



Evaluation of Pumpkin Cultivars against Cucumber Mosaic Virus Disease under Field Condition

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Authors' contributions

This work was carried out in collaboration among all authors. 'All authors worked together to complete this work. All authors read and approved the final manuscript.

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ABSTRACT

The family Cucurbitaceae includes pumpkin (*Cucurbita moschata* Duch.), one of the most significant vegetable crops cultivated both in India and overseas. Various biotic and abiotic factors affect pumpkin production, and one of the biggest threats to its cultivation is the cucumber mosaic virus disease. An experiment was conducted in the experimental field of the Department of Plant Pathology, Biswanath College of Agriculture, Assam Agricultural University, Assam during 2022–2023 with the aim of screening out various varieties of pumpkin and identifying the one that was most resistant to cucumber mosaic virus in view of the disease's significance. Out of eighteen pumpkin cultivars evaluated against cucumber mosaic virus disease, six were moderately susceptible, eleven were susceptible and one cultivar was observed to be highly resistant against the disease.

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Keywords: Pumpkin, cucumber mosaic virus; screening; moderately resistant; susceptible; highly resistance.

1. INTRODUCTION

Pumpkin (*Cucurbita moschata* Duch) is one of the important vegetables in Indian cuisine and belongs to the family Cucurbitaceae. Pumpkin fruit is rich in vitamins and minerals but low in calories. Pumpkin is loaded with a wide range of biological and medicinal values such as anti-inflammatory, anti-oxidant, anti-cancer, anti-angiogenesis, and anti-diabetic activities [1]. Most often it is used as a functional food and herbal medicine. Besides fruits, all other parts of pumpkin plants, i.e., seeds, fruits, and stems contain broad nutritional and medicinal values such as high amounts of β -carotene, and moderate amounts of carbohydrates, vitamins, and minerals [1].

Pumpkin crop suffer from a number of biotic and abiotic stresses. A number of insect pests and diseases attack pumpkin crop causing heavy losses in yield. Among various diseases attacking the crop cucumber mosaic virus disease caused by Cucumber Mosaic Virus (CMV) is becoming the most serious disease in pumpkins in recent years. CMV possesses quite distinctive polyhedral particles with a hollow core that are generally 30 nm in size [2]. The three plus sense single-stranded RNAs that are bundled in distinct particles constitute the genome. CMV particles contain about 18% RNA. There are four RNAs in the RNA. To be infectious, only the biggest RNA3 is necessary.

Cucumber Mosaic Virus infects over 1000 susceptible plant species including monocots, dicots, herbaceous plants, shrubs, and trees. CMV is efficiently transmitted by several aphid species in a non-persistent manner. The most important aphid species are the *Aphis gossypii* and *Myzus persicae*. It has also been reported that the virus can spread through pumpkin seeds [3]. Sap and dodder can also mechanically convey it.

Instances of the cucumber mosaic virus disease have been documented in various pumpkin-growing regions in India and Assam. In Assam, there is little information available regarding the evaluation of local pumpkin germplasm for viral resistance. The current investigation aimed to test the available pumpkin germplasm for CMV resistance.

2. MATERIALS AND METHODS

2.1 Location of the Experiment

The experiment was conducted in the post-graduate experimental field, Department of Plant Pathology, Biswanath College of Agriculture, Biswanath Chariali, Assam Agricultural University, Assam during 2022-23.

2.2 Collection of Pumpkin Germplasm

Seeds of different pumpkin cultivars (local) were collected from six districts of Assam viz., Dima Hasao, Karbi Anglong, Barpeta, Sonitpur, Sivasagar, Kamrup (R), and Shillong of Meghalaya (Fig. 1).

2.3 Experimental Materials and Design

The land was prepared by ploughing with a tractor-drawn disc plough. Seeds were sown at a distance of 1m from plant to plant and 2.5m between rows in a randomized complete block design with three replication only to observe the disease symptoms according to the scale followed by Akbar et al. [4].

2.4 Data Collection and Analysis

After sowing, each plant was thoroughly examined for disease symptoms in order to document the infection of the cucumber mosaic disease in several cultivars. When the first symptoms of the cucumber mosaic disease appeared, its incidence was regularly monitored until the senescence of the crop. Disease scoring was done by the scale following by Akbar et al. [4] method and the cultivars were categorized based on the reaction against the CMV disease.

