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EFFECT OF DIFFERENT MANAGEMENT TREATMENTS ON WHITEFLY PARASITIZATION BY *ENCARSIA* SPP. UNDER FIELD CONDITION ON COTTON

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ABSTRACT

Effect of different management modules on *Encarsia* spp. at different intervals during Kharif, 2015 was studied. Maximum parasitization 32.28 and 31.50% was recorded in T_{12} [Control (without water spray)] in both the intervals (5- and 10-days interval) followed by 30.30 and 29.85% in T_2 nimbecidine (six sprays at 5 days interval) + Yellow sticky trap in both the intervals, respectively. While minimum parasitization (15.02 and 14.91%) was recorded in T_5 [First spray of dimethoate followed by imidacloprid, thiamethoxam, triazophos, imidacloprid and thiamethoxam (at 5 days interval)] and T_8 [first spray of nimbecidine followed by dimethoate, triazophos, novaluron (at 10 days interval)], respectively. It is concluded that high whitefly pupae parasitization was found in neem treated plots than insecticide treated plots. So, nimbecidine was found relatively less toxic and much safer to natural enemy.

Key words: *Encarsia* spp., insecticides, whitefly, parasitization, nimbicidine, yellow sticky trap, dimethoate, imidacloprid, thiamethoxam, triazophos, novaluron

In many agricultural systems the potential of biological control to contribute to pest suppression is limited than the use of insecticides to both the pest and their natural enemies (Croft, 1990). The important contribution of both chemical and biological control to pest management in agricultural systems i.e. integrated control concept was formalized (Stern et al., 1959). In this concept the fundamental components involved was the application of insecticides done on the basis of economic thresholds and the use of selective materials, rates, and/or selective application methods that minimize impacts on natural enemy populations (Newsom et al., 1976 and Stern et al.,1959). *Bemisia tabaci* (Gennadius) is a cosmopolitan pest of field and horticultural crops (Oliveira et al., 2001). Agrihotri et al., (1999) reported that due to whitefly outbreaks, there was widespread use of insecticides for its control that resulted in large-scale reductions of its natural enemies, environmental pollution, resurgence of minor pests into major, and development of resistance to most of the synthetic insecticides (Mehrotra, 1991). This required alternate methods for pest management that are not only effective but selective and safe also. Natural enemies (Predators and parasitoids) are primarily bioagents, which biologically manage whiteflies in the field. *Encarsia* and *Eretmocerus* spp. are the primary genera of the whitefly parasitoids; that feed and parasitize the nymphal instars (Goolsby et al., 1996 and Goolsby et al., 1998). *E. sophia* (Heraty and Polaszek, 2000), *E. lutea* and *E. bimaculat* (Sharma et al., 2003; Antony et al., 2004) are the potentially useful parasitoids of *B. tabaci. Encarsia lutea* was the only nymphal parasitoid in a field trial conducted to determine the natural enemies of *B. tabaci* in 14 cultivated crops in Hisar, Haryana (Kedar et al., 2014). Due to the effectiveness of the natural enemies in suppressing the whitefly population it is one of the methods of pest control and also necessary to conserve these in the ecosystem. Few management modules were tested against parasitoids of whitefly to find out the safer treatment to them. So, keeping in the following investigation was carried out to evaluate safest management modules for parasitization of whitefly in cotton.

MATERIALS AND METHODS

Studies on "Effect on parasitization (%) of whitefly parasitoid, *Encarsia* spp. by different management modules at different intervals under field condition on cotton" were carried out during Kharif, 2015 at the Cotton Research Area, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar. Effectiveness of different management module for parasitoids of whitefly was studied. The experiment was conducted on Bt cotton hybrid Bio-6588 BG II having twelve treatments with three replications in RBD design. The plot size of each treatment was 81 m^2 comprising sixteen rows of 6 meter length with the spacing of 67.5 cm x 60 cm (row to row and plant to plant). To avoid the influence of the treatments on the pest population in neighboring plots a gap of 2 m was left between plots (Men et al., 2003). The experiment material was sown on the first fortnight of May 2015. The spray schedule started in the month of July when the population of whitefly reached at economic threshold level (ETL) i.e. 6-8 adults per leaf. Insecticides and fertilizers were sprayed with a knapsack sprayer using 200 litres of water/acre. There were twelve management treatments including control. Different management modules studied for whitefly parasitization on cotton during 2015-16 are as followes. T_1 : Spray of nimbecidine (six sprays at 5 days interval); T_2: Spray of azadirachtin nimbecidine (six sprays at 5 days interval) + Yellow sticky trap; T_3: First spray of nimbecidine followed by alternate spray of novaluron and nimbecidine (at 5 days interval) + Yellow sticky trap; T_4: First spray of azadirachtin followed by dimethoate, triazophos, novaluron, nimbecidine and triazophos (at 5 days interval); T_5: First spray of dimethoate followed by imidacloprid, thiamethoxam, dimethoate, imidacloprid and thiamethoxam (at 5 days interval); T_6: Spray of Urea+ DAP + Zn (2.5kg +2.5kg+ 0.5 kg/acre) (four sprays at 10 days interval); T_7: Spray of nimbecidine (four sprays at 10 days interval); T_8: First spray of nimbecidine followed by dimethoate, triazophos, novaluron (at 10 days interval); T_9: First spray of dimethoate followed by imidacloprid, thiamethoxam, dimethoate (at 10 days interval); T_{10}: Control (water spray) (six sprays at 5 days interval); T_{11}: Control (water spray) (four sprays at 10 days interval); T_{12}: Control (no water spray)

