Original Research Article

Management of yellow vein mosaic virus disease of okra through cultural approaches

ABSTRACT

Okra (*Abelmoschus esculentus* L. Moench) cultivation is threatened in the tropics due to the high incidence of okra yellow vein mosaic virus (OYVMV) disease. The experiment was conducted under field conditions to evaluate different dates of sowing and row to row spacing with a susceptible cultivar of okra 'Pusa Sawani' in a split-plot design during *kharif* 2018. The disease incidence and percent disease index (PDI) of OYVMV of okra were strongly impacted by the date of sowing and row to row spacing of the okra crop. Early (15 June) sown crop with closer row spacing of 30 cm had the lowest terminal disease incidence (49.30%), while late (14 July) sown crop with wider (60 cm) spaced crop had the highest (73.96%). The PDI was also lowest (47.82 percent) in an early (15 June) sown crop with 30 cm row spacing and greatest (68.19 percent) in a late (14 July) sown crop with 60 cm row spacing. During the study, it was observed that the early date of sowing with closer row to row spacing was decrease the incidence and severity of OYVMV disease.

Key words: Okra, OYVMV, PDI, date of sowing, spacing

Introduction

Okra (Abelmoschus esculentus L. Moench) is a member of the Malvaceae family and belongs to the genus Abelmoschus. Okra is native to Afro-Asian countries, although it is commonly grown in India, Nigeria, Pakistan, Ghana, and Egypt, among other places (Akanbi *et al.,* 2010). It is a bisexual plant with or without branches. It is grown on over 0.528 million hectares in India, with a yield of 6.15 million metric tonnes and productivity of 11.63 metric tonnes per hectare. Okra is high in vitamin A, B, and C, as well as protein, minerals, and iodine (Baloch *et al.*, 1990). Okra seeds have a crude protein content of 20-30% and oil content of 18-20% (Berry *et al.,* 1988). The 100 g of fresh edible fruit of okra contains moisture (89.60 g), carbohydrates (6.40 g), protein (1.90 g), fibre (1.20 g), minerals (0.70 g), fat (0.20 g), calcium (66 mg), phosphorus (56 mg), magnesium (43 mg), oxalic acid (8 mg), iron (1.50 mg), potassium (103 mg), copper (0.19 mg), sulphur (30 mg), sodium (6.90 mg), vitamin A (88 IU), thiamine (0.07 mg), riboflavin (0.10 mg), vitamin C (13 mg) and nicotinic acid (0.60 mg) (Thakur *et al*, 2003). Okra has a greater average nutritive value (ANV) than brinjal, tomato, and most cucurbits, except bitter gourd (Grubben, 1977).

Okra is chiefly attacked by the number of viruses, fungi, bacteria, phytoplasma, nematodes, and insect pests that attack this crop (Prakasha *et al*., 2010). The most dangerous viral disease of okra is yellow vein mosaic, which is spread by the whitefly (*Bemisia tabaci* Gen.) (Fajinmi and Fajinmi, 2006). The virus has a monopartite genome and circular ssDNA. Kulkarni (1924) was the first to report this disease, and Uppal *et al.* (1940) verified the disease's viral etiology, named it yellow vein mosaic.

Initially, on young leaves, the first signs are a widespread, mottled appearance. Small veins begin to clear along the leaf margin at various spots 15 to 20 days after infection. Vein clearing is followed by vein chlorosis. Interveinal chlorosis develops in diseased leaves owing to a fiber shortage, and all of the leaves turn yellow. Infected fruits have a yellow or creamy tint to them, are fibrous, tiny, and rough (Brunt *et. al.*, 1996). The overall loss of raw vegetable yield is estimated to be around 20-30 per cent, with the possibility of increasing to 80-90 percent (Ali et al., 2005). The infection rate can reach 100 per cent, however, in the field, yield loss varies from 50 per cent to 94 per cent, depending on the stage of crop growth. When a plant becomes infected within the first 20 days of germination, it stops growing, produces few leaves and fruits, and loses up to 94 per cent of its output (Sastry and Singh, 1974). Hence, the present investigation was undertaken to manage the okra yellow vein mosaic virus disease by using the different dates of sowing and spacings.

