Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 705-711

Received: 05-09-2020
Accepted: 09-10-2020

Sunil Kumar Ghosh
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Hafijur Rahaman
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Thakoor Pavan
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Rajib Karmakar
Department of Agricultural Chemicals, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Corresponding Author:
Sunil Kumar Ghosh
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Whitefly (*Bemisia tabaci*) and aphid (*Aphis gossypii*) management on lady'sfinger (*Abelmoschus esculentus* L.) by using safe insecticides

Sunil Kumar Ghosh, Hafijur Rahaman, Thakoor Pavan and Rajib Karmakar

DOI: https://doi.org/10.22271/j.ento.2020.v8.i6j.7926

Abstract
Lady'sfinger *Abelmoschus esculentus* (L.) Moench is an annual kharif vegetable crop belongs to the family Malvaceae. This crop is cultivated in various parts of tropical and sub-tropical areas of the world. In West Bengal, India it is cultivated in a commercial scale but its pest complex is very high which limit its production. Contribution of whitefly *(Bemisia tabaci)* and aphid *(Aphis gossypii)* as sucking pest in this case is of great importance. Three doses of dinotefuron 20 SG (@ 20, 30 and 40 a.i. g /ha) two doses of imidacloprid 70 WG (@ 21 and 24.5 a.i. g /ha) and two doses of fipronil 5% SC (@ 25 and 37.5 a.i. g /ha) were applied to control whitefly and aphid. From overall observation it was revealed that dinotefuron 20 SG @ 40 g a.i./ha, fipronil 5% SC @ 37.5 g a.i./ha and imidacloprod 70 WG @ 24.5 g a.i/ha provided best suppression of whitefly (83.46 %, 82.59 % and 68.94 % white fly population suppression respectively) and aphid (79.02 %, 76.96 % and 70.46 % aphid population suppression respectively). These insecticides may be recommended for farmers use to control sucking pest.

Keywords: dinotefuran, fipronil, imidacloprid, persistency, phytotoxicity

1. Introduction
Lady'sfinger *Abelmoschus esculentus* (L.) Moench is an annual kharif vegetable crop belongs to the family Malvaceae and grown in various parts of tropical and sub-tropical areas of the world. In the sub-Himalayan region of north east India lady'sfingers is cultivated at a commercial scale but insect pest damage constitutes a limiting factor in successful production (Ghosh, 2013 [7]; Ghosh, *et al.*, 2013 [18]). Lady'sfinger is infested by a large number of sucking pest *viz.* jassid, thrips, mites, whitefly, aphid etc. Damage caused by whitefly may be directly through phloem feeding, or indirectly by transmission of viruses (Mehta *et al.*, 1994 [20]). White fly was found active throughout the year and highest population (1.66/leaf) on eggplant was recorded on 32nd standard week (Ghosh *et al.*, 2004 [13]; Ghosh, 1999 [5]). Subba *et al*. (2017) [24] reported that the maximum population of whitefly infesting tomato was during 11th - 18th standard week with peak population (0.47/leaf). They also reported that population of white fly on tomato showed non-significant negative correlation (p=0.05) with temperature and weekly total rainfall and significant negative correlation with relative humidity. Ghosh (2014) [8] reported that the *Bemisia tabaci* on lady, sfinger was active throughout the growing period with a peak population (3.98 white fly /leaf). Thakoor *et al.* (2020) [26] reported that highest population of whitefly on lady'sfinger was recorded on 7th standard meteorological week and the population showed positive correlation with temperature maximum and negative correlation with relative humidity. Severe aphid infestations cause stunting, crinkling and curling of leaves, delayed flowering, resulting in yield reduction. Ghosh *et al*. (2004 [14]) reported that *Aphis gossypii* was found active throughout the year on with highest population in August and positively correlated with average temperature, relative humidity and rainfall.
For the effective control of whitefly, aphid in vegetable field farmers usually use a lot of pesticides chemicals indiscriminately and frequently (Ghosh, 1999 [5]). Ghosh *et al*. (2009) [15] reported that imidacloprid was found most effective (91.15 % control) against aphid three days after treatment. Imidacloprid was the most effective in providing more than 80% aphid suppression followed by azadirachtin (Ghosh *et al.*, 2016) [17]. Ghosh (2017) [11] reported that acetamiprid was found highly efficacious against aphid and found to suppress 85.11% aphids

