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Efficacy of some novel insecticides against vector white fly of yellow vein mosaic disease in Okra (*Abelmoschus esculentus* L. Moench)

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Abstract

A field experiment was conducted at Agricultural Farm of Palli-Siksha Bhavan (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal during kharif season, 2018 with some chemicals, novel compounds and botanicals to evaluate their efficacy against vector whitefly (*Bemisia tabaci* G.). Lowest disease incidence and whitefly population was recorded in Emmamectin benzoate 5SG @ 1ml/lit followed by Thiamethoxam 25WG @ 2gm/5lit, Imidacloprid 70WG @ 2ml/5lt, Acetamiprid 20SP @ 1ml/lit and Cypermethrin 10EC @ 1ml/5lit. Among ten insecticidal treatments including control, T4 (Emmamectin benzoate 5SG) gave highest fruit yield (77.90 qt/ha) followed by T5 (Thiamethoxam 25WG) 67.09q/ha and T7 (Imidacloprid 17.5SL) 59.19q/ha. While the lowest yield 19.58q/ha was recorded from control plot (T10) followed by treatment T1 (Chlorpyrifos 20EC) 26.36qt/ha. Benefit cost ratio was evaluated maximum in Emmamectin benzoate 5SG (1.81) followed by Thiamethoxam 25WG (1.55).

Keywords: Yellow vein mosaic disease (YVMD), Yellow vein mosaic virus (YVMV), Novel insecticides, *Bemisia tabaci*, Okra

1. Introduction

Among all vegetables okra is one of the popular vegetable in India. Okra is rich in iron content and nutritive value. Okra (*Abelmoschus esculentus* L. Moench) is the member of Malvaceae and known as Lady's finger. It is locally known as "dherosh" or "bhindi". It is an annual vegetable crop grown from seed in tropical and sub-tropical parts of the world. Okra is probably originated in tropical Africa or possibly in tropical Asia, and is now widely grown throughout the tropics. The crop is well distributed throughout the Indian subcontinent and East Asia (Rashid, 1999) [3]. It is widely cultivated as a summer season crop in North India and as a Kharif and summer season crop in Maharashtra, West Bengal, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu. It grows well in the areas where day temperature remain between 25 to 40 °C and that of night over 22 °C. West Bengal is the largest okra producing state. The state produces about 0.88 metric tonne of okra from an area of 0.08m.ha. With productivity of 11.7tonne/ha. The major okra growing belts in the state are Nadia, Murshidabad, North and South 24 Parganas and Bardhaman. Okra infected with YVMV has been reported in Asia in Bangladesh, India and China (Kulkarni 1924; Tsai *et al.*, 2013). First time this disease is reported before 86 years by Kulkarni (1924) in Mumbai, Maharashtra. It had appeared in epidemic form for first time in Maharashtra in 1950 (Capoor and Varma, 1950) [17]. The main symptom of the disease in bhendi is vein clearing followed by veinal chlorosis of the leaves. The yellow network of vein is very conspicuous and the vein and veinlets become thick. In severe case, the chlorosis may extend to interveinal areas and may result in the complete yellowing of leaves. Fruits are dwarfed, malformed and are yellowish green in color. Capoor and Verma (1950) [17] had shown that the virus isn't sap-transmissible but under artificial conditions, it can be transmitted by grafting. The vector transmitting the okra yellow vein mosaic virus is *Bemisia tabaci* Gennand the okra leaf hopper (*Empoasca devastans*). The whitefly-transmitted virus species, 90% belong to the Begomovirus genus (Jones 2003) and family Geminiviridae. The virus persists in female whiteflies throughout their life if the insects are allowed to feed on diseased plants for 4-6 hours (Verma, 1995).

During kharif 2018, okra crop from the field of Department of Agronomy, Visva-Bharati University, Santiniketan was found suffered from yellow vein mosaic disease. Also in nearby villages wherever okra was grown, the crop was found affected with this disease. In order to find out an effective management practice through various novel insecticides was under taken in this investigation.

