Efficacy of Chemical Insecticides and Neem Oil Against White Fly (*Bemisia tabaci* Genn.) Infesting ladysfinger (*Abelmoschus esculentus* L.)

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Abstract

Okra (*Abelmoschus esculentus* L.) is susceptible to various pests of which white fly (Bemisia tabaci Genn.) causes heavy damage. The field study evaluated the efficacy of nine new insecticides including one phytopesticide neem oil (*Azadiracta indica*) against this pest during the post-*kharif* season of 2004 and 2005. Significant differences were found in the efficacy of different treatments in reducing white fly populations. All the insecticides gave a satisfactory control, recording more than 60% mortality. λ-cyhalothrin (Karatzeon) was found most effective insecticide closely followed by a mixed formulation of chloropyriphos and cypermethrin (Nurelle). A rapid degradation of persistency was observed in imidachloprid closely followed by neem oil than other insecticides tested. Satisfactory control (>60% population suppression) was achieved with imidacloprid and neem oil. Imidachloprid, having lower persistency is suitable for white fly control. Neem oil of biological origin (bio-pesticides) have less or no hazardous effects on human health and the environment, therefore, it can be incorporated in IPM programmes and organic farming in vegetable cultivation.

1. Introduction

Okra (*Abelmoschus esculentus* L.) is an annual crop in the family Malvaceae and one of the most important vegetable crops in tropical and sub-tropical areas of the globe. In the sub-Himalayan region of north-east India, okra is cultivated at a commercial scale but insect and mite pest damage constitutes a limiting factor in successful production (Ghosh et al., 1999). One of the most important pests of this crop is the white fly, *Bemisia tabaci* Genn. The adults suck the sap of the leaves and transmit the yellow vein mosaic virus disease of okra.The field studies carried out by Obnesorge (1981) in Jordan on the population dynamics revealed that the density of pest was lowest in *kharif* and winter crops. As observed by Watson et al. (1993) low rainfall caused significant outbreaks and dense population developed only where humidity low and temperatures high. Higher temperature and low rainfall were found to favour rapid multiplication of the pest (Threhan, 1944). Kumashiro et al. (1983) found a significant positive correlation between temperature and whitefly abundance and negative correlation between the pest incidence and rainfall on cotton, indicating both temperature and rainfall played an important role in regulating the whitefly population, besides natural enemies. Ali et al. (2005) reported that the incidence of population had a significant and positive correlation with temperature and sunshine hours while a negative correlation with relative humidity and total rainfall. The disease incidence had a significant and positive correlation with population (Pun et al., 2005).

Different groups of insecticides have been recommended to control this white fly (Suryawanshi et al., 2000; Satpathy et al., 2004). However, the use of synthetic insecticides during the fruit bearing stage is problematic because the fruit is picked at frequent intervals, creating the possibility that toxic residues could pose a health hazard. Previous research has evaluated less toxic and more environmentally safe insecticides. For example, Mishra and Mishra (2002) reported that the botanical insecticides Neemax (neem seed kernel extract) and Multineem (neem oil) regulated populations of this white fly. Acharya et al. (2002) studied the efficacy of the insecticides imadacloprid and abamectin and reported they were safer to use in the presence of coccinellid predators. The objective of this study was to determine the efficacy of some new insecticides and neem oil against white fly.

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2. Materials and Methods

Studies were conducted in the Instructional Farm of Uttar Banga Krishi Viswavidyalaya at Pundibari, Coochbehar, West Bengal, India for two years (2004-2005) situated between $25^{0}57'$ and 27^{0} N latitude and $88^{0}25'$ and $89^{0}54'$ E longitude. The soil of the experimental field was sandy loam with pH value 6.9. The climate of this zone is subtropical humid with a short winter spell during December to February. The okra variety *Nirmal-101* was grown during the post-*kharif* (early September) season in both years under recommended fertilizer levels (120:60:60 kg NPK ha^{-1}) and cultural practices in 4×5 m^2 plots at a spacing of 75×35 cm^2. Nine insecticides viz., clothianidin 50 WDG (1 g 5 l^{-1}), flubediamide 20 WDG (1 g 3 l^{-1}), profenphos 50 EC (1.5 ml l^{-1}), λ-cyhalothrin 5 EC (0.5 ml l^{-1}), imidachlorprid 17.8 SL (1 ml 6 l^{-1}), dimethoate 30 EC (1.5 ml l^{-1}), neem 1500 ppm (2.5 ml l^{-1}) and two mixed formulations such as profenphos 44%+cypermethrin 4% (44 EC) (1.0 ml l^{-1}), chlorpyriphos 50%+cypermethrin 5% (55 EC) (1.50 ml l^{-1}) along with control where no insecticide were replicated three times in a RBD.

