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Evaluation of agropesticides and botanicals for management of yellow vein mosaic virus disease of okra [*Abulmoschus esculentus* (L.) Moceh.] in Mewar region of Udaipur, Rajasthan

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ABSTRACT

The yellow vein mosaic virus (YVMV) disease of okra [*Abulmoschuse sculentus* (Linnaeus) Moench.] caused by virus is a common and highly destructive disease in Mewar region of Rajasthan. The experiments were conducted under field condition to develop the effective, safe and economical management strategies through evaluation of agro-insecticides and botanicals. Among insecticides and botanicals evaluated, two foliar sprays of Imidacloprid 17.8 per cent SL and two sprays Azadirachtin were found effective against YVMV disease of okra. Maximum per cent efficacy of disease control (77.6 %) and per cent increase in yield (70.37 %) was recorded when plant were sprayed with Imidacloprid 17.8 per cent SL twice followed by two sprays of Azadirachtin 1500 ppm which was followed by two sprays of Imidacloprid and two sprays of Karanj oil 77.7 per cent and 63.31 per cent increase in fruit yields. All insecticides and botanicals alone or in their combinations increased the fruit yield. However, maximum increase was observed by two sprays of Imidacloprid and two sprays of Azadirachtin, where increase was 79.30 per cent (2011) and 72.60 (2012) as compared to other treatments including untreated control. The minimum white fly population 2.9/plant (2011) and 2.4/plant (2012) was recorded when plant were sprayed with Imidacloprid plus Azadirachtin followed by 2.8/plant (2011) and 3.6/plant (2012) white fly population was recorded when crop was sprayed with Imidacloprid plus Karanj oil.

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INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an important and extensively grown vegetable crop. It is placed in placed in Malvaceae family. It is thought that its origin is tropical Africa. Okra is a vital crop of tropical and sub-tropical regions of the world (Akinyele and Osekita,2009; Alam and Hossain, 2008 and Wammanda *et al*., 2010). Okra is chiefly attacked by numbers of viruses, fungi, bacteria, phytoplasma, nematodes and insect pests attack this crop (Ali *et al*., 2005 and Prakasha *et al*., 2010). Okra yellow vein mosaic is the

most serious disease of okra and is transmitted by white fly (*Bemisia tabaci* Gen.) (Fajinmi and Fajinmi, 2006 and Ghanem, 2003). Infection rate may reaches up to 100 per cent but in field yield loss ranges between 50 per cent and 94 per cent depending on the stage of crop growth (Sastry and Singh, 1975). Okra belongs to the family Malvaceae is one of the most important vegetable crops grown extensively throughout India during the summer and *Kharif* seasons. Due to intensive cultivation practices, the crop has been found to suffer from many diseases of which, yellow vein mosaic virus disease has been contributing significantly for low yield in Udaipur (Rajasthan) which caused mosaic, uneven development of chlorophyll surrounded by yellow margin followed by yellowing shrinking of leaves. Yellow vein mosaic virus is very important which considerably affects the production of okra. Among them Bhindi yellow vein mosaic virus (BYVMV) disease caused by okra yellow vein mosaic virus (Family: Geminiviridae, Genus: Begomovirus) is the important one. The virus contains circular ssDNA with a monopartiate genome transmitted by whitefly, *Bemisia tabaci* Genn., more serious and possesses serious constraints to its production. This disease was first reported by Kulkarni (1924) and the viral nature of the disease was established by Uppal *et al*. (1940) who also named it as yellow vein mosaic.

As per available literature, it has been found that almost no studies have been done regarding the control measures, losses occurred due to disease and alterations occurring contents in fruits of virus infected Bhindi plant at physiological and biochemical levels at Udaipur of Mewar region.

Yellow vein mosaic virus is a foliar disease of okra which is very common and destructive in Rajasthan, India. The main virus disease of okra is the foliar yellow mosaic caused by virus. The prospects of okra cultivation in west Mewar region has got setback due to the occurrence of disease in severe proportion, which further adds to more crop losses. The pathogen causes extensive damage to the okra crop, where the disease spears in severe form due to hot and humid condition.