2. Materials and Methods

Field experiment for management of YVMV of okra was conducted at Agricultural Farm of Palli-Siksha Bhavan (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal during kharif season, 2018. Experiment was set up to find out the effectiveness of nine treatments (soft novel

insecticides, new generation insecticides and botanicals) along with untreated(control) (Table-1) in Randomized Block Design (RBD) with three replicates. Okra variety "Japanese jahar" were transplanted on 5th August 2018. The spacing between plant to plant and row to row was kept 35cm and 50cm respectively. Normal fertilizer doses and recommended agronomical practices were adopted. All insecticides under study were applied as foliar spray using manual hand sprayer. To determine the efficacy of chemicals total three sprays of insecticides on okra crop were done. Suspensions were prepared by dissolving specific amount of chemicals in required quantity of plain water. Spray initiated at 60DAS and subsequently another 2sprays were given at 75DAS and 90DAS at 15days intervals.

Table 1: Details of insecticidal treatments

SL. No.	Treatments	Field doses	Source
1	Chlorpyrifos 20EC	2.5ml/lit	Excel Crop Core Limited
2	Cypermethrin 10EC	1ml/5lit	Krusha crop science
3	Alphamethrin 10EC	1ml/lit	National pesticides and chemicals
4	Emamectin Benzoate 5SG	1ml/lit	Agrolife Science Corporation
5	Thiamethoxam 25WG	2gm/5lit	Dhanuka Agritech Limited
6	Acetamiprid 20SP	1ml/lit	Agro life science corporation
7	Imidacloprid 70WG	2ml/5lit	Willwood Crop Sciences Pvt. Ltd.
8	Neem oil 0.03EC	1ml/lit	Multiplex Agricare Pvt. Ltd.
9	Dimethoate 30EC	1ml/lit	Rallis India Limited
10	Control		

2.1 Procedure of data collection

To study the incidence pattern of YVMV, numbers of infected plants at 5 days interval from 30 days after sowing were recorded and percentage of infected plants was worked out. Per cent disease incidence (PDI) was calculated using following formula.

$$\text{PDI (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plant observed}}$$

2.1.1 Total number of Plant observed

Whitefly population was recorded during the crop growing period by counting the number of whiteflies from bottom, middle and top leaves of five randomly selected plants from each plot. Observations were recorded early in the morning from 6:30am to 7:30am at an interval of five days throughout the season. The average numbers of whiteflies per plant were worked out.

Tender okra fruits were harvested from 58DAS at an interval of four days after first picking. Numbers of fruits, weight of fruits from selected plants and per plot fruits weight were recorded in each treatment. The yield data was computed and analyzed statistically. Cumulative yield of each picking was converted into q/ha along with increase in yield. Cost benefit ratio, net return per rupees invested, was calculated by using the following formula-

$$\text{Cost: benefit ratio} = \frac{\text{Cost of increased yield (Rs/ha)}}{\text{Cost of treatment (Rs/ha)}}$$

2.2 Statistical analysis

To find out the best effective treatment in terms of PDI and whitefly population analysis of variance (ANOVA) was done in randomized block design. Square root transformation and angular transformation were done for number and per cent data respectively.

The results obtained during present investigation were analyzed statistically at 1% & 5% level of significance, following standard statistical method (Raghava Rao, 1983 and Gomez, 1984).

3. Results and Discussion

3.1 Efficacy of different insecticidal treatments against whitefly, *Bemisia tabaci* in relation with PDI of YVMD of okra

Incidence of yellow vein mosaic disease and whitefly population in okra throughout the crop growing period and the data on yellow vein mosaic disease incidence (Table-2 & Fig.1) and whitefly population per plant are depicted in (Table-3 & Fig-2). Pre-treatment observations recorded ten hours before spraying that is at morning 6-7 am.

At 45 days after sowing first spray was done and after fifth day of first spray(50DAS) the minimum population (1.2 whiteflies/plant) and minimum disease incidence 3.92 was recorded in the treatment emamectin benzoate 5% SG. It was followed by thiamethoxam 25% WG, imidacloprid 17.8 SL showing 1.27 whiteflies/plant, 1.67 whiteflies/plant and 3.97, 6.05 PDI respectively at 50DAS. Dimethoate 30EC showed 3.67 whiteflies/plant, 9.52 PDI and chlorpyrifos 20EC showed 3.8 whiteflies/plant, 9.80PDI. Maximum whitefly population (5.53 whiteflies/plant) and per cent disease incidence (13.82) was recorded in control plot.