MATERIALS AND METHODS

The field experiment was conducted during *Kharif* 2018 by using a susceptible variety, Pusa Sawani, at the research farm Department of Plant Pathology, CCS Haryana Agricultural University, Hisar., to assess the effectiveness of cultural practices *i.e.* date of sowing and row to row spacing against okra yellow vein mosaic virus. The experiment was laid out with a split-plot design in plots measuring 13.5 sq. m with four replications. The okra seeds were sown on three different dates of sowing i.e. 15th June, 30th June and 14th July with three different spacings i.e. 30cm×30cm, 45cm×30cm and 60cm×30cm. Several intercultural operations such as thinning of plants, gap filling, weeding, irrigation and drainage were practiced as per necessity to keep the plants healthy. The Data of disease incidence and disease severity of OYVMV on okra were recorded at 15 days intervals up to 95 days old crop.

Disease assessment:

The disease severity was calculated at 7 days interval by using a 0-6 scale (Ali *et al.*, 2005). Percentage disease index (PDI) was calculated with the method of McKinney, 1923.

Chart 1 : Disease severity scale

Rating	Category	Severity Range
0	Immune	0%
1	Highly resistant	1-10%
2	Moderately resistant	11-25%
3	Tolerant	26-50%
4	Moderately susceptible	51-60%
5	Susceptible	61-70%

6	Highly susceptible	71-100%

The percentage disease index (PDI) was calculated by McKinney's, 1923 formula:

$$\text{Per cent disease index} = \frac{\text{Sum of all numerical ratings}}{\text{No. of plant examined} \times \text{maximum disease rating}} \times 100$$

Disease incidence

For disease incidence, 20 plants were randomly chosen, the number of infected plants was counted in every 15 days, and the percentage of infected plants was computed. The following formula was used to compute the per cent disease incidence.

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

RESULTS AND DISCUSSION

1. Effect on disease incidence

1.1 Row to row spacing

From the study, it was observed that the incidence of OYVMV was started 20 days after sowing. A significant increase in disease incidence was recorded for all the periods except S1 (30 × 30 cm) and S2 (45 × 30 cm) at 20 DAS. In S1 (30 × 30) the disease incidence was lower as compared to the crop spaced at 45 and 60 cm. At 20 DAS minimum disease incidence (4.48%) was observed in S1 (30 × 30) and maximum (9.27%) was in S3 (60 × 30 cm). The crop spaced at 45 cm recorded 5.82 per cent disease incidence. A dense crop stand may have reduced whitefly populations, resulting in lower OYVMV infection and higher fruit yields (Handa and Gupta, 1993). A similar tendency was observed in the following observations, with the lowest disease incidence recorded in a 30 cm spacing crop and the highest in a 60 cm spaced crop. Similarly, Sonwane (2004) that plant spacing had no significant impact on infection rate, it did have a significant impact on disease development. Okra with a 30 x 30 cm spacing had a lower incidence and a slower development of yellow vein mosaic. A considerable rise in disease incidence was noticed when the spacing of the okra crop increased. Closely spaced patients had a lower disease incidence, whereas those with broader spacing had a higher incidence.

1.2 Date of sowing

On 15 June sown crop disease incidence started with 3.93 per cent and ended with the terminal disease incidence of 49.30 per cent. At 20 DAS disease incidence was maximum (9.05%) on 13 July sown crop while 29 June sown crop registered 6.54 per cent disease incidence. As sowing of okra was delayed significant increase in disease incidence was observed. A considerable rise in disease incidence was seen as okra sowing was delayed. Gill *et al*. (1982) also reported that different dates of sowing and plant spacing had an important role in reducing the OYVMV disease. They claimed that the disease incidence was lower in June sown crops than in July sown crops. The 13 July planted crop had the highest terminal disease incidence (73.96 percent), whereas the 15 June sown crop had the lowest disease incidence at the end. Similarly, Dahal *et al.* (1992) observed in Nepal that the onset and development of the OYVMV disease varied with crop sowing time. The disease incidence was lower (29.8%) in May sown crop as compared to June (84.1%) and August (96.2%) sown crop.

Table 1: Effect of spacing and date of sowing on disease incidence of OYVMV disease

