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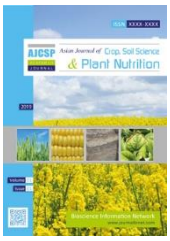

Effect of time sowing on incidence of okra yellow vein mosaic virus (OYVMV)

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ABSTRACT

A field experiment was conducted at the central farm of Sher-e-Bangla Agricultural University, Dhaka-1207, during March to August, 2018. The aim of the study was to investigate the time sowing effect on disease incidence (%) of Yellow Vein Mosaic Virus (YVMV) in the selected okra variety. The experiment was carried out in three blocks layout with RCBD comprising three different sowing times. It was observed that among the sowing time, the lowest disease incidence (22.56 %) was found in first sowing (15th March) and the highest disease incidence (59.00%) was recorded in third sowing (15th April) at 80 DAS. Yield and yield contributing characters showed significant variance among the three different sowing times. Maximum yield/ plant (0.73 kg) and plot (3.88 kg) were obtained in first sowing. The relationship study depicted that the quantity of yield and plant height had an inverse relationship with disease incidence percentage. Therefore, a suitable and proper date of sowing (15th March) is essential for higher okra production and lower disease incidence.

Key Words: *Investigate, Disease incidence, Inverse relationship and Yield contributing characters.*

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I. Introduction

Okra (*Abelmoschus esculentus*), popularly known as Lady's finger or Bhendi. It is cultivated throughout the year in tropical and warm temperate regions of the earth. Although Okra is low in calories but it contains vitamin C, vitamin K and has great medicinal value. It is very common and well distributed over the Indian subcontinent and East Asia (Rashid, 1999). Okra is a popular vegetable in different parts of Bangladesh, but it is grown with very poor land coverage. In Bangladesh, the annual okra production is 54.901 thousand metric tons from 28.106 thousand hectares of land (BBS, 2017). The production is lower than our neighbour country; in India, it produces 8896.3 thousand metric tons from 1158.0 thousand hectares of land (FAO, 2018). Yellow Vein Mosaic Virus (YVMV) is the most important factor responsible for reducing the average yield and quality of okra, as reported by (Sastry and Singh, 1974). Several viruses infect okra (Kucharek, 2004), including that causing Okra Yellow Vein Mosaic Virus (OYVMV), transmitted by the whitefly (Ali et al., 2000). Among several diseases,

yellow vein mosaic disease is the most severe one affecting the quantity and quality of the fruits (Uppal et al., 1940). YVMV reduces the yield of okra by around 20- 50% and this loss may reach up to 90% (Pullaiah et al., 1998). Yellow Vein Mosaic Virus proved to be a severe problem in Bangladesh, which can alone make the okra cultivation non-profitable (Akanda, 1991 and Ali, 1999). The systematic works on Yellow Vein Mosaic Virus have not yet been done in Bangladesh. Some sporadic works have been reported to find resistant variety or control measures (Ali 1999; Ali et al. 2000 and Rashid et al., 2005). Most of the research conducted in Bangladesh was disease survey type which listed the name of the disease, observing the field symptoms, screening the varieties against the disease under natural conditions (Akanda 1991 and Akanda et al. 1991).

There is no effective control measure against the virus in the field once it is established. The most effective method of controlling the disease is the cultivation of resistant varieties, but the resistant variety and sustainability of resistance in okra are rare. Early sowing can give maximum vegetative growth and fruit yield of okra (Ruchi, 2019). Minimum temperature and relative humidity have significant correlation with OYVMV disease severity and whitefly population. The disease incidence increased with the rise in minimum temperature and whitefly population decreased with increased relative humidity. Therefore, the research experiment was carried out to optimize the sowing time and minimize the insecticidal use for the cultivation of okra.

II. Materials and Methods

Experimental site and duration

The experiment was conducted in the central research field, Department of Plant Pathology, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207. The experiment was carried out in Kharif-1 season during March to August, 2018.

Characteristics of soil and climatic condition

The soil of the experimental site was a medium high land belonging to the Modhupur Tract under the Agro-Ecological Zone (AEZ- 28). The soil texture was silty loam with a pH of 6.7. The weather condition of the experimental field was under the sub-tropical monsoon climate, which is heavy rainfall during Kharif season (May-September) and scanty in the rabi season (October-March). The average maximum temperature of the experimental site was 33.7^{0}C and the average minimum temperature was 20.4 ^{0}C.

