Tobacco Research 38 (1) : 34-39, 2012

BIO-INTENSIVE INTEGRATED MODULE FOR MANAGEMENT OF TOBACCO APHID, *MYZUS NICOTIANAE* BLACKMAN UNDER KARNATAKA LIGHT SOIL CONDITION

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(Received on 25th November, 2011)

A field trial for two consecutive years (2008-09 and 2009-10) was conducted for management of tobacco aphid *Myzus nicotianae* Blackman which is the only major pest on FCV tobacco in Karnataka Light Soil region (KLS). The treatments consisted of two rows of border crop (bajra), an entomopathogenic fungus (*Verticillium lecanii* @ 3X10^{11} CFU/ha), recommended chemical pesticide (imidacloprid @ 50 g a.i./ha) and their combinations. One spray of imidacloprid and one spray of acephate (@ 750 g a.i./ha) at 10 days interval served as recommended chemical control practice against aphids in KLS. An unsprayed plot without any border crop served as control. Spray were given at 45 and 55 days after planting. Results revealed that all the treatments were significantly superior over control in reducing aphid infestation after 10 days of second spray. Cent per cent reduction of infestation was recorded in chemical control plot and also in plots which received one spray of imidacloprid in combination with either bajra border or one spray of *V. lecanii*. Among other treatments, *V. lecanii* applied twice at 45 and 55 days was superior with 86.60% reduction of aphid infestation followed by border crop with *V. lecanii* at 45 days and border with *V. lecanii* at 55 days with 77.98 and 72.12% reduction of infestations, respectively. Bio-intensive module consisting of two rows of bajra border as barrier crop to tobacco with one spray of *Verticillium lecanii* @ 3X10^{11} CFU/ha at 45 days after transplanting reduced aphid infestation, sooty mold formation and increased bright grade leaf yields over control in KLS.

INTRODUCTION

Tobacco aphid, *Myzus nicotianae* Blackman is the only major pest on tobacco crop in Karnataka Light Soil (KLS) region. Winged forms of aphids also act as vectors for some viral diseases. This insect causes de-sapping and honey dew secretion leading to significant yield losses (Mistric and Clark, 1979). Sooty mold developed by *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; Nagalakshmi, 1994). 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 bio-intensive approach. Towards this goal, the present study was conducted on the integrated management of tobacco aphid with major emphasis on bio-agents, in KLS.

MATERIALS AND METHODS

A replicated field trial was conducted at CTRI Research Station, Hunsur during 2008-09 and 2009-10 for the management of tobacco aphid, *Myzus nicotianae*. Three modules *viz.*, bio, bio + chemical and chemicals were tested for the conservation of arthropod predators as well as mismanagement of aphid infestation in Flue-cured Virginia tobacco var. Kanchan. The treatments consisted of bajra border, an entomopathogenic fungus (*Verticillium lecanii* @ 3X10^{11} CFU/ha), recommended chemical pesticide (imidacloprid @ 50 g a.i./ha) and their combinations. The plot with only chemical spray *viz.*, one spray of imidacloprid and one spray of acephate (@ 750 g a.i./ha) served as recommended chemical control. An unsprayed plot without any border crop was maintained for comparison (control). Two rows of bajra border crop with 30 cm spacing were sown simultaneously with the

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plantings of tobacco. Sprays were given at 45 and 55 days after planting. All other recommended practices were followed (Shenoi, 1998) to raise the crop. Observations on aphid infested plants, predators, sooty mold incidence and viral diseases 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, bright grade, medium grade, low grade and total cured leaf were also recorded. Data recorded for two consecutive years were pooled and analyzed statistically (Tables 1 to 6).

RESULTS AND DISCUSSION

Aphid infestation

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). Per cent reduction of infestation over control ranged from 72.12 to 100. Cent per cent reduction of infestation was recorded in chemical control and also with one spray of imidacloprid in combination with bajra border or with one spray of *V. lecanii*. In control plot, the per cent aphid infested plants were 55.66. Among other treatments, *V. lecanii* applied twice at 45 and 55 days reduced aphid infestation 86.6% and by border crop with *V. lecanii* at 45 days and border with *V. lecanii* at 55 days showed 77.98 and 72.12% reduction of infestations, respectively. There was no significant difference in reduction of aphid infestation between the two years.

