Incidence of white fly (Bemisia tabaci Genn.) and their sustainable management by using biopesticides

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Abstract

Ladysfinger (Abelmoschus esculentus L.) is susceptible to various pests of which white fly (Bemisia tabaci Genn.) causes heavy damage. The pest was active throughout the growing period with a peak population (3.98 white fly /leaf) and (4.33 /leaf) during 20rd SMW (middle of May) in the pre-kharif and during 42nd -43rd SMW (middle of October) in the post kharif crop respectively. Sudden fall of population was found during July because of heavy rains. White fly showed insignificant positive correlation (p=0.05) with maximum temperature, minimum relative humidity(RH) whereas insignificant negative correlation with maximum RH and significant negative correlation with weekly total rainfall. This study evaluated the efficacy of extracts from plants, microbial insecticides against B. tabaci infesting ladysfinger. Imidacloprid was the most effective treatment followed by the microbial insecticide spinosad. Satisfactory white fly control (> 50 % population suppression) was achieved with extract of Polygonum plants (5 % concentration) and spinosad. The Polygonum extract was very effective against the white fly, achieving more than 60 % mortality at 3 and 7 days after spraying. Plant extracts and microbial insecticides of biological origin (biopesticides) have less or no hazardous effects on health and the environment, therefore they can be incorporated in IPM programmes and organic farming.

Introduction

In the sub-Himalayan region of north east India ladysfinger (*Abelmoschus esculentus* L.), an annual vegetable crop is cultivated at a commercial scale but insect and mite pest damage constitutes a limiting factor in successful production. One of the most important pests of this crop is the white fly, *Bemisia tabaci* Genn. As observed by Watson et al*.* (2003) 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). The use of synthetic insecticides is problematic because the toxic residues in the fruits could pose a health hazard. *Polygonum* is a well known weed in the terai agro-climatic region of West Bengal, India. Acharya et al. (2002) reported that abamectin was safer to use in the presence of coccinellid predators. Information on seasonal activity of white fly pests helps to take up effective management strategies. The objective of this study was to determine the efficacy of the biopesticides against *B. tabaci*.

Material and methods

Studies were conducted in the Instructional Farm of UBKV (Agri. University), West Bengal, India for two years (2010-11). The experimental area is situated in the sub-Himalayan region of north-east India. This so called terai zone is situated between $25^0$57' and 27^0 N latitude and $88^0$25' and $89^0$54' E longitude.

The ladysfinger variety 'Nirmal-101' was grown round the year which excludes winter during 2010-2011 in both years under recommended fertilizer levels (120:60:60 kg NPK/ha) and cultural practices in 4.8 m x 4.5m plots at a spacing of 75 cm x 35 cm. The treatments were replicated five times in a Randomized Block Design (RBD). The total white fly population per leaf from five randomly selected plants per replication was recorded at seven days (Standard Meteorological Week) interval. Data obtained over two years were presented graphically with important weather parameters viz. temperature, relative humidity. Correlation co-efficient (r) was worked out between incidence of white fly and important weather parameters during the period to find out influence of weather on population fluctuation.
The ladysfinger variety 'Nirmal-101' was grown during the post-kharif (early September) season in both years under recommended fertilizer levels and cultural practices. The treatments were replicated three times in a Randomized Block Design. Two microbial insecticides, *Saccharopolyspora spinosa* (Spinosad 45 SC) @ 1.0 ml/ 3 L and *Beauveria bassiana* (Bals.) Vuillemin (Biorin 10^7 conidia /ml) @ 1.0 ml/L, and two botanical extracts, *Pongamia pinnata* leaf extract @ 1.0 % and 5.0 % and *Polygonum hydropiper* flower extract @ 1.0 % and 5.0 %, were evaluated and compared with the ability of imidacloprid (Confidor 17.8 SL) @ 1ml/5 L)

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to control *B. tabaci*. The *Pongamia* leaves and *Polygonum* floral parts were extracted in methanol as follows. After washing with water, the plant parts were powdered in a grinder. The powder (50 g) samples of each tested plant were transferred separately to a conical flask (500 ml) and dipped in 250 ml methanol. The material was allowed to stand for 72 hours at room temperature with occasional stirring. After 72 hours the extract was filtered through Whatman 42 filter paper.

