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Survey, Symptomatology and Host Range of Yellow Vein Mosaic Disease in Pumpkin

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ABSTRACT: The pumpkin is an important vegetable crop in southern India due to its nutritional value. The yellow mosaic disease, transmitted by *Bemisia tabaci* is a serious disease at many locations. The survey was conducted during *kharif* 2016-17 to determine the prevalence of incidence of mosaic disease in major pumpkin growing districts namely, Chikkaballapura, Kolar, Bengaluru rural and Tumkuru. The per cent incidence of mosaic disease based on symptoms in field noticed was highest in Kolar (22.30 %) and the least incidence of mosaic disease was observed in Chikkaballapura (19.20%). The symptoms includes mottled leaves with areas of tonal differences in color, shriveled, puckered, or contorted leaves, vein yellowing, Infected plants were stunted and flowers drop prematurely. Host range studies under glasshouse conditions revealed that PYVMD is transmitted artificially by whitefly, *Bemisia tabaci*. Among 22 host plants tested, 3 plant species, *Luffa acutangula* (L.) Roxb.| (ridge gourd), *Cucumis pepo* L. (squash), *Legenaria sciceraria* (Molina.) Standl. (bottle gourd) were infected with the pumpkin yellow vein mosaic virus disease. The disease was prevalent in all the fields visited with the disease incidence of up to 22.30 per cent and the few cucurbitaceous hosts will serve as reservoirs for the virus.

Keywords: Pumpkin, PYVMD, *Bemisia tabaci*, host range and survey

INTRODUCTION

Pumpkin (*Cucurbita moschata* Duch. Ex Poir) is an important vegetable crop in India and is grown extensively throughout the year in different parts of the country. It is one of the most popular summer vegetables grown on commercial scale. The crop is also extensively grown in United States of America, Mexico and China. In India, it is mainly grown in Odisha, Uttar Pradesh, Madhya Pradesh, West Bengal, Chhattisgarh, Karnataka, Tamil Nadu, Kerala and Bihar. In India, pumpkin is cultivated over an area of 67640 ha, with a total production of 1508990 mt and the productivity is about 22.31 mt/ha (Anon., 2016). The crop is cultivated over an area of 1480 ha in Karnataka with the production of 64870 tonnes and productivity of 25.74 t/ha. In Karnataka the major pumpkin growing districts are Hassan, Mandya, Kolar, Haveri, Koppal, Bagalkot, Kolar, Chikkaballpur (Anon., 2006).

The fruits are having creamy orange color flesh and almost all parts of plant are edible. The fruit contains protein 1.0 g, moisture 91.5 per cent, fat 0.1 g, carbohydrate 6.5g, energy 26 k cal, cholesterol 0 mg, dietary fiber 0.5 g, Vitamin A (7384 mg/100g, Vitamin C (9.0 mg/100g), Vitamin E (1.06 mg/100g), riboflavin 0.110 g, potassium 340 mg, phosphorous 44 mg, iron 0.8 mg and magnesium 12 mg for 100 g edible portion. Because of its high carotene content and good keeping quality, it is considered as vegetable of immense value. The crop has been reported to be affected with a number of diseases. Among them viral diseases are known to cause severe yield losses.

Pumpkin Yellow Vein Mosaic Disease (PYVMD) is an important disease infecting the plants at all stages of growth and is responsible for the distortion and

mottling of fruits, which is unmarketable (Nath, 1994). The casual virus is designated as "Pumpkin Yellow Vein Mosaic Disease" (PYVMD) and occurrence of this disease was first reported by Varma (1955) from New Delhi; Capoor and Ahmad (1975) from Pune, Maharashtra; Bharghava and Bharghava (1977) from Uttar Pradesh; Ghosh and Mukhyopadhyay (1979) from West Bengal; Latha and Gopalkrishnan (1993) from Kerala; Babhitha (1996), Jayashree *et al*. (1999) and Muniyappa *et al*. (2003) from Karnataka. In 1990 a severe epidemic of leaf curl in muskmelon (*Cucumis melo* L.) and yellow vein mosaic in pumpkin, caused by begomoviruses, appeared in northern India (Varma, 1990). This epidemic was caused due to increase in whitefly populations early in the cucurbit-growing season. Since then, disease caused by begomoviruses have emerged as a major constraint in the production of a variety of cucurbits in India (Varma and Giri 1998; Muniyappa *et al.,* 2003; Varma and Malathi, 2003).