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, no aphid population was observed both on top and middle leaves in chemical control plot and also in plots which received one spray of imidacloprid in combination with bajra border or with one spray of *V. lecanii*. The population was also less in *V. lecanii* applied at 45 and 55 days with 0.83 score on top leaves only. In control plot, population scores of 2.83 and 2.50 on top and middle leaves, respectively were recorded. In the remaining two treatments *viz.*, border crop with *V. lecanii* at 55 day and border with *V. lecanii* at 45 day, population scores were 1.50 & 1.00 on top leaves and 1.16 & 0.66 on middle leaves, respectively.

Natural enemy population

The treatments with chemical spray schedules showed drastic reduction in the population of natural enemies in tobacco (Table 3). Predator population was more (27.00 to 28.23/ plant) in plots sprayed with *V. lecanii* alone or with border crop and was at a par with untreated control (28.61/plant). In insecicide applied plots, predator population ranged from 3.26 to 9.91/ plant which indicated that entomopathogenic fungus has not shown any adverse effect on predator population. The natural enemy population on bajra border was also recorded (Table 4). Among them, coccinellid predators were dominant followed by spiders, wasps and syrphid flies. Imidacloprid sprayed on tobacco at 45 or 55 day had no effect on predator population present on bajra border. The total predator population in bajra was varied from 7.01 to 7.73/plant.

Sooty mold incidence

As aphid population was low to moderate, the level of sooty mold formation was also low to medium. All the treatments were significantly superior over control in reducing sooty mold incidence (Table 5). Except control and border crop with *V. lecanii* at 55 days, in the remaining treatments, sooty mold incidence was zero to low. The incidence of other viral diseases was also not observed. Treatments receiving chemical spray and also two sprays of *V. lecanii* at 45 and 55 days were highly significant with 100% reduction of sooty mold incidence. Only low level of incidence (3.50%) was recorded in bajra border with one spray of *V. lecanii* at 45 days. Both low (5.33%) and medium (1.83%) levels of incidence was recorded in bajra border with one spray of *V. lecanii* at 55 days. In control plot, sooty mold incidence was 13.16 and 19.16% of low and medium levels, respectively.

Yield

Green leaf, cured leaf and bright leaf yields were more in treatment plots, whereas, low and medium grade yields were more in control plot (Table 6). Highest yields of 12235, 1394 and 979

Table 1: Integrated management of aphids in FCV tobacco under KLS (% infested plants)

Treatments	Aphid infested plants (%)			
	Pre count (45 days)	10 days after 1st spray (55 days)	10 days after 2nd spray (65 days)	Per cent reduction in infestation over control
Bajra border + *V. lecanii* at 45 days	30.33	8.66	12.83	77.98
Bajra border + *V. lecanii* at 55 days	33.66	50.50	15.66	72.12
Bajra border + imidacloprid at 45 days	33.83	0.00	0.00	100.00
Bajra border + imidacloprid at 55 days	30.83	50.16	0.00	100.00
V. lecanii at 45 days and 55 days	32.83	12.00	8.50	86.60
V. lecanii at 45 days + imidacloprid 55 days	30.50	10.50	0.00	100.00
Imidacloprid at 45 days + acephate 55 days	31.33	0.00	0.00	100.00
Control (no border & no spray)	31.50	47.16	55.66	——-
SEm±	**1.10**	**0.39**	**0.24**	**0.69**
CD (P=0.05)	**NS**	**1.12**	**0.69**	**2.02**
CV (%)	**8.47**	**4.22**	**5.00**	**1.86**
Seasons				
2008-09	**54.66**	**38.62**	**19.95**	**90.26**
2009-10	**9.04**	**6.12**	**3.20**	**91.65**
SEm±	**3.61**	**1.79**	**0.93**	**1.87**
CD (P=0.05)	**14.17**	**7.01**	**3.64**	**NS**
CV (%)	**55.52**	**39.11**	**39.22**	**9.25**

Table 2: Integrated management of aphids in FCV tobacco under KLS (Aphd population)

