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INTEGRATED MANAGEMENT OF TOBACCO APHID, *MYZUS NICOTIANAE* BLACKMAN IN CENTRAL BLACK SOILS OF ANDHRA PRADESH

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A field trial for two consecutive seasons (2015-16 and 2016-17) was conducted for management of tobacco aphid *Myzus nicotianae* Blackman. Three modules *viz.*, bio, bio + chemical and chemical were tested for managing aphid infestation in Flue Cured Virginia tobacco variety, Siri. The treatments consisted of maize border (two rows), an entomopathogenic fungus (*Lecanicillium lecanii* @ 3X10^{11} CFU/ha), recommended chemical pesticide (imidacloprid @ 0.05%) and their combinations. The plot with only chemical spray *viz.*, one spray of imidacloprid @ 0.05% and one spray of thiomethaxam @ 0.05% served as recommended chemical control plot. An unsprayed plot without any border crop was maintained for comparison (control). Sprayings were given at 55 and 65 days after planting (DAP). Results revealed that all treatments were significantly superior over control. Aphid infestation was nil and cured leaf yields were more i.e. 1945 and 1941 kg/ha in chemical control plot with and without border crop, respectively. Bio-intensive IPM module with two rows of maize border as barrier crop, one spray of *Lecanicillium lecanii* @ 3X10^{11} CFU/ha at 55 DAP and one spray of imidacloprid @ 0.05% at 65 DAP exhibited 95.10% reduction of infestation by tobacco aphid, *Myzus nicotianae* Blackman and 5.26% increase of cured leaf yields over untreated control which was on par with recommended chemical control practice. There was no significant difference between two seasons in respect of aphid infested plants, aphid population on infested plants and sooty mold incidence.

INTRODUCTION

Tobacco aphid, *Myzus nicotianae* Blackman is the major sucking pest on tobacco in Central Black Soils of Andhra Pradesh. Winged forms of aphids also act as vectors for some virus diseases. This insect causes de-sapping and honey dew secretion leading to significant yield losses (Mistric and Clark, 1979). Sooty mold developed by the fungus, *Fumago vagans* due to honeydew secretion of aphid feeding, renders leaf unfit for curing resulting in huge loss. Several pesticides were found effective in controlling aphid infestation (Semtner *et al.,* 1990). However, extensive use of chemical insecticides has led to the disruption of ecosystems because of the death of non-target species, the accumulation of pesticide residues in the environment and food, and the build up of pesticide resistance in the target species (Devonshire, 1989). The increased concern over the indiscriminate use of pesticides and loss of biodiversity resulted in research orientation towards bio-intensive approach. Studies were conducted on the integrated management of tobacco aphid with major emphasis on bio agents, in central black soils of Andhra Pradesh.

MATERIALS AND METHODS

A replicated field trial for two consecutive seasons was conducted at CTRI Research Station, Guntur, Andhra Pradesh during 2015-16 and 2016-17 for the management of tobacco aphid, *Myzus nicotianae* Blackman in Flue Cured Virginia tobacco variety, Siri. The treatments consisted of maize border (two rows), an entomopathogenic fungus (*Lecanicillium lecanii* @ 3X10^{11} CFU/ha), recommended chemical pesticide (imidacloprid @ 0.05%) and their combinations. The plot with only chemical spray *viz.*, one spray of imidacloprid @ 0.05% and one spray of thiomethaxam @ 0.05% served as recommended chemical control plot. An unsprayed plot without any border crop was maintained for comparison (control). Two rows of border crop with 30 cm spacing were sown simultaneously with the plantings of tobacco. Sprayings were given at 55 and 65 days after planting (DAP). All other recommended practices were followed to raise the crop. Observations on aphid infested plants and sooty mold incidence

were recorded at regular intervals. Aphid population was recorded on five randomly selected plants in each plot following the method of Karla and Gupta (1986) improved by Sreedhar *et al.*, (1993). Various yield parameters *viz.*, green leaf, cured leaf, bright grade, medium grade and low grade were also recorded. Data recorded over two years on the above observations were pooled and analyzed statistically.

RESULTS AND DISCUSSION

Aphid infestation

The pooled data of two years revealed that all the treatments were significantly superior over control in reducing aphid infestation after 10 days of second spray (Table-1). The per cent reduction of infestation over control ranged from 33.15 to

Table 1: Integrated management of aphid infestation - % infested plants

S.N.	Treatments	Aphid infested plants (%)			Per cent reduction of infestation over control at 75 days
		Pre count (55 days)	10 days after 1st spray (65days)	10 days after 2nd spray (75days)	
1	Maize border (2 rows) + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days	10.33	8.83	7.08	72.49
2	Maize border + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days+ imidacloprid 0.05% at 65days	10.42	9.50	1.17	95.10
3	Maize border + imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	11.00	3.08	0.00	100.00
4	Maize border (2 rows)	9.67	14.08	18.08	33.15
5	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55& 65 days	15.33	12.33	8.67	66.70
6	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days + imidacloprid 0.05% at 65days	14.83	10.67	2.25	91.93
7	Imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	14.42	3.83	0.00	100.00
8	Control (no border & no spray)	14.50	20.75	27.67	——
	S.Em±	**0.98**	**0.65**	**0.43**	**2.33**
	C.D at 5%	**2.81**	**1.88**	**1.24**	**6.71**
	C.V (%)	**8.23**	**7.04**	**6.84**	**10.37**
	Seasons				
	2015-16	**14.39**	**11.81**	**9.12**	**80.07**
	2016-17	**10.73**	**8.96**	**7.10**	**79.74**
	S.Em±	**2.58**	**2.07**	**1.19**	**1.02**
	C.D at 5%	**NS**	**NS**	**NS**	**NS**