Hence, the present investigation was under taken to screen various insecticidesand phyto-extracts *in vivo* conditions to manage the yellow vein mosaic virus diseasewith objective to develop an IDM module for YVMV disease of okra.

MATERIAL AND METHODS

Field experiment was conducted for two consecutive years that is during *Kharif* 2011 and 2012, using a susceptible variety, Nirmal 101, at Horticulture Farm, Rajasthan Collage of Agriculture, Udaipur, to assess the effectiveness of insecticides and botanicals alone or in combinations against yellow vein mosaic virus of okra. The experiment was laid out in a Randomized Block Design (RBD) with fifteen treatments including untreated control with four replications. The size of each plot was 2.80×2.70 m^2 with an inter row spacing of 45×30 cm. The seeds were treated before sowing with indofil M-45 @ 02g/kg seeds. All other agronomical practices recommended for harvesting of higher fruits yield were followed. First spray of insecticide was given when crop was 30 days old and subsequent sprays were given at 15 days intervals. Check plots were sprayed with water instead of insecticides. Disease severity (PDI) was recorded at regular interval by using 0-5 rating scale.The chemicals and botanicals were applied by foot spray with required concentration and the concentration of chemicals was prepared by dissolving required quantity chemical in water.The vector, whitefly population was counted directly from 5 randomly selected plants from each treatment at early hours of the day (*i.e.* 6:00 to 8:00 AM) when the whiteflies (*Bemisia tabaci*) were less active. Six leaves from three different positions (*viz.*, two leaves from top, 2 leaves from middle and 2 leaves from bottom) of each plant were taken into consideration. The fruit picking were taken at weekly interval regularly up to final harvesting of the okra plant from the field.

Disease assessment :

The disease rating scale (0-5) as described by Safdar *et al*. (2005) was used for disease scoring,
where,

0= No infection,
1=upto 10 per cent of leaf area infected,
3= 26-50 per cent leaf area infected,
4= 51-75 per cent leaf area infected,
5= above 75 per cent leaf area infected.

Infection index :

Procedure followed was of Mc Kinney's (1923), Chester (1959) and Wheeler (1969). The infection index was calculated by using following formula :

$$\text{Infection index} = \frac{\text{Sum of all numerical ratings}}{\text{No. of plants examined} \times \text{maximum disease category}} \times 100$$

Per cent efficacy of disease control :

The per cent efficacy of disease control (PEDC) was determined by using the following formula :

$$\text{PEDC} = \frac{\text{Infection index in control} - \text{infection index in treatment}}{\text{infection index in control}} \times 100$$

Fruit yield was also recorded for each treatment and per cent increase in yield was calculated by using the

following formula :

$$\text{Per cent increase in yield} = \frac{\text{Yield in treatment - yield in control}}{\text{Yield in control}} \times 100$$

RESULTS AND DISCUSSION

The disease has been appearing every year in Udaipur district, and causing the severe yield losses. Chemical control is generally practiced by farmers for harvesting higher fruit yields, but its injudicious utilization has created many field problems. Sole, reliance on chemical control leads to problems of pest resistance, resurgence of pests, pesticide residues, destruction of beneficial fauna and environmental pollution. Under such circumstances, the use of both chemical and botanical insecticides in pest management is considered ecologically viable proposition which may overcome the above mentioned problems. Considering the importance of ecofriendly approaches to the pest's management the present investigations were undertaken to find out the suitable control measures by chemicals and botanical insecticides.

Keeping in view the severity of the disease in Udaipur region and the availability of new systemic insecticides and botanicals, these have not been tested against yellow vein mosaic of okra and due to the encouragement by the results obtained by Ali *et al.* (2005) it was decided to test some new systemic insecticides and botanicals against this disease. Investigations were undertaken using four insecticides *i.e.* Dimethoate, Imidacloprid, Acetamipride and Melathion and two botanicals *i.e.* Azadirachtin, Karanj oil and their combination with each insecticide.