10th day after first spray (i.e. 55DAS), the whitefly population decreased slightly in all treatments with exception in control and ranged from 0.87 to 3.67 whiteflies/plant. Among all the treatments, emamectin benzoate 5SG and thiamethoxam 25WG both showed minimum population of 0.87 whiteflies/plant and 4.04 PDI & 4.94 PDI respectively. The next treatments in order were imidacloprid 17.8SL and acetamiprid which recorded 1.47 & 1.53 whiteflies/plant and 6.79 PDI & 7.03 PDI respectively and significantly superior over rest of the treatments in respect of reducing whiteflies

population. The maximum population (5.73 whiteflies/plant) and 16.82 PDI was recorded in control plot.

The population of whitefly increased slightly in all the treatments on 15days after first application (i.e. 60DAS) except emamectin benzoate. The minimum whitefly population (0.87 whiteflies/plant) was again recorded with emamectin benzoate 5SG and 0.93 whiteflies/plant with thiamethoxam 25WG, these two insecticides were significantly superior over rest of the treatments. It was noticed that the PDI gradually increased at each observation. Minimum PDI also recorded with emamectin benzoate 5SG and thiamethoxam 25WG (4.75 & 5.91) respectively. The highest whitefly population and PDI was recorded in control plot 4.93 whiteflies/plant, 17.96PDI respectively.

Almost same trend of whitefly population and PDI was recorded on 5th, 10th, 15th day after the second and third spray (Table 2&3). The order of effectiveness of these treatments was emamectin benzoate > thiamethoxam > imidacloprid > acetamiprid > cypermethrin > alphamethrin > neem oil > dimethoate > chlorpyrifos.

The data revealed that 5th day after third application (80 DAS), 0.33 whitefly population and 7.53 PDI was recorded in emamectin benzoate 5SG treated plots and it was found best among all treatments (Table 3). The other treatments in order were thiamethoxam 25WG and imidacloprid 17.8SL which recorded 0.53 & 1.2 whitefly/plant and 8.17 PDI & 14.58 PDI respectively. The maximum population (5 whiteflies/plant) and 25.65 PDI was recorded in control plot.

Tenth day of third application (85 DAS), the treatment emamectin benzoate 5SG again proved the most effective treatment with minimum population 0.2 whiteflies/plant & 8.40PDI and it was followed by thiamethoxam 25WG, imidacloprid 17.8SL and acetamiprid 20SP where whitefly population ranged from 0.67 to 1.33 whiteflies/plant and PDI ranged from 9.27 to 17.40. The maximum population 4.73 whiteflies/plant and 27.93PDI was recorded in control plot.

Observations recorded on 15th day after third application (90 DAS) revealed that the lowest population (0.2 whiteflies/plant) and 9.07PDI was recorded with emamectin benzoate 5SG and again it was significantly superior over rest of the treatments. The maximum whitefly population 4.67 whiteflies/plant was recorded in control plot. Again the order of effectiveness of these treatments remained same that is emamectin benzoate > thiamethoxam > imidacloprid > acetamiprid > cypermethrin > alphamethrin > neem oil > dimethoate > chlorpyrifos.

It is evident from the above findings that all the treatments were effective in reducing whitefly population at different intervals after each spray in comparison to untreated plot. The most effective treatment was emamectin benzoate 5SG followed by thiamethoxam 25WG for the present study for reducing whitefly population and minimum PDI.

Researchers also reported that imidacloprid could effectively control whitefly population as well as restrict the yellow mosaic incidence which also supported the present findings (Ali, *et al.*, 2012; Ansar *et al.* 2013) [3].