closely followed by *neem* + *Spilanthes* (73.29%). It is reported that maximum reduction of whitefly population was found in imidacloprid treated plot followed by spinosad (Ghosh, 2012) [6]. Das *et al.* (2010) [4] and Ghosh *et al*. (2012) [16] reported that a rapid degradation of persistency was observed in imidacloprid which had a greater importance as fruits and vegetables are consumed after little cooking. Most of the Conventional chemicals *viz*. organochlorines and rganophosphates are broad spectrum, persistent in nature and having long residual action (Subba *et al*., 2017 [24]; Nayar, *et al.*, 1992 [21]). Acharya *et al*. (2002) [2] reported that the efficacy of new molecules like imidacloprid, abamectin were safer to lady bird beetles. The objective of the study was to formulate suitable management of sucking pests of lady'sfinger with the use of some new safe molecules and less harmful to beneficial insects and environment.

2. Materials and Methods

2.1. Period and location of the study

The studies were done at A-B Block Farm of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, West Bengal, India during the year 2018-2019. The geographical position of the areas are 23° N latitude, 89° E longitude and 9.75 meter above mean sea level Priyadarshini *et al.* (2017) [22]. The soil was gangetic alluvial soil (Entisol) with sandy clay loam texture, neutral in reaction with moderate in fertility (Priyadarsini *et al.*, 2019) [23]. The soil type of the experimental field was sandy loam with PH range 5.75 to 6.5 and climate of this zone is subtropical humid having short winter spell during December –January (Bala *et al*., 2015 [3]; Karmakar *et al.*, 2017 [19]). The experimental plot was situated on upland with good irrigation and drainage facility. The soil has good water holding capacity.

2.2. Treatment Details

Treatment details are as follows

Treatment	Dose g or ml. a.i. / ha	Dose (g or ml/ha)	Spray fluid used
T_1: Untreated Control	--	--	500
T_2: Dinotefuron 20 SG	20	100	500
T_3: Dinotefuron 20 SG	30	150	500
T_4: Dinotefuron 20 SG	40	200	500
T_5: Imidacloprid 70WG	21	30	500
T_6: Imidacloprod 70 WG	24.5	35	500
T_7: Fipronil 5% SC	25	500.0	500
T8: Fipronil 5% SC	37.5	750.0	500
T_9: Dinotefuron 20 SG	80	400	500
T_{10}: Imidacloprod 70 WG	49	70	500
T_{11}: Fipronil 5% SC	75	1500	500

* For phytotoxicity study-- T_9, T_{10} and T_{11}

2.3. Lay out of the experiment

Season of experiment : Kharif-2018
Variety of lady'sfinger : Samrat
Date of sowing : 12.07.2018
Plot size : 5m X 5m
Spacing : P-P X R-R = 5 cm X 20 cm
Fertilizers : N: P: K @ 100:60:60
Design of experiment : Randomized Block Design (RBD)
Number of replications : Three
Number of spraying : Two
Application date of spray : First spray: 10.08.2018 and second spray: 25.08.2018
Application method : ASPEE Knapsack Sprayer with hollow cone nozzle
Harvesting : Multiple picking

2.4. Methodology for Bio-efficacy data recording against pests

The data of target pests were recorded from randomly selected five plants in each plot. Observations of total number of whitefly and aphid on lady'sfinger were recorded from five top young leaves of each plant per plot and converted to number of insect pest/leaf. First count was taken one day before first spray and post treatment counts were recorded on 3, 7, 10 and 14 days after each spray. All the observations were recorded with the help of a hand lens (10X). Reduction of insect population in different treatments over control was used as an indicator of insecticidal efficacy which was calculated from the following formula (Abbott, 1925) [1]:

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

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.

2.5. Methodology for phytotoxicity studies

The observations on phyto-toxicity symptoms (*viz*., leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty), if any, on the crop due to application of dinotefuron 20 SG @ 80 g a.i. / ha imidacloprod 70 WG @ 49 g a.i. / ha and fipronil 5% SC @ 75 g a.i. / ha were recorded at 1, 3, 5, 7, 10 & 15 days after first and second spray using the scores shown below.

