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HOST RESISTANCE OF PUMPKIN GERMPLASMS AGAINST MOSAIC DISEASE

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ABSTRACT

Pumpkin common mosaic caused by number of viruses which includes Cucumber mosaic virus (CMV), Watermelon mosaic virus 2 (WMV2), Papaya ring spot virus-watermelon strain (PRSV-W), and Zucchini yellow mosaic virus (ZYMV) and Pumpkin yellow vein mosaic disease caused by Pumpkin yellow vein mosaic virus (PYVMV) have appeared as the most important, serious and often overwhelming diseases of pumpkin throughout India (FAOSTAT, 2010, Jayashree, 1999). Out of 6 pumpkin germplasms tested, two cultivars were found resistant (R), 2 moderately resistant (MR), and two moderately susceptible (MS). Minimum incidence 17.16 % was recorded from variety Kumra (a local variety very recently being introduced in this locality) followed by variety Pusa-shrabani 24.28 %. Significant differences among all the varieties were observed in terms of their response to common mosaic disease. Pumpkin variety, Kumra and Pusa-Shrabani can be considered as prominent varieties against common mosaic under the environmental conditions of lateritic zone of West Bengal.

Keywords: Pumpkin, screening, resistant cultivar, CMV, WMV2.

INTRODUCTION

Various types of vegetables under a wide range of agro-climatic conditions are grown in India and is recognized globally as a major player in vegetables. India is the second largest producer of vegetables in the world, next only to china and produces around 90.75 million MTs of vegetables which accounts for nearly 9.64% of country's share in the world production of vegetables (Muniyappa, 2003). The contribution of West Bengal in India in terms of vegetable production is quite satisfactory as it occupies 18.65 per cent of the total area and 19.44 per cent vegetable production. Cucurbits are vegetable crops belonging to the family Cucurbitaceae, which primarily comprised species consumed as food worldwide. The family consists of about 118 genera and 825 species. Cucurbits share about 5.6% of the total vegetable production of India and according to FAO estimate, cucurbits were cultivated on about 4,290,000 ha with the productivity of 10.52 tones /ha (Rai, 2008). Pumpkin (*Cucurbita moschata*) is an important cucurbits as well as cash crop which is well known among farmers in many

localities. Pumpkins are grown all around the world for a variety of reasons ranging from agricultural purposes (such as animal feed) to commercial and ornamental sales. Whitaker and Bemis (Whitaker, 1975) assigned a key role to *Cucurbita moschata* as the nearest putative ancestor of the genus *Cucurbita*. The major exports of pumpkin from India are going to UAE (74.32%), Bangladesh (6.5%), Nepal (4.5%), UK (8.5%) and Malaysia (7.3%) etc. In India pumpkin are mostly grown in states like Andhra Pradesh, Maharashtra, Uttar Pradesh, Bihar, Orissa and West Bengal. Pumpkin is grown in summer and winter season in Northern India and in South India it is grown in winter season. In West Bengal, pumpkin is the principle crop and mainly grown in winter season. One hundred grams pumpkin provides 450 mcg of beta- carotene (Emmons, 1999). Beta-carotene, found in pumpkin, is a powerful antioxidant as well as an anti-inflammatory agent (Treutter, 2006). Increase in cultivated area and availability of a wide range of new verities of cucurbits will not lead to much advances unless and until proper attention has been paid on disease and pest problems, as most of the cucurbits are severely attacked by large number of insect pests and diseases of which viruses play a significant role in declining the cucurbit production. Among the viral diseases, mosaic, latent mosaic and yellow vein mosaic disease are the most important ones. Considering the immense economic significance of pumpkin mosaic disease, investigations are being carried out both at national and international levels of different aspects of this disease with major emphasis on the management. The chemical management of the vector is not cost-effective since numerous sprays of insecticides are required to control aphid. Recurrent spraying also lead to health danger and ecological influence. On the contrary, use virus resistant/ tolerant varieties are the best approach to alleviate occurrence of mosaic disease in areas where the infection is a major constraint to production. The reasonable, robust and perfect method of controlling viral disease is regarded as the use of resistant crop varieties. Plants disease resistance protects plant from pathogen in two ways: by pre-formed structures and chemicals, and by infection responses of the immune system. Many researchers evaluated different cultivars of pumpkin against the mosaic disease in different countries (Rashid, 2002, Brown 2003, Moura, 2005) but, information in the context of India is very scanty. Considering the potentiality of the spread of mosaic disease of pumpkin and its annual recurrent, the present investigation has been undertaken with a view to study the genetic resistance of various pumpkin germplasms against mosaic disease of pumpkin.