Two species of geminiviruses, with bipartite genome, causing PYVM have been reported from India. Tomato leaf curl New Delhi virus-India (Maruthi *et al.,* 2007) has been reported from North India and squash leaf curl China virus-India, from South India. Later, bipartite *Squash leaf curl Palampur virus* was also reported to be associated with PYVM (Jaiswal *et al.,* 2011). Most of the viruses causing yellow vein mosaic in crop pants belong to genus begomovirus. Taking the severity of the disease in the field in to consideration the work on survey, symptomatology and host range of PYVMV was taken up.

MATERIAL AND METHODS

A roving survey was conducted during 2016-17 to determine the prevalence of incidence of mosaic disease in major pumpkin growing districts of Southern Karnataka (Chikkaballapura, Kolar, Bengaluru Rural and Tumkuru). Plants were observed for the typical symptoms *viz.,* yellowing of veins, mosaic symptoms, mottling etc. For each one acre of field five randomly selected sites (10m × 10m) were selected and the average disease incidence was calculated using the following formula.

$$\text{Per cent disease incidence (PDI)} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

To study the host range for PYVMD and to determine the natural reservoirs of PYVMD, the different plants belong to family solanaceae like tomato, brinjal, chilli, capsicum and cucurbitaceae like bottle gourd, ridge gourd, bitter gourd, watermelon, cucumber, muskmelon and other crops like tobacco, okra, french bean, soya bean, green gram, black gram and also the other weed hosts, which were found in and around the field were inoculated by using viruliferous whiteflies as described by Sohrab (2005). The plants were kept in insect proof net house and observed for symptom expression and the symptoms were recorded. Later the details on date of inoculation, days for symptom expression and number of plants infected and per cent transmission also was recorded.

RESULTS AND DISCUSSION

The survey was undertaken in four different districts in southern Karnataka. In Kolar district, the percent disease incidence was ranged from 16.30 to 38.10 per cent and in Chikkaballapura district the percent disease incidence was ranged from 14.50 to 22.60 per cent, in Tumkuru district the per cent disease incidence was ranged from 12.70 to 36.30 per cent, and in Bengaluru district the per cent disease incidence was ranged from 12.70 to 28.10 percent (Table 1, Fig. 1 and Plate 1). The disease incidence was varied from taluk to taluk in different districts. This difference may be attributed to different climatic factors, vectors activity, different cultivars and different cultivation practices followed. It may also be due to variation in plant protection practices followed by the farmers, low quality seeds. The similar work was carried out by Namrata (2012), conducted roving survey, pumpkin plants exhibited different kinds of symptoms such as severe yellow-vein mosaics accompanied by leaf curl and stunted growth. The incidence of symptomatic plants varied between fields at different locations and it was ranged from 40 to 80 per cent in monocropping system. Rekha *et al.* (2005) conducted survey in pumpkin-growing areas of Karnataka to assess the incidence and severity indicated that PYVMD incidences ranged from 45 to 100% in Kunigal and Nagamangala taluks of Tumkur and Mandya districts. Therefore, the natural incidence of pumpkin yellow vein mosaic virus disease would vary from field to field in the surveyed area.

Table 1: Per cent disease incidence of pumpkin yellow vein mosaic disease in different districts in Southern Karnataka.

