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Research Paper

COMPARATIVE FIELD EFFICACY OF DIFFERENT TREATMENT SCHEDULES AGAINST APHID, *Aphis gossypii* GLOVER AND WHITEFLY, *Bemisia tabaci* GENN. ON BRINJAL

Amitava Konar, Lakshman Chandra Patel and Anirban sarkar[1]

College of Agriculture (Extended Campus of BCKV),
Fram Gate 1, Kalna Road,
Burdwan Sadar – 713101, W.B.
[1]Department of Agril. Entomology,
BCKV, Mohanpur, Nadia, 741252.

Abstract

The comparative field efficacy of different treatment schedules were studied against aphid, *Aphis gossypii* and whitefly, *Bemisia tabaci d*amaging brinjal during kharif season of 2012 and 2013. Among the seven treatment schedules, T_2 (i.e. soil application of phorate 10 G @ 1.5 kg a.i./ha) at transplanting , followed by spray with acephate, thiodicarb, *Bacillus thuringiensis var kurstaki* respectively at 50, 70 and 90 DAT) and T_5 (i.e. seedling treatment with imidacloprid, followed by spray with imidacloprid, novaluron, *Bacillus thuringiensis var kurstaki* and novaluron respectively at 30, 50, 70 and 85 DAT) were recorded most effective in decreasing the population of aphid and whitefly on brinjal over control. The results indicated percent aphid reduction by 85.51 – 86.95 ($T_{2)}$ followed by 85.02 to 85.05 ($T_{5)}$ and whitefly reduction respectively by 69.79 – 74.05 and 64.80 – 78.63. But maximum marketable yield of brinjal fruits was obtained in T_1 (i.e. soil application of neem cake followed by spray with chlorpyriphos + cypermethrin, cartap hydrochloride and azadirachtin respectively at 30, 50 and 70 DAT) followed by T_6 (i.e. spray with thiamethoxam, spinosad and abamectin respectively at 30, 50 and 70 DAT). Cost benefit ratio was recorded highest in T_3 (i.e. spray with fipronil, novaluron, deltamethrin and fenvalerate respectively at 30, 50, 70 and 90 DAT).

Key words: Efficacy, Schedules, *Aphis gossypii*, *Bemisia tabaci*, Brinjal.

INTRODUCTION

Brinjal (*Solanum melongena*) is an important commercial vegetable crop grown throughout the year over the country (1). Brinjal is a hardy crop and does best in warm and moist climate, which is also congenial for the infestation of many insect pests. It is attacked by many insect pests at different stages of its growth (2). Generally brinjal suffers maximum pest damage due to plant canopy and succulence and there is a greater possibility of carryover of insect pests from one season to other as it is grown throughout the year. It is reported that brinjal is attacked by about 140 species of insect and non insect pests belonging to 50 families. But in India, about 44 species of insect

pests have been found to infest the crop (3) and among these, only 10 have been recognized to be of major economic significance in West Bengal (4). Aphid, *Aphis gossypii* Glover (Aphididae: Hemiptera) and white fly, *Bemisia tabaci* Genn. (Aleyrodidae: Hemiptera) are the most important pests to cause serious damage to brinjal crop (5). The nymphs and adults of the pests suck the sap from the tender parts of the plants and are responsible for premature drops of leaves, flowers and fruits and reduce the yield of the brinjal fruits. Beside their direct damage, these pests are also responsible to transmit the various viral diseases on crop and destroy the entire crop. So this pest acts as one of the limiting factors in higher production of brinjal. Therefore to minimize the damage by this pest, a number of synthetic insecticides are used randomly, but with limited success. These insecticides are thought to create ecological and environmental problems. Therefore, the present investigation was undertaken to evaluate the chemical and non chemical insecticides against these two sucking pests, namely aphid and whitefly on brinjal to adopt such control measures which not only be complementary way to control the pests, but also will be ecologically sound, economically viable and safer to health.

