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ECO-FRIENDLY APPROACHES FOR THE MANAGEMENT OF *OKRA YELLOW VEIN MOSAIC VIRUS* DISEASE (OYVMVD) INCIDENCE

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A B S T R A C T

Okra is an important vegetable crop consumed as fresh and canned food. *Okra yellow vein mosaic virus* (OYVMV) causes the most devastating disease in terms of quality and quantity of the produce. OYVMV is transmitted by whitefly (*Bemisia tabaci* Genn.). As no viricide is available, viral diseases are controlled indirectly by using insecticides against their vectors. Extensive use of insecticides poses a great threat to the environmental safety causing air, water and soil pollution. In order to avoid the environmental deterioration different eco-friendly approaches were used against the OYVMVD. These approaches include resistant source, nutritional management and plant extracts. In order to find out the resistant source against the OYVMVD seven okra varieties were phenotypically screened. None of the variety was found to be immune against OYVMVD. Chinese Red and Ikra-3 gave highly resistant response. Green Wonder and PMS-Beauty were regarded as resistant. Selection-31, Laxmy and Parbhani Kranti were moderately resistant. Different nutrients and plant growth regulators were evaluated for the management of OYVMVD. NPK solution and neem extract were the most effective among nutrients and plant extracts respectively followed by the other treatments in terms of reducing the OYVMVD incidence.

Keywords: Phenotypic, response, OYVMVD, eco-friendly, management.

INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench belongs to family *Malvaceae* Juss. is an important vegetable of the sub-continent. It is native to Afro-Asian countries but also cultivated widely in India, Nigeria, Pakistan, Ghana and Egypt etc. (Akanbi *et al*., 2010). Average world production is 12.035 million tons. (FAO, 2011). In Pakistan it is cultivated on an area of 13.900 h and a total production of about 113,200 thousand tons (MINFAL, 2013).

Okra is consumed as fresh and canned food. It contains much energy, protein, fats, carbohydrates, vitamins and nutrients (Oyelade *et al.*, 2003). It is also used as a mucilaginous food additive against gastric, irritative and inflammative diseases (Lengsfeld *et al*., 2007).

Okra crop is challenged by a constant array of fungal, bacterial, viral and nematode diseases. Viral diseases are the most threatening factor for the okra crop (Prakasha *et al*., 2010). Among viral diseases OYVMV is the most important and devastating. It belongs to the genus *Begomovirus* and family *Geminiviridae* (Jose and Usha, 2003). It is transmitted by whitefly (*B. tabaci*) in a persistent circulative manner (Fajinmi and Fajinmi, 2010). The disease infects all the stages of crop growth. The symptoms include alternate green and yellow patches, vein clearing, and chlorosis of leaves. In severe cases, chlorosis may result in complete yellowing of leaves. Fruits are dwarfed, malformed and yellow green (Baghat *et al*., 2001). Yield losses may range from 50-94% depending upon the stage of the growth (Sastry and Singh, 1974). Chemical pesticides usage for the control of insect vectors of plant viruses is very hazardous to the environment as well as the humans directly associated with insecticides application or consumption of treated produce (Jabbar and Mohsin, 1992). Keeping in view the environmental deterioration and hazardous effects of pesticides on the human and animal health, present study was planned to use the environmental friendly approaches for the management of OYVMVD.

MATERIALS AND METHODS

Management of OYVMVD through resistant varieties:

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In order to find out the resistant source different varieties were screened against OYVMVD. The experiment was conducted in the research area of Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan. The following varieties were sown in the experiment: Chinese Red, PMS Beauty, Laxmy, Green Wonder, Selection-31, Ikra-3 and Parbhani Kranti. Each entry was planted in three rows with maintaining row to row distance of 60 cm and plant to plant 20 cm. A susceptible check was planted after every three entries to ensure the virus source in the field. The disease on each of test entries was assessed by percent disease incidence. Data of disease incidence percentage was recorded by the following formula

% Disease incidence (DI) = No. of infected plants/Total no. of plants×100.

Phenotypic response of okra germplasm against OYVMVD was assessed by using a 0-6 rating scale (Ali *et al*., 2005).

Disease rating scale.

Category	Description	Reaction
0	Complete absence of disease	Immune
1	Vein Clearing 1-10%	Highly Resistant
2	Vein Yellowing of small leaves 11-25%	Resistant
3	Yellow network on some leaves 25-50%	Moderately Resistant
4	Yellow network on all leaves 51-60%	Moderately Susceptible
5	Complete leaves turn Yellow or cream color 60-70%	Susceptible
6	Plant stunted having few deformed and small fruits and the whole plants become colorless > 70%	Highly Susceptible

Management of OYVMVD through nutrients and plant extracts: Different nutrients and plant extracts were used against OYVMVD incidence. The nutrients (NPK solution, Zn & B solution, and urea) and plant extracts (*Azadirachta indica*, *Mentha arvensis*, and *Eucalyptus globules*) were applied. Moderately susceptible to moderately resistant varieties were used in this experiment. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications and seven treatments including one control.