Planting materials used for experiment

Okra variety, namely Green Finger was used as planting material in the study. The seeds of okra were collected from the local market.

Experimental design

The experiment was laid out in a randomized complete block design (RCBD) in three blocks comprised 8 unit plot and total number of plots were 24 (8 X 3=24). Size of each unit plot was 6 m^2 and each plot contained 22 plants. The distance between unit plots was 0.70 m and blocked to 1 m.

Land Preparation and Fertilizer Application

The selected land for the experiment was ploughed and cross-ploughed several times with a power tiller, laddering was done to obtain good tilth and the experimental plot was separated into the unit plots. The whole amount of cow dung, TSP, MP and one third of urea were applied at the time of final land preparation @Cow dung 14 ton/ha, TSP 150 kg/ha, MP 150 kg/ha and Urea 150 kg/ha. The rest amount of urea was applied as top dressing in two equal installments.

Seed sowing

In this study, seeds were sown three times, the first sowing was on 15th March, the second on 30th March and the third on 15th April, respectively. Seeds were sown in rows of raised beds. Row to row and plant to plant spacing was maintained at 50 cm and 45cm, respectively.

Management Practices

Several intercultural operations such as thinning of plants, gap filling, weeding and mulching, irrigation and drainage were practiced as per necessity to keep the plants healthy.

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Data Collection

The data were collected on different morphological parameters from the selected plants; following parameters were documented-

I.	Disease incidence percentage	VI.	Number of fruits/ plant
II.	Number of fresh leaves/plant	VII.	Fresh fruit weight (Kg)
III.	Number of infected leaves/ plant	VIII.	Fruit yield (Kg)
IV.	Number of vectors/ leaf	IX.	Plant height (cm)
V.	Number of flowers/ plant	X.	Root length (cm)

Based on studying of typical symptoms of okra yellow vein mosaic virus tested of okra plant were described by Capoor and Verma (1950), Begum (2002) and Hossain (1998). The okra plants were observed regularly until harvest. Moreover, the symptom was recorded found in the okra plants. The growth stage of the okra plants was categorized as follows-

i. Early stage - 5 weeks after seed sowing
ii. Mid stage - 5 weeks after early stage and
iii. Late stage - after mid stage up to harvest.

The disease incidence was expressed in percentage based on crop growth stages as well as an average of three stages. The percent of disease incidence was calculated by using the following formula.

$$\text{Disease incidence (\%)} = \frac{X1}{X} \times 100$$

Where,

X = Total number of plants
X1 = Number of infected plants

Statistical analysis of data

Computer based software Statistix- 10.0 was used to analyze data obtained from the study. Tables, graphs and bar diagrams were used to present analyzed data according to necessity.

III. Results and Discussion

Effect of three different sowing time on disease incidence percentage at 40, 60 and 80 days after sowing (DAS)

Seeds were sown three times; the first sowing was done on 15th March, the second sowing on 30th March and the third sowing on 15th April, 2018. From the study, it was observed that disease incidence was significantly influenced by sowing time, the highest disease incidence (7.50%) was recorded in 3rd sowing followed by 1st sowing (3.21%) and 2nd sowing (2.09%) at 40 DAS, respectively. At 60 DAS, the highest disease incidence (22.15%) was recorded in 3rd sowing, followed by 1st sowing (10.65%) and 2nd sowing (9.59%), respectively. It was noted that the disease incidence in 1st and 2nd sowing was statistically similar at 60 DAS.