During the *Kharif* 2011 and 2012, four insecticides namely, Dimethoate 30 per cent EC @ (1ml/l), Imidacloprid 17.80 per cent SL @ (1ml/3l), Acetamiprid 20 per cent SP @ (2g/l) and Melathion 30 per cent EC @ (2ml/l) and two botanicals *i.e.* Azadirachtin 1500 ppm @ (5ml/l) and Karanj oil @ (2%) were tested alone or in combination with botanicals at different concentrations against yellow vein mosaic virus disease of okra on variety Nirmal-101, under field conditions. All the four insecticides and two botanicals alone or in combination with botanicals assessed were found effective against YVMV disease of okra. (Table 1 and Fig. 1 and 2) Imidacloprid 17.80 per cent SL applied @ (1ml/3l), was found most effective among the insecticide, shown the least disease severity of 8.6 per cent (2011) and 11.8 per cent (2012) and maximum fruit yield 5.1 kg/plot (2011) and 4.8 kg/plot (2012) with minimum whitefly population 4.6/plant (2011) and 3.5/plant followed by Dimethoate 30 per cent EC used @ (1ml/l), recorded disease severity (10.4%) 2011and 15.5 per cent 2012 (mean, 12.9%) as compared to 32.8 per cent disease severity in (2011) and 36.2 per cent PDI (2012) in untreated control as shown in (Table 1).

Among two botanicals, Azadirachtin 1500 ppm used

Table 1 : Effect of different agropesticides and botanicals on intensity of yellow vein mosaic virus disease, yield and white fly population of okra under field condition

Sr. No.	Treatments	PDI (%)			PDC (%)			Yield (Kg/plot)			Per cent increase in yield			Mean white fly population		
		2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
1.	Dimethoate 30(%)EC(1ml/l)	10.4	15.5	12.9	68.3	57.2	71.8	4.2	3.9	4.05	57.72	37.81	47.76	5.4	6.4	5.9
2.	Imidaclopride17.8(%)SL (1ml/3l)	08.6	11.8	10.2	73.8	67.4	77.6	5.1	4.8	4.95	71.14	69.61	70.37	4.6	3.5	4.0
3.	Acetamipride 20(%)SP (2g/l)	13.6	17.2	15.4	58.5	52.5	66.3	4.1	3.9	4.45	37.58	37.81	37.69	6.5	6.7	6.6
4.	Melathion30(%)EC(2ml/l)	17.0	20.2	18.6	48.2	44.2	59.2	3.3	3.5	3.40	10.74	23.67	17.23	8.8	9.2	9.0
5.	Azadirachtin1500ppm(5ml/l)	12.7	16.2	14.4	61.3	55.2	68.4	3.5	3.7	3.60	17.44	30.74	24.09	5.8	6.4	6.1
6.	Karanj oil(2%)	24.7	26.0	25.4	24.7	28.2	44.1	3.2	3.0	3.10	06.00	12.8	09.40	7.0	8.6	7.8
7.	Dimethoate + Azadirachtin	08.5	12.6	10.6	74.1	65.2	76.8	4.9	4.7	4.80	64.43	66.08	65.25	3.2	4.5	3.8
8.	Imidaclopride + Azadirachtin	06.8	09.9	08.3	79.3	72.6	81.8	5.3	5.5	5.40	77.85	94.35	86.10	2.9	2.4	2.6
9.	Acetamipride + Azadirachtin	12.8	15.3	14.1	61.0	57.7	69.1	4.5	3.1	3.80	51.00	09.54	30.27	5.5	5.7	5.6
10.	Melathion + Azadirachtin	19.6	23.7	21.6	40.2	34.5	52.5	3.5	3.2	3.35	17.45	13.07	15.26	8.1	9.8	8.9
11.	Dimethoate + Karanj oil	14.3	19.9	17.1	56.4	45.0	62.7	4.2	3.9	4.05	40.94	37.81	39.37	6.7	7.7	7.2
12.	Imidaclopride + Karanj oil	7.2	13.4	10.7	78.0	63.0	77.7	5.1	4.4	4.75	71.14	55.48	63.31	2.8	3.6	3.2
13.	Acetamipride + Karanj oil	14.9	18.6	16.8	54.6	48.6	63.1	4.0	3.6	3.80	34.23	27.21	30.72	6.9	7.5	7.2
14.	Melathion + Karanj oil	21.8	25.4	23.6	33.5	29.8	49.2	3.4	3.2	3.30	14.09	13.07	13.58	8.6	10.2	9.4
15.	Control	32.8	36.2	34.5	----	----	----	2.98	2.83	2.90	----	---	---	15.5	12.7	14.1
	S.E. ±	1.12	1.15					1.81	1.87					0.042	0.037	
	C.D. (P=0.05)	3.37	3.34					5.26	5.63					0.126	0.111	
	C.V. (%)	6.56	8.24					6.00	8.45							