Rating	Phytotoxicity (%)
0	No phytotoxicity
1	1 – 10
2	11 – 20
3	21 – 30
4	31 – 40
5	41 – 50
6	51 – 60
7	61 – 70
8	71 – 80
9	81 – 90
10	91 – 100

2.6. Yield recording

The yield of marketable fruit was recorded separately for each plot at each plucking. Yield obtained cumulative of all the plucking was converted into t/ha and presented in Table-5. Besides this, Percent (%) increase in yield over control was also calculated using the following formula.

$$\text{Percent (\%) increasein yield} = \frac{T}{C} \times 100$$

Where, T = Yield of respective treatment (t/ha); C = Yield of Control (t/ha)

3. Results and Discussion

Three doses of dinotefuron 20 SG (@ 20, 30 and 40 a.i. g/ha) two doses of imidacloprid 70 WG (@ 21 and 24.5 a.i. g/ha) and two doses of fipronil 5% SC (@ 25 and 37.5 a.i. g/ha) were sprayed to work out their efficacy against whitefly *(Bemisia tabaci)* and aphid *(Aphis gossypii)*. To work out phytotoxicity effect on lady's finger plant high dose of dinotefuron 20 SG (@ 80 a.i. g/ha), imidacloprid 70 WG (@ 49 a.i. g/ha) and fipronil 5% SC (@ 75 a.i. g/ha) were sprayed. Two round spraying has been done where first round was initiated during second week of July and subsequent spraying has been done at 15 days interval. The data on the result of bio-efficacy of insecticides has been presented in table 1-4, yield potentiality in table- 5 and phytotoxicity of insecticides on plant in the table-6.

3.1. Efficacy evaluation of insecticides against whitefly (*Bemisia tabaci*)

Data presented in Table 1 and 2 revealed that, all the insecticide treatments significantly reduced the infestation of whitefly as compared to untreated control (5.32-8.94 whitefly/leaf). From the two round spray it was revealed that dinotefuron 20 SG @ 40 g a.i./ha provided best suppression of whitefly population (first spray 79.46 % and second spray 87.45 % with a mean of 83.46 % suppression) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (first spray 78.13 % and second spray 87.04 % with a mean of 82.59 % suppression) and imidacloprod 70 WG @ 24.5 g a.i/ha (first spray 65.26 % and second spray 72.61 % with a mean of 68.94 % suppression).

Three days after first spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (1.03whitefly/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (1.04 whitefly/L) and imidacloprod 70 WG @ 24.5 g a.i/ha (1.67whitefly/L). There were no significant differences among these three treatments. Similar trend was followed 7 days, 10 days and 14 days after first spraying.

Three days after second spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (0.23 whitefly/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (0.24 whitefly/L) and imidacloprod 70 WG @ 24.5 g a.i/ha (0.67 whitefly/L). There were no significant differences among these three treatments. Similar trend was followed 7 days and 10 days after second spraying. Fourteen days after second spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (0.57 whitefly/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (0.59 whitefly/L). There were no significant differences between these two treatments but significant differences from imidacloprid treatments.

Table 1: Effect of insecticides on the population abundance of whitefly (*Bemisia tabaci*) in lady'sfinger *Kharif*-2018 (1st spray)

Treatments	Dose/ha		Pre-treatment Count (w. fly/L)	Mean no. of whitefly/leaf				Post mean	% reduction over control
				1st Spray					
	(g.or ml a.i.)	Formulation (g or ml)		3 DAS	7 DAS	10 DAS	14 DAS		
T_1: Untreated Control	--	--	4.32	4.78	5.87	6.23	7.35	5.32	0.00
			(2.59)	(2.70)	(2.93)	(3.01)	(3.22)		
T_2: Dinotefuron 20 SG	20	100	4.35	3.45	3.78	3.98	4.02	3.62	32.57
			(2.60)	(2.37)	(2.45)	(2.50)	(2.51)		
T_3: Dinotefuron 20 SG	30	150	4.63	3.12	3.45	3.78	3.95	3.29	42.43
			(2.66)	(2.28)	(2.37)	(2.45)	(2.50)		
T_4: Dinotefuron 20 SG	40	200	4.46	1.03	1.23	1.44	1.67	1.13	79.46
			(2.62)	(1.52)	(1.62)	(1.71)	(1.80)		
T_5: Imidacloprid 70WG	21	30	4.75	3.40	3.67	3.92	4.01	3.54	39.61
			(2.69)	(2.35)	(2.43)	(2.49)	(2.51)		
T_6: Imidacloprod 70 WG	24.5	35	4.13	1.67	1.87	1.94	2.34	1.77	65.26
			(2.54)	(1.80)	(1.88)	(1.90)	(2.04)		
T_7: Fipronil 5% SC	25	500	4.77	3.14	3.47	3.79	3.96	3.31	43.72
			(2.69)	(2.28)	(2.37)	(2.46)	(2.50)		
T_8: Fipronil 5% SC	37.5	750	4.23	1.04	1.24	1.45	1.68	1.14	78.13
			(2.56)	(1.52)	(1.61)	(1.70)	(1.80)		
S Em (±)			--	0.23	0.22	0.21	0.26	--	
C.D (p<0.05)			NS	0.66	0.65	0.59	0.74	--	

