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Symptomatology and host range of mosaic disease of pumpkin (*Cucurbita moschata*)

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Abstract
Pumpkin (*Cucurbita moschata* Duch) is an important crop species for Indian agriculture of Cucurbitaceae family and is grown extensively throughout the year. Pumpkin is a common man's vegetable consumed by both rich and poor alike. Pumpkin is an important article of diet, the main nutrients are lutein and both alpha and beta carotene, the latter which generates vitamin A in body. Among the various problems involved in the cultivation of pumpkin crop, insect, pest and diseases are of prime importance. Among the major diseases the viruses are most important pathogens of cucurbits (cucumber, watermelon, melon and pumpkins) belonging to the family Cucurbitaceae. More than 30 infectious viruses causing destructive symptoms and considerable economic losses were reported. Present investigation was undertaken in Kharif------ for the study of symptomatology and host range of mosaic disease of pumpkin. The result showed that, the symptoms shown by virus Isolate I were severe mosaic mottling, dark green blistering, leaf deformation, stunted growth and leaf malformation whereas the symptom shown by virus isolate II were vein yellowing, vein clearing, mosaic, stunted growth and smaller leaves. On the other hand host range study showed that isolate I was very narrow, mainly restricted to family Cucurbitaceae. Systemic symptoms were incited on *Citrullus lanatus*, *Cucumis sativus* L., *Momordica charantia* L., *Cucumis melo* L., *Luffa cylindrical* Roem, *Lagenaria siceraria* (M.), *Trichosanthes anguina* L., *Luffa acutangula* L., *Cucurbita moschata* Duch. whereas isolate II has a very limited host range only two species of Cucurbitaceae family was infected.

Keywords: pumpkin, mosaic, virus, symptomatology, host range

Introduction
Pumpkin (*Cucurbita moschata* Duch) is an important crop species for Indian agriculture of Cucurbitaceae family and is grown extensively throughout the year. Pumpkins are thought to have originated in North America. Pumpkins are grown all round the world for variety of regions ranging from agricultural purposes to commercial and ornamental sales. It is most common rather cheaper and popular vegetable in all states in India as well as in world. The biggest international producers of pumpkin are United States, Canada, Mexico, India and China. The nutritional status of pumpkin is protein 1.2 g, dietary fiber 0.6 g, carbohydrates 7.5 g. It also contain calcium 24.4 mg, magnesium 13.9 mg, phosphorous 51mg, potassium 394 mg, vitamin A, vitamin C, vitamin K, thiamine 0.1 mg, niacin 0.7 mg, riboflavin 0.1 mg/100 g of edible portion. Demand for year-round production of pumpkin in many parts of the world has resulted in a serious prevalence of the pest and diseases of pumpkin crop. Among the various problems involved in the cultivation of pumpkin crop, insect, pest and diseases are of prime importance. Among the major diseases, diseases caused by viral pathogen are one of major threat in pumpkin cultivation which can cause mare economic losses of crop plant. Viruses are the most important pathogens of cucurbits (cucumber, watermelon, melon and pumpkins) belonging to the family Cucurbitaceae. More than 30 infectious viruses causing destructive symptoms and considerable economic losses were reported on these plants (Zitter *et al.* 1996) [9]. It is usually not easy to find appropriate control measures to reduce the extent of destruction. Viruses cause extensive losses in cucurbit crops. Zucchini yellow mosaic virus known to be one of the most destructive viruses of pumpkins (Dukia, 2001) [2]. Due to mosaic disease of pumpkin causes more economic losses of crop. Mosaic disease of pumpkin not easy to control completely.
Keeping all above fact present investigation on Symptomatology and host range of mosaic disease of pumpkin was undertaken to find out actual symptomatology and host range of virus isolates in Kharif-…….. at glass house and field condition of department of Plant pathology and Agril. Microbiology at MPKV., Rahuri.

