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# Screening of diverse okra genotypes for yellow vein mosaic virus tolerance under field condition

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**Abstract**
The present study was undertaken on thirty two okra genotypes along with two checks for screening against okra yellow vein mosaic virus (OYVMV) in open field condition in rainy season. Viruses play major constraints to okra production as it is susceptible to at least 19 plant viruses, among these viruses, yellow vein mosaic virus (YVMV) causes significant losses in the okra production causing yellow vein mosaic disease. The disease pressure of OYVMV was high in rainy season crop because of high humidity and rainfall along with more multiplication of whiteflies. Infection of 100% plants in a field is very usual and yield losses range from 50 to 94%, depending on stage of crop growth at which infection occurs and its vector whitefly (*Bemisia tabaci* Gen.). These genotypes were screened and evaluated in open field conditions in rainy season of 2017. Of the 32 genotypes none of the test genotypes showed immunity against OYVMV disease incidence and white fly population. Response of these genotypes towards OYVMV disease shows variability on the basis of their comparisons to each other. The genotype (IIVR-11) was found highly resistant and Kashi Kranti, 135-10-1, EC-169459 were found resistant. Seven genotypes exhibited moderately resistant reaction against YVMV while nine genotypes showed moderately susceptible, however only two genotypes IC-69304 and IC-282240 show susceptible and genotype Pusa Sawani exhibited highly susceptible to YVMV.

**Keywords:** genotypes, okra, resistance, YVMV incidence

## Introduction
Okra (*Abelmoschus esculentus* L. Moench) belongs to the family Malvaceae is an important vegetable crop which is widely cultivated in different parts of the world mostly for human consumption and also for industrial use as fibre (Alegbejo *et al.*, 2008) [1]. There is a wide range of significant variation in chromosome number and ploidy level in different species under the genus *Abelmoschus*. The lowest number of chromosome (2n = 56) is reported in *Abelmoschus angulosus*, while the highest chromosome number (2n = 200) is reported in *A. caillie* (Singh and Bhatnagar, 1975) [12]. The cultivated species i.e., *A. esculentus* have somatic chromosome number 130. Okra appears to have originated in South Africa or Asia (Thompson and Kelley, 1957) [14]. Young okra fruit contain good amount of vitamins A, B, C as well as protein, carbohydrates, fats, minerals, iron and iodine. 100 g of fresh okra fruits provides 20%, 15%, and 50% of the daily requirement of calcium, iron and ascorbic acid, respectively. The old mature fruits are used in processed products (Li *et al*., 2002) [11]. In spite of its high nutritive value, well acceptability among end users and wide range of available genetic variability, the country is still lagging behind the leading productive countries like Ghana and Egypt in the world. The crop is affected by various biotic and abiotic diseases but among the various biotic diseases yellow vein mosaic virus is a most serious disease and caused substantial yield losses (80-90%) in okra crops (Ali *et al*., 2005) [2]. Okra YVMV is believed to be originated from India (Usha, 2008) [15]. The virus attack on all the above ground plant parts, and finally the disease is characterized by a homogenous knotted, yellow veins and yellowish or creamy colour of green leaf, stunted plant growth and bear very few deformed small fruits (Ali *et al*., 2005, 2012) [2, 3].

The disease pressure of OYVMV was high in rainy season crop because of high humidity and rainfall along with more multiplication of whiteflies (*Bemisia tabaci* Gen.), which transmits YVMV disease of okra belonging to genus begomovirus and family of geminivireadea (Chakraborty *et al*. 1999) [6].

Khan *et al.* (2005) [9] observed total yield loss of 49% due to disease attack after 65 days of germination. This loss may increase up to 90% depending on severity of the disease (Kucharek, 2004) [10]. If infection occurs in first 20 days after germination, the growth of plants become stop, few leaves and fruits are formed and yield loss reaches up to 94%. These findings suggested that delay in infection leads to reduce yield loss. Considering the above constraints in view, the present investigation had been conducted to screen the okra genotypes

for YVMV tolerance based on per cent disease incidence which helps in identification of stable source of resistance for this disease.

## Materials and Methods

The experiment was conducted in the Vegetable Research Farm, Kalyanpur, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P) during the rainy season of year 2016-17. A total of 30 okra genotypes (VRO-3, Pusa Makhmali, IC-69304, IIVR-11, EC-169417, IC-282240, IC-090184, Kashi Satdhari, 135-10-1,158-10-1, EC-102605, IC-282232, Pusa Sawani, Arka Abhay, Kashi Kranti, IC-117217, EC-169850, VRO-5, IC-43750, VRO-4, EC-169419, IC-117336, IC-033206, Prabhani Kranti, VRO-6, 392, Arka Anamika, EC-112241, EC-169459, 21-10-1 and two checks Pusa-A-4 and GS-123 were received from different gene banks. Each variety was replicated thrice having row to row and plant to plant distance 60 and 45 cm respectively. The experiment was conducted in a randomized complete block design. The cultural operations and cultivation aspects were followed throughout years of the crop season according to the recommendation of package of practice for okra. The rainfall of this region is mainly distributed between middle of July to middle of October. The meteorological data recorded during the growing season of the crop is depicted in Fig. 1.