100. Cent per cent reduction of infestation was recorded in chemical control plot with and without maize border. In control plot (no border and no spray), the per cent aphid infested plants were 27.67. Among other treatments, tobacco with border crop and sprayed with *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days and imidacloprid 0.05% at 65 days was superior with 95.10% reduction of aphid infestation followed by the same treatments without border crop (91.93%). Entomopathogenic fungus alone sprayed at 55 and 65 days reduced aphid infestation by 66.70% and border crop alone reduced infestation by 33.15%, whereas, the combination of both bio-agent and border crop reduced aphid infestation by 72.49%. From the above data it can be stated that bio-intensive IPM module with two rows of maize border as barrier crop, one spray of *Lecanicillium lecanii* @ $3X10^{11}$ CFU/ha at 55 DAP and one spray of imidacloprid @ 0.05% at 65 DAP exhibited 95.10% reduction of infestation by tobacco aphid, *Myzus nicotianae* Blackman which was on par with recommended chemical control practice.

Aphid population

The aphid population counted on infested plants in each treatment showed similar trend (Table-2). Aphid population was confined to top and middle leaves (1-5 score). After ten days of second spray i.e. 75 DAP, aphid population was nil both on top and middle leaves in chemical control plot with and without border crop. In case of maize border with 2 sprays of bio-agent and maize border with one spray of bio-agent and one spray of insecticide, aphid population was nil on middle leaves and drastically reduced on top leaves also. The population was also less in plot sprayed with *L. lecanii* twice at 55 and 65d with 1.08 and 0.50 scores on top and middle leaves, respectively. In control plot, population scores of 3.92 and 2.33 on top and middle leaves were recorded.

Sooty mold incidence

As aphid population was moderate to high, the level of sooty mold formation was also medium to high. All the treatments were significantly superior over control in reducing sooty mold incidence (Table-3). Sooty mold incidence was zero in the plots received either two sprays or one spray of pesticide in combination with maize border or entomopathogenic fungus or both. The incidence of other viral diseases was nil. In control plot, sooty mold incidence was high (22.17%) followed by maize border alone (13.83%), bio-agent alone (6.33%) and border crop + bio-agent (4.66%).

Yield

Green leaf and cured leaf yields were significantly more in treatments over control. In case of cured leaf, bright grades were more in treatment plots, whereas, low and medium grade yields were more in control plot (Table-4). The highest yields of 13406, 1945 and 1217 kg/ha of green leaf, total cured leaf and bright leaf, respectively were recorded in chemical control plot with maize border crop, whereas, the lowest yields of 12590, 1807 and 932 kg/ha were recorded in control plot. In all theremaining treatments, green leaf and total cured leaf yields varied from 12847 to 13400 and 1829 to 1941 kg/ha, respectively.

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 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 crop filtered PVY from aphid mouth parts. 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 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). Among the different trap crops evaluated against chilli pests at Dharwad, population of sucking pests and leaf curl index was least in tomato and brinjal trap cropping systems, respectively. Whereas, significantly least larval population and fruit borer damage was recorded in chilli trap cropped with marigold (Sujay and Giraddi, 2016).

Harichandra Naik and Shekharappa (2009) reported that an entomopathogenic fungi, *Verticillium lecanii* oil based formulation showed 100% mortality of okra aphid, whereas, wettable powder (WP) formulation recorded 93.33%

Table 2: Integrated management of aphid infestation - aphid population

S.N.	Treatments		Aphid population (score)					
			Pre count (55 days)		10 days of 1st spray (65 days)		10 days of 2nd spray (75days)	
			Top leaf	Middle leaf	Top leaf	Middle leaf	Top leaf	Middle leaf
1	Maize border (2 rows) + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days		1.83	0.75	1.08	0.50	0.83	0.00
2	Maize border + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days+ imidacloprid 0.05% at 65days		1.50	1.00	1.33	0.50	0.50	0.00
3	Maize border + imidacloprid 0.05% at 55 days + thiomethaxam 0.05% at 65 days		1.75	1.67	1.33	0.17	0.00	0.00
4	Maize border (2 rows) 1.83		1.67	2.67	1.67	3.17	1.83	
5	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days		2.50	0.92	1.50	0.83	1.08	0.50
6	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days + imidacloprid 0.05% at 65days		2.83	1.33	1.67	0.83	0.92	0.50
7	Imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days		2.75	1.17	1.33	0.50	0.00	0.00
8	Control (no border & no spray)		2.50	1.17	3.17	1.83	3.92	2.33
		S.Em±	**0.15**	**0.19**	**0.06**	**0.11**	**0.07**	**0.05**
		C.D at 5%	**0.43**	**NS**	**0.17**	**0.30**	**0.20**	**0.14**
		C.V (%)	**11.05**	**17.00**	**7.13**	**10.32**	**11.67**	**9.18**
	Seasons	**2015-16**	**2.19**	**1.21**	**1.76**	**0.85**	**1.30**	**0.65**
		2016-17	**2.33**	**1.23**	**1.87**	**0.99**	**1.42**	**0.75**
		S.Em±	**0.23**	**0.10**	**0.18**	**0.17**	**0.13**	**0.12**
		C.D at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