METHODS AND MATERIALS

Design of the Experiment

Experiments were conducted at Raipur farmer's field and accordingly layout and design were fixed separately for each of the experiment. For conducting the experiment on screening of different pumpkin varieties against mosaic disease six varieties i.e. Chaitali, Pusa-Shrabani, Kumra, Chandipur-25, Pusa- Padini and Rani-Round were sown following the Randomized Block Design with four replications for each treatment (Fig. 1).

Screening of Pumpkin Germplasms for Resistance against Mosaic Disease

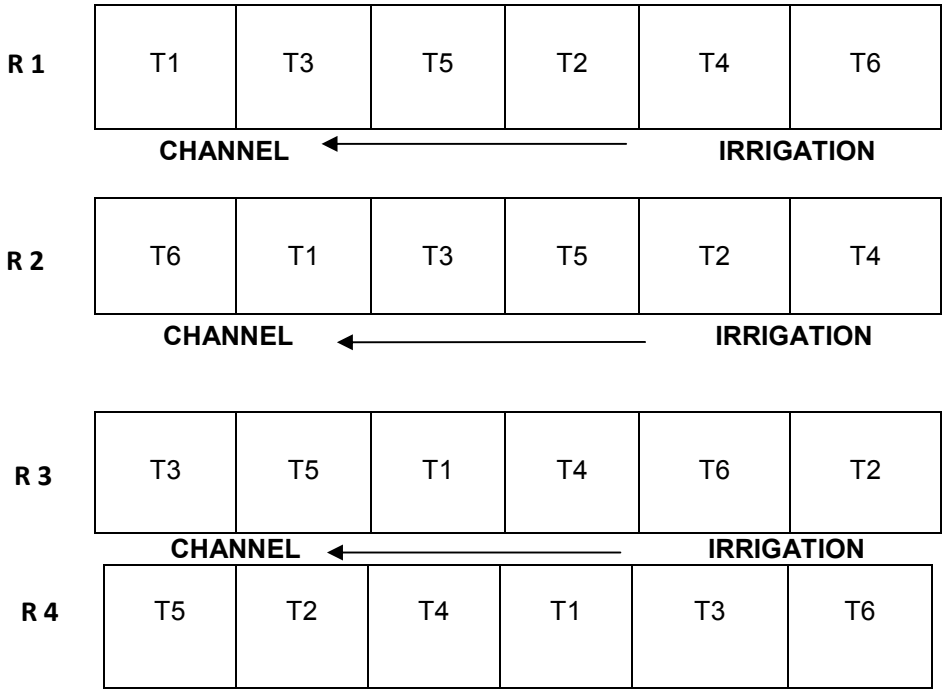
Six varieties of pumpkin i.e. Chaitali, Pusa-Shrabani, Kumra, Chandipur-25, Pusa- Padini, Rani-Round were grown in the farmers field of Raipur village. To record the initial infection of mosaic disease in different varieties, all plants were examined properly after sowing. Incidence of the pumpkin

mosaic disease was recorded at an interval of fifteen days after appearance of first disease symptoms and it was continued up to the senescence of crop. The interval between the date of sowing and the appearance of first symptoms in different varieties and the period from the initial appearance of symptoms and the final incidence of the disease were also considered. Apparent infection rate of spread of the disease was calculated according to the following formula (Van der Plank, 1963).

$$R = \frac{2.3}{t_2 - t_1} \left\{ \text{Log} \left(\frac{X_2}{1-X_2} \right) - \text{Log} \left(\frac{X_1}{1-X_1} \right) \right\}$$

Where,

r = Apparent infection rate at exponential growth stage
t_1 = First day of observation
t_2 = Last date of observation
X_1 = Production of the disease on first day of observation
X_2 = Production of the disease on last day of observation



Size of each plot = 5×2 sq m. Row to row distance = 1 m.
Plant to plant distance = 45 cm. Irrigation channel = 90 cm.
T1= Chaitali, T2 = Rani-round, T3 = Chandipur-25,
T4 = Pusa-padini, T5 = Pusa-shrabani, T6 = Kumra

Fig. 1. Lay out of the experiment- Screening of Pumpkin genotypes against mosaic disease

Disease infection was scored on 1-5 arbitrary scale as described by (Rashid, 2002). The following scoring scale (1-5) was followed to determine the response of pumpkin to mosaic diseases.