@ (5ml/l) was found to be best and showed the least disease severity of 14.4 per cent and recorded maximum fruit yield 3.60 kg/plot, followed by Karanj oil applied (@ 2 per cent gave 25.4 per cent disease severity, with fruit yield of 3.1kg/ plot) compared to (34.5 % disease severity and yield 2.90 kg/plot.) in control. Similarly both the botanicals *i.e.* Azadirachtin 1500 ppm (5ml/l) and Karanj oil (2%) were also tested in combination with all insecticides for the management of YVMV disease.The result depicted in Table 1 clearly indicate that lowest disease severity (8.3%) and high fruit yield (5.40kg/plot) were recorded in (Imidacloprid + Azadirachtin) treated plot followed by (Imidacloprid + Karanj oil) which gave disease severity 10.7 per cent and yield 5.1kg/plot recorded.

Similarly, 10.6 per cent disease severity and yield 4.80 kg/plot was recorded in Dimethoate +Azadirachtin treated plants, followed by 17.1 per cent disease severity and yield 4.05 kg/plot was recorded in combined Dimethoate + Karanj oil treated plants. Therefore, maximum reduction in disease severity was however, found to be 81.8 per cent in plant sprayed with Imidacloprid + Azadirachtin followed by 77.7 per cent in Imidacloprid + Karanj oil. (Fig. 1).

The maximum per cent disease control (81.8%) and per cent increase in yield (86.10 %) with minimum whitefly population 2.6/plant was recorded in the plot where Imidacloprid + Azadirachtin was sprayed. The next best in order of merit was Imidacloprid + Karanj oil (77.7% disease control) and per cent increase in yield (63.31%) with insect population (3.2/plant)] followed by Dimethoate + Azadirachtin (76.8 % PEDC) and per cent increase in yield (65.25%) and 62.70 per cent PEDC and 39.37 per cent increase in yield was recorded in plot where Dimethoate + Karanj oil was sprayed.