Treatments were applied in each block as follows:

T_1 = NPK solution (Fashion) @ 5ml/litre
T_2 = Zn & B solution (Classic) @ 5ml/litre
T3 = Urea @ 8.4gm/litre
T_4 = Neem extract (*Azadirachta indica*) @ 5ml/litre
T_5 = Mint extract (*Mentha arvensis*) @ 5ml/litre
T_6 = Eucalyptus extract @ 5ml/litre
T7 = Control

The crop was sprayed at 7 days interval. All data of OYVMVD incidence as influenced by treatments was statistically analyzed. All possible interactions were determined through ANOVA and the treatment means were compared by LSD test at 5% level of probability (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Management of OYVMVD through resistant source: The data recorded at 7 day intervals for disease incidence (DI) on okra varieties caused by OYVMV (Table.1) shown that none of the variety was found to be immune with regard to this virus. The response of varieties varied greatly regarding their level of resistance or susceptibility. Less infected varieties were Chinese Red and Ikra-3 which gave 7.90% and 8.70% DI and classed as highly resistant. Green Wonder and PMS-Beauty which gave 18.8% and 21.4% DI. Selection-31, Laxmy and Parbhani Kranti were moderately resistant by giving 25-50% DI. No variety exhibited more than 45.4% DI. These results coincide with the findings of Sangar (1997) screened 8 varieties of okra for resistance to OYVMV and found that Arka Anamika was highly resistant; Arka Abhey resistant, Parbhani kranti and V-6 were moderately resistant to disease. Others were susceptible or highly susceptible. Twelve okra varieties were screened against OYVMV, two were highly resistant while others found to be resistant including Parbhani Kranti (Ragupathi *et al*., 2000). Under field conditions, lines OK-292 and OK-285 showed resistance to OYVMV and OK 315, OK 316 and OK 317 were found tolerant (Rashid *et al*., 2002).

Management of OYVMVD through nutrients and plant extracts: In this experiment different nutrients and plant extracts were evaluated for their efficacy against OYVMVD incidence. NPK solution minimized the DI percentage most effectively followed by the Zn & B solution, Urea, neem extract, mint extract and

eucalyptus extract in all varieties. Maximum DI percentage was found in control where no treatment was applied. Similarly, minimum DI was found in Laxmy followed by Selection-31 and Parbhani Karanti (Table. 2).

Table.1. Response of okra varieties to OYVMV under field conditions.

Sr. No.	Cultivars	Means of disease rating	Severity Rating	Level of resistance/ Susceptibility
1	Laxmy	43.1	3	Moderately resistant
2	PMS-Beauty	21.4	2	Resistant
3	Parbhani Kranti	45.4	3	Moderately resistant
4	Chinese Red	7.90	1	Highly resistant
5	Green Wonder	18.8	2	Resistant
6	Ikra-3	8.70	1	Highly resistant
7	Selection-31	32.7	3	Moderately resistant

Table. 2. Effect of nutrients and plant extracts on OYVMVD incidence in different varieties.

Varieties	Treatments							Mean
	T1	T2	T3	T4	T5	T6	T7	
Laxmy	24.65	26.37	27.58	32.22	35.45	37.67	56.79	34.10 C
Parbhani Karanti	22.34	24.01	26.20	28.15	35.75	36.48	58.32	77.13 A
Selection-31	22.35	23.71	25.10	27.64	29.99	30.22	48.08	69.03 B
Mean	23.11 G	24.70 F	26.29 E	29.34 D	33.73 C	34.79 B	54.40 A	

T1 = NPK, T2 = Zn & B, T3 = Urea, T4 = Neem, T5 = Mint, T6 = Euclyptus, T7= Control.

The application of NPK gave significant reduction in yellow mosaic virus disease incidence (Sekhar and Hari Chand, 2001). Incidence and severity of yellow mosaic disease of mungbean was low in the plots treated with Zn & B as compared to control (Islam *et al*., 2002). Single application of boron (2 kg/ha) significantly reduced the severities of yellow mosaic virus (Pramanik and Ali, 2001). The strains of tobacco mosaic virus were denatured by the application of urea (Bawden and Pirie, 1937). Inactivation of tobacco mosaic virus by urea led to a separation of the nucleic acid from the protein (Stanley and Lauffer, 1939). Urdbean leaf crinkle virus disease (ULCVD) was considerably reduced by the application of urea (Zeshan *et al*., 2012). Neem extract was found the most effective as compared to other plant extracts against *B. tabaci* and OYVMVD (Ali *et al*., 2005). Efficacy of six plant products in the management of OYVMVD incidence was studied. Neem oil and neem seed kernel extract proved most effective in minimizing the disease incidence and also in increasing the yield (Pun *et al.,* 2005).

CONCLUSIONS

All three management tactics save the environment from adverse effects. Resistant germplasm is the cheapest and safest option for disease management. Nutrient application increases the plants ability to fight against the diseases. Plant extracts repel the whiteflies and thus decrease the OYVMV infection.

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