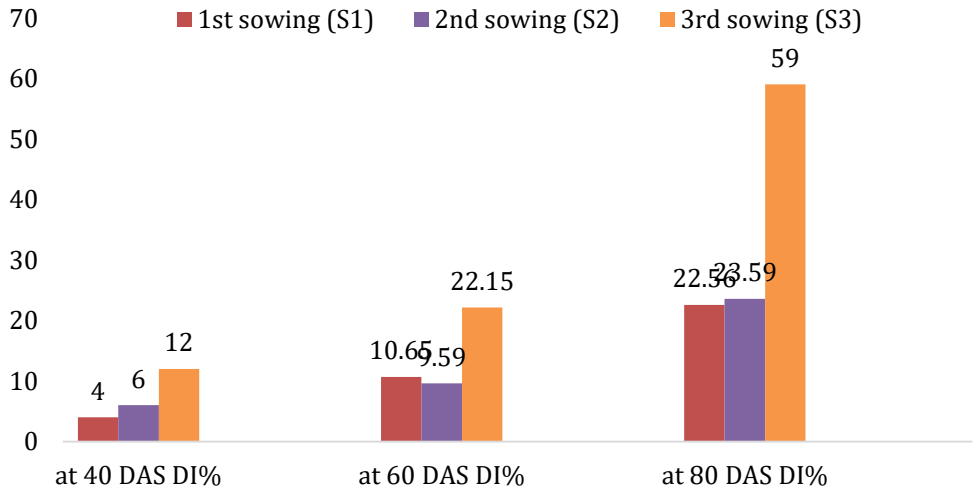

Figure 01. Effect of three different sowing times on the (%) disease incidence of (OYVMV) at 40, 60 and 80 days after sowing.

It was also observed that among the three different sowing dates, the highest disease incidence (59.00%) was recorded in 3rd sowing followed by 2nd sowing (23.59%) and 1st sowing (22.56%) at 80 days after sowing, respectively. It was also noted that percent disease incidence in 1st and 2nd sowing was statistically similar at 80 DAS. The results mentioned above revealed that the highest disease incidence was recorded in 3rd sowing (on 15th April) in each observation. These results are presented in (Figure 01).

Whitefly association per leaf at three different sowing time

The maximum amount of whitefly association (12.00) per leaf of okra plant was counted in third sowing (S3) and minimum number (4.00) of whitefly association per leaf was counted in first sowing (S1). In second sowing (S2), whitefly association per leaf counted was higher than 1st sowing (6.00) and less than 3rd sowing (4≥6≤12). Results of whitefly association are presented in (Figure 02).

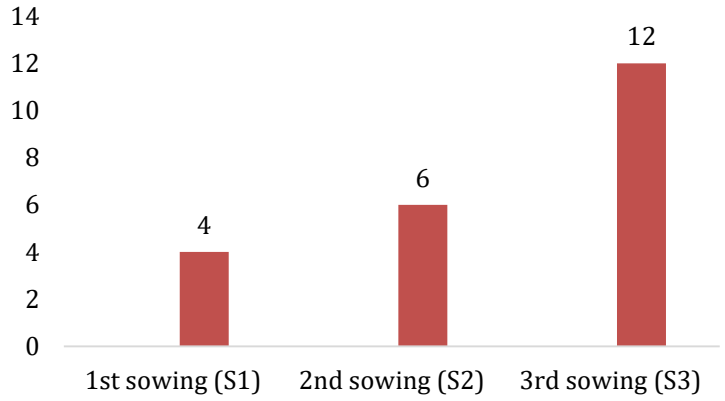

Figure 02. Whitefly association per leaf at different sowing time

Effect of different sowing time on morphological characters of okra plant against Yellow Vein Mosaic Virus (YVMV)

Early infection of OYVMV causes a drastic reduction of all the growth contributing character of all the okra varieties. The extent of damage in different growth contributing characters was largely dependent upon the stage of infection of OYVMV, condition of growing seedlings and okra varieties. The almost same phenomenon with the OYVMV infection was noted by Gupta (2000).

Number of leaves per plant: The maximum number (22.63) of leaves per plant was counted in first sowing (S1) and minimum number (14.09) of leaves per plant was counted in third sowing (S3). In second sowing (S2), moderate number (15.40) of leaves per plant observed that was lower than 1st sowing (22.63) but higher than 3rd sowing (14.09). These results are presented in (Table 01).

Number of flowers per plant: The maximum number (26.89) of flowers per plant was counted in first sowing (S1) and minimum number (11.89) of flowers per plant was counted in third sowing (S3). In second sowing (S2), moderate number (16.96) of flowers per plant observed that was lower than 1st sowing (26.89) but higher than 3rd sowing (16.96). These results are presented in (Table 01).

Number of fruit per plant: The maximum number (22.73) of fruits per plant was counted in first sowing (S1) and minimum number (9.27) of fruits per plant was counted in third sowing (S3). In second sowing (S2), moderate number (13.50) of fruits per plant observed that was lower than 1st sowing (22.63) but higher than 3rd sowing (9.27). These results are presented in (Table 01).