Two sprays at 15 day intervals were made, starting with the initiation of infestation. White fly populations were recorded 3, 8 and 14 days after each spraying by counting white fly on each leaf of five apical leaves from five randomly selected plants $replication^{-1}$. The results were expressed as white fly population suppression (%) compared to densities recorded on the control treatment. Percent reduction of mite population over control was calculated by the following formula (Abbott, 1925):

$$Pt = \frac{Po\text{-}Pc}{100\text{-}Pc} \times 100$$

where, *Pt*=Corrected mortality, *Po*=Observed mortality and *Pc*=Control mortality. Data were analyzed by using INDO-STAT- software.

The fruits were harvested at frequent intervals when they reached marketable size. The yield of marketable produce was calculated in different years separately on the basis of fruit yield $plot^{-1}$.

3. Results and Discussion

The different treatments and their persistence at different days after application varied significantly in their suppression of white fly populations (Table 1 and Table 2). Among the ten

Table 1: Effect of different application schedules of insecticides and neem oil against white fly (pooled of 2004 and 2005)

Treatments	Dose ml l^{-1} (%)	Pre-treatment observation of white fly $leaf^{-1}$	% Reduction on different days after treatment (DAT)					
			1st Spraying			2nd Spraying		
			Days after treatment					
			3	8	14	3	8	14
Clothianidin (T_1)	1 g 5 l^{-1}	1.83	75.82 (60.94)	75.31 (60.65)	66.56 (54.71)	80.80 (64.53)	73.71 (59.58)	71.42 (59.30)
Flubandiamide (T_2)	1 g 3 l^{-1}	1.80	82.51 (68.21)	66.67 (54.78)	63.69 (54.10)	73.27 (59.23)	79.21 (62.87)	62.49 (51.95)
Profenphos (T_3)	1.5 ml l^{-1}	1.70	88.89 (75.54)	60.75 (44.98)	48.23 (43.98)	89.29 (76.12)	83.41 (70.08)	58.35 (50.00)
Profenphos+Cypermethrin (T_4)	1 ml l^{-1}	1.87	85.73 (68.75)	62.07 (51.85)	49.44 (45.18)	76.47 (61.55)	78.11 (65.11)	51.6 (46.13)
Chlorpyriphos+Cypermethrin (T_5)	1.5 ml l^{-1}	1.97	87.65 (74.98)	63.46 (52.83)	55.58 (48.21)	81.71 (65.55)	90.46 (72.14)	71.24 (58.75)
λ-cyhalothrin (T_6)	0.50 ml l^{-1}	1.57	83.55 (66.12)	65.29 (53.89)	60.92 (51.54)	89.69 (71.22)	82.33 (65.25)	68.74 (56.54)
Imidachlorprid (T_7)	1.0 ml 6 l^{-1}	1.90	70.02 (57.84)	69.63 (57.40)	38.58 (38.66)	75.06 (60.41)	82.19 (65.14)	43.48 (41.88)
Dimethoate (T_8)	1.5 ml l^{-1}	1.80	76.82 (61.87)	66.59 (54.74)	60.50 (51.12)	78.52 (63.12)	69.49 (56.56)	80.74 (63.88)
Neem (T_9)	2.5 ml l^{-1}	1.73	81.75 (64.82)	72.51 (58.10)	50.23 (45.14)	75.61 (60.77)	66.47 (54.41)	54.55 (47.26)
Untreated Control (T_{10})	-	1.80	115.61	157.80	127.17	258.38	127.17	96.53
SEm±			6.95	4.65	3.37	4.19	4.62	4.46
CD (p=0.05)			19.83	13.82	10.02	12.44	13.74	13.25

Figures in parentheses are angular transformed values; NS=Not significant

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Table 2: Overall efficacy of insecticides and neem oil against white fly and the fruit yield (pooled of 2004 and 2005)