Figures in parentheses indicate √X+0.5 transformed value, L=leaf, DAS: Days after spraying

Table 2: Effect of insecticides on the population abundance of whitefly (*Bemisia tabaci*) in lady'sfinger *Kharif*-2018 (2nd Spray)

Treatments	Dose/ha		Pre-treatment Count (w.fly/L)	Mean no. of whitefly/leaf 2nd Spray				Post mean	% reduction over control
	(g.or ml a.i.)	Formulation (g or ml)		3 DAS	7 DAS	10 DAS	14 DAS		
T1: Untreated Control	--	--	4.32	8.43	9.45	10.23	10.67	8.94	0.00
			(2.59)	(3.41)	(3.58)	(3.71)	(3.78)		
T2: Dinotefuron 20 SG	20	100	4.35	2.12	2.34	2.68	3.01	2.23	54.42
			(2.60)	(1.97)	(2.04)	(2.15)	(2.24)		
T3: Dinotefuron 20 SG	30	150	4.63	1.23	1.35	1.68	1.98	1.29	73.17
			(2.66)	(1.62)	(1.67)	(1.81)	(1.92)		
T4: Dinotefuron 20 SG	40	200	4.46	0.23	0.28	0.34	0.57	0.26	87.45
			(2.62)	(0.99)	(1.04)	(1.09)	(1.26)		
T5: Imidacloprid 70WG	21	30	4.75	2.11	2.31	2.62	3.00	2.21	54.72
			(2.69)	(1.96)	(2.03)	(2.13)	(2.24)		
T6: Imidacloprod 70 WG	24.5	35	4.13	0.67	0.89	1.02	1.34	0.78	72.61
			(2.54)	(1.33)	(1.45)	(1.52)	(1.67)		
T7: Fipronil 5% SC	25	500	4.77	1.25	1.35	1.69	2.01	1.30	73.03
			(2.69)	(1.63)	(1.67)	(1.81)	(1.93)		
T8: Fipronil 5% SC	37.5	750	4.23	0.24	0.29	0.36	0.59	0.27	87.04
			(2.56)	(0.99)	(1.04)	(1.10)	(1.27)		
S Em (±)			--	0.20	0.23	0.25	0.24	--	
C.D (p<0.05)			NS	0.54	0.62	0.69	0.68	--	

Figures in parentheses indicate √X+0.5 transformed value, L=leaf, DAS: Days after spraying

3.2. Efficacy evaluation of insecticides against aphid *(Aphis gossypii)*

Data presented in Table 3 and 4 revealed that, all the insecticide treatments significantly reduced the infestation of thrips as compared to untreated control (9.27-16.84 aphid/leaf). From the two round spray it is revealed that dinotefuron 20 SG @ 40 g a.i./ha provided best suppression of thrips population (first spray 87.81 % and second spray 70.22 % with a mean of 79.02 % suppression) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (first spray 83.88 % and second spray 70.04 % with a mean of 76.96 % suppression) and imidacloprod 70 WG @ 24.5 g a.i/ha (first spray 75.91 % and second spray 65.01 % with a mean of 70.46 % suppression).