Treatments	Aphid population (score)					
	Pre- count (45 day)		10 days of 1st spray (55 day)		10 days of 2nd spray (65 day)	
	Top leaf	Middle leaf	Top leaf	Middle leaf	Top leaf	Middle leaf
Bajra border + *V. lecanii* at 45 days	1.66	0.83	1.00	0.66	1.00	0.66
Bajra border + *V. lecanii* at 55 days	1.50	0.83	2.50	1.66	1.50	1.16
Bajra border + imidacloprid at 45 days	1.33	0.66	0.00	0.00	0.00	0.00
Bajra border + imidacloprid at 55 days	1.83	1.00	2.33	1.83	0.00	0.00
V. lecanii at 45 day and 55 days	1.33	0.66	1.00	0.33	0.83	0.00
V. lecanii at 45 day + imidacloprid 55 days	1.50	0.66	1.00	0.33	0.00	0.00
Imidacloprid at 45 day + acephate 55 days	1.50	0.66	0.00	0.00	0.00	0.00
Control (no border & no spray)	1.66	1.00	2.00	1.66	2.83	2.50
SEm±	**0.07**	**0.12**	**0.03**	**0.06**	**0.04**	**0.02**
CD (P=0.05)	**NS**	**NS**	**0.09**	**0.18**	**0.13**	**0.06**
CV (%)	**12.17**	**14.81**	**5.95**	**18.90**	**14.08**	**9.87**
Seasons						
2008-09	**1.58**	**0.83**	**1.45**	**1.04**	**0.91**	**0.58**
2009-10	**1.50**	**0.70**	**1.08**	**0.58**	**0.62**	**0.50**
SEm±	**0.31**	**0.26**	**0.11**	**0.22**	**0.13**	**0.11**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV (%)	**98.16**	**165.25**	**42.38**	**132.84**	**83.57**	**103.20**

Table 3: Integrated management of aphids in FCV tobacco under KLS (natural enemy population on tobacco)

Treatments	Predator population/ plant on tobacco			
	Nesidiocoris bugs	Coccinellid beetles	Others	Total
Bajra border + *V. lecanii* at 45 days	24.65	1.93	1.03	27.67
Bajra border + *V. lecanii* at 55 days	25.25	1.96	1.05	28.23
Bajra border + imidacloprid at 45 days	8.63	0.88	0.40	9.91
Bajra border + imidacloprid at 55 days	7.13	0.86	0.30	8.30
V. lecanii at 45 days and 55 days	23.95	2.05	1.00	27.00
V. lecanii at 45 days + imidacloprid 55 days	6.51	0.86	0.35	7.73
Imidacloprid at 45 days + acephate 55 days	2.63	0.45	0.18	3.26
Control (no border & no spray)	25.33	2.23	1.05	28.61
SEm±	**0.08**	**0.03**	**0.04**	**0.11**
CD (P=0.05)	**0.24**	**0.09**	**0.11**	**0.32**
CV (%)	**2.32**	**5.38**	**13.80**	**2.52**
Seasons				
2008-09	**17.46**	**1.45**	**0.66**	**19.57**
2009-10	**13.55**	**1.36**	**0.67**	**15.59**
SEm±	**1.58**	**0.16**	**0.11**	**1.53**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**
CV (%)	**49.89**	**54.39**	**77.10**	**42.73**

Table 4: Integrated management of aphids in FCV tobacco under KLS (natural enemy population on border crop Bajra)

Treatments	Predator population/ plant							
	Cocci-nellids	Spiders	Wasps	Syrphid flies	Dragon flies	Damsel flies	Mirid bugs	Total
Bajra border + *V. lecanii* at 45 days	3.37	2.15	0.72	0.58	0.32	0.37	0.23	7.73
Bajra border + *V. lecanii* at 55 days	3.27	2.08	0.76	0.55	0.35	0.33	0.18	7.48
Bajra border + imidacloprid at 45 days	2.98	2.02	0.73	0.55	0.33	0.28	0.20	7.10
Bajra border + imidacloprid at 55 days	3.00	1.98	0.70	0.57	0.30	0.27	0.20	7.01
V. lecanii at 45 days and 55 days	—	—	—	—	—	—	—	—
V. lecanii at 45 days + imidacloprid 55 days	—	—	—	—	—	—	—	—
Imidacloprid at 45 days + acephate 55 days	—	—	—	—	—	—	—	—
Control (no border & no spray)	—	—	—	—	—	—	—	—