MATERIALS AND METHODS

The field trial was conducted to study the bio-efficacy of different treatment schedules including control against aphid and whitefly on brinjal for two consecutive kharif seasons from June to October in 2012 and 2013 at Adisaptagram Block Seed Farm, Hooghly, West Bengal. The brinjal seedlings (cv. Muktakeshi) were transplanted during end June in 3.75 m x 4.50 m plots having 75 cm x 75 cm spacing. The experiment was laid in an RBD with three replications. All standard agronomic practices in this region were followed for raising the crop along with the pesticidal treatments at frequent intervals. The treatment schedules were consisting of both chemical and non-chemical insecticides which are mentioned in table 1.

The incidence pattern of aphid and whitefly was recorded from randomly selected 10 plants in each plot at 10 days interval. The population was counted from one upper, one middle and one lower leaves from randomly selected 10 plants. The number and weight of marketable and unmarketable fruits were recorded separately in each plot during harvesting of the crop. Then the data were converted into necessary forms before undertaking statistical analysis.

RESULTS AND DISCUSSION

Incidence pattern of aphids on brinjal under different treatment schedules

The results obtained through application of different treatment schedules on the mortality and population reduction in aphid, *Aphis gossypii* which causes appreciable damage to brinjal crop, have been presented in Table 2. All the treatment schedules were significantly superior over control throughout the entire period of study during 2012. The pest was first appeared during mid July in T_7 (control) along with T_3, T_4 and T_6 while in T_5, it was first observed far later than the others in early September. But instead of T_5, T_2 was most effective in controlling aphids throughout the crop life as it supported 19.78 mean aphid population per 30 leaves, which was succeeded by T_5 (22.66), T_4 (23.09), T_1 (34.54), T_3 (39.69), T_6 (43.15) and T_7 (151.57). Similarly, the percent decrease of population over control was found maximum in T_2 (86.95) and it was minimum in T_6 (71.53).

In the second year of study during 2013, all the treatment schedules were statistically significant in reducing the aphid population over control through the entire crop period

(Table 2). The pest was first observed in mid July in untreated check along with T_3 and T_6. The mean aphid population per 30 leaves was found minimum in T_2 (21.51) followed by T_5 (22.24), T_4 (25.60), T_1 (38.78), T_6 (39.93) and T_7 (148.48). Consequently T_2 gave maximum percent decrease of population (85.51) over control while it was recorded minimum in T_6 (73.11).

Therefore, it is evident from the results of the present study that all the treatment schedules were significantly superior over control in decreasing the aphid population on brinjal throughout the crop life. Among different treatment schedules, T_2, i.e. soil application of phorate 10 G before transplanting followed by foliar spray with acephate 75 SP at 50 DAT, thiodicarb 75 WP at 70 DAT and *B. thuringiensis var kurstaki* 5 WP at 90 DAT and T_5 i.e. seedlings treatment with imidacloprid 17.8 SL before transplanting followed by foliar spray with imidacloprid 17.8 SL at 30 DAT, novaluron 10 EC at 50 DAT, *B. thuringiensis var kurstaki* 5 WP at 70 DAT and novaluron 10 EC at 90 DAT were most effective against the pest. This is because that during population development of the pest in early to full vegetative phase of brinjal, the crop was treated with systemic insecticides like phorate, acephate and imidacloprid and as a result, the pest population did not grow high. Consequently, these two treatment schedules (T_2 and T_5) gave maximum percent decrease of aphid population over control. This observation is in more or less agreement with that of Stufkens and Wallace (6), Gore *et al*. (7) and Halder *et al*. (8), where it was documented that imidacloprid and acephate were quite effective against aphids.

Incidence pattern of whitefly on brinjal under different treatment schedules

During 2012, all the treatment schedules were significantly superior over control in reducing the whitefly population on brinjal but not throughout the growing season of the crop (Table 3). In T_2 and T_5, lower population of whitefly was recorded upto early reproductive stage of the crop, the mean whitefly population was found minimum in T_2 (5.84 per 30 leaves), followed by T_5 (7.91), T_1 (8.93), T_4 (10.51), T_6 (12.36), T_3 (13.66) and T_7 (22.51), respectively and hence, T_2 gave maximum percent decrease of pest population (74.05) over control while it was found minimum in T_3 (39.31).

