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INTEGRATED MANAGEMENT OF TOBACCO LEAF CURL VIRUS DISEASE TRANSMITTED BY WHITEFLY, *BEMISIA TABACI* IN FCV TOBACCO

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Tobacco whitefly, *Bemisia tabaci* Gennadius, a vector of tobacco leaf curl virus disease (TLCV) is one of the major insect pests of FCV tobacco in southern black soil (SBS) region of Andhra Pradesh. Evaluation of four pest management modules against TLCV was carried out for two consecutive years i.e. from 2016-17 to 2017-18 at CTRI Research Station, Guntur. Observations were recorded on TLCV infected plants, natural enemy population on Jowar & tobacco and yield data of tobacco. The data revealed that IPM module (M1) exhibited 81.45% reduction of TLCV disease, 6.97% increase of cured leaf yields with incremental benefit cost ratio of 2.84 over untreated control. Whereas, Chemical control module (M2) reduced TLCV disease by 83.79%, increased cured leaf yields by 7.74% and incremental benefit cost ratio of 3.16 over untreated control. Jowar border alone (M3) reduced 25.86% TLCV, increased 1.80% cured leaf yields with 2.76 incremental benefit cost ratio which was significantly superior to untreated control. Both IPM module and chemical control module were on par and significantly superior in reducing TLCV infected plants over the M3 & M4 modules. The treatments with chemical spray schedules showed drastic reduction of natural enemy population in tobacco. Predator population in tobacco was more (42.5/ plant) in jowar border plot and control plot (39.0/ plant). In pesticide applied plots (M1 and M2), predator population recorded in tobacco were 9.9 and 9.0 per plant, respectively. Coccinellid predators were dominant followed by spiders, wasps and syrphid flies. Predator population on jowar plants was more (12.1/plant)in M3 and it was comparatively less (9.0/plant) in M1 due to the effect of pesticides. The present study helps in reducing pesticide application in tobacco which in turn reduces pesticide residues in the cured leaf.

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) an important non-food commercial crop is infested by several insect pests and diseases. Tobacco whitefly, *Bemisia tabaci* Gennadius, a vector of tobacco leaf curl virus disease (TLCV) is one of the major insect pests of FCV tobacco in southern black soil region of Andhra Pradesh. In the recent past, sucking pest complex especially, whitefly infestation increased drastically (>10%). The adult white fly sucks the sap from leaves and transmits the leaf curl virus disease from infected to healthy plants. The leaves get twisted, puckered and thickened with abnormally prominent veins. Severe curl infected leaves are unfit for curing. The plants show stunted growth which results in reduction of both yield and quality of tobacco. Though effective chemical management strategy is available, efforts 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). New pesticide molecules having high GRL levels with low persistency and effectiveness at low dose were tested to manage this pest and also to promote the exports. Towards this goal, studies were conducted on the effectiveness of border crop along with new pesticide molecules in managing the pest coupled with increased natural enemies in the crop vicinity.

MATERIALS AND METHODS

Evaluation of four pest management modules against tobacco leaf curl was carried out for two consecutive years i.e. from 2016-17 to 2017-18 in

Key Words: FCV tobacco, Whitefly, *Bemisia tabaci*, TLCV, IPM module

0.5 acre area at CTRI Research Station, Guntur. The IPM module (M1) consists of four rows of jowar as barrier crop with one spray of flonicamid 50 WG @ 0.02% at 10 days, one spray of pymetrozine 50 WG @ 0.02% at 25 days and one spray of imidacloprid 200 SL @ 0.005% at 40 days of planting. Chemical control module (M2) consits of one spray of flonicamid @ 0.02% at 10 days, one spray of pymetrozine @ 0.02% at 25 days, one spray of thiamethoxam 25 WG @ 0.005% at 40 days and one spray of imidacloprid @ 0.005% at 55 days of planting. An unsprayed plot with only jowar border (M3) and another unsprayed plot without any border crop (M4) were kept as controls. Each plot size is 28x18m holding1000 plants. Prominent FCV tobacco variety, Siri was selected for this study and planted with recommended spacing of 70X70cm. Four rows of jowar (border crop) with 30 cm spacing were sown simultaneously with the plantings of tobacco. All other recommended practices were followed to raise the crop. Observations on per cent leaf curl infested plants at 10, 25, 40, 55 & 70 days of planting, natural enemy population in Jowar & tobacco and yield data of tobacco were recorded in each treatment following the method of Karla and Gupta (1986) improved by Sreedhar *et al.* (2004).Data on percent leaf curl infested plants were subjected to Arc Sine transformation and significance was tested by 't' test. Incremental benefit cost ratio was also calculated for each treatment.