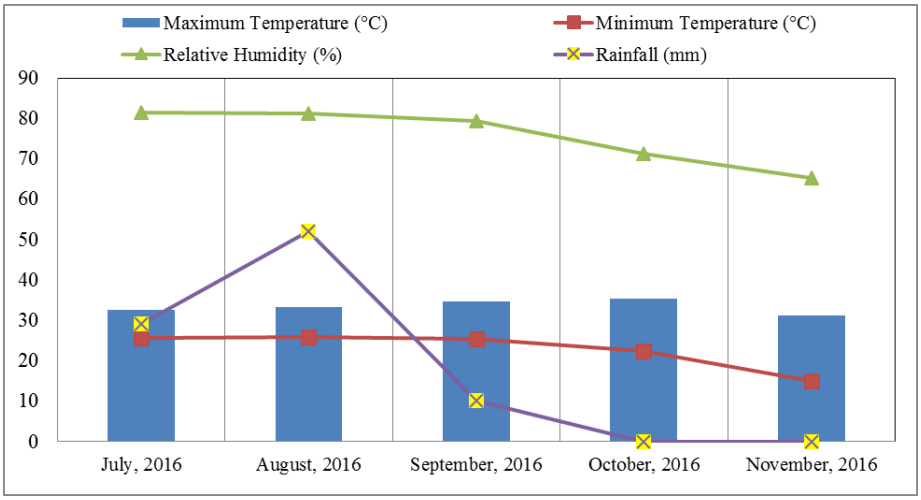


**Fig 1:** Meteorological data during crop growing period (July– November, 2017)

The scoring of disease was done by using the standard scale of 0 to 4 (Table 1) at 15 days interval (30, 45 and 60 days) after sowing. Percent disease incidence (PDI), response value (RV) and coefficient of infection (CI) were calculated by the standard procedure suggested by Banerjee and Kalloo (1987).

$$\text{PDI (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

$$CI = RV \times PDI$$

Where, PDI = percent disease incidence, RV = response value, CI= coefficient of infection

**Table 1:** Classification of disease reaction based on standard scale for YVMV in okra

| Symptoms | Severity grade | Response value | Coefficient of infection | Reaction |
|---|---|---|---|---|
| Symptom absent | 0 | 0 | 0 – 4 | HR |
| Very mild symptom up to 25% leaves | 1 | 0.25 | 4.1 – 9 | R |
| Appearance of disease between 26 to 50% leaves | 2 | 0.50 | 9.1 – 19 | MR |
| Symptom between 51 to 75% leaves | 3 | 0.75 | 19.1 – 39 | MS |
| Severe disease infection at 75% leaves | 4 | 1.00 | 39.1 – 69 | S |
| Above 75% leaves | >4 | >1.00 | 69.1 – 100 | HS |

**Note:** HR = Highly resistant, R = Resistant, S = Susceptible, HS = Highly susceptible, MR = Moderately resistant, MS = Moderately susceptible. Correlation between variables were tested for significance (Gomez and Gomez, 1984).

## Results and Discussion

The above results suggested that disease incidence and its severity depends upon the genotype and also environmental factors. Screening of genotypes provides an idea in identification of stable source of resistance for YVMV in okra which can be utilized for development of disease resistant cultivars. Out of total 32 genotypes, only one genotype (IIVR-11) showed highly resistant reaction against YVMV disease (Table 2). However, three genotypes Kashi Kranti, 135-10-1 and EC-169459 were expressed resistant reaction. Seven parents (VRO-4, EC-112241, IC-033206, IC-282232, 392, VRO-5 and IC-43750) exhibited moderately resistant reaction, while nine genotypes (VRO-3, Prabhani Kranti, Arka Abhay, Arka Anamika, EC-169419, 158-10-1, 21-10-1, EC-169350 and Kashi Satdhari were moderately susceptible, however two genotypes IC-69304 and IC-282240 showed susceptible reaction and one genotype Pusa Sawani exhibited highly susceptible reaction against YVMV disease. In the similar way Bhagat (2000) [5] also reported that the variety Pusa Sawani expressed the highly susceptible reaction against yellow vein mosaic virus. These results were also similar to the findings of Chattopadhya *et al.* (2011) [7] and Das *et al.* (2013) [8] they conducted the experiments on okra YVMV during rainy season. Similar results were also reported by Solankey *et al.* (2014) [13].