Three days after first spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (0.82 aphid/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (0.83 aphid/L) and imidacloprod 70 WG @ 24.5 g a.i/ha (1.54aphid/L). There were no significant differences among these three treatments. Similar trend was followed 7 days and 10 days after first spraying. Fourteen days after first spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (2.08 aphid/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (2.10 aphid/L). There were no significant differences between these two treatments. But these two treatment were significant different from imidacloprid treatment.

Three days after second spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (0.58 aphid/L) closely followed by Fipronil 5% SC @ 37.5 g a.i./ha (0.59 aphid/L) and imidacloprod 70 WG @ 24.5 g a.i/ha (0.98 aphid/L). There were no significant differences among these three treatments. Similar trend was followed 7 days and 10 days after second spraying. Fourteen days after second spraying lowest population was recorded in dinotefuron 20 SG @ 40 g a.i./ha treated plot (1.02 aphid/L) closely followed by fipronil 5% SC @ 37.5 g a.i./ha (1.11 aphid/L). There were no significant differences between these two treatments. But these two treatment were significant different from imidacloprid treatment.

Table 3: Effect of insecticides on the population abundance of aphid *(Aphis gossypii)* in lady'sfinger *Kharif*-2018 (1st Spray)

Treatments	Dose/ha		Pre-treatment Count (w.fly/L)	Mean no. of aphid/leaf 1st Spray				Post mean	% reduction over control
	(g.or ml a.i.)	Formulation (g or ml)		3 DAS	7 DAS	10 DAS	14 DAS		
T1: Untreated Control	--	--	8.82	8.98	9.56	12.45	15.32	9.27	0.00
			(3.48)	(3.51)	(3.60)	(4.04)	(4.42)		
T2: Dinotefuron 20 SG	20	100	8.84	3.54	4.13	4.37	5.26	3.83	58.73
			(3.48)	(2.39)	(2.54)	(2.60)	(2.80)		
T3: Dinotefuron 20 SG	30	150	8.76	3.17	3.76	4.15	5.17	3.46	62.39
			(3.47)	(2.29)	(2.45)	(2.55)	(2.78)		
T4: Dinotefuron 20 SG	40	200	8.12	0.82	1.26	1.52	2.08	1.04	87.81
			(3.36)	(1.41)	(1.63)	(1.74)	(1.95)		
T5: Imidacloprid 70WG	21	30	8.83	3.48	4.01	4.31	5.25	3.74	59.65
			(3.48)	(2.38)	(2.51)	(2.59)	(2.80)		
T6: Imidacloprod 70 WG	24.5	35	6.95	1.54	1.98	2.08	2.99	1.76	75.91
			(3.15)	(1.75)	(1.92)	(1.95)	(2.24)		
T7: Fipronil 5% SC	25	500	8.77	3.19	3.78	4.16	5.18	3.49	62.19
			(3.47)	(2.30)	(2.45)	(2.55)	(2.79)		
T8: Fipronil 5% SC	37.5	750	6.21	0.83	1.27	1.53	2.10	1.05	83.88
			(2.99)	(1.41)	(1.63)	(1.74)	(1.95)		
S Em (±)			--	0.25	0.26	0.22	0.28	--	
C.D (p<0.05)			NS	0.73	0.74	0.63	0.77	--	

Figures in parentheses indicate √X+0.5 transformed value, L=leaf, DAS: Days after spraying

Table 4: Effect of insecticides on the population abundance of aphid *(Aphis gossypii)* in ladysfinger *Kharif* (2018, 2nd Spray)