	Aphid score
Score	**Aphid population / leaf**
0	0
1	1-50
2	51-250
3	251-500
4	501-1000
5	>1000

Table 3: Integrated management of aphid infestation - sooty mold incidence

S.N.	Treatments	Per cent sooty mold infested plants			
		Total	Low	Medium	High
1	Maize border (2 rows) + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days	4.66 (12.40)	3.16 (10.19)	1.50 (6.94)	0.00 (0.00)
2	Maize border + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days+ imidacloprid 0.05% at 65days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
3	Maize border + imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
4	Maize border (2 rows)	13.83 (22.05)	2.33 (8.74)	6.83 (15.05)	4.67 (12.45)
5	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days	6.33 (14.50)	4.00 (11.45)	2.33 (8.75)	0.00 (0.00)
6	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days + imidacloprid 0.05% at 65days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
7	Imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
8	Control (no border & no spray)	22.17 (28.07)	4.33 (11.96)	4.83 (12.65)	13.00 (21.12)
	S.Em±	**0.38**	**0.28**	**0.79**	**1.40**
	C.D at 5%	**1.10**	**0.80**	**2.28**	**4.03**
	C.V (%)	**9.08**	**7.22**	**17.28**	**22.98**
	Seasons				
	2015-16	**6.12 (9.86)**	**1.87 (5.53)**	**2.04 (5.61)**	**2.20(4.18)**
	2016-17	**5.63 (9.39)**	**1.58 (5.08)**	**1.83 (5.23)**	**2.21(4.21)**
	S.Em±	**1.12**	**0.57**	**0.64**	**0.49**
	C.D at 5%	**NS**	**NS**	**NS**	**NS**

Figures in parentheses are arc sine transformed values

mortality under *in vitro*. In cotton, 0.25% liquid formulation of *Verticillium lecanii* recorded the highest mortality of sucking pests, *viz*., aphids (100%), whitefly (100%) and jassids (93.33%) under *in vitro* (Karthikeyan and Selvanarayanan, 2011). In Dharwad, Karnataka, *Verticillium lecanii* 1.15% WP applied @ 7.50kg/ha registered least number of thrips, aphids and leaf hoppers and found to be on par with acetamiprid 20 SP @ 100g/ha on transgenic *Bt* cotton (Patil *et al*., 2012). From the two seasons study, it can be stated that treatment of two rows of maize border as barrier crop, one spray of *Lecanicillium lecanii* @ $3X10^{11}$ CFU/ha at 55 DAP and one spray of imidacloprid @ 0.05% at 65 DAP exhibited 95.10% reduction of infestation by tobacco aphid, *Myzus nicotianae* Blackman and

Table 4: Integrated management of aphid infestation - yield parameters (kg/ha)

S.N	Treatments	Green leaf	Cured leaf	Bright grade	Medium grade	Low grade
1	Maize border (2 rows) + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days	12850	1868	1122	497	250
2	Maize border + *L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days+ imidacloprid 0.05% at 65days	12991	1902	1139	533	230
3	Maize border + imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	13406	1945	1217	601	127
4	Maize border (2 rows)	13205	1829	985	448	396
5	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 & 65 days	12847	1850	1048	480	322
6	*L. lecanii* @ $3X10^{11}$ CFU/ha at 55 days + imidacloprid 0.05% at 65days	13195	1905	1112	522	272
7	Imidacloprid 0.05% at 55days + thiomethaxam 0.05% at 65 days	13400	1941	1198	596	147
8	Control (no border & no spray)	12590	1807	932	438	437
	S.Em±	**61.91**	**8.60**	**6.97**	**4.99**	**3.57**
	C.D at 5%	**179.54**	**24.89**	**19.82**	**14.46**	**10.38**
	C.V (%)	**9.08**	**7.20**	**7.90**	**8.25**	**8.50**
	Seasons					
	2015-16	**13679**	**1969**	**1138**	**540**	**292**
	2016-17	**12442**	**1792**	**1050**	**489**	**253**
	S.Em±	**534.72**	**125.39**	**79.18**	**36.50**	**29.64**
	C.D at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

5.26% increase of cured leaf yields over untreated control which was on par with recommended chemical control practice.

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