Table 2: Percent Disease Index (PDI) for Yellow Vein Mosaic Disease of Okra at different days after sowing (DAS) in insecticidal treatment

Treatments	45DAS	50DAS	55DAS	60DAS	65DAS	70DAS	75DAS	80DAS	85DAS	90DAS
T1 Chlorpyrifos 20EC	*3.64 **(11.00)	9.80 (18.18)	14.27 (22.09)	16.1 (23.51)	16.83 (24.15)	17.53 (24.48)	19.20 (25.83)	20.76 (27.05)	23.4 (28.89)	26.51 (30.96)
T2 Cypermethrin 10EC	2.81 (9.60)	7.21 (15.57)	8.30 (16.70)	10.77 (19.11)	11.52 (19.84)	12.72 (20.88)	14.66 (22.46)	15.84 (23.32)	17.67 (24.82)	19.72 (26.26)
T3 Alphamethrin 10EC	3.41 (10.57)	7.81 (16.17)	8.89 (17.26)	12.12 (20.09)	13.12 (21.06)	14.04 (21.94)	16.04 (23.51)	16.49 (23.81)	21.6 (27.56)	24.32 (29.49)
T4 Emamectin Benzoate 5SG	3.17 (10.22)	3.92 (11.39)	4.04 (11.42)	4.33 (11.95)	4.75 (12.53)	6.08 (14.27)	6.6 (14.85)	7.53 (15.86)	8.40 (16.80)	9.07 (17.26)
T5 Thiamethoxam 25WG	3.18 (10.25)	3.97 (11.48)	4.94 (12.81)	4.94 (12.84)	5.91 (14.07)	6.81 (15.05)	6.84 (15.13)	8.17 (16.49)	9.27 (17.56)	9.91 (18.15)
T6 Acetamiprid 20SP	4.44 (12.15)	6.56 (14.83)	7.03 (15.37)	9.4 (17.66)	10.53 (18.73)	11.97 (20.09)	14.31 (22.05)	16.09 (23.53)	17.40 (24.61)	19.68 (26.20)
T7 Imidacloprid 70WG	4.57 (12.33)	6.05 (14.13)	6.79 (15.01)	9.29 (17.64)	10.39 (18.73)	11.59 (19.90)	12.7 (20.80)	14.58 (22.32)	15.22 (22.82)	16.14 (23.55)
T8 Neem oil 0.03EC	3.46 (10.66)	8.14 (16.53)	9.57 (17.91)	12.24 (20.43)	13.06 (21.14)	14.61 (22.40)	16.02 (23.51)	18.34 (25.30)	22.05 (27.95)	25.59 (30.37)
T9 Dimethoate 30EC	3.58 (10.82)	9.52 (17.74)	11.49 (19.66)	13.64 (21.54)	14.75 (22.53)	15.56 (23.17)	18.97 (25.74)	19.97 (26.46)	22.49 (28.24)	25.61 (30.23)
T10 Control	4.05 (11.58)	13.82 (21.77)	16.82 (24.17)	17.96 (25.04)	19.96 (26.47)	22.02 (27.83)	24.50 (29.61)	25.65 (30.37)	27.93 (31.71)	31.82 (34.24)
SE m	0.82	1.15	1.21	1.53	1.43	1.57	1.59	1.78	1.97	2.12
CD at 1%	2.38 (NS)	3.32	3.50	4.42	4.14	4.53	4.60	5.15	5.70	6.14

DAS= Days after sowing, Average of three replications, **Figure in parenthesis are agcsign transformed values

Table 3: Number of whitefly per plant at different days after sowing (DAS) in insecticidal treatment.

Treatments	45DAS (1 st spraying)	50DAS	55DAS	60DAS (2 nd spraying)	65DAS	70DAS	75DAS (3 rd spraying)	80DAS	85DAS	90DAS
T1 Chlorpyrifos 20EC	*4.67 **(2.26)	3.8 (2.06)	3.67 (2.02)	3.87 (2.08)	3.27 (1.93)	3.87 (2.09)	3.67 (2.04)	2.6 (1.74)	2.73 (1.79)	2.8 (1.81)
T2 Cypermethrin 10EC	4.13 (2.12)	2.13 (1.62)	1.8 (1.52)	1.93 (1.56)	1.6 (1.44)	2 (1.58)	1.87 (1.54)	1.53 (1.42)	1.67 (1.47)	1.8 (1.52)
T3 Alphamethrin 10EC	4.13 (2.15)	2.53 (1.74)	1.87 (1.54)	2.27 (1.66)	2.13 (1.62)	2.33 (1.68)	2.33 (1.68)	1.73 (1.49)	1.73 (1.49)	1.87 (1.53)
T4 Emamectin Benzoate 5SG	4.53 (2.24)	1.2 (1.30)	0.87 (1.17)	0.87 (1.17)	0.67 (1.08)	0.6 (1.05)	0.67 (1.07)	0.33 (0.91)	0.2 (0.84)	0.2 (0.84)