Disease scoring scale (1-5) for Pumpkin mosaic diseases

Points	Reaction Grade	Reaction Group
1.	Highly Resistance (HR) (0% infection, all plants free of symptoms)	I
2.	Resistance (R) (1-25 % plants infected with PMD)	II
3.	Moderately Resistance (MR) (26-50 % plants infected with PMD)	III
4.	Moderately Susceptible (MS) (51-75 % plants infected with PMD)	IV
5.	Susceptible (S) (76-100 % plants infected with PMD)	V

RESULTS AND DISCUSSION

Screening of Pumpkin Germplasms for Resistance against Mosaic Disease

Six germplasms of pumpkin i.e. Chaitali, Pusa-Shrabani, Kumra, Chandipur-25, Pusa- Padini, Rani-Round were grown under natural environmental condition at farmer's field of Raipur village to evaluate their resistance against common mosaic diseases of pumpkin. To determine the response of pumpkin genotype against the disease, the germplasms were assessed on the basis of scoring scale (1-5) and the data obtained are presented in Table 1. The symptoms of common mosaic disease (CM) was appeared in the field within 115 to126 days of sowing in all varieties and the incidence of common mosaic varied greatly within the germplasms. The first symptoms was developed in variety, Chaitali (115 DAS) which was minimum among all the varieties. While, it took maximum (126 DAS) in variety Kumra. Out of six pumpkin varieties, two cultivars were found resistant (R), 2 moderately resistant (MR), and two moderately susceptible (MS). Minimum incidence 17.16% was recorded from variety Kumra (a local variety very recently being introduced in this locality) followed by variety Pusa-shrabani 24.28% and both found resistant (R) against common mosaic disease. Whereas, variety Rani-Round Chandipur-25 exhibited 32.48% and 41.26% incidence respectively and found moderately resistance (MR) against the disease. Other two varieties i.e. Pusa-Padini and Chaitali were found to be moderately susceptible (MS), showed 55.25 % and 65.44 % disease incidence respectively. Variety Chaitali (a common variety of pumpkin having maximum cultivated area in this region) bears much susceptibility against the disease (65.44%) and differ significantly from other varieties. All the varieties differ significantly in their response towards the disease but, the correlation in between the intervals of first appearance of natural symptoms of common mosaic in field and final incidence of the disease in different varieties was found insignificnt (Fig. 2). The

Table 1. Screening of pumpkin germplasms for their resistance against common mosaic disease

Sl. no.	Variety	Time taken for developing 1st disease symptoms in field	Date of 1st appearance of disease symptoms	Date of final incidence of the disease	Incidence range %	Disease incidence %	Apparent infection rate of the disease	Symptoms	Reaction grade	Reaction group
1.	Chaitali	115 days	02.03.2015	25.04.2015	5.40-65.44	65.44	0.064	CM	MS	V
2.	Rani-round	119 days	06.03.2015	27.04.2015	2.0-32.48	32.48	0.060	CM	MR	III
3.	Chandipur-25	121 days	08.03.2015	02.05.2015	2.80-41.26	41.26	0.057	CM,	MR	III
4.	Pusa-padini	118 days	05.03.2015	30.04.2015	3.20-55.25	55.25	0.064	CM	MS	IV
5.	Pusa-shrabani	124 days	11.03.2015	05.05.2015	4.33-24.28	24.28	0.035	CM	R	II
6.	Kumra	126 days	13.03.2015	04.05.2015	2.60-17.16	17.16	0.039	CM	R	II
SE (treatment mean)		*1.579*				*1.758*	*0.000258*			
CD at 5% =		*4.759*				*5.299*	*0.000778*			