Treatments	Dose ml l^{-1} (%)	Pre-treatment observation of white fly $leaf^{-1}$	Overall efficacy (% reduction) Days after treatment 3	8	14	Mean	Fruit Yield (q ha^{-1})
Clothianidin (T_1)	1 g 5 l^{-1}	1.83	78.31 (62.26)	74.51 (59.75)	68.99 (56.27)	73.94 (59.43)	30.94
Flubandiamide (T_2)	1 g 3 l^{-1}	1.80	77.89 (62.27)	72.94 (58.67)	63.09 (52.62)	71.30 (57.85)	32.90
Profenphos (T_3)	1.5 ml l^{-1}	1.70	89.09 (70.86)	72.08 (58.10)	53.29 (46.89)	71.49 (58.62)	38.06
Profenphos+Cypermethrin (T_4)	1 ml l^{-1}	1.87	81.10 (64.30)	70.09 (56.85)	50.52 (45.30)	67.24 (55.48)	35.13
Chlorpyriphos+Cypermethrin (T_5)	1.5 ml l^{-1}	1.97	84.70 (67.22)	76.96 (61.32)	63.41 (52.78)	75.02 (60.44)	40.20
λ-cyhalothrin (T_6)	0.50 ml l^{-1}	1.57	86.62 (68.99)	73.81 (54.27)	64.83 (53.67)	75.09 (58.98)	42.17
Imidachlorprid (T_7)	1.0 ml 6 l^{-1}	1.90	72.54 (58.51)	75.91 (60.74)	41.03 (39.83)	63.16 (53.03)	37.68
Dimethoate (T_8)	1.5 ml l^{-1}	1.80	77.67 (62.21)	68.04 (55.63)	70.62 (56.84)	72.11 (58.23)	35.53
Neem (T_9)	2.5 ml l^{-1}	1.73	78.68 (62.98)	66.60 (55.08)	52.39 (55.18)	65.22 (54.41)	37.57
Untreated Control (T_{10})	-	1.80	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	27.09
SEm±			2.46	1.33	1.43	-	1.14
CD (p=0.05)			7.25	3.94	4.26	-	3.87

Figures in parentheses are angular transformed values; NS=Not significant

treatments, all the insecticide treatments including phyto-insecticide, neem oil were significantly more effective than untreated control in reducing the *Bemisia* population (Table 2). λ-cyhalothrin (Karate) provided the best suppression of populations (75.09%), closely followed by a mixed formulation of chloropyriphos and cypermethrin (Nurelle) (75.02%).

Persistency of toxicity against white fly the best result was obtained at 3 DAT which was also significantly superior on 8 DAT and 14 DAT. Most of the insecticides provided a promising reduction in pest population, being more than 70% at 3 DAT. Three days after spraying, prophenophos was the most effective (89.09% suppression) against the white fly, followed by λ-cyhalothrin (86.62% suppression) and a mixed formulation of chloropyriphos and cypermethrin (Nurelle) (84.70%). These three insecticides were not significantly different with each other. Eight days after spraying, a mixed formulation of chloropyriphos and cypermethrin (Nurelle) was found very effective against the white fly (76.96% suppression) followed by imidacloprid (75.91% suppression). Persistency of insecticides gradually decreased with passing of days after treatment and it became lowest at 14 DAT. Fourteen days after spraying, dimethoate was the most effective insecticide (70.62% suppression) against the white fly followed by clothianidin (68.99% suppression).

A rapid degradation of persistency was observed in Imidachlorprid (41.03%) suppression in pest population after 14 DAT) followed by a mixed formulation of profenophos and cypermethrin (50.52% suppression) and neem oil (52.39% suppression) than other insecticides, which had a great importance as fruits were plucked at frequent interval and consumed after little cooking and there was every possibility to retain toxic residue in the fruits, may caused health hazard.

Yield was directly related to the efficacy of the insecticides. The highest yield was obtained from plots treated with λ-cyhalothrin (42.17 q ha^{-1}), followed by a mixed formulation of chloropyriphos and cypermethrin (Nurelle) (40.20 q ha^{-1}) (Table 2). There was no significant difference in yield between these two treatments.

4. Conclusion

Satisfactory white fly control was achieved with imidacloprid and neem oil with the production of 37.68 and 37.57 q ha^{-1},

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respectively. Imidachloprid, having lower persistency is suitable for white fly control. However, neem (bio-pesticides) can be incorporated in future IPM programme and organic farming in vegetable cultivation because of its efficacy and yield as well as low toxicity to natural enemies.

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