Material and Methodology
1. Symptomatology: The symptoms of pumpkin mosaic disease were observed at different growth stages on infected plants under field condition as well as on sap and insect inoculated experimental plants. The symptoms of mosaic disease were observed periodically in sap and insect inoculated plants of pumpkin and cucumber. On the basis of symptoms viruses are grouped into two isolates (Isolates I) and (Isolate II).
2. Host range studies: For host range studies, the host of different plant species belonging to various families viz., *Cucurbitaceae*, *Chenopodiaceae*, *Solanaceae*, *Leguminoceae*, *Cruciferaceae*, *Malvaceae* and *Poaceae* were mechanically sap inoculated. Twenty plants of different Cucurbitaceae plants species were inoculated at the cotyledonous stage and other plants of different species were inoculated at 5-6 leaf growth stage with sap extracted from different virus isolates of pumpkin by conventional leaf rub method to ascertain the host range each virus isolate. Inoculated plants were kept in insect proof glasshouse and the test plants were recorded periodically up to 30-50 days for symptoms expression. The plants which did not show any symptoms were back indexed on test

plants of pumpkin and cucumber and also on local lesion host, *Chenopodium amaranticolor*. The host range studies indicate to find out suitable experimental hosts and also to investigate other possible host plants. The knowledge of present studies could provide information on possible natural sources of the virus for infection of pumpkin plants under field conditions.

Results

1. Symptomatology

Table 1: Symptoms produced by different isolates of Pumpkin virus on test plant, pumpkin and cucumber

Sr. no	Virus Isolates	Locations	Incubation period	Symptom patterns
1	Isolate I	Vegetable Improvement project, MPKV, Rahuri	10-12	Blistering, Mosaic, mottling, stunted growth.
2	Isolate II	Gunjalwadi, Sangamner	22-26	Vein yellowing, mosaic
3	Isolate II	Chincholi Gurao, Sangamner	20-25	Vein yellowing and mosaic, stunted growth
4	Isolate II	Vegetable Improvement project MPKV	22-26	Vein yellowing and mosaic, stunted growth
5	Isolate II	Kalas, Akole	22-26	Mosaic patches, vein clearing
6	Isolate II	Buldhana	20-26	Mosaic patches, vein clearing

In present studies symptoms of various pumpkin virus isolates were studied in detailed are as bellow

i) Isolate I under field condition: The initial symptoms observed under field conditions by this isolate were severe mosaic, mottling, green blistering and severe deformation of leaves. The internodes were found shortened with smaller leaves, stunted growth. Fruits produced on diseased plants were mottled, small sized, irregular shaped with dark green margin and deformed.

ii) Isolate I under glasshouse condition: The isolate exhibited mosaic mottling symptoms within 10-12 days of mechanical sap inoculation followed by stunted growth, smaller leaves chlorotic leaf area with green blistering.

iii) Isolate II under Field condition: This isolate showed yellowing of vein which later developed into mosaic patches. Affected plants were stunted and smaller leaves.

iv) Isolates II under glasshouse condition: The plants of pumpkin were observed at different growth stages and showed symptoms patterns such as mild yellow vein, stunted growth, vein clearing, irregular chlorotic mottling and mosaic.

2. Host range

Observation on host reaction of isolate I and isolate II of pumpkin are presented in Table 2 and 3

Table 2: Host range of Isolate – I virus

Sr. No.	Family *Cucurbitaceae*	Symptom	Infected/ Inoculated	Days for symptoms expression	% Transmission
1	*Cucumis sativus* L.	LD,S,B, MM, SL, SI,	17/20	10-12	85
2	*Citrullus lanatus*	LD,S,B,MM,SL,SI	18/20	9-12	90
3	*Momodica charantia* L.	LD, S,MM	8/20	10-12	40
4	*Luffa cylindrical* Roem	MM	13/20	9-10	65
5	*Lagenaria siceraria*	MM	9/20	8-9	45
6	*Cucumis melon L.*	MM,LD,S,B	16/20	11-12	80
7	*Trichosanth anguina L.*	MM	11/20	10-12	55
8.	*Luffa acutangula L.* Roxb	MM	15/20	9-10	75
9	*Cucurbita moschata Duch.*	MM,LD,B,SL,S	18/20	10-12	90

(Where, LD = leaf distortion, S=Plant stunting, B = Blistering, MM= Mosaic mottling, SL= Smaller leaves, SI= Shortening of internode)

i) Isolate I: The results presented in Table 2 revealed that this isolates infected nine plant species belonging to *Cucurbitaceae* family on artificial inoculation by sap. Severe mosaic mottling, leaf distortion, green blistering, plant stunting, smaller leaves, shortening of internodes were produced on *Citrullus lanatus* and *Cucumis sativus* L., *Momordica charantia* L., *Cucumis melo* L. produced systemic mosaic, plant stunting, blistering and leaf distortion symptoms. *Luffa cylindrica* Roem, *Lagenaria siceraria* M. and *Trichosanthes anguina* L. produced systemic mosaic symptoms. *Cucurbita moschata* Duch. produced systemic mosaic and leaf distortion symptoms.