Disease rating scale by Akbar et al. [4]:

- 1 = Highly Resistant (no symptoms; 0% - 10% infection);
- 2= Resistant (vein clearing after sometime; 11%-20%);
- 3 = Moderately Resistant (vein clearing and mild mottle; 21% - 30%);
- 4 = Moderately Susceptible (mild mosaic on few leaves; 31% - 40%);
- 5= Susceptible (mosaic, wrinkling, mottling; >60%).

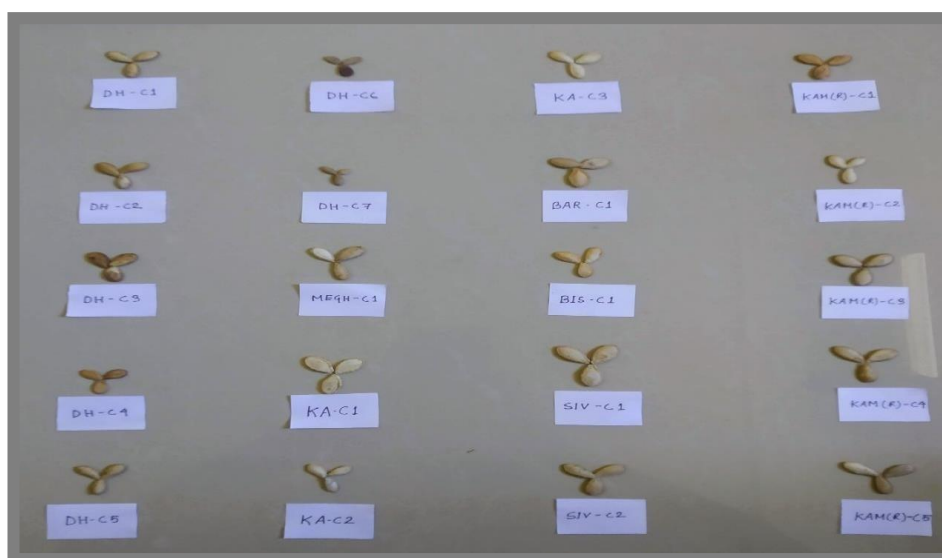


Fig. 1. Pumpkin seeds collected from different districts and states

3. RESULTS AND DISCUSSION

Pumpkin cultivars collected from different places in Assam and Meghalaya were evaluated for their reaction against cucumber mosaic virus disease and the result is presented in Table 1. From the table, it is evident that most of the cultivars fall in susceptible and moderately susceptible ranges except cultivar MEGH-C1 which was highly resistant to the disease. Cultivar DH-C1, DH-C4, DH-C6, DH-C7, KA-C2, BAR-C1, BIS-C1, SIV-C2, KAM(R)-C1, KAM(R)-C2 and KAM(R)-C4 were categorized as susceptible whereas cultivar DH-C3, DH-C5, KA-C3, SIV-C1, KAM(R)-C3 and KAM(R)-C5 were moderately susceptible against Cucumber Mosaic Virus.

A similar to the current study by Lebeda et al. [5] was done and they have reported that seven and eighteen days later, after mechanical inoculation of the virus, the cotyledons and true leaves of the seedlings were evaluated for symptoms. There was a noticeable variance in resistance. Only a small percentage of cultivars lacked visible signs of infection. Thirteen *Cucurbita maxima* cultivar and one *Cucurbita pepo* cultivar both exhibited great resistance. In general, it can be said that *Cucurbita maxima* is more resistant to CMV than *Cucurbita pepo*. In the study of similar kinds by Rahman et al. [6], the incidence of CMV varied between 3.00 and 21.21 percent depending on the variety among the eleven chili cultivars that were examined. CMV incidence varied among cultivars, with the lowest being 3.0% and the greatest being 21.21%. Al-Ani et al. [7] reported