Four sprays at 12 day intervals were made, starting with the initiation of infestation. White fly population densities were recorded 3, 7, and 11 days after each spraying by counting white fly on each leaf of five apical leaves from five randomly selected plants per replication. Percent reduction of pest population over control was calculated by the following formula (Abbott, 1925):

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

Where, Pt = Corrected mortality, Po = Observed mortality and Pc = Control mortality. Data were analyzed by using INDO-STAT- software for analysis of variance following randomized block design (RBD) treatment means were separated by applying CD Test (critical difference) at 5 % level of significance.

The fruits were harvested at frequent intervals when they reached marketable size. The yield of marketable produce was converted to tons per hectare.

Results

The pest was active throughout the growing period except 9-11 SMW i.e., last week of February to first week of March (Fig 1). However, population appeared during middle of March and remained very low up to middle of April and thereafter increased gradually with the rise of temperature. Pest population reached high (3.98 white fly/leaf) during 20th SMW (mid of May) in the pre-kharif crop and thereafter started decline with the onset of monsoon and heavy rainfall, and this tendency was continued up to 33 SMW (2nd week of August). After rainy season, again pest population increased and reached highest population (4.33/leaf) on the 42nd – 43rd SMW (mid of October) in the post kharif crop when the average temperature, average relative humidity and weekly total rainfall ranged 27.12-28.65 ^{0}c, 78.63-79.88 % and 6.20-23.80 mm. respectively. However, white fly was most active during May i.e., 17-21 SMW and October i.e., 40-45 SMW. There was a sudden fall of population was found with the heavy rains (weekly total 175.05 mm) during monsoon in 30th SMW (last week of July).

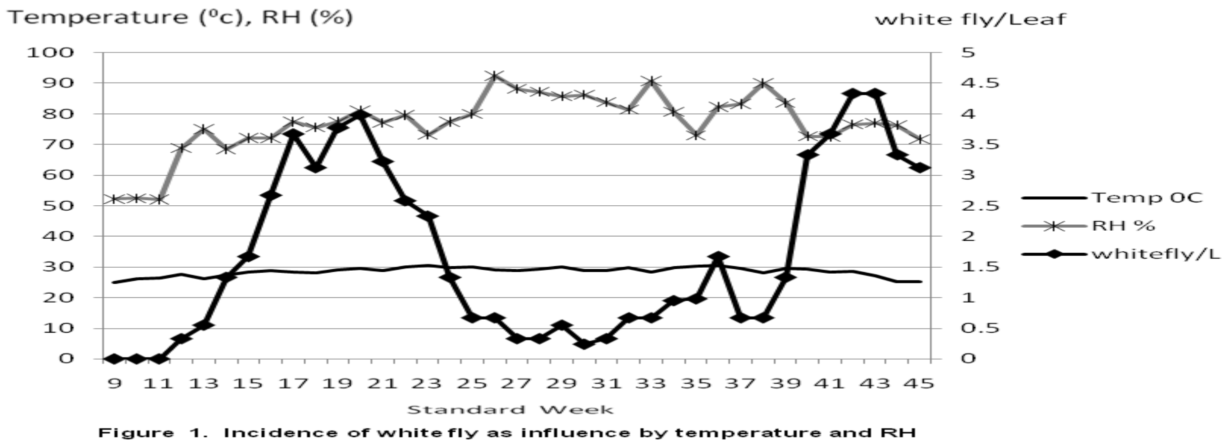

Figure 1. Incidence of white fly as influence by temperature and RH

Correlation between white fly infestations with important weather parameters (table 1) showed non-significant positive correlation (p=0.05) with maximum temperature, minimum relative humidity whereas non-significant negative correlation with maximum relative humidity and significant negative correlation with weekly total rainfall.