Table 3: List of non-host plant for Isolate-I

Family *Chenopodiaceae*	Family *Solanaceae*	Family *Leguminoceae*	Family *Cruciferae*
Chenopodium amaranticolor	*Capsicum annuum L.*	*Arachis hypogea L.*	*Brassica compestris*
C. quinoa Wild	*Datura stramonium L.*	*Cajanus cajan* L.	*B. oleracea* L.
C. murale L.	*Lycopersicon esculentum Mill*	*Cier arietinum* L.	
Family *Malvaceae*	*Nicotiana glutinosa L.*	*Cyamopsis tetragonoloba* L.	Family *Poaceae*
Abelmoschus esculentus L.	*N. rependa*	*Glycine max* L.	*Zea mays* L.
	N. rustica	*Phaseolus vulgaris*	
	N.tabacum var. White Burley	*Vigna sinensis L.*	
	Solanum melongena L.	*Pisum sativum*	

Table 4: Host range of Isolate-II virus

Sr. no	Family	Symptoms	Infected/ Inoculated	Days for symptom expression	% of infection
1	*Cucurbita moschata Duch*	Vein yellowing and mosaic	10/10	22-23	100
2	*Lagenaria siceraria* (Bottle gourd)	Mild mosaic	9/10	24-25	90

ii) Isolate II- The results presented in Table 4 revealed that this isolate infected two plant belonging to *Cucurbitaceae* family inoculated using whiteflies. Infection of bottle gourd (*L. siceraria*) was associated with only a mild mosaic but no vein yellowing. No reaction was produced on *Cucumis sativas* (Cucumber), *Cucumis melo* (Muskmelon), *Citrullus lanatus* (Watermelon), *Luffa vulgaris* (Round melon), *Luffa acutangula* L. Roxb. (Ridge gourd), *Luffa cylindrica* L. Roem. (Sponge gourd), *Momordica charantia* L. (Bitter gourd), *Glycine max* Merrill. (Soyabean), *Sorghum bicolar* L. Moench (Sorghum), *Vigna mungo* L. Hepper (Black gram), *Vigna radiate* L. Wilczek (Green gram), *Chenopodium amaranticolor*, *Nicotiana glutinosa* L., *N. rependa*, *N.rustica*, *N.gossei.*

Discussion

The symptoms produced by virus isolate I under field conditions were severe mosaic mottling, green blistering and deformation of leaves. The internodes were found shortened and leaves became smaller, stunted plant growth and leaf malformation was noticed. Fruit produced on diseased plants became mottled, small sized, irregular shaped with dark green margin and deformed. Similar types of symptoms were also reported by Provvidenti and Schroeder (1970) [5]. Isolate II showed symptoms like faint vein clearing symptoms developed first in the tertiary veins of the younger leaves of pumpkin plants. The symptoms extended gradually to secondary and primary veins as a prominent vein yellowing and, later, coalesced to a yellow mosaic. As disease symptoms progressed, vein yellowing developed on older leaves causing early senescence, and plant growth was retarded similar symptoms were recorded by Munniyappa *et al.*, (2003). The virus isolate I produced systemic symptoms *on Citrullus lanatus* L.,*Cucumis sativus* L., *Momordica charantia* L., *Cucumis melo* L., *Luffa cylindrical* Roem. *Lagenaria siceraria* (M.), *Trichosanthes anguina* L. and *Luffa acutangula* L. but no any reaction produced on *Tobacco* spp. and *Chenopodium* spp. similar host range have been reported by several workers in case of watermelon mosaic caused by watermelon mosaic virus 1 they are Bhargava *et al*., 1975; Purcifull and Hiebert, 1979 and Makkout and Lesemann,1980. Pumpkin virus isolate II, systemically infect two plant of *Cucurbitaceae* family, pumpkin and bottle gourd. Similar host range have been reported by several workers in case of pumpkin mosaic caused by pumpkin vein mosaic virus they are Varma, 1955; Saikia and Muniyappa, 1989.

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