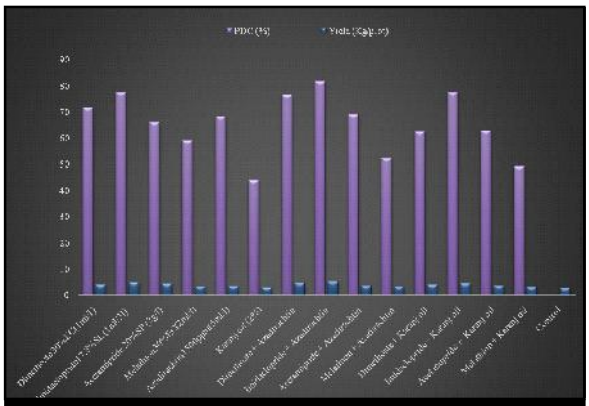

Fig. 1 : Per cent disease control and yield kg/ plot of okra

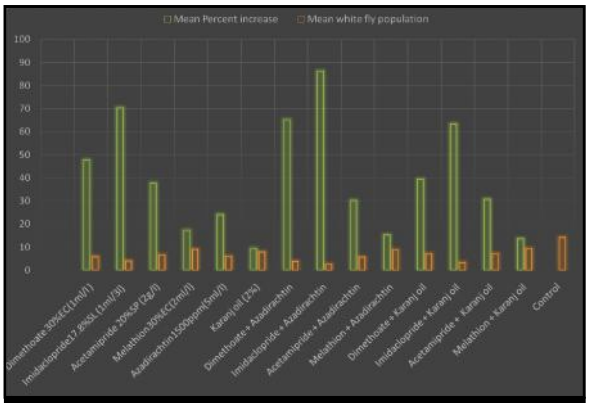

Fig. 2 : Mean per cent increase in yield and mean whitefly population in okra

The 15.4 per cent PDI, 4.45 kg yield/plot and 6.6 mean white fly population was recorded when Acetamipride 20 per cent SP was@ 2g/l whereas 14.1 per cent PDI, recorded 3.80 kg/plot and 5.6/plant white fly population was noted when Acetamipride 20 per cent SP applied along with azadirachtin, and 16.8 per cent PDI, 3.80 kg yield/plot and 7.2/plant white fly population was recorded when Acetamipride plus Karanj oil applied as spray on okra.

The present investigation revealed that Imidacloprid 17.80 per cent SL (1ml/l) was found most effective among the insecticides tested giving the least disease severity (10.2%) and maximum fruit yield (4.95 kg/plot) with minimum whitefly population 4.0/plant followed by Dimethoate 30 per cent EC used @ (1ml/l), recorded disease severity (12.9%) as compared to 34.5 per cent disease severity in control. Among two botanicals, Azadirachtin 1500 ppm use @ (5ml/l) was found to be the best giving least disease severity of 14.4 per cent and maximum fruit yield 3.60 kg/plot.

The mean PDI 15.4 per cent, mean PDC 66.3 per cent, mean whitefly population 6.6/plant, mean yield (4.45kg/plot) and recorded 37.69 per cent increase in yield in this treatment when Acetamipride 20 per cent SP applied @2g/L whereas mean PDI 14.1per cent, mean PDC 69.1per cent, mean whitefly population 5.6/plant, mean yield (3.80 kg/plot) and recorded 30.27 per cent increase in yield when Acetamipride plus Azadirachtin sprayed @ 2g/L+1ml/3L of water. Similarly, the mean PDI 16.8 per cent, mean PDC 63.1per cent, mean whitefly population 7.2/plant, mean yield 3.80 kg/plot and recorded 30.72 per cent increase in yield when Acetamipride @ 2g/L+ Karanjoil @2 per cent used. Under the untreated control, recorded mean 34.5 mean PDI, mean 2.90kg/plot yield and mean whitefly population (14.1) was recorded.

Lowest disease severity (8.3%) and highest fruit yield (5.4 kg/plot) with minimum whitefly population (2.6/plant) was recorded when plant treated with two sprays of Imidacloprid and two sprays of Azadirachtin followed by application of combination of Imidacloprid + Karanj oil and recorded 10.7 per cent disease severity and yield 4.75kg/plot with 3.2/plant whitefly population. Similar results were found by various workers (Sastry and Singh, 1973; Pun *et al.*, 2000; Kumar *et al.*, 2001; Fazlul *et al.*, 2002; Srabani and Nath, 2003; Ali *et al.*, 2005; Bhyan *et al.*, 2007; Gowadar *et al.*,

2007 and Adalakshmi, 2008).

Sastry and Singh (1973) found that YVMV disease could be restricted by 4 sprays, each of parathion (0.02%) oxydemeton-methyl (0.02%) or dimethoate (0.05%) at 10 days intervals from germination, or one application of phorate 10G (15 kg/ha) at sowing. A higher incidence in *A. esuclentus* by YVMV disease occurred when sprays were delayed. Pun *et al*. (2000) conducted pot experiment in glass house to determine the efficacy of virus inhibitory chemicals and botanicals on the YVMV disease of okra. They found that neem oil and neem seed kernel extract reduced virus infection by 88.3 and 86.7 per cent, respectively. Gowdar *et al*. (2007) reported that acetamiprid, Imidacloprid, triazophos and monocrotophos reduced the YVMV disease of okra. Two sprays of acetamiprid 20 SP at 40 g a.i. /ha were effective in the YVMV disease and increase the yield of okra.

Therefore, it can be concluded that to develop an effective IDM module, a systemic insecticide Imidacloprid 17.80 per cent SL @ (1ml/3l) along with Azadirachtin1500 ppm @ (5ml/l) may be applied as curative spray to protect the crop from yellow vein mosaic virus disease and achieve maximum yield of okra under field conditions.

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