RESULTS AND DISCUSSION

Leaf curl infestation

Leaf curl infested plants in different treatments/modules were recorded and presented in Table 1. The per cent reduction of infestation in different modules ranged from 25.86 to 83.79 over untreated control. In control plot, the per cent leaf curl infested plants were 13.0 at 70 days after planting. In Jowar border plot, 9.6% curl infested plants were recorded. In both IPM applied plot and chemical control plot, infestation was reduced to 2.4 and 2.1% at 70 days after planting, respectively. Jowar border plot was significantly superior to untreated control, whereas both IPM module and chemical control module were on par and significantly superior in reducing leaf curl infested plants over control.

Predator population

Natural enemy population in both Jowar & tobacco were recorded in each module and presented in Table 2. The treatments with chemical spray schedules showed drastic reduction in the population of natural enemies in tobacco. Predator population in tobacco was more (42.5/plant) in jowar border plot and control plot (39.0/plant). In pesticide applied plots i.e. module 1 and 2, predator population was 9.9 and 9.0 per plant, respectively. The total predator population on jowar plants was more in module 3 (12.1/plant) and it was comparatively less in module 1 (9.0/plant) probably due to the effect of chemical spray.

Yield

As leaf curl infestation was more during the season, there was significant difference in yield among all experimental plots. Maximum yields of 13425, 1945and 1080 kg/ha of green, cured and bright leaf was recorded in chemical control module followed by IPM module with 13245, 1934, 1045 kg/ha and Jowar border plot with 12600, 1837 and 920 kg/ha, respectively (Table3). In control plot, 12455, 1805 and 835 kg/ha of green, cured and bright leaf, respectively were recorded. There was an increase of 1.80 to 7.74% cured leaf was recorded in treatments over untreated control.

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.12705/ha) and incremental benefit cost ratio (3.16) were more in chemical control module followed by IPM module (Rs.11386/ha & 2.84) and bio module (Rs.2760/ha & 2.76). IPM (M1) was on par with chemical module (M2) in respect of reduction of leaf curl incidence, increase of tobacco yields and incremental benefit cost ratio.

The present findings are in conformity with the studies conducted by Fahrig and Jonsen (1998) who reported that border crop of sunflower significantly reduced PVY virus spread to pepper crop. Aphids landed on the border crop probed and in the process, lost their charge of virus to the non-host crop. Border crops also reduced pest populations by increasing predation rates and also

reduced the movement rate of pests out of crop fields. Similarly, butternut plots bordered by maize recorded the highest butternut squash yield (16t/ ha), least aphid population and least viral disease incidence during the 7th week after planting when compared to control (Sipiwe *et al.*, 2016). Difonzo *et al.* (1996) also reported that soybean was the most preferred crop to use as a border to potato because it was not a host for aphids or potato viruses.