T5 Thiamethoxam 25WG	4.33 (2.20)	1.27 (1.32)	0.87 (1.17)	0.93 (1.19)	0.8 (1.14)	1.13 (1.28)	1.6 (1.43)	0.53 (1.01)	0.67 (1.08)	0.67 (1.07)
T6 Acetamiprid 20SP	4.13 (2.11)	1.93 (1.56)	1.53 (1.43)	1.87 (1.53)	1.47 (1.40)	1.73 (1.49)	1.8 (1.50)	1.27 (1.32)	1.33 (1.35)	1.53 (1.42)
T7 Imidacloprid 70WG	4.53 (2.24)	1.67 (1.47)	1.47 (1.40)	1.67 (1.47)	1.4 (1.38)	1.67 (1.47)	1.73 (1.48)	1.2 (1.30)	1.27 (1.32)	1.47 (1.40)
T8 Neem oil 0.03EC	4.27 (2.18)	2.93 (1.85)	2.47 (1.72)	2.67 (1.78)	2.27 (1.66)	2.53 (1.74)	2.87 (1.83)	2.07 (1.60)	2.27 (1.66)	2.4 (1.70)
T9 Dimethoate 30EC	4.2 (2.17)	3.67 (2.04)	3.3 (1.91)	3.27 (1.92)	3.13 (1.90)	3.53 (1.95)	3.6 (2.02)	2.47 (1.72)	2.6 (1.72)	2.73 (1.76)
T10 Control	4.53 (2.20)	5.53 (2.41)	5.73 (2.49)	4.93 (2.31)	5.07 (2.29)	5.8 (2.48)	5.2 (2.31)	5 (2.33)	4.73 (2.24)	4.67 (2.23)
SE m	0.19	0.12	0.12	0.12	0.14	0.16	0.16	0.11	0.16	0.13
CD at 1%	0.56(NS)	0.36	0.35	0.35	0.40	0.45	0.45	0.30	0.45	0.38