The sprays at 5 days intervals were done to see the effect of different insecticides on whitefly parasitoids that usually emerge from their pupal cases in 5 days. The sprays at 10 days intervals were done to evaluate the effectiveness of farmers practice i.e. spray of fertilizer (Urea+DAP+Zn) against whitefly. Parasitization (%) was recorded one day before and 5 days after each spray in treatment T_1, T_2, T_3, T_4, T_5 and T_{10} from thirty leaves randomly selected in each plot. Total six sprays were done at five days interval in each schedule. In treatment T_6, T_7, T_8, T_9 and T_{11} observations were recorded one day before and 5, 10 days after each spray from thirty leaves randomly selected in each plot. Total four sprays were done at a ten days interval in each treatment schedule. Healthy and parasitized pupae were counted and % parasitization was worked out.

Different chemicals & their doses (per acre in 200 litres water) used in this experiment are, Nimbecidine 300 ppm (1000ml), Dimethoate 30 EC (300ml), Thiamethoxam 25WG (40g), Triazophos 40 EC (600ml), Novaluron 10 EC (200 ml), Urea + DAP + Zn (2.5kg + 2.5kg + 0.5kg), Imidacloprid 17.8 SL (40ml) and yellow sticky trap (no. 3cm×5cm, 50/acre).

The data were tabulated and subjected to the analysis of variance and standard error by using one factor Randomized Block Design. The differences were compared using critical difference (CD) at $p=0.05$ level of significance. The data were transformed using angular in OPSTAT.

RESULTS AND DISCUSSION

Total six sprays were done at five days interval in treatment T_1, T_2, T_3, T_4, T_5 and T_{10} whereas, in treatments T_6, T_7, T_8, T_9 and T_{11} four sprays were done at 10 days interval and the data was recorded one day before and five days after spray. The results revealed that all the insecticides evaluated against the whitefly parasitization had lower parsitization compared to control (Table 1). The whitefly pupal parasitization ranged from 0.3 to 56.31% during end July to mid-September. In five days interval module maximum parasitization (32.28%) was recorded in T_{12} [Control (without water spray)] followed by (30.30%) in T_2 [Spray of nimbecidine (six sprays at 5 days interval) + yellow sticky trap] and (24.65%) in T_1 [Spray of nimbecidine (six sprays at 5 days interval)] while minimum parasitization (15.02%) was found in T_5 [First spray of diafanthiuron, followed by imidacloprid, thiamethoxam, triazophos, imidacloprid and thiamethoxam] followed by (16.00%) in T4 (First spray of nimbecidine followed by dimethoate, triazophos, novaluron, nimbecidine and triazophos). Partially in ten days interval module also maximum parasitisation (31.50%) was recorded in T_{12} [Control (without water spray)] followed by (29.85%) in T_7 [Spray of nimbecidine (four sprays)] and (24.84%) in T_6 [Spray of Urea+ DAP + Zn (2.5kg +2.5kg+ 0.5 kg/acre) (four sprays)] whereas minimum parasitization (14.91%) was found in T_8 (First spray of nimbecidine followed by dimethoate, triazophos, novaluron) and (16.51%) in T_9 (First spray of dimethoate followed by imidacloprid, thiamethoxam, dimethoate) (Table 2).

Present findings are in accordance with Sharma et al., 2003 who reported that neem treated plots

Table 1. Effect of different insecticidal sprays on the pupal parasitoid (%) *Encarsia* sp at 5 days interval