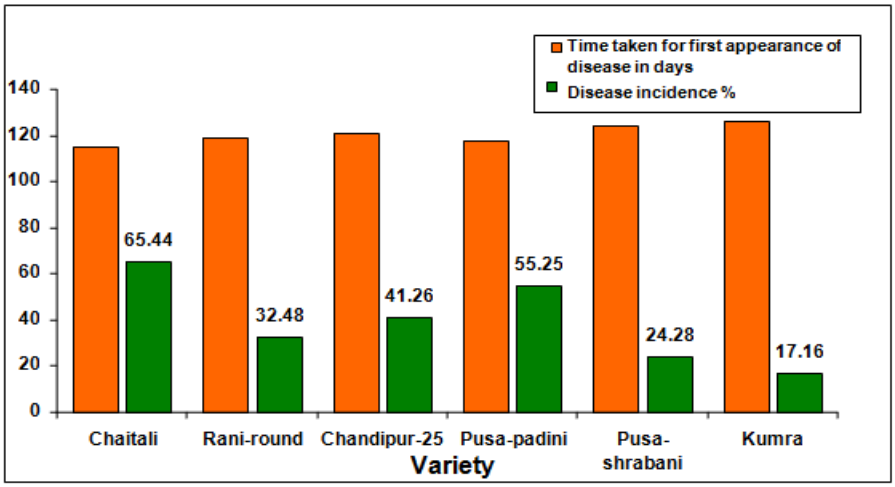


Fig. 2. Relationship between time taken for first disease appearance and disease incidence in field

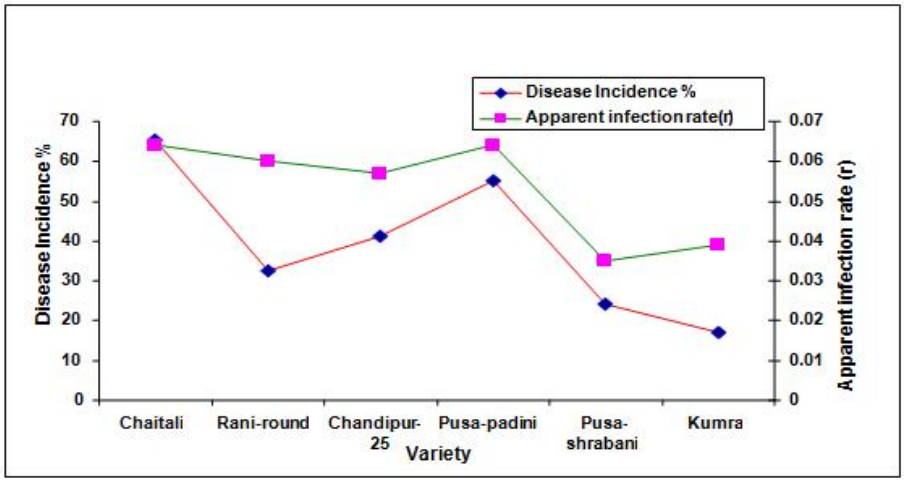


Fig. 3. Relationship between disease incidence and rate of infection of common mosaic disease

infection rate (r) of common mosaic was found maximum (0.064) in variety Chaitali and Pusa-padini followed by Rani-round Pusa – Shrabani (0.035). Minimum infection rate (0.039) was observed in variety Kumra which have shown maximum resistance against the disease in field (Fig. 3). The varietal characters i.e. medium plant height, medium size of leaf, and dark green leaf colour could be the reasons for minimum infection of common mosaic disease in variety Kumra (resistant) as it attract lesser number of aphid vectors (Plates 1 and 3). While, bigger leaf size, mild green colour, erect plant growth habit and presence of more older yellow leaves in plants would be the reasons of disease proneness in variety Chaitali and Pusa Padni (moderately susceptible) Plate 2. Pumpkin genotype Kumra and Pusa-Shrabani can be

considered as prominent varieties against common mosaic under the environmental conditions of lateritic zone of West Bengal.

Plate 1. Variety Kumra, a local variety with dark green leaves exhibited Maximum resistance (R)

Plate 2. Variety Chaitali, a local variety exhibited Maximum disease incidence in field (MS)