Treatments	Dose/ha		Pre-treatment Count (w.fly/L)	Mean no. of aphid/leaf 2nd Spray				Post mean	% reduction over control
	(g.or ml a.i.)	Formulation (g or ml)		3 DAS	7 DAS	10 DAS	14 DAS		
T1: Untreated Control	--	--	8.82	16.23	17.45	18.23	22.32	16.84	0.00
			(3.48)	(4.54)	(4.69)	(4.78)	(5.23)		
T2: Dinotefuron 20 SG	20	100	8.84	3.64	4.11	4.35	4.76	3.88	32.98
			(3.48)	(2.42)	(2.54)	(2.60)	(2.69)		
T3: Dinotefuron 20 SG	30	150	8.76	3.22	3.68	3.89	4.15	3.45	39.26
			(3.47)	(2.31)	(2.43)	(2.48)	(2.55)		
T4: Dinotefuron 20 SG	40	200	8.12	0.58	0.78	0.92	1.02	0.68	70.22
			(3.36)	(1.27)	(1.39)	(1.47)	(1.52)		
T5: Imidacloprid 70WG	21	30	8.83	3.57	4.01	4.12	4.34	3.79	34.30
			(3.48)	(2.40)	(2.51)	(2.54)	(2.59)		
T6: Imidacloprod 70 WG	24.5	35	6.95	0.98	1.32	1.66	1.98	1.15	65.01
			(3.15)	(1.50)	(1.66)	(1.80)	(1.92)		
T7: Fipronil 5% SC	25	500	8.77	3.25	3.74	3.95	4.22	3.49	38.65
			(3.47)	(2.31)	(2.44)	(2.50)	(2.56)		
T8: Fipronil 5% SC	37.5	750	6.21	0.59	0.79	0.99	1.11	0.69	70.04
			(2.99)	(1.27)	(1.39)	(1.49)	(1.55)		
			0.24	0.24	0.23	0.26	0.28	--	
C.D (p<0.05)			--	0.69	0.67	0.75	0.82	--	

Figures in parentheses indicate √X+0.5 transformed value, L=leaf, DAS: Days after spraying

3.3. Effect of treatments on Yield

The yield of healthy lady'sfinger fruits recorded in different treatments is presented in Table 5. All the insecticidal treatments significantly increased the yield as compared to the control (6.43t/ha in *Kharif* 2018). Dinotefuron 20 SG @ 40 g a.i/ha.gave the maximum yield (10.34 t/ha) and it was at per with dinotefuron 20 SG @ 30 g a.i./ha (9.67 t/ha), fipronil 5% SC @ 37.5g a.i/ha (9.64 t/ha) and imidacloprod 70 WG@ 24.5 g a.i./ha(9.32 t/ha). Yield obtained in other treatments were as follows: fipronil 5% SC @ 25 g a.i/ha.(8.52 t/ha), imidacloprod 70% WG @ 21 g a.i/ha. (8.98 t/ha) and dinotefuron 20 SG @ 20 g a.i./ha (7.65 t/ha).

Table 5: Effects of different treatment on fruit yield, *Kharif*-2018

Treatments	Dose/ha		Yield (t/ha)	
	(g.or ml a.i.)	Formulation (g or ml)	(t/ha)	% yield increase over control
T1: Untreated Control	--	--	6.43	0.00
T2: Dinotefuron 20 SG	20	100	7.65	18.97
T3: Dinotefuron 20 SG	30	150	9.67	50.39
T4: Dinotefuron 20 SG	40	200	10.34	60.81
T5: Imidacloprid 70WG	21	30	8.98	39.66
T6: Imidacloprod 70 WG	24.5	35	9.32	44.95
T7: Fipronil 5% SC	25	500	8.52	32.50
T8: Fipronil 5% SC	37.5	750	9.64	49.92
S Em (±)			0.43	--
C.D (p<0.05)			1.27	--

3.4. Phytotoxicity studies

No phytotoxic symptoms were observed as irrespective doses of different treatments and untreated control in respect of leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty.

Table 6: Evaluation phytotoxicity on ladysfinger during *Kharif*-2018

Sl. No.	Treatments	Leaf injury on tips/ surface	Wilting	Vein clearing	Necrosis	Epinasty	Hyponasty
1	T1: Untreated Control	0	0	0	0	0	0
2	T9: Dinotefuron 20 SG @ 80 g a.i./ha	0	0	0	0	0	0
3	T10: Imidacloprod 70 WG @ 49 g a.i./ha	0	0	0	0	0	0
4	T11: Fipronil 5% SC @ 75 a.i./ha	0	0	0	0	0	0

No phytotoxicity = 0; * Mean observations recorded at 1, 3, 5, 7, 10 and 15 days after each spraying