Treatments	Pupal parasitisation of whitefly (%)							
	Before spray	After 1st spray	After 2nd spray	After 3rd spray	After 4th spray	After 5th spray	After 6th spray	Pooled mean
T1	9.13 (17.58)*	6.77 (14.87)	33.89 (35.57)	22.85 (28.54)	9.91 (18.27)	43.49 (41.24)	31.03 (33.82)	24.65 (29.76)
T2	19.46 (26.15)	23.06 (28.66)	22.41 (28.66)	16.42 (23.88)	32.41 (34.68)	45.24 (42.25)	42.24 (40.52)	30.30 (33.38)
T3	7.98 (16.40)	9.27 (17.69)	25.26 (30.15)	22.40 (28.23)	44.00 (41.54)	12.67 (20.78)	22.79 (28.40)	22.73 (28.46)
T4	6.14 (14.33)	5.03 (12.87)	15.36 (23.03)	4.02 (11.55)	38.77 (38.48)	16.51 (23.87)	16.34 (23.81)	16.00 (23.56)
T5	5.33 (13.29)	3.21 (9.36)	9.37 (17.81)	2.79 (9.61)	32.31 (34.61)	32.31 (34.62)	10.14 (18.41)	15.02 (22.80)
T10	5.53 (13.58)	5.68 (13.75)	17.86 (24.98)	23.39 (28.91)	22.71 (28.39)	26.64 (31.06)	46.36 (42.81)	23.77 (29.16)
T12	10.14 (18.56)	12.66 (20.82)	41.02 (39.81)	35.71 (36.68)	30.12 (33.27)	34.48 (35.94)	39.69 (39.03)	32.28 (34.60)
CD at P=0.05	(1.65)	(4.90)	(2.20)	(1.26)	(3.05)	(2.96)	(6.06)	(1.60)

*Figures in parentheses are angular transformed values

Table 2. Effect of different insecticidal sprays on the pupal parasitoid *Encarsia* sp. at 10 days interval

Treatment	Pupal parasitisation whitefly (%)									
	Before spray	1st spray		2nd spray		3rd spray		4th spray		Pooled Mean
		5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	5 DAS	10 DAS	
T6	17.09 (24.40)*	18.26 (25.29)	13.85 (21.82)	10.67 (19.05)	25.84 (30.49)	26.20 (30.76)	22.43 (28.21)	36.25 (37.00)	45.26 (42.26)	24.84 (29.88)
T7	6.04 (14.22)	3.73 (10.94)	7.30 (15.67)	15.21 (22.94)	20.03 (26.57)	47.17 (42.39)	42.57 (40.69)	48.27 (43.99)	55.54 (48.16)	29.85 (33.11)
T8	10.22 (18.63)	7.11 (15.33)	9.28 (17.72)	10.64 (19.02)	15.63 (23.08)	46.65 (43.06)	8.43 (16.85)	8.85 (17.30)	12.72 (20.85)	14.91 (22.70)
T9	6.34 (14.57)	4.56 (12.20)	19.77 (26.38)	10.30 (18.70)	16.39 (23.86)	33.24 (35.18)	7.06 (15.35)	20.38 (26.81)	20.38 (26.81)	16.51 (23.96)
T11	4.16 (11.73)	3.39 (10.58)	5.07 (12.99)	13.03 (21.13)	49.19 (44.52)	45.38 (42.33)	21.05 (26.77)	25.87 (30.53)	31.37 (34.04)	24.29 (29.51)
T12	10.14 (18.56)	12.66 (20.82)	41.02 (39.81)	35.71 (36.68)	30.12 (33.27)	34.48 (35.94)	39.69 (39.03)	24.90 (29.90)	33.40 (35.28)	31.50 (34.13)
CD at P=0.05	(1.19)	(3.31)	(1.75)	(1.81)	(4.32)	(2.90)	(6.21)	(2.86)	(3.44)	(1.48)

*Figures in parentheses are angular transformed values

have higher (28.8%) whitefly pupae parasitization than insecticide treated plots (3.1%). Kalkal et al., 2018 also reported the similar results that the whitefly parasitization ranged from 51.83 to 88.43% in different spray schedules during August to September. Whereas maximum pupal parasitization (74.79%) was observed in T_2 [nimbecidine (six sprays at 5 days interval) + Yellow sticky trap] followed by T_1 [nimbecidine (six sprays at 5 days interval] (70.82%) and S_{12} (Control no water spray) (70.68%) being at par with each other and the minimum parasitization was found in T_5 [dimethoate followed by imidacloprid, thiamethoxam, dimethoate, imidacloprid and thiamethoxam (at 5 days interval)] (56.47%) followed by T_8 [nimbecidine followed by dimethoate, triazophos, novaluron (at 10 days interval)] (59.73%). Similarly, Mehra and Rolania, 2020 reported that whitefly nymphal parasitization by *E. lutea* varied from 6.0 to 28.1% during the period of study (June to October). The study also revealed that nimbecidine was found to be much safer to natural enemies and relatively less toxic than the other insecticidal treatments. It is also reported that neem products are safer for the parasitoids and prolonged the parasitoids life span by Joshi et al., 1982. Natarajan, 1991 reported neem oil as harmless to hymenopterous parasitoids of cotton whitefly, e.g. *Eretmocerus mundus, Encarsia* spp.

On the basis of above results, it was concluded that among different management treatments after control most safest treatment was T_2 incorporated with six sprays of nimbecidine 300 ppm @ 5ml/ l at 5 days interval along with yellow sticky traps @ 50/acre during 2015 followed by T_7 [Spray of nimbecidine (four sprays at 10 days interval)]. The study also revealed that from insecticidal treatments the nimbecidine was found relatively less toxic and much safer to natural enemy.

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