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INTEGRATED MANAGEMENT OF TOBACCO BUDWORM, *HELICOVERPA ARMIGERA* (HUBNER) IN FCV TOBACCO

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Tobacco budworm, *Helicoverpa armigera* (Hubner) is one of the major insect pests of FCV tobacco causing damage above economic threshold level (>10% infestation) in southern black soil region of A.P. Farmers totally depend upon the chemical management practices and hence, the project was designed to develop an effective, eco-friendly and integrated management strategy for tobacco budworm and to minimize the usage of chemical insecticides in FCV tobacco. Evaluation of four pest management modules against tobacco budworm, *Helicoverpa armigera* was carried out for two consecutive seasons i.e. from 2019-20 to 2020-21 in 0.5 acre area at CTRI Research Station, Guntur. The two years data was pooled and analyzed statistically (T-test). Incremental benefit cost ratio was also worked out for each treatment/module The IPM module consists of growing 2 rows of marigold as trap crop around tobacco, setting up of bird perches @ 20/ha, hand picking of larvae for every 5 days from 25 DAP, spraying of NSKE 2% at 25 DAP, spraying Ha NPV @ 250 LE/ha at 40 DAP and one spray of chlorantraniliprole 18.5 SC @ 0.03% at 55 DAP. An unsprayed plot without any border crop was kept as control. The data revealed that IPM module (M1) exhibited 85.53% reduction of infestation by tobacco budworm, 6.07% increase of cured leaf yields with incremental benefit cost ratio of 2.42 over untreated control. Whereas, Chemical control module (M2) reduced budworm infestation by 89.94%, increased cured leaf yields by 6.72% and incremental benefit cost ratio of 2.78 over the control. Bio-module (M3) was also significantly superior to untreated control (M4), Both IPM module and chemical control module were on par and significantly superior in reducing budworm infestation over other two modules. The treatments with chemical spray schedules showed drastic reduction of natural enemy population.

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) an important non-food commercial crop is infested by several insect pests and diseases. Tobacco budworm, *Helicoverpa armigera* is one of the major insect pests of FCV tobacco causing damage above economic threshold level (ETL) in southern black soil region of Andhra Pradesh The incidence of budworm is observed during grand growth phase of the crop under favourable conditions, preferably after heavy rains in untopped fields. The incidence is seen from 30 days after planting. Generally one larva is seen on the terminal bud. Between 30 - 50 days, it feeds on the terminal bud and then on the young leaves and causes loss to the crop. More than one larva per plant is seen after the flowering and then it feeds on the developing seeds inside the capsules. Though effective chemical management strategy is available, affords were being made to reduce the pesticide use through integrated approach. The increased concern over the indiscriminate use of pesticides and loss of biodiversity resulted in research orientation towards integrated approach (Devonshire, 1989). The search for new solutions to control insect pests is currently gaining momentum (Scott *et al.*,2003). Today over 2000 species of plants and bio agents are known that possess some insecticidal activity (Jacobson, 1989). New pesticide molecules having high GRL levels with low persistency and effective at low dose will also be tested to promote the exports and also to manage this pest. Towards this goal, studies were conducted on the effectiveness of trap crop along with bio-pesticides, botanicals and new chemical pesticide molecules in managing tobacco budworm by increased natural predators in the crop vicinity.

MATERIALS AND METHODS

Evaluation of four pest management modules against tobacco budworm, *Helicoverpa armigera* was carried out for two consecutive seasons i.e.

Key Words: FCV tobacco, Budworm, *Helicoverpa armigera*, IPM module, ICBR

from 2019-20 to 2020-21 in 0.5 acre area at CTRI Research Station, Guntur. The IPM module (M1) consists of growing 2 rows of marigold as trap crop around tobacco, setting up of bird perches @ 20/ha, hand picking of larvae for every 5 days from 25 days after planting (DAP), spraying of NSKE 2% at 25 DAP, spraying Ha NPV @ 250 LE/ha at 40 DAP and one spray of chlorantraniliprole 18.5 SC @ 0.03% at 55 DAP. Chemical control module (M2) with one spray of flubendiamide 48 SC @ 0.03% at 25 DAP, one spray of Novaluron 10 EC @ 0.1% at 40 DAP and one spray of chlorantraniliprole 18.5 SC @ 0.03% at 55 DAP was kept for comparison (farmer practice). The bio-intensive module (M3) consists of growing 2 rows of marigold as trap crop around tobacco, setting up of bird perches @ 20/ha, hand picking of larvae for every 5 days from 25 days after planting, spraying of NSKE 2% at 25 DAP, spraying Ha NPV @ 250 LE/ha at 40 DAP and spraying of *Bacillus thuringiencis* @ 1kg/ha at 55 DAP. An unsprayed plot without any border crop (M4) was kept as control. Each plot size is 28x18m (40x25=1000 plants). Prominent FCV tobacco variety, Siri was selected for this study and planted with recommended spacing of 70X70cm. Two rows of marigold (border crop) with 70 cm spacing were planted simultaneously with the plantings of tobacco. All other recommended practices were followed to raise the crop. Observations on budworm infested plants at 25, 40, 55 & 70 days of planting, natural enemy population in marigold & tobacco and yield data of tobacco were recorded in each module. The two years data were pooled and analyzed statistically (T-test). Incremental benefit cost ratio was also worked out for each treatment/module and the data were presented in Tables-1 to 4.

