all other treatments at all the observations i.e. 40, 50 and 60 DAP (15.26, 15.83 and 14.66/plant). All the trap crops planted around Virginia tobacco plots sprayed with NSKE recorded significantly higher number of eggs as compared to trap crops planted around tobacco without NSKE spray (Table 2). Marigold –sw with NSKE spray on tobacco recorded significantly higher number of eggs than all other treatments except rustica tobacco as trap crop + NSKE spray

*Short note

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Table 1 Bud worm infestation in Virginia tobacco

	Per cent tobacco plants infested					
	40 DAP		50 DAP		60 DAP	
Trap crop	2006–07	2007–08	2006–07	2007–08	2006–07	2007–08
Tagetes –mw	7.0 (15.3)	6.3 (14.5)	9.0 (17.3)	8.7 (17.1)	9.7 (18.0)	9.0 (17.4)
Tagetes – sw	5.0 (12.9)	5.7 (13.7)	6.0 (14.1)	6.7 (14.9)	7.0 (15.3)	7.3 (15.7)
Rustica tobacco	5.7 (13.7)	5.3 (13.3)	6.7 (14.9)	6.3 (14.5)	7.3 (15.6)	7.7 (16.0)
Tagetes –mw + NSKE 0.5%	4.3 (11.9)	4.0 (11.5)	5.3 (13.3)	5.0 (12.8)	5.7 (13.7)	5.3 (13.3)
Tagetes –sw + NSKE 0.5%	2.7 (9.3)	3.0 (9.9)	3.0 (9.9)	3.3 (10.3)	3.0 (9.9)	3.3 (10.3)
Rustica tobacco+ NSKE 0.5%	3.0 (9.9)	2.7 (9.3)	3.3 (10.3)	3.0 (9.9)	3.3 (10.5)	3.7 (10.9)
NSKE 0.5%	12.7 (20.78)	12.0 (20.2)	14.0 (21.9)	14.3 (22.29)	16.3 (23.8)	16.7 (24.0)
Control (Virginia tobacco without trap crop and without NSKE)	15.7 (23.2)	14.7 (22.4)	17.7 (24.8)	17.0 (24.3)	18.0 (25.1)	18.3 (25.3)
SEm ±	1.11	0.84	1.26	1.03	1.03	1.25
CD at 5%	3.35	2.56	3.82	3.12	3.11	3.81

Figures in parentheses are arc sine transformed values

Table 2 Population of *H.armigera* on trap crops with and without NSKE spray on Virginia tobacco

	Mean No. of eggs/plant			Mean No. of larvae/plant		
	40 DAP	50 DAP	60 DAP	40 DAP	50 DAP	60 DAP
Trap crop	2006–08	2006–08	2006–08	2006–08	2006–08	2006–08
Tagetes –mw	4.82	5.43	4.94	3.63	4.07	3.73
Tagetes – sw	7.00	7.70	6.70	4.63	5.33	4.93
Rustica tobacco	8.20	9.36	8.18	4.93	5.57	5.49
Tagetes –mw + NSKE 0.5%	10.16	11.83	10.01	5.43	6.00	5.93
Tagetes –sw + NSKE 0.5%	13.30	14.86	13.16	6.50	7.66	7.50
Rustica tobacco+ NSKE 0.5%	15.26	15.83	14.66	6.76	7.86	7.83
SEm ±	0.31	0.35	0.31	0.30	0.34	0.32
CD at 5%	0.90	0.50	0.88	0.87	1.00	0.92

on Virginia tobacco at all the observations (13.30, 14.86 and 13.16/plant). Marigold-mw without NSKE spray on tobacco recorded least number of eggs (4.82, 5.43 and 4.94) among all the treatments.

As regards larval population, rustica tobacco with NSKE spray on Virginia tobacco (6.76, 7.86 and 7.83) and marigold-sw + NSKE (6.50, 7.66 and 7.50) recorded significantly higher larval population than all other treatments and were on par with each other. Marigold-mw + NSKE recorded significantly less population (5.43, 6.00 & 5.93) as compared to rustica + NSKE and marigold-sw + NSKE at all the observations. All the trap crops with NSKE spray on tobacco recorded significantly more larval population as compared to trap crops without NSKE spray on tobacco.

On tobacco *Nesidiocoris* sp., coccinellids, spiders and syrphids were recorded of which *Nesidiocoris* sp. was predominant. More coccinellids and syrphids were recorded on marigold-mw and their activity was also found to be more on tobacco with marigold-mw as trap crop. The population of syrphids was least on rustica tobacco trap crop. More spiders were recorded on marigold-mw followed by marigold-sw. Similarly population of other predators and parasitoids were more on marigold-mw, followed by marigold-sw. No parasitoids were recorded on rustica tobacco. As such the parasitoids on tobacco with or without trap crops were negligible. NSKS spray did not adversely affect the activity of natural enemies on tobacco.

Tobacco plots with marigold-sw + NSKE (2 000 kg/ha) and rustica + NSKE (1 974 kg/ha) recorded significantly higher cured leaf yield than all other treatments. The cured leaf yield in marigold mw + NSKE (1 770 kg/ha) was found to be at par with all the tarp crops without NSKE as well as NSKE alone. Among the treatments significantly higher bright leaf yield was recorded in rustica tobacco and marigold-sw with and without NSKS spray than marigold-mw with and without NSKE, NSKE alone and control. As regards grade index, marigold-sw + NSKE recorded the highest (1 428), followed by rustica tobacco + NSKE (1 426), which were

significantly superior to all other treatments. The grade index in marigold-mw + NSKE (1 323) was at par with all the trap crops without NSKE. From the experimental results based on the pest infestation on tobacco, eggs and larvae of budworm trapped on the trap crops and yield data it can be inferred that conjunctive use of tarp crops, marigold-SW and rustica tobacco with NSKE spray is effective for management of budworm, *H.armigera* in Virginia tobacco. Trap cropping was found effective in several crops in reducing the infestation, enhancing natural enemy activity, management of insecticide resistance in insect pests (Srinivasan *et al*. 2004, Hath and Das 2005, Shelton and Badenes-Perez 2006, Van Den Berg 2006, Khan *et al*. 2006). More trapping of *H.armigera* population on trap crops where the main crop was treated with NSKE may be due to the anti-feedent, repellent and anti ovipositional effects of neem which are well documented (Saxena and Vyas 2005). It can be inferred that use of marigold-sw or rustica tobacco as trap crops along with application of NSKE on tobacco diverts *H.armigera* away from the main crop and can be used successfully for management of the pest in FCV tobacco. The benefits of trap crop can be enhanced when the constraints and risks are fully understood and the strategy is used in conjunction with other methods of control in an integrated pest management system.

SUMMARY

Two seasons experimentation for management of *H. armigera* in Virginia tobacco, by integrating trap crop and bio-pesticide, neem seed kernel extract (NSKE) revealed a significant reduction in budworm infestation in Virginia tobacco plots with trap crops + NSKE spray as compared to plots with trap crop and without NSKE spray. All the trap crops planted around Virginia tobacco plots sprayed with NSKE recorded significantly higher number of eggs and larvae as compared to trap crops planted around tobacco without NSKE spray. The natural enemy activity was not affected and was found to be more on tobacco with marigold-mw as trap crop. Conjunctive use of trap crops, marigold-SW or rustica tobacco with NSKE spray was effective for management of budworm, *H.armigera* in Virginia tobacco and also resulted in better grade index.

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