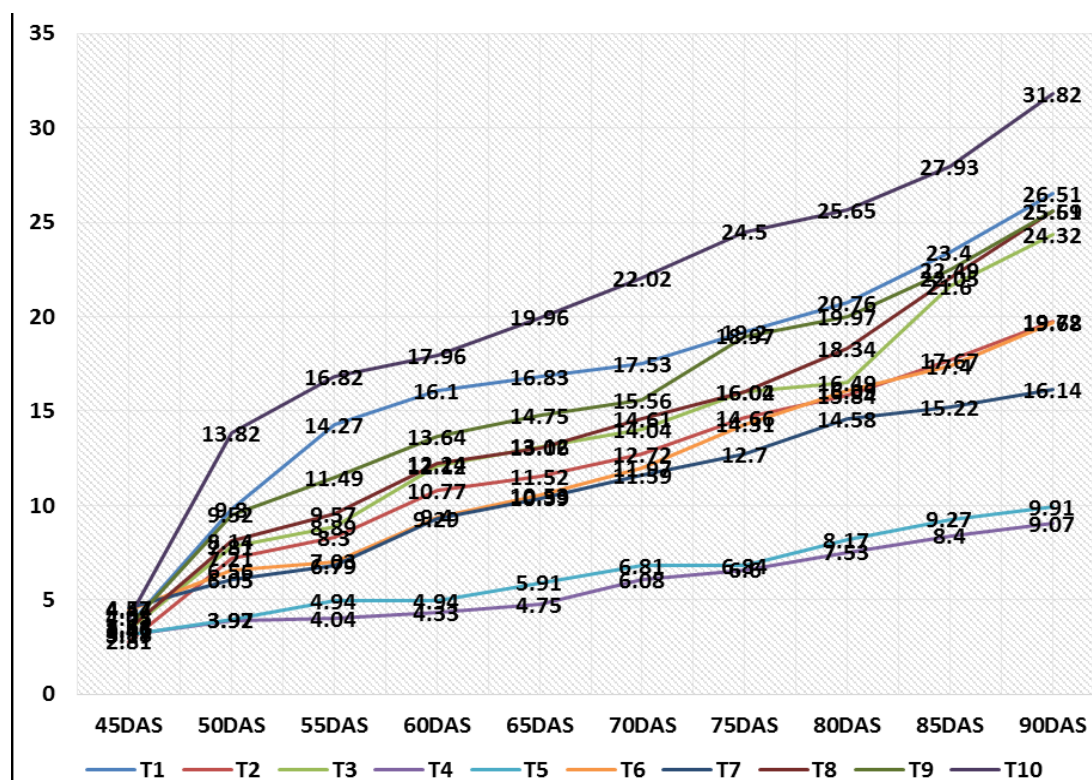


Fig 1: PDI for yellow vein disease of okra in insecticidal treatments

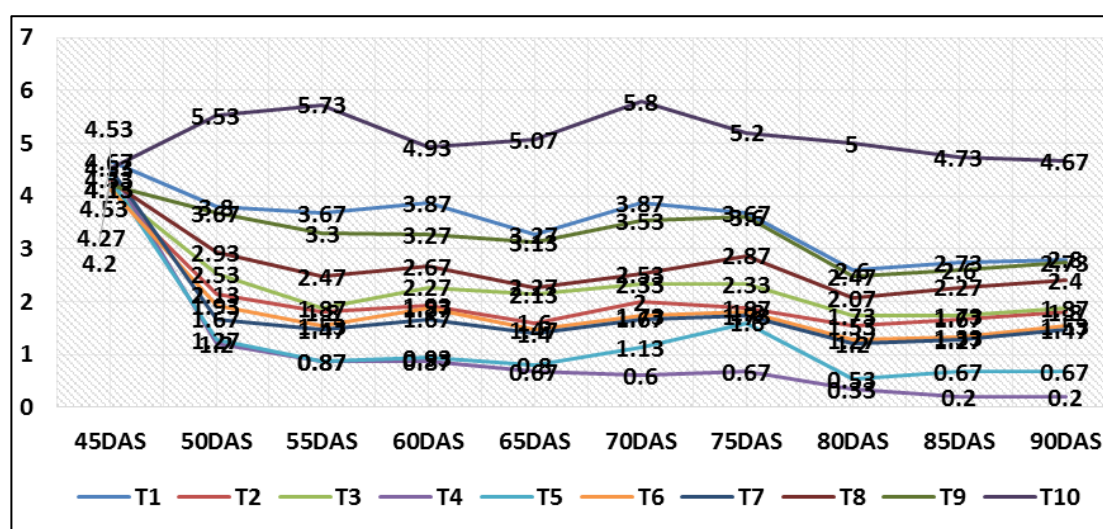


Fig 2: No. of whitefly per plant at different growth stages of crop in insecticidal treatments

3.2 Correlation between whitefly population and PDI

The correlation between whitefly population and disease incidence was presented in (Table- 4). Overall whitefly population and yellow vein mosaic virus disease incidence

were found to be positively correlated in kharif season. Correlation between whitefly population and PDI is highly significant from 55DAS to 90DAS. The correlation was found non-significant i.e. 0.16609 at 50 days after sowing. The

correlation was found minimum *i.e.* 0.89217 at 90 days after sowing and reached peak value *i.e.* 0.98012 at 55 days after sowing.