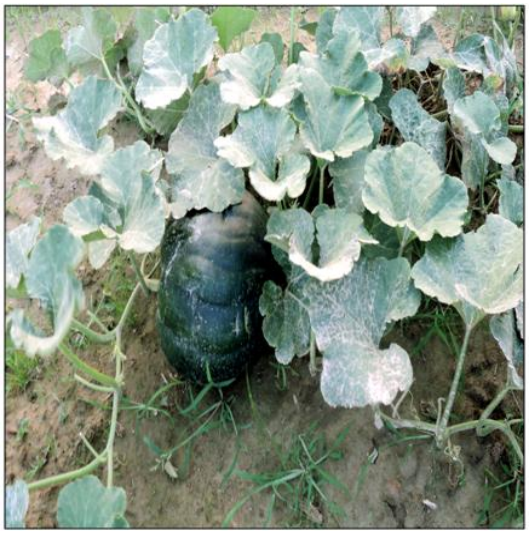


Plate 3. Kumra, a suitable pumpkin variety found most suitable in this region

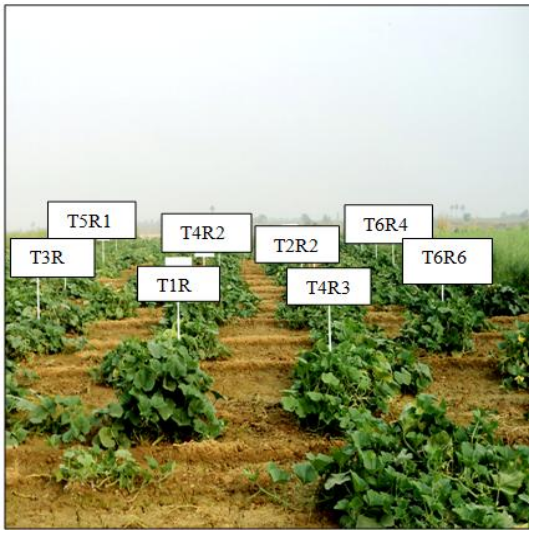


Plate 4. Experimental field: Screening of pumpkin genotypes against pumpkin mosaic disease

SUMMARY AND CONCLUSION

Six germplasms of pumpkin i.e. Chaitali, Pusa-Shrabani, Kumra, Chandipur-25, Pusa- Padini, Rani-Round were seeded under natural environmental conditions for evaluating their resistance against common mosaic disease. Out of six pumpkin varieties, two cultivars were found resistant (R), 2 moderately resistant (MR), and two moderately susceptible (MS). Minimum incidence 17.16% was recorded from variety Kumra (a local variety very recently being introduced in this locality) followed by variety Pusa-shrabani 24.28% and both found resistant (R) against common mosaic disease. Minimum infection rate (0.039) was observed in variety Kumra which have shown maximum resistance against the disease in field. Pumpkin genotype Kumra and Pusa-Shrabani can be considered as prominent varieties against common mosaic under the environmental conditions of lateritic zone of West Bengal. This information will help the farmers for selecting the resistant cultivar for maximize the profit in pumpkin cultivation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

References

Brown, R. N., Bolanos, H. A., Myers, J. R., Jahn, M. M. 2003. Inheritance of resistance to four cucurbit viruses in *Cucurbita moschata*. Euphytica. 129(3): 253-258.

Emmons, C.L. and Peterson, D.M. (1999) Antioxidant activity and phenolic contents of oats groats and hull. Cereal Chem. 76:902-906.

FAOSTAT 2010. Statistics Division FAO. FAO Statiscal Yearbook. Available:http://www.faostat.fao.org

Jayashree, K., Pun, K.B. and Doraiswami, S. (1999). Virus-vector relationship of yellow vein mosaic virus and white fly (*Bemisia tabaci*) in pumpkin. India Phytopthol. 52:10-13.

Moura,-M-da-C-C-L, Zerbini,-F-M, Silva,-D-J-H-da and Queiroz,-M-A-de. 2005. Identification of pumpkin populations as resistance sources against the *Zucchini yellow mosaic virus* (ZYMV). Horticultura-Brasileira. 23(2):206-210

Muniyappa, V., Maruthi, M.N., Babitha, C.R., Clovin, J., Briddon, R.W., Rangaswamy, K.T. (2003) Characterization of pumkin yellow vein mosaic virus. Ann Appl Biol. 142:323-331.

Rai, M., Pandey, S., and Kumar, S., (2008) IIVR: Cucurbit research in India: a retrospect. Proceedings of the IXth EUCARPIA meeting on genetics and breeding of Cucurbitaceae (Pitrat M, ed), INRA, Avignon (France).

Rashid, M.A., Masud, M.A.T., Sulatana, N.A., Ahmed, B.; Luther, G., Black, L.L. and Wang, J.F. 2002. Screening of pumpkin germplasm against watermelon mosaic 2 poty virus (WM2V). IPM CRSP, ANNUAL REPORT, no. 9:91-92.

Treutter, D. (2006) sinnificance of flavonoids in plant resistance. Environ chem. Lett. 4(3):147-157.

Van der Plank, J.E. (1963). 'Plant diseases: Epidemics and control. Acad. Press, New York, 349.

Whitaker, T.W. and Bemis, W.P. (1975) Bull. Torrey Bot. Club. 102:362-368.