		Per cent disease incidence at different time period (Days after sowing)					
		20	35	50	65	80	95
Spacing	S1 (30×30)	4.48 (10.92)	15.21 (22.87)	24.84 (29.81)	35.99 (36.77)	44.94 (42.05)	52.22 (46.27)
	S2 (45×30)	5.82 (13.46)	19.07 (25.79)	27.98 (31.90)	38.42 (38.28)	53.93 (47.25)	66.23 (54.69)
	S3 (60×30)	9.27 (17.43)	20.94 (27.19)	30.16 (33.25)	40.85 (39.70)	55.25 (48.01)	72.01 (58.53)
	CD (P=0.05)	(3.20)	(2.90)	(1.34)	(0.80)	(1.75)	(1.90)
	SE±	(0.91)	(0.82)	(0.38)	(0.23)	(0.50)	(0.54)
Date of sowing	D1 (15 June)	3.93 (10.22)	16.01 (23.46)	25.09 (30.00)	34.07 (35.65)	46.52 (42.96)	49.30 (44.57)
	D2 (29 June)	6.54 (14.34)	18.90 (25.66)	26.84 (31.13)	37.76 (37.89)	51.21 (45.68)	67.19 (55.24)
	D3 (13 July)	9.05 (17.24)	20.31 (26.68)	31.01 (33.82)	43.43 (41.20)	56.40 (48.67)	73.96 (59.67)
	CD (P=0.05)	(2.25)	(1.01)	(1.45)	(0.93)	(1.71)	(1.28)
	SE±	(0.75)	(0.34)	(0.49)	(0.31)	(0.57)	(0.43)

2 Effect on PDI

2.1 Row to row spacing

The disease severity was rated at 20, 35, 50, 65, 80 and 90 DAS, and PDI was calculated. There was a significant increase in PDI except S2 (45×30) and S3 (60×30) at 20 and 35 days after sowing. At 20 DAS, the lowest percent disease index (5.83%) was found in a 30 cm spacing crop, the highest (10.90%) in a 60 cm spaced crop, and the lowest (9.44%) in a 45 cm spaced crop. The terminal disease severity was lowest (48.37 per cent) in S1 (30 × 30), followed by S2 (45 × 30) (58.33 per cent), and S3 (60 × 30) (67.22 per cent). A considerable rise in PDI was noticed when the spacing of the okra crop increased. S3 (60 × 30) had the highest terminal PDI (67.22 percent). Magar (2007) found that narrower plant spacing, such as 30 x 30 cm, 50 x 30 cm, and 60 x 40 cm, had much fewer whiteflies and OYVMV illness than broader plant spacing, such as 60 x 60 cm.

Table 2: Effect of spacing and date of sowing on PDI of OYVMV disease

		Per cent disease index (PDI) at different time period (DAS)					
		20	35	50	65	80	95
Spacing	S1 (30×30)	5.83 (13.15)	10.27 (18.37)	23.19 (28.60)	29.72 (32.83)	37.64 (37.66)	48.37 (44.02)
	S2 (45×30)	9.44 (17.82)	15.41 (23.01)	25.97 (30.47)	32.91 (34.86)	46.80 (43.13)	58.33 (49.87)
	S3 (60×30)	10.90 (19.17)	17.35 (24.49)	28.47 (32.07)	36.94 (37.33)	50.55 (45.30)	67.22 (55.19)
	CD (P=0.05)	(2.26)	(2.11)	(1.64)	(0.91)	(1.40)	(2.32)
	SE±	(0.64)	(0.60)	(0.46)	(0.26)	(0.40)	(0.66)
Date of sowing	D1 (15 June)	7.07 (14.54)	12.22 (20.30)	21.11 (27.24)	26.66 (30.99)	36.11 (36.79)	47.82 (43.69)
	D2 (29 June)	8.34 (16.60)	13.75 (21.24)	24.58 (29.58)	31.38 (33.96)	44.44 (41.75)	57.91 (49.59)
	D3 (13 July)	10.76 (19.00)	17.08 (24.33)	31.94 (34.32)	41.52 (40.08)	54.44 (47.54)	68.19 (55.80)
	CD (p=0.05)	(2.10)	(1.47)	(1.45)	(0.81)	(1.09)	(1.26)
	SE±	(0.70)	(0.49)	(0.48)	(0.27)	(0.36)	(0.42)

2.2 Date of sowing

The disease severity was also impacted by the date of sowing, as shown in Table 2, which showed a substantial rise in PDI for all periods except D1 (15 June) and D2 (29 June) at 20 and 35 DAS. At 20 DAS, the lowest percent disease index (7.07%) was recorded in the 15 June planted crop, while the highest (10.76%) was observed in the 13 July sown crop. A similar phenomenon was observed by Jitu *et. al.*, 2021 that among the sowing time, the lowest disease incidence (22.56 %) was found in the first sowing (15th March), and the highest disease incidence (59.00%) was recorded in the third sowing (15th April) at 80 DAS. It was observed that as the date of sowing of okra was delayed significant increase in percent disease index was observed. It was concluded that as the date of sowing was delayed and row to row spacing was increased the incidence of OYVMV disease also increased.

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