Table 1:Correlation co-efficient (r) of white fly with environmental parameters

pest	Temperature				Relative Humidity			Weekly total rainfall (mm)
	Max.	Min.	Difference	Average	Max.	Min.	Average	
White fly	0.149	(-) 0.063	0.130	(-) 0.004	(-) 0.008	0.221	0.133	(-) 0.429**

* significant at P< 0.05 and ** significant at P< 0.01

Among the seven treatments (Table 2), imidacloprid provided the best suppression of populations (77.00 %), followed by microbial toxin *Saccharopolyspora spinosa* (69.80 %). Among the biopesticides, *Saccharopolyspora spinosa* was the most effective followed by the *Polygonum* flower extract at 5.0 % concentration (54.31% suppression). Three days after spraying, imidacloprid was the most effective (85.95 % suppression) against the white fly, followed by *Saccharopolyspora spinosa* (80.19 % suppression). *Polygonum* flower extract at 5.0 % concentration provide better results against white fly (62.44 % suppression). Likewise, the ability of imidacloprid to suppress white fly populations extended to seven and 11 days after spraying. At seven and eleven days after spraying, among the biopesticides, *Saccharopolyspora spinosa* was found very effective against the white fly (70.50 % and 58.71 % suppression respectively) followed by the *Polygonum* flower extract at 5.0% concentration (60.07% and 40.41 % suppression respectively).
The highest yield was obtained from plots treated with imidacloprid (41.17 q/ha), followed by *Saccharopolyspora spinosa* (40.20q/ha) (Table 2). There was no significant difference in yield between these two treatments. The *Polygonum* flower extract at 5.0 % concentration was very effective against *Bemisia tabaci* (62.44 % mortality at 3 days after application).

Discussion

Low rainfall coupled with high temperature and low RH causes outbreak of white fly population. These findings indicated that post kharif crop as well as pre-kharif crop is
most susceptible to white fly infestation. The population of white fly had a tendency to

Table 2: Overall efficacy of plant extracts and microbial insecticides against *Bemisia tabaci* , and the fruit yield of Ladysfinger

Treatments	Dose ml./litre (%)	Pre treatment observation of w.fly/Leaf	Overall efficacy (% reduction) Days after treatment				Fruit Yield (q/ha)
			3	7	11	Mean	
S. *sponisa* (Spinosad 45 SC)(T_1)	1 ml/3 L	0.83	80.19 (63.62)	70.50 (57.13)	58.71 (50.03)	69.80 (56.92)	40.20
Imidacloprid (Confidor 17.8 S.L.)(T_2)	1 ml/5 L	0.72	85.95 (68.28)	73.36 (58.95)	71.69 (57.89)	77.00 (61.70)	41.17
Pongamia (1.0 %) (T_3)	10.00 (1.0 %)	0.69	43.34 (41.16)	38.48 (38.29)	25.81 (30.50)	35.76 (36.58)	32.90
Pongamia (5.0 %) (T_4)	50.00 (5.0 %)	0.77	54.28 (47.47)	48.36 (44.05)	34.48 (35.93)	45.70 (42.48)	36.13
Polygonum (1.0 %) (T_5)	10.00 (1.0 %)	0.63	49.94 (44.96)	47.39 (43.67)	30.23 (33.50)	42.50 (40.59)	31.49
Polygonum (5.0 %) (T_6)	50.00 (5.0 %)	0.77	62.44 (52.16)	60.07 (50.34)	40.41 (39.46)	54.31 (47.47)	36.53
B.bassiana (Biorin 10^7 conidia/ml) (T_7)	1 ml/L	0.75	46.80 (43.16)	42.30 (40.56)	29.60 (32.85)	39.56 (38.85)	32.51
Untreated Control (T_8)	-	0.83	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	27.08
SE m (±)	-	-	2.14	2.81	1.75	-	1.14
CD at 5 %	-	NS	6.36	8.35	5.21	-	3.87

Figures in parentheses are angular transformed values, NS = Not significant increase with the decrease of relative humidity and rainfall and with increase of maximum temperature. This observation was supported by Watson et al. (1993) and Threhan (1944).The flower extract of *Polygonum* and the microbial toxin *Saccharopolyspora spinosa* gave satisfactory white fly suppression. Based on their moderate to high efficacy levels, as well as low toxicity to natural enemies and human health, we conclude that biopesticides can be incorporated in future IPM programme and organic farming in vegetable cultivation.

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