In the second year of study during 2013, the treatments were not always significantly superior over control in decreasing the pest population on brinjal (Table 2). The aleurodid was appeared on the crop just after transplanting. The mean whitefly population was found highest in T_5 (6.72 per 30 leaves) and then in order were T_2 (9.51), T_4 (11.39), T_1 (12.33), T_6 (14.42), T_3 (19.36) and T_7 (31.45), respectively. Therefore the percent decrease of population was obtained maximum in T_5 (78.63) and minimum in T_3 (38.44).

It is evident from the present study that all the treatment schedules were statistically significant in reducing the pest population over control, but not all round the season. It may be concluded that T_2 and T_5 were most were most effective as they supported 69.79 – 74.05 and 64.86 – 78.63 % decrease of pest population over control. It may be due to application of systemic insecticides with higher persistency like phorate and imidacloprid (9). Tarande and Dethe (10), Borad *et al.* (11) and Anandkumar *et al.* (12) also recorded lower whitefly population in phorate and imidacloprid treated plots.

Yield of brinjal and economics of different treatment schedules against aphid and whitefly

The marketable yield (t/ha) of brinjal fruit in 2012 was found maximum in T_1 (13.89 t/ha), followed by T6 (13.28), T_3 (12.68), T_2 (12.25), T_4 (11.68), T_5 (10.87) and T_7 (8.38), respectively (Table 4). Hence, T_1 gave highest net profit per ha (Rs. 48,306) over control, but it was succeeded by T_3 (Rs. 39,380), T_6 (Rs. 38,228), T_2 (Rs. 35,393), T_4 (Rs.

30,210) and T_5 (Rs. 20,943), respectively. But the cost benefit ratio was found maximum in T_3 (1:20.73) and then in T_4 (1:20.55), T_2 (1:20.12), T_1 (1:10.52), T_5 (1:7.07) and T_6 (1:4.34).

During 2013, the marketable fruit yield (t/ha) was obtained maximum in T_1 (14.29) followed by T_6 (13.48), T_3 (13.32), T_4 (11.83), T_2 (11.74), T_5 (10.74) and T_7 (7.83), respectively. The highest net profit per ha over control was recorded from T_1 (Rs. 52,258) and then from T_3 (Rs. 46,412), T_6 (Rs. 40,859), T_4 (Rs. 33,730), T_2 (Rs. 32,649) and T_5 (Rs. 22,647), respectively. Thus, T_3 produced maximum monetary return (1:24.43) over control and then in order were T_4 (1:22.94), T_2 (1:18.56), T_1 (1:11.38), T_5 (1:7.65) and T_6 (1:4.61).

It may be concluded that among the treatment schedules, T_1, T_3 and T_6 yielded greater amount of marketable fruits. Added to this, T_2 and T_4 were also gave quite better yield. But the CBR was always found maximum in T_3 (1:20.73-24.43). Because in this schedule, two synthetic pyrethroids were used which were most effective against this pest and less costly. Tripathi and Patnaik (13) also concluded that these two pyrethroids were most effective and economical insecticides as they returned 8.09-40.40 times benefit over the cost.

Table 1: Insecticidal treatment schedules for the control of aphid and whitefly in brinjal