**Table 2:** Disease incidence for YVMV in 32 genotypes of okra during rainy season

| Genotype | Severity grade | Response value | % of disease infection | Coefficient of infection | Reaction | Yield (Q/ha) |
|---|---|---|---|---|---|---|
| VRO-4 | 2 | 0.50 | 38.00 | 19.00 | MR | 157.98 |
| VRO-3 | 3 | 0.75 | 51.61 | 38.71 | MS | 148.07 |
| Pusa Sawani | >4 | >1.00 | 94.67 | 94.67 | HS | 112.33 |
| Prabhani Kranti | 3 | 0.75 | 52.00 | 39.00 | MS | 143.12 |
| Kashi kranti | 1 | 0.25 | 16.77 | 4.19 | R | 263.25 |
| Arka Abhay | 3 | 0.75 | 50.75 | 38.06 | MS | 151.12 |
| Arka Anamika | 3 | 0.75 | 51.15 | 38.36 | MS | 152.98 |
| IIVR-11 | 1 | 0.25 | 13.35 | 3.38 | HR | 268.83 |
| EC-169419 | 3 | 0.75 | 51.85 | 38.89 | MS | 145.43 |
| IC-282240 | 4 | 1.00 | 68.41 | 68.41 | S | 138.76 |
| 135-10-1 | 2 | 0.25 | 23.75 | 5.94 | R | 252.90 |
| EC-112241 | 2 | 0.50 | 37.71 | 18.86 | MR | 169.98 |
| 158-10-1 | 3 | 0.75 | 51.71 | 38.78 | MS | 147.74 |
| IC-090184 | >4 | >1.00 | 78.87 | 78.87 | HS | 119.59 |
| IC-117217 | >4 | >1.00 | 75.15 | 75.15 | HS | 131.89 |
| 21-10-1 | 3 | 0.75 | 49.67 | 37.25 | MS | 155.47 |
| EC-169417 | 4 | 1.00 | 75.07 | 75.07 | HS | 133.57 |
| IC-033206 | 2 | 0.50 | 34.75 | 17.38 | MR | 186.57 |
| IC-282232 | 2 | 0.50 | 37.57 | 18.79 | MR | 179.07 |
| EC-169350 | 3 | 0.75 | 50.00 | 37.50 | MS | 153.07 |
| 392 | 2 | 0.50 | 32.43 | 16.22 | MR | 189.07 |
| IC-117336 | >4 | >1.00 | 78.58 | 78.58 | HS | 121.99 |
| Pusa Makhmali | >4 | >1.00 | 76.87 | 76.87 | HS | 128.85 |
| Kashi Satdhari | 3 | 0.75 | 51.57 | 38.68 | MS | 149.99 |
| EC-102605 | >4 | >1.00 | 83.57 | 83.57 | HS | 118.39 |
| VRO-5 | 2 | 0.50 | 29.57 | 14.79 | MR | 201.87 |
| IC-69304 | 4 | 1.00 | 68.00 | 68.00 | S | 140.96 |
| EC-169459 | 1 | 0.25 | 25.77 | 6.44 | R | 242.78 |
| IC-43750 | 2 | 0.50 | 37.94 | 18.97 | MR | 168.00 |
| IC-117216 | >4 | >1.00 | 77.78 | 77.78 | HS | 125.97 |
| Pusa-A-4 | 1 | 0.25 | 12.35 | 3.08 | HR | 295.30 |
| GS-123 | 1 | 0.25 | 11.55 | 2.88 | HR | 281.73 |

Among all genotypes the highest yield was observed in check ($F_1$) hybrid variety Pusa-A-4 (295.30q/ha) followed by $F_1$ hybrid GS-123 (281.73q/ha), IIVR-11 (268.83q/ha), Kashi kranti (263.25q/ha) and 135-10-1 (252.90q/ha), respectively (Table 2). The one of the major reason for higher yield of these genotypes is less incidence of YVMV which occur at the cost of more trichomes on leaf structure and typical leaf texture. The genotype Pusa Sawani is highly susceptible to YVMV so the lowest yield was observed (112.33 q/ha).

The similar studies were also described by many workers for screening of resistant and susceptible reactions against okra yellow vein mosaic virus disease (Bhagat 2000, Anand *et al*., 2007 and Ali *et al*., 2012) [5, 4, 3]. Das *et al.* (2013) [8] also reported that rainy season okra having more intensity of YVMV due to favourable environmental conditions. A large number of variations were observed for disease resistance in each genotype. Screening of genotypes provides an idea in identification of stable source of resistance for YVMV in okra which can be utilized for development of disease resistant cultivars. By the finding of our experiment we can concluded that IIVR-11 and Kashi Kranti could be recommended for commercial cultivation in YVMV disease prone area during rainy season.

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