Ajanta *et al.* (2019) reported that by adopting IPM strategy including minimum application of new generation pesticides, border crops like sorghum or pearl millet or maize , sucking pests in Bt cotton were successfully managed along with conservation of natural enemies. The plants affected with the leaf curl virus were uprooted and burnt in order to avoid the spread of the virus (Bhupen Kumar and Samal, 2020). Duraimurugan and Alivelu (2017) reported that new insecticide, clothianidin provided 95.1 per cent reduction in thrips population followed by acetamiprid (86.6%) in castor. Significantly highest seed yield was harvested from the clothianidin treated plots (1116 kg/ ha) with maximum net returns (Rs. 16068/ ha) and benefitcost ratio (1.70). Similar study on management of sucking pests by using newer insecticides and their effect on natural enemies in tomato was conducted by Wagh *et al.* (2017). They revealed that the spinosad 45 SC @ 125 g a.i/ha was most effective treatment to reduce the aphid (2.09-3.07), whitefly (1.51-2.27), thrips (0.71-1.64) per three leaves/plant and it gave highest marketable yield of tomato (45.47 t/ha).

The IPM module with four rows of jowar as barrier crop, one spray of flonicamid @ 0.03% at 10 days, one spray of pymetrozine @ 0.03% at 25 days and one spray of imidacloprid @ 0.05% at 40 days of planting exhibited 81.45% reduction of infestation by tobacco whitefly (leaf curl). Cured leaf yields also increased by 6.97% with incremental benefit cost ratio of 2.84 over untreated control.

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Table 1: Validation of IPM module against tobacco leaf curl virus transmitted by whitefly, *Bemisia tabaci* – % infested plants

S.N	Module	Leaf curl infested plants (%)					Per cent reduction of infestation over control at 70 DAP	T-test (P=0.05) at 70DAP
		10 DAP	25 DAP	40 DAP	55 DAP	70 DAP		
M1	IPM module	0.6 (3.08)	1.2 (5.12)	1.7 (6.90)	2.1 (8.54)	2.4 (9.50)	81.45	Sig**
M2	Chemical module	0.9 (4.36)	1.8 (7.56)	1.9 (8.23)	2.1 (9.31)	2.1 (9.31)	83.79	Sig**
M3	Jowar border	0.5 (2.41)	2.6 (9.38)	6.0 (13.12)	8.3 (16.63)	9.6 (19.54)	25.86	Sig*
M4	Control (no border and no spray)	0.8 (3.82)	3.4 (10.60)	9,2 (17.37)	11.7 (20.34)	13.0 (21.49)	——-	——

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

Table 2: Validation of IPM module on natural enemy population

S.N	Module	Predator population on Jowar plant					Predators on Tobacco plant			
		Cocci-nellids	spiders	wasps	others	Total	Nesidi-ocoris	Coccine-llids	others	Total
M1	IPM module	3.6	2.2	0.8	2.4	9.0	5.7	1.9	2.3	9.9
M2	Chemical module	—-	—-	—-	—-	—-	4.4	2.0	2.6	9.0
M3	Jowar border	4.3	2.7	1.6	3.5	12.1	35.3	3.2	4.0	42.5
M4	Control (no border and no spray)	—-	—-	—-	—-	—-	31.9	2.7	4.4	39.0

Table 3: Validation of IPM module on yield parameters

S.N	Module	Green Leaf kg/ha	Cured Leaf kg/ha	Bright Leaf kg/ha	Grade Index kg/ha	Per cent increase of cured leaf over control
M1	IPM module	13245	1934	1045	1235	6.97
M2	Chemical module	13425	1945	1080	1285	7.74
M3	Jowar border	12600	1837	920	1125	1.80
M4	Control (no border and no spray)	12455	1805	835	1045	—-

Table 4: Economics of white fly management

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)	Incre-mental Benefit Cost ratio
M1	IPM module	1934	129	15386	4000	11386	2.84
M2	Chemical module	1945	140	16705	4000	12705	3.16
M3	Jowar border	1836	31	3760	1000	2760	2.76
M4	Control	1805	—-	—-	—-	—-	—-

Cost of cured leaf/kg	=	Rs. 117/-
Labour wages for 4 sprays/ha	=	Rs. 1000/-
Quantity of pesticide required/ha (4 sprays)	=	1 litre/1 kg
Average cost of pesticide/ha	=	Rs.3000/- per lit/kg
Cost of jowar (5 kgX Rs.50)+sowing+ watering charges/ha	=	Rs. 1000/-

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