Treatment schedules	Insecticides with dose and time of application
T1	i) Soil application of neem cake @ 300 kg/ha before transplanting ii) Foliar spray with chlorpyriphos 20 EC + Cypermethrin 5 EC @ 1.5 ml/litre of water at 30 DAT (days after transplanting). iii) Foliar spray with cartap hydrochloride 50 SP @ 1 g/litre of water at 50 DAT iv) Foliar spray with azadirachtin 1 EC @ 4 ml/litre of water at 70 DAT
T2	i) Soil application of phorate 10 G @ 1.5 kg a.i./ha before transplanting ii) Foliar spray with acephate 75 SP @ 0.75 g/litre of water at 50 DAT iii) Foliar spray with thiodicarb 75 WP @ 0.75 g/litre of water at 70 DAT iv) Foliar spray with *Bacillus thuringiensis var kurstaki* WP @ 2.0 g/litre of water at 90 DAT
T3	i) Foliar spray with fipronil 5 EC @ 0.5 ml/lit. of water at 30 DAT ii) Foliar spray with novaluron 10 EC @ 0.75 ml/lit of water at 50 DAT iii) Foliar spray with deltamethrin 2.8 EC @ 0.5 ml/lit of water at 70 DAT iv) Foliar spray with fenvalerate 20 EC @ 0.5 ml/lit at 90 DAT
T4	i) Seedling treatment with carbosulfan 25 EC @ 2 ml/lit of water before transplanting ii) Foliar spray with thiamethoxam 25 WG @ 1 g/3lit of water at 30 DAT iii) Foliar spray with endosulfan 35 EC @ 2 ml/lit of water at 60 DAT iv) Foliar spray with *B. thuringiensis var kurstaki* 5 WP @ 2 g/lit of water at 80 DAT
T5	i) Seedling treatment with imidacloprid 17.8 SL @ 3 ml/10 lit of water before transplanting ii) Foliar spray with imidacloprid 17.8 SL @ 1.5 ml/7.5 lit of water at 30 DAT iii) Foliar spray with novaluron 10 EC @ 0.75 ml/lit of water at 50 DAT iv) Foliar spray with *Bacillus thuringiensis var kurstaki* 5 WP @ 2 g/lit of water at 70 DAT v) Foliar spray with novaluron 10 EC @ 0.75 ml/lit of water at 90 DAT
T6	i) Foliar spray with thiamethoxam 25 WG @ 1 g/3 lit of water at 30 DAT ii) Foliar spray with spinosad 2.5 EC @ 1 ml/3 lit of water at 50 DAT iii) Foliar spray with abamectin 1.9 EC @ 2 ml/lit of water at 70 DAT
T7	Only water spray

Table 2: Incidence of whitefly on brinjal under different treatment schedules during 2012 and 2013 at Adisaptagram Block Seed Farm, Hooghly

Treatment schedules	Population of aphids on brinjal at different observations								Mean population		Percent decrease over control	
	July		August		September		October					
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
T1	9.33 (0.97)	14.66 (1.16)	34.11 (1.48)	32.11 (1.42)	48.55 (1.65)	61.00 (1.76)	61.33 (1.78)	66.33 (1.81)	35.54	38.78	77.21	73.88
T2	0.0 (0.0)	0.0 (0.0)	25.44 (1.33)	24.88 (1.34)	23.44 (1.32)	26.77 (1.40)	35.50 (1.53)	40.83 (1.60)	19.78	21.51	86.95	85.51
T3	42.33 (1.56)	31.00 (1.44)	25.66 (1.35)	30.11 (1.41)	59.44 (1.75)	55.88 (1.72)	49.33 (1.69)	36.00 (1.55)	39.69	35.63	73.81	76.00
T4	14.50 (1.11)	10.33 (1.03)	14.11 (1.14)	14.22 (1.09)	36.55 (1.54)	44.66 (1.61)	58.50 (1.75)	47.33 (1.67)	27.09	25.60	82.13	82.76
T5	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	6.33 (0.81)	47.22 (1.62)	28.88 (1.41)	53.83 (1.73)	75.83 (1.87)	22.66	22.24	85.05	85.02
T6	52.16 (1.68)	32.83 (1.41)	23.55 (1.36)	20.11 (1.29)	51.22 (1.68)	46.44 (1.62)	73.00 (1.84)	87.00 (1.92)	43.15	39.93	71.53	73.11
T7	41.83 (1.59)	31.16 (1.46)	210.22 (2.30)	165.77 (2.20)	269.78 (2.42)	287.55 (2.46)	71.83 (1.81)	105.50 (1.98)	157.57	148.48	-	-
SEM (±)	0.09	0.05	0.08	0.04	0.07	0.02	0.07	0.03	-	-	.-	-
CD (p=0.05)	0.22	0.13	0.21	0.11	0.20	0.06	0.18	0.06	-	-	-	-