From overall observation it was found that Dinotefuron 20 SG @ 40 g a.i./ha, Fipronil 5% SC @ 37.5 g a.i./ha and imidacloprod 70 WG @ 24.5 g a.i/ha provided best suppression of whiteflyand aphid population. There were no significant differences among these treatments. These findings were supported by some research works. Thakoor Pavan *et al.* (2019) [25] reported that maximum tomato sucking pest population reduction was found in the imidacloprid. Ghosh and Chakraborty (2015) [12] reported that imidacloprid was found the most effective treatment for controlling lady'sfinger jassids, followed by the microbial insecticide spinosad. Ghosh (2020) [10] reported that fipronil 5% SC @ 37.5 a.i. g/ha recorded 72.14 % and 73.88 % aphid control at one day and three days after spraying respectively which supports the present investigation. Ghosh, (2015) [9] reported that imidacloprid was effective treatment for potato aphid

control followed by plant extract. Das *et al.* (2010) [4] reported that a rapid degradation of persistency was observed in Imidacloprid which had a greater importance as fruits and vegetables are consumed after little cooking. This also supports the present investigation.

4. Conclusion/Recommendation

Dinotefuron 20 SG @ 40 g a.i./ha, Fipronil 5% SC @ 37.5 g a.i./ha and imidacloprod 70 WG @ 24.5 g a.i/ha provided best suppression of whiteflyand aphid population. Dinotefuron 20 SG @ 40 g a.i/ha gave the maximum yield (10.34 t/ha) and it was at par with dinotefuron 20 SG @ 30 g a.i./ha (9.67 t/ha), fipronil 5% SC @ 37.5g a.i/ha (9.64 t/ha) and imidacloprod 70 WG@ 24.5 g a.i./ha(9.32 t/ha). These may be recommended for general farmers use for control of sucking pest of lady'sfinger

5. Acknowledgements

This study was carried out with the support of the Director of research and Department of Agricultural Entomology, BCKV; I thank the Department, and those who have contributed to it.