that among twelve melon cultivars evaluated against CMV, only three cultivars showed resistance against the virus. In the study by Masud et al. [8], forty pumpkin lines showed resistance to CMV, papaya ring spot virus, watermelon mosaic virus, and zucchini yellow mosaic virus evaluated through artificial inoculation in the field. According to the forty test lines visual appearance, two lines were found to be highly resistant to the viruses, one line to be resistant, seventeen to be moderately resistant, eleven to be moderately susceptible, and nine were susceptible which shows similarity with the current research work. The response of 49 Iranian lines and cultivars of common beans to CMV was investigated by Azazi et al. [9]. After being rubbed with CMV during the primary leaf stage, the plants were housed at 20°C in an insect-proof growing chamber. The inoculated plants were evaluated on the basis of their symptoms, growth rate, fresh and dried weights, and viral titer three weeks after the injection. The results indicated that 42 lines were sensitive to the CMV, six lines and cultivars were determined to be tolerant, and one line, D81883, had moderate resistance which also justifies the similarity of the current research work. In the findings of Akbar et al. [4], of the seventeen cucumber germplasm samples, fourteen germinated and displayed the typical CMV symptoms, but none of them displayed virus resistance. There was no evidence of resistance in commercially available germplasm. P. Naresh et al. [10] reported that by mechanically inoculating fifty genotypes of capsicums, resistance to Chilli vein mottle virus and CMV

Table 1. Reaction of pumpkin cultivars against cucumber mosaic virus disease

SI No.	Cultivars	Symptoms Appearance	Disease Rating	Level of resistance/susceptibility
1	DH-C1	Mosaic, crinkling and mottling	5	Susceptible
2	DH-C3	Mild mosaic on few leaves	4	Moderately susceptible
3	DH-C4	Mosaic, crinkling and mottling	5	Susceptible
4	DH-C5	Mild mosaic on few leaves	4	Moderately susceptible
5	DHC6	Mosaic, crinkling and mottling	5	Susceptible
6	DH-C7	Mosaic, crinkling and mottling	5	Susceptible
7	MEGH-C1	No symptoms	1	Highly resistant
8	KA-C2	Mosaic, crinkling and mottling	5	Susceptible
9	KA-C3	Mild mosaic on few leaves	4	Moderately susceptible
10	BAR-C1	Mosaic, crinkling and mottling	5	Susceptible
11	BIS-C1	Mosaic, crinkling and mottling	5	Susceptible
12	SIV-C1	Mild mosaic on few leaves	4	Moderately susceptible
13	SIV-C2	Mosaic, crinkling and mottling	5	Susceptible
14	KAM(R)-C1	Mosaic, crinkling and mottling	5	Susceptible
15	KAM(R)-C2	Mosaic, crinkling and mottling	5	Susceptible
16	KAM(R)-C3	Mild mosaic on few leaves	4	Moderately susceptible
17	KAM(R)-C4	Mosaic, crinkling and mottling	5	Susceptible
18	KAM(R)-C5	Mild mosaic on few leaves	4	Moderately susceptible

was evaluated of which eight highly resistant, five resistant, and two moderately resistant genotypes were found to be resistant to CMV, although symptoms ranging from localized chlorotic lesions to severe leaf distortion were observed which illustrates the research under study in a similar way. In the years 2010–2011 and 2011–2012, the response of thirty different genotypes of chillies to CMV was evaluated in both artificial and field inoculation conditions by Rahman et al. [11]. Genotypes differed significantly in terms of disease incidence, severity indexes, and yield losses. Based on observed results, genotype CA12 (Comilla-2) was identified as moderately resistant to CMV in both natural and inoculated conditions, but genotype CA23 (Noakhali) was shown to be resistant. Choskit et al.[12] found that out of forty cucumber germplasm, Dasher II and viz Poinsett were found to be resistant to cucumber mosaic disease, while CS-13, CS-16, CS-51, CS-54, Fumiko-10, and Don-1 were found to be moderately resistant during both the cropping season (2019 and 2020). We may infer that the current study has similarities with all of the previously reported findings.

4. CONCLUSION AND RECOMMENDATION

Pumpkin is one of the important vegetable crops grown in India and abroad. The crop is infected by various pathogens among which infection by

CMV is one of the important threats causing severe yield loss up to the extent of 100 per cent.

Based on the research, we are able to speculate that cultivars DH-C3, DH-C5, KA-C3, SIV-C1, KAM(R)-C3, and KAM(R)-C5 may have the potential to be sources of resistance against the CMV disease in pumpkin, while MEGH-C1 may have the potential to be a highly resistant source.

In order to develop cucumber mosaic virus-resistant cultivars, more research on the resistant cultivar (MEGH-C1) should be conducted based on symptom and molecular detection. This is because the use of resistant varieties seems to be an economical and sustainable method of controlling CMV disease in pumpkin under resistance breeding. It may be suggested to conduct further studies on the assessment of pumpkin germplasms that are available in North-eastern states of India in order to identify sources of CMV resistance.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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