Table 01. Effect of sowing time on the number of leaves, flowers and fruits per plant

Sowing time	No. of leaves/plant	No. of flowers/plant	No. of fruits/plant
1st sowing (S1)	22.63 a	26.89 a	23.73 a
2nd sowing (S2)	14.39 b	16.96 b	13.50 b
3rd sowing (S3)	15.09 b	11.89 c	9.27 c
CV%	10.18	10.18	12.85
LSD(0.05)	2.02	2.16	3.54

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Effect of three different sowing time on yield

Yield (kg/plant): In first sowing (S1), maximum yield (0.73 kg) per plant was observed. In second sowing (S2), yield (0.72 kg) per plant was recorded. In third sowing (S3), minimum yield (0.67 kg) per plant was observed. Among the three different sowing times, comparatively in third sowing (S3) yield per plant (kg) was less. Because of different sowing time, yield per plant was (kg) varied respectively. The results are presented in (table 02).

Yield (kg/plot): Maximum yield (3.88 kg, 3.86 kg) per plot was recorded in first sowing (S1) and second sowing (S2). In third sowing (S3), minimum yield (2.19 kg) per plot (kg) was observed. Among the three different sowing times, comparatively, in 3rd sowing (S3) yield per plot (kg) was less than the 1st sowing and 2nd sowing. Because of different sowing time, yield (kg) per plot was varied, respectively. The results are presented in (table 02). The highest yield on each plot and plant was registered in S1 (first sowing) and S_2 (second sowing). Regarding in yield and yield contributing characters, only early sowing gave the best result. Where the lowest yield per plant/plot was recorded in S_3 (third sowing). The present findings are same as Moniruzzaman and Uddin (2007), who recommended that the highest germination percentage and seed vigour index was obtained from 15th February and 15th March sowing because the fruits faced less rainfall during their harvesting period compared to others.

Table 02. Effects of sowing time on yield

Sowing time	Yield per plant (kg)	Yield per plot (kg)
1st sowing (S1)	0.73 a	3.88 a
2nd sowing (S2)	0.72 a	3.86 a
3rd sowing (S3)	0.67 b	2.19 b
CV%	18.28	23.35
LSD (0.05)	0.02	0.88

Plant height in cm and root length in cm

In first sowing (S1), maximum plant height (105.84) was observed. In second sowing (S2), plant height (85.92) was recorded. In third sowing (S3), minimum (74.18) was observed. Among the three sowing, comparatively in third sowing (S3), plant height per plant was less than the 1st sowing and 2nd sowing. Because of different sowing time, plant height per plant was varied respectively. In first sowing (S1), maximum plant height (105.84) was observed. In second sowing (S2), plant height (85.92) was recorded. In third sowing (S3), minimum (74.18) was observed. The results are presented in (Table 03).

Table 03. Effect of sowing time on plant height (cm) and root length (cm)

Sowing time	Plant height (cm)	Root length (cm)
1st sowing (S1)	105.84 a	30.71 a
2nd sowing (S2)	85.92 b	20.73 b
3rd sowing (S3)	74.18 c	14.40 c
CV%	10.89	12.23
LSD (0.05)	11.07	3.07

Effect of sowing time between disease incidence (%) and yield per plot (kg)

The relationship study between DI% and yield of okra plants revealed that when disease incidence increased, the yield of okra decreased. There was a negative relation between disease incidence and yield of okra. In late sowing there were highest DI% with lowest yield (Figure 03).

Effect of sowing time between disease incidence (%) and yield (t/ha)

The relationship study between DI% and yield (t/ha) of okra plants depicted that when disease incidence is increased, the quantity of okra per ha is decreased. There is an inverse relation between DI% and yield (t/ha) (Figure 04).

Relationship between DI% and plant height (cm)

From the relationship study between DI% and plant height (cm), it was revealed that when disease incidence is increased, the height of okra plant is decreased. When plant height is maximum, DI% is minimum (Figure 05).

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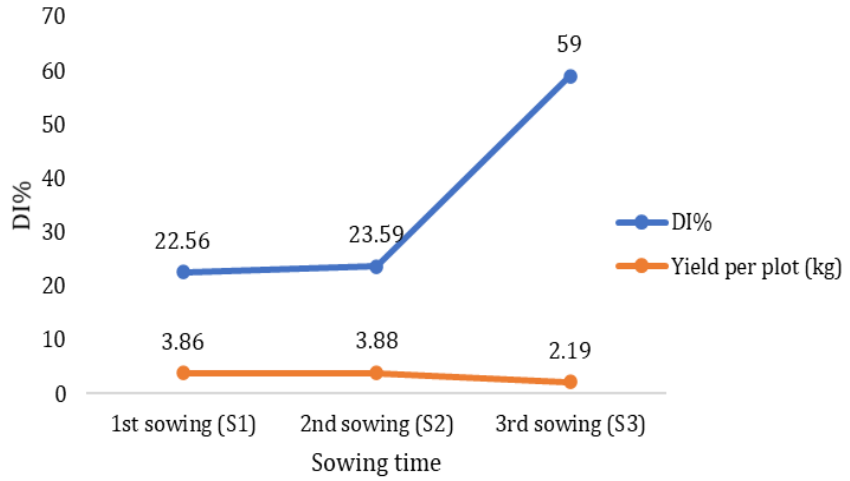