*Figures in parenthesis are angular transformed values

Table 3: Incidence of whitefly on brinjal under different treatment schedules during 2012 and 2013 at Adisaptagram Block Seed Farm, Hooghly

Treatment schedules	Population of whitefly on brinjal at different dates of observation								Mean population		Percent decrease over control	
	July		August		September		October					
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
T1	16.11 (22.37)	20.88 (25.33)	6.89 (14.57)	9.44 (17.23)	16.66 (23.65)	15.22 (22.59)	8.50 (16.30)	10.99 (18.69)	12.36	14.42	45.09	54.15
T2	0.0 (0.0)	6.33 (13.97)	5.11 (11.59)	14.44 (21.53)	9.66 (17.29)	13.22 (20.83)	9.99 (17.91)	7.67 (15.39)	5.84	9.51	74.05	69.79
T3	17.22 (23.57)	19.78 (25.15)	10.77 (18.4)	17.55 (23.15)	16.22 (22.75)	25.66 (29.64)	8.33 (16.73)	11.99 (19.63)	13.66	19.36	39.31	38.44
T4	9.77 (16.93)	13.16 (19.10)	5.88 (15.09)	6.44 (14.02)	14.44 (21.65)	17.33 (24.11)	12.66 (20.32)	13.83 (21.34)	10.51	11.39	53.31	63.78
T5	0.0 (0.0)	5.33 (12.84)	2.66 (7.69)	2.16 (6.74)	17.77 (24.47)	14.00 (21.30)	12.83 (20.43)	11.16 (18.84)	7.91	6.72	64.80	78.63
T6	0.0 (0.0)	8.99 (16.34)	8.88 (16.63)	15.22 (22.48)	10.99 (18.72)	15.11 (21.95)	11.50 (18.70)	8.83 (16.64)	8.93	12.33	60.33	60.79
T7	16.44 (22.89)	19.33 (25.02)	32.44 (34.43)	50.33 (45.22)	26.55 (30.57)	36.77 (36.86)	10.66 (18.45)	13.33 (23.0)	22.51	31.45	-	-
SEM (±)	2.41	2.34	3.31	2.76	3.08	2.87	2.99	2.51	-	-	-	-
CD (p=0.05)	6.08	5.91	8.34	6.96	7.81	7.22	NS	NS	-	-	-	-

*Figures in parenthesis are angular transformed values

Table 4: Cost effectiveness of different treatment schedules against important insect pest of brinjal during 2012 and 2013.

Treatment schedules	Marketable yield (t/ha)		Increased yield over control		Added benefit over control (Rs./ha)		Cost of treatment (Rs./ha)		Net profit (Rs./ha)		CBR (Cost benefit ratio)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
T1	13.89	14.28	5.51	6.46	52,896	56,848	4,590	4,590	48,306	52,258	1:10.52	1:11.38
T2	12.25	11.74	3.87	3.91	37,152	34,408	1,759	1,759	35,393	32,649	1:20.12	1:18.56
T3	12.68	13.32	4.30	5.49	41,208	48,312	1,900	1,900	39,380	46,412	1:20.73	1:24.43
T4	11.68	11.83	3.30	4.00	31,680	35,200	1,470	1,470	30,210	33,730	1:20.55	1:22.94
T5	10.87	10.74	2.49	2.91	23,904	25,608	2,961	2961	20,943	22,647	1:7.07	1:7.65
T6	13.28	13.48	4.90	5.65	47,040	49,720	8,812	8,861	38,228	40,859	1:4.34	1:4.61
T7	8.38	7.83	-	-	-	-	-	-	-	-	-	-

i) Selling price of brinjal during 2012 – Rs. 9600 per ton
ii) Selling price of brinjal during 2013 – Rs. 8800 per ton

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