Table 5: Integrated management of aphids in FCV tobacco under KLS (sooty mold incidence)

Treatments	Sooty mold infested plants (%)		
	Total	Low level	Medium level
Bajra border + *V. lecanii* at 45 days	3.50 (10.29)	3.50 (10.29)	0.00 (0.00)
Bajra border + *V. lecanii* at 55 days	7.16 (13.79)	5.33 (12.15)	1.83 (5.26)
Bajra border + imidacloprid at 45 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bajra border + imidacloprid at 55 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
V. lecanii at 45 days and 55 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
V. lecanii at 45 days + imidacloprid 55 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Imidacloprid at 45 days + acephate 55 days	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Control (no border & no spray)	32.33 (33.16)	13.16 (20.77)	19.16 (23.12)
SEm±	**0.29**	**0.15**	**0.35**
CD (P=0.05)	**0.84**	**0.44**	**1.00**
CV (%)	**9.87**	**6.85**	**23.94**
Seasons			
2008-09	**9.04 (10.20)**	**4.16 (7.07)**	**4.87 (5.86)**
2009-10	**1.70 (4.10)**	**1.33 (3.73)**	**0.37 (1.23)**
SEm±	**1.02**	**0.55**	**0.84**
CD (P=0.05)	**3.99**	**2.16**	**3.28**
CV (%)	**69.64**	**49.91**	**115.43**

Figures in parentheses are arc sin transformed values

Table 6: Integrated management of aphids in FCV tobacco under KLS (yield parameters kg/ha)

Treatments	Green leaf	Cured leaf	Bright grade	Medium grade	Low grade
Bajra border + *V. lecanii* at 45 days	11415	1311	913	250	148
Bajra border + *V. lecanii* at 55 days	11514	1316	916	255	146
Bajra border + imidacloprid at 45 days	11963	1373	960	259	155
Bajra border + imidacloprid at 55 days	11722	1350	947	252	151
V. lecanii at 45 days and 55 days	11495	1312	920	249	143
V. lecanii at 45 days + imidacloprid 55 days	11866	1360	943	261	157
Imidacloprid at 45 days + acephate 55 days	12235	1394	979	256	159
Control (no border & no spray)	10959	1218	718	288	212
SEm±	**52.18**	**5.07**	**3.23**	**1.38**	**1.37**
CD (P=0.05)	**151.14**	**14.68**	**9.37**	**4.01**	**3.95**
CV (%)	**4.10**	**2.93**	**2.87**	**3.31**	**4.11**
Seasons					
2008-09	**11826**	**1348**	**923**	**257**	**169**
2009-10	**11466**	**1310**	**901**	**260**	**149**
SEm±	**260.06**	**28.46**	**19.61**	**6.80**	**6.72**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**
CV (%)	**10.94**	**10.49**	**10.53**	**12.89**	**20.77**

kg/ha of green leaf, cured leaf and bright leaf, respectively were recorded in chemical control plot. Whereas, highest yields of 288 and 212 kg/ha of medium and low grades, respectively were recorded in control plot. Green leaf and cured leaf yields varied from 11415 to 11963 and 1311 to 1373 kg/ha, respectively in other treatment plots. There was no significant difference in yields between the two years of experiment.

The present findings are in conformity with the studies conducted by Difonzo *et al.* (1996). They 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. Sorghum and wheat also proved as border crops. Alate (winged) aphids are recognized as playing a significant role in PVY spread in many potato growing areas of world. Generally, wind currents deposit and spread aphids in large numbers. In such case, border crops act as barriers to trap the aphids and prevent their spread. They also 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 (Fahrig and Jonsen, 1998).

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% mortality under *in vitro*. In cotton, 0.25% liquid formulation of *Verticillium lecanii* recorded highest mortality of sucking pests *viz.*, aphids (100%), whitefly (100%) and jassids (93.33%) under *in vitro* (Karthikeyan and Selvanarayanan, 2011). It is concluded that two rows of bajra border as barrier crop with one spray of *Verticillium lecanii* @ $3X10^{11}$ CFU/ha at 45 DAT reduced tobacco aphid, *Myzus nicotianae* infestation by 77.98% over control in Karnataka Light Soils

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