6. References

1. Abbott WS. A method of computing the effectiveness of an insecticide. Journal of Economic Entomology 1925;18:265-267.
2. Acharya S, Mishra HP, Dash D. Efficacy of insecticides against okra jassid (*Amrasca biguttula biguttula* Ishida). Annals of Plant Protection Science 2002;10(2):230-232.
3. Bala SC, Karmakar K, Ghosh SK. Population dynamics of mite, *Aceria tulipae* Keif on garlic (*Allium sativum* L.) and its management under Bengal basin. International Journal of Science, Environment and Technology 2015;4(5):1365-1372.
4. Das K, Biswas S, Chakraborty G, Ghosh SK. Efficacy of insecticides against Jassid (*Amrasca biguttula biguttuka* Ishida) on okra in terai agro-ecology of West Bengal. Journal of Applied Zoological Research 2010;21(1):33-35.
5. Ghosh SK. Studies on the pest constraints of brinjal/eggplant (*Solanum melongena* L.) and their management under terai region of West Bengal, India. Ph.D. Thesis awarded by BCKV-Agriculture University, West Bengal, India 1999, 43-44.
6. Ghosh SK. Integrated field management of *Bemisia tabaci* infesting ladysfinger. Proceedings of conference on Agriculture, Science and Engineering. Port Harcourt, Nigeria 2012;1(1):118-121. ISBN: 978-84-612-8486-3. Publiser: Rivers State University of Science and Technology, Port Harcourt, Nigeria.
7. Ghosh SK. Harmful effect of insecticides in the population dynamics of spiders on lady'sfingers *Abelmoschus esculentus* (L.) Moench at field level. American-Eurasian Journal of Agricultural & Environmental Sciences 2013;13(9):1181-1186.
8. Ghosh SK. Incidence of *Bemisia tabaci* and their sustainable. Publisers: Johann Heinrich von Thünen Institut RAHMANNG & AKSOYU (Eds.) Building Organic Bridge 2014;2:623-626.
9. Ghosh SK. Integrated field management of aphid (*Myzus persicae* Sulz. And *Aphis gossypii* Glov. Together) on potato (*Solanum tuberosum* L.) using bio-pesticides International Journal of Science, Environment and Technology 2015;4(3):682-689.
10. Ghosh SK. Evaluation of safe insecticides against sucking pests, jassid (*Amrasca bigutula bigutula* Ishida) and aphid (*Aphis gossypii* Glov.) infesting chilli (*Capsicum annum* L.) crop. Journal of Entomology and Zoology studies 2020;8(5):1428-1433.
11. Ghosh SK. Seasonal Incidence of aphid (*Aphis gossypii* Glove.) Infesting tomato (*Lycopersicon esculentum* L.) and their management by using botanical pesticides International Journal of Advances in Science Engineering and Technology 2017;5(3, Spl. Issue-1):14-17.
12. Ghosh SK, Chakraborty K. Integrated field management of jassid (*Amrasca biguttula biguttula* Ishida.) infesting ladys finger *Abelmoschus esculentus* (L.) Moench using bio-pesticides. International Journal of Science, Environment and Technology 2015;4(2):459-467.
13. Ghosh SK, Laskar N, Basak SN, Senapati SK. Seasonal fluctuation of *Bemisia tabaci* on brinjal and evaluation of pesticides. Environment and Ecology 2004;22(4):758-762.
14. Ghosh SK, Laskar N, Senapati SK. Seasonal fluctuation of *Aphis gossypii* Glov on brinjal/eggplant and field evaluation of pesticides from different origin against *A. gossypii* under tcrai region. Indian Journal of Agriculture Research 2004;38(3):171-177.
15. Ghosh SK, Mahapatra GSS, Chakraborty G. Field efficacy of plant extracts and microbial insecticides against aphid (*Aphis gossypii*) infesting okra (*Abelmoschus esculentus*). Redia, Itali XC11 2009, 249-252. (with sub-title Journal of Entomology).
16. Ghosh SK, Mandal T, Biswas S, Chakraborty K. Field evaluation of cultivars and bio-efficacy of insecticides against pest complex of ladysfinger (*Abelmoschus esculentus* L.). Journal of Applied Zoological Research 2012;23(2):121-128.
17. Ghosh SK, Mandol T, Chakraborty K. Population fluctuation of aphid (*Aphis craccivora Koch*.) infesting Som plant leaves (*Machilus bombycina* King..) and its management. Journal of Entomological Research 2016;40(3):235-241.
18. Ghosh SK, Mandal T, Chakraborty K. Efficacy of chemical insecticides and neem oil against white fly (*Bemisia tabaci* Genn.) Infesting ladysfinger (*Abelmoschus esculentus* L.). International Journal of Bio-resource and Stress Management 2013;4(2):special348-351.
19. Karmakar K, Bala SC, Ghosh SK. Population dynamics of sheath mite *(Stenotarsonemus spinki*) Infesting rice cultivar IET-4786 and its management under Gangetic basin of West Bengal. Journal of Entomology and Zoology Studies 2017;5(4):663-666.
20. Mehta P, Wyman JA, Nakhla MK, Maxwell DP. Transmission of tomato yellow leaf curl *Gemini virus* by *Bemisia tabaci*. Journal of Economic Entomology 1994;87:1291-1297.
21. Nayar KK, Ananthakrishnan TN, David BV. General and Applied Entomology 1992, 430-431.
22. Priyadarshini S, Pal S, Ghosh SK. Field screening of chilli cultivars against thrips (*Scirtothrips dorsalis* Hood.) and its management under West Bengal condition. Journal of Entomology and Zoology Studies 2017;5(6):2106-2110.
23. Priyadarshini S, Ghosh SK, Nayak AK. Field screening of different chilli cultivars against important sucking pests of chilli in West Bengal. Bulletin of Environment,

Pharmacology and Life Sciences 2019;8(7):134-140.
24. Subba B, Pal S, Mandal T, Ghosh SK. Population dynamics of white fly (*Bemisia tabaci* Genn.) Infesting tomato (*Lycopersicon esculentum* L.) and their sustainable management using bio-pesticides. Journal of Entomology and Zoology Studies 2017;5(3):879-883.
25. Thakoor P, Ghosh SK, Nihal R, Ramya Sri N. Effect of abiotic factors on seasonal incidence and bio-efficacy of some newer insecticides against aphid (*Aphis gossypii*) in tomato (*Abelmoschus esculentus*). Journal of Entomology and Zoology Studies 2019;7(3):513-516.
26. Thakoor P, Ghosh SK, Bala SC. Effect of abiotic factors on seasonal incidence and bio-efficacy of some newer insecticides against white fly (*Bemisia tabaci*) on tomato crop (*Solanum lycopersicon* L) in West Bengal. Journal of Entomology and Zoology Studies 2020;8(3):267-271.