Table 4: Correlation between whitefly population and PDI

50DAS	0.16609(NS)
55DAS	0.98012**
60DAS	0.91617**
65DAS	0.97254**
70DAS	0.95966**
75DAS	0.94521**
80DAS	0.92580**
85DAS	0.89627**
90DAS	0.89217**

**1% level of significance

3.3 Effect of insecticidal treatments on yield and benefit cost ratio: Among all the treatments Emmamectin benzoate

5SG recorded significantly highest yield (77.90q/ha) with highest per cent increase (193.08) in yield followed by Thiamethoxam 25WG (67.09q/ha and 152.41% increase in yield) and Imidacloprid 17.5SL (59.19q/ha and 122.69% increase in yield). While the lowest yield (19.58 q/ha) was recorded from control plot (Table-5).

Benefit cost ratio of the treatments showed that emmamectin benzoate 5SG ranked first indicating maximum 1.81 followed by thiamethoxam 25WG, Imidacloprid 70WG and Acetamiprid 20SP with 1.55, 1.20 and 0.92 benefit cost ratio respectively. The lowest benefit cost ratio (0.12) was obtained in chlorpyrifos 20EC followed by Dimethoate 30EC (0.22) and Neem oil 0.03EC (0.36). In control plot least benefit cost ratio was obtained (0.02). Though the applications of emmamectin benzoate and thiamethoxam found effective against whitefly control as compared to other treatments, they showed high benefit- cost ratio (Table-7) (Fixed cost calculation has shown in Table-6).

Table 5: Effect of treatments on yield.

Treatments no.	Treatments	Doses	Mean(q/ha)	Per cent Increase in Yield
T1	Chlorpyrifos 20EC	2.5ml/lt	29.36	10.46
T2	Cypermethrin 10EC	1ml/5lit	45.26	70.28
T3	Alphamethrin 10EC	1ml/lt	40.81	53.54
T4	Emmamectin Benzoate 5SG	1ml/lit	77.90	193.08
T5	Thiamethoxam 25WG	2gm/5lit	67.09	152.41
T6	Acetamiprid 20SP	1ml/lt	50.93	91.61
T7	Imidacloprid 70WG	2ml/5lt	59.19	122.69
T8	Neem oil 0.03EC	1ml/lt	35.64	34.08
T9	Dimethoate 30EC		31.83	19.75
T10	Control		26.58	
SE m	-		5.05	
CD at 1%	-		14.60	

Table 6: Fixed cost of cultivation

Common cost of cultivation	Rupees/ha
Field preparation(5hr @Rs.1000/hr)	5000
Layout (25man days @Rs.250/man day)	6,500
Sowing(25 man days @ Rs.250/manday)	6,500
Seed(6kg @Rs. 950)	5700
Fertilizer (NPK 110:60:60)	
a) Urea260kg @Rs. 6/kg	1560
b) SSP200kg @ Rs. 8.5kg/ha	1700
c) MOP 60kg @ Rs. 24/kg	1440
Intercultural operations (including spraying) (20 mandays @ 250Rs./ha)	5000
Irrigation(Rs. 200/ irrigation/ha, 3 irrigation)	600
Harvesting (20 man days @ Rs. 250/ mandays)	5000
Total common cost	39000

Table 7: Economics of different treatment against whitefly

Treatments	Yield (qt/ha)	Value of yield (Gross return) (Rs./ha)	Total cost of treatment application (Rs./ha)	Total cost of cultivation (fixed cost of treatment)	Net return (Gross return – total cost of cultivation) (Rs./ha)	Benefit:cost ratio
T1	29.36	44,040	350	39,350	4,690	0.12
T2	45.26	67,890	40.6	39,040.6	28,849.4	0.74
T3	40.81	61,215	332.5	39,332.5	21,882.5	0.56
T4	77.9	1,16,850	2590	41,590	75,260	1.81
T5	67.09	1,00,635	514.8	39,514.8	61,120.2	1.55
T6	50.93	76,395	875	39,875	36,520	0.92
T7	59.19	88,785	1287	40,287	48,498	1.20
T8	35.64	53,460	227.5	39,227.5	14,232.5	0.36
T9	31.83	47,745	245	39,245	8,500	0.22
T10	26.58	39,870	0	39,000	870	0.02