RESULTS AND DISCUSSION

A. Budworm infested plants

Budworm infestation was above economic threshold level (>10%) in control plot and started after one month of planting. The infested plants in different treatments/modules were recorded and presented in Table-1. The per cent reduction of infestation in different modules ranged from 72.96 to 89.94 over untreated control. In control plot, the per cent budworm infested plants were 15.9 at 70 days after planting. In bio-module plot, 4.3% budworm infested plants were recorded. In both IPM applied plot and chemical control plot, infestation was reduced to 2.3 and 1.6% at 70 days of planting, respectively. Bio-module was significantly superior to untreated control, whereas both IPM module and chemical control module were on par and significantly superior in reducing budworm infested plants over the above two modules.

B. Predator population

Natural enemy population in both tobacco & marigold (trap crop) were recorded in each module

Table 1: Validation of IPM module against tobacco budworm, *Helicoverpa armigera* – % infested plants

S.N	Module	Budworm infested plants (%)				Per cent reduction of infestation over control at 70 DAP	T-test (P=0.05) at 70 DAP
		25 DAP	40 DAP	55 DAP	70 DAP		
M1	IPM module	0.0 (0.00)	1.6(7.55)	2.4(9.58)	2.3(8.82)	85.53	Sig**
M2	Chemical module	0.0 (0.00)	1.1(6.14)	1.6(7.52)	1.6(7.39)	89.94	Sig**
M3	Bio module	0.0 (0.00)	2.1(8.52)	2.8(10.31)	4.3(12.20)	72.96	Sig*
M4	Control (no border & no spray)	0.0 (0.00)	9,4(17.32)	12.5(21.05)	15.9(23.70)	——-	——

Figures in parenthesis are arc sin transformed values
Sig** - Significant against controls and non-significant against chemical control
Sig* - Significant against control

and presented in Table-2. The treatments/modules with chemical spray schedules showed drastic reduction in the population of natural enemies in tobacco as well as trap crop. Predator population in tobacco was more (45.8/plant) in control plot followed by bio module plot (42.3/plant) and IPM module (22.2/plant). In chemical control plot, predator population was very less (8.0/plant). The total predator population in marigold was more (14.5/plant) in bio module and it was comparatively less (9.3/plant) in IPM module due to the effect of one chemical spray. Among the predator population recorded, spiders were predominant in marigold and *Nesidiocoris* bugs in tobacco.

C. Yield

As budworm infestation was above ETL during the season, there was significant difference in yield among all experimental plots. Maximum yields of 14,680, 2,144 and 1,278 kg/ha of green, cured and bright leaf was recorded in chemical control module followed by IPM module with 14,570, 2,131, 1,269 kg/ha and bio-module plot with 14,468, 2,109 and 1,238 kg/ha, respectively (Table-3). In control plot, 13,829, 2,009 and 1,153 kg/ha of green, cured and bright leaf, respectively were recorded. There was an increase of 4.98 to 6.72% cured leaf was recorded in treatments/modules over untreated control.