Figure 03. Relationship between DI %, yield and sowing time

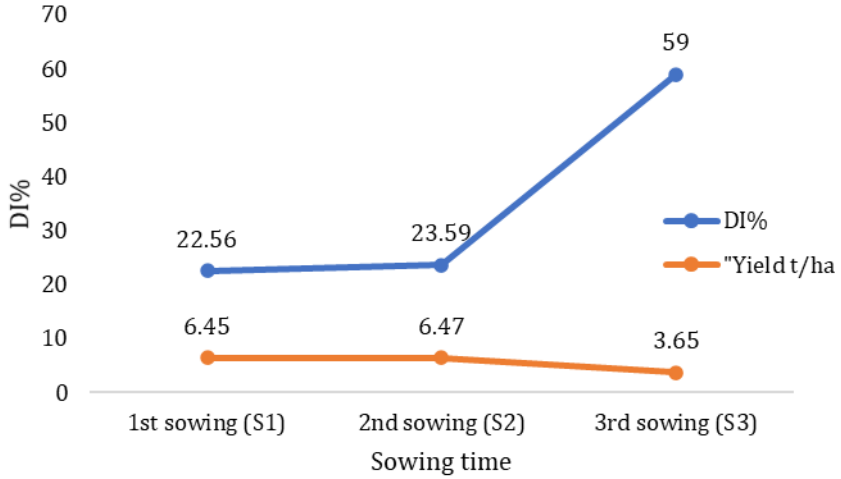

Figure 04. Relationship between DI %, sowing time and yield (t/ha)

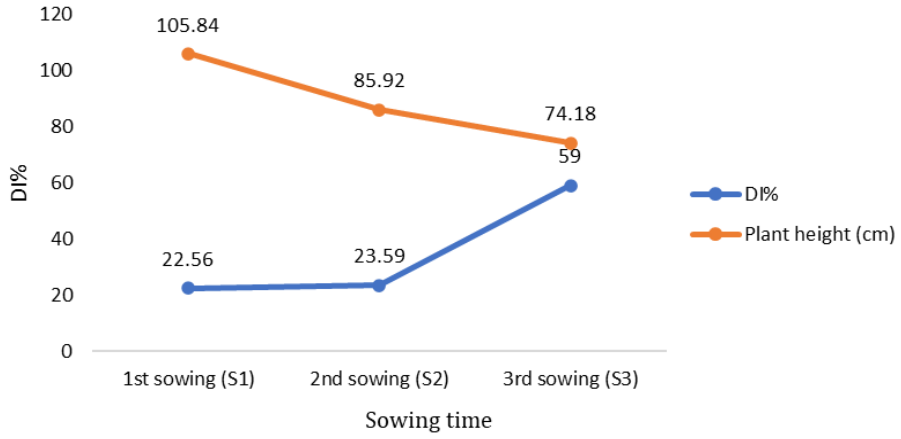

Figure 05. Relationship between DI%, sowing time and plant height (cm)

IV. Conclusion

The study was to investigate the time sowing effect on disease incidence (%) of Yellow Vein Mosaic Virus (YVMV) in selected okra variety. Seeds were sown in three different sowing times at an interval 15 days. It was observed that among the three different sowing times, the lowest disease incidence (22.56%) was found in 1st sowing (on 15 March) and the highest disease incidence (59.00%) was found in 3rd sowing (on 15 April) at 80 DAS. In 2nd sowing (on 30 March), the disease incidence (23.59%) was moderate. In case of morphological parameters, the highest number of leaves, flowers and fruits per plant was recorded in first sowing (on 15 March) which was 22.63, 26.89 and 23.731 per plant, respectively. Yield and yield contributing characters showed significant variation among the

three different sowing times. The study may conclude that the month March is suitable for okra seeds sowing to avoid the insect vectors and get the best okra production.

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