4. References

1. Adiroubane D, Letachoumanane S. Field efficacy of botanical extracts for controlling major pests of okra. *Indian J Agric. Sci.* 1998; 68:168-70.
2. Ahmed NE, Kanan HO, Sugimoto Y, Ma YQ, Inanaga S. Effect of imidacloprid on incidence of Tomato yellow leaf curl virus. *Plant Disease.* 2001; 85:84-87.
3. Ali MI, Khan MA, Rashid A, Ehetisham-ul-Haq M, Javed MT, Sajid M. Epidemiology of Okra Yellow Vein Mosaic Virus (OYVMV) and Its Management through Tracer, Mycotal and Imidacloprid. *American Journal of Plan Sciences.* 2012; 3:1741-1745.
4. Ali S, Khan MA, Habib A, Rasheed S, Iftikhar Y. Management of yellow vein mosaic disease of okra through pesticide/bio-pesticide and suitable cultivars. *International Journal of Agriculture and Biology.* 2005b; 7:145-147.
5. Bhagat AP, Yadav BI, Prasad Y. Management of Bhindi Yellow Vein Mosaic Virus Disease by Insecticides. *Journal of Mycology and Plant Pathology.* 1997; 27:215-216.
6. Chaudhary A, Khan M, Bilal Y. Management of Okra Yellow Vein Mosaic Virus and its Vector through Plant Extracts. *Journal of Plant Pathology & Microbiology.* 2016; 8:1-3.
7. Dahal G, Neupane FP, Boral DR. Effect of planting and imidacloprid and spread of yellow vein mosaic of okra in Nepal. *International Journal of Tropical Plant Diseases.* 1992; 10(1):109-124.
8. Goswami SP, Pussio GB, Khaskheli MI. Effect of okra yellow vein mosaic virus (OYVMV) on growth and yield. *Journal of Basic & Applied Sciences.* 2017; 13:1-7.
9. Gowdar SB, Ramesh Babu HN, Aswathanarayana Reddy N. Efficacy of insecticides on Okra Yellow Vein Mosaic Virus and Whitefly Vector, *Bemisia tabaci* (Guenn.). *Ann. Pl. Protec. Sci.* 2007; 15(1):116-119.
10. Jambhulkar PP, Singh V, Babu RS, Yadav RK. Insecticides and bioproducts against whitefly population and incidence of yellow vein mosaic virus in Okra Indian *Journal of Plant Protection.* 2013; 41(3):253-256.
11. Sastry KSM, Singh SJ, "Effect of Yellow Vein Mosaic Virus Infection on Growth and Yield of Okra Crop," *Indian Phytopathology.* 1974; 27(3):294-297.
12. Kumar A, Sachan SK, Kumar S, Kumar P. Efficacy of novel insecticide against whitefly in brinjal. *Journal of Entomology and Zoology Studies.* 2017; 5(3):424-427.
13. Muqit A, Khalequzzaman KM, Muzahid-E-Rahman M. Efficacy of imidacloprid and thiamethoxam for the management of yellow mosaic disease of okra. *Int. J Sustain. Crop Prod.* 2016; 11(1):1-3.
14. Shastri KSM, Singh SJ. Effect of yellow vein mosaic virus infection on growth and yield of okra crop. *Indian Phytopathology.* 1974; 27:294-297.
15. Sarabani D, Nath PS. Management of yellow vein mosaic disease of okra through insecticides, plant products and suitable varieties. *Ann Plant Prot Sci.* 2002; 10:340-342.
16. Shastri KSM, Singh SJ. Restriction of Yellow Vein Mosaic Virus Spread in Okra through the Control of Vector Whitefly (*Bemisia tabaci*). *Indian Journal of Mycology and Plant Pathology.* 1931; 3:76-80.
17. Varma PM. Studies on the relationship of bhindi yellow vein mosaic virus and its vector, the whitefly (*Bemisia tabaci*). *Indian Journal of Agriculture Science.* 1952; 22:75-91.
18. Venkataravanappa V. Molecular characterization of okra yellow vein mosaic virus. Ph D. thesis, GKVK, Bangalore, 2008.
19. Verma J, Dubey NK. Prospective of botanical and microbial products as pesticides of tomorrow. *Curr Sci.* 1999; 76:172-179.