D. Economics

Economics of all modules were worked out based on the prevailing cost of inputs, labour wages, crop yields and market value of produce. The data presented in Table-4 revealed that net returns (Rs.13, 900/ha) and incremental benefit

Table 2: Validation of IPM module against tobacco budworm, *Helicoverpa armigera* – Natural enemy population

S.N	Module	Predator population on marigold/plant					Predators on tobacco/plant			
		Cocci-nellids	piders	wasps	others	Total	Nesidi-ocoris	Coccine-llids	others	Total
M1	IPM module	1.1	5.7	0.7	1.8	9.3	15.8	2.4	4.0	22.2
M2	Chemical module	—	—-	—-	—-	—-	4.6	1.3	2.1	8.0
M3	Bio module	1.3	8.4	1.7	3.1	14.5	33.8	3.9	4.6	42.3
M4	Control (no border & no spray)	—-	—-	-—-	—-	—-	35.6	4.0	6.2	45.8

Table 3: Validation of IPM module against tobacco budworm, *Helicoverpa armigera* – Yield parameters

S.N	Module	Green Leaf (kg/ha)	CuredLeaf (kg/ha)	BrightLeaf (kg/ha)	Grade Index (Kg/ha)	Per cent increase of cured leaf over control
M1	IPM module	14570	2131	1269	1578	6.07
M2	Chemical module	14680	2144	1278	1603	6.72
M3	Bio module	14468	2109	1238	1530	4.98
M4	Control (no border & no spray)	13829	2009	1153	1420	—-

cost ratio (2.78) were more in chemical control module followed by IPM module (Rs.12, 080/ha & 2.42) and bio module (Rs.9, 500/ha & 2.11). Module-1 i.e. IPM plot with marigold as barrier/ trap crop was on par with chemical module (M2) in respect of reduction of budworm incidence, increase of tobacco yields and incremental benefit cost ratio.

The present findings are in conformity with the studies conducted by Swadesh Rijal and Bhishma Raj Dahal (2019) who reported that integrated pest management was most effective for management of tomato fruit borer, *Helicoverpa armigera (*Hubner) in Nepal. Among different trap crops evaluated against chilli pests at Dharwad, significantly least larval population and fruit borer damage of *Helicoverpa armigera* was recorded in chilli trap cropped with marigold (Sujay and Giraddi, 2016). Border crops also reduced pest populations by increasing predation rates and also reduced the movement rate of pests out of crop fields. Integration of weeding, hand picking and indoxacarb (an oxadiazine insecticide) proved to be the most effective in reducing the larval population and pod infestation of *Helicoverpa armigera* and resulted in the maximum grain yield of chickpea in rainfed areas of Punjab (Wakil *et al*, 2009).

Sujayanand *et al* (2021) reported that chlorantraniliprole 20 SC had resulted in highest percent reduction in larval population of *Helicoverpa armigera* in green gram over control (highest BCR). Further, chlorantraniliprole 20 SC showed compatibility with five *Bacillus thuringiensis* isolates evaluated, i.e. *Bt* growth didn't inhibited in nutrient agar containing field dose of chlorantraniliprole 20 SC. Among the bio-pesticides, spinosad 45SC @ 0.20 ml/lit found to be effective against *Helicoverpa armigera* as it showed 72.51% reduction of fruit infestation in tomato over untreated plot (Kumar *et al*. 2020).

For effective management of tobacco budworm, *Helicoverpa armigera*, an Integrated Pest Management (IPM) approach consists of 2 rows of marigold as trap crop around tobacco, setting up of bird perches @ 20/ha, hand picking of larvae for every 5 days from 25 days after planting (DAP), spraying of NSKE 2% at 25 DAP, spraying Ha NPV @ 250 LE/ha at 40 DAP and one spray of

Table 4: Validation of IPM module against tobacco budworm, *Helicoverpa armigera* – Economics

S.N	Module	Mean cured leaf yield (kg/ha)	Increased yield over control (kg/ha)	Price of increased yield (Rs/ha)	Additional cost on each module (Rs/ha)	Benefit due to module (Rs/ha)	Incremental benefit cost ratio (IBCR)
M1	IPM module	2131	122	17080	5000	12080	2.42
M2	Chemical module	2144	135	18900	5000	13900	2.78
M3	Bio module	2109	100	14000	4500	9500	2.11
M4	Control (no border & no spray)	2009	—-	—-	—-	—-	—-

Cost of cured leaf = Rs. 140/kg
Labour wages for 3 sprays = Rs. 1500/ha
Quantity of pesticide required (3 sprays) = 750 ml or 750g/ha
Average cost of pesticide = Rs.5,000/lit/kg
Cost of NSKE or NPV or Bt = Rs.1,000/lit/kg
Cost of tagetes+ planting+watering charges= Rs.1000/ha

chlorantraniliprole 18.5 SC @ 0.03% at 55 DAP is recommended which exhibited 85.53% reduction of infestation by tobacco budworm, 6.07% increase of cured leaf yields with incremental benefit cost ratio of 2.42 over untreated control..

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