Sr. No.	Districts	Per cent disease incidence	
		Average	Range
1.	Kolar	22.30	16.30-38.10
2.	Bengaluru rural	20.40	12.70-28.10
3.	Chikkaballapura	19.20	14.50-22.60
4.	Tumkuru	21.20	12.70-36.30

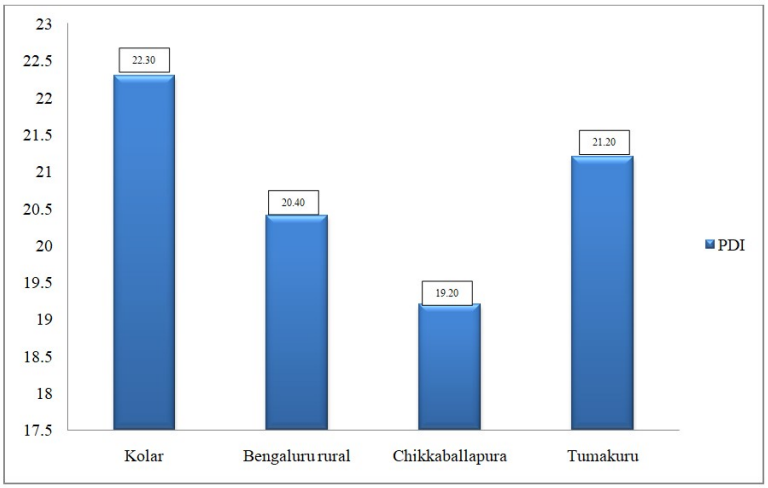

Fig. 1. Per cent disease incidence of pumpkin yellow vein mosaic disease in selected districts of Southern Karnataka during 2016-17.

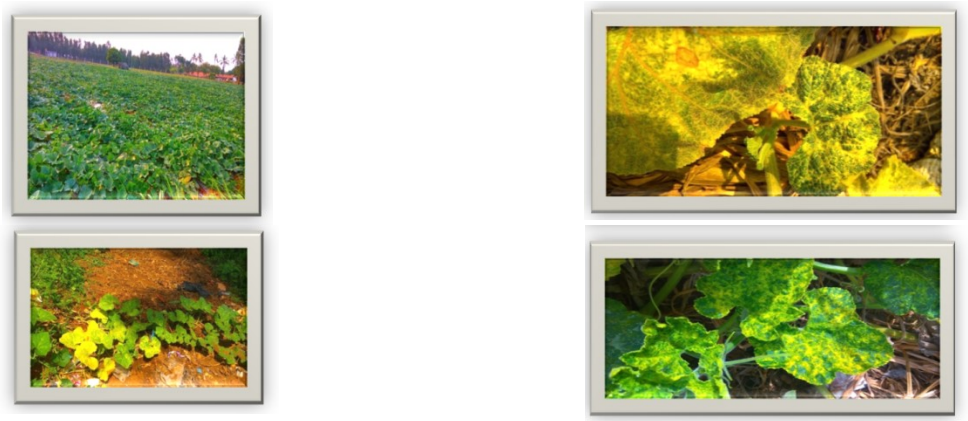

Plate 1. Symptoms of PYVMV infection in different fields during survey.

The symptoms of disease started occurring on 11th day of inoculation and symptoms includes the development of yellow vein mosaic. The diseased plants show vein yellowing, later coalesces to form chlorotic patches. Infected plants stunted in growth and flowers drop prematurely, greatly reducing yields. The entire plants will become yellow vein mosaic in 24-30 days (Plate 2). Similar symptoms of stunted growth, vein yellowing, chlorotic patches, premature flower drop were reported by Muniyappa *et al.* (2003).

To identify the natural reservoirs and those susceptible to virus, the host range study of the virus was conducted. Twenty two different plant species belong to family solanaceae like tomato, brinjal, potato, chilli, capsicum and cucurbitaceous crops like bottle gourd, ridge gourd, bitter gourd, watermelon, cucumber, muskmelon and other crops like tobacco, okra, french bean, soya bean, green gram, black gram and also the weed species like *Acalypha indica* L., *Euphorbia geniculata* Orteg., *Chenopodium amaranticolor, Datura metel* L. *Parthenium hysterophorus* L. from among these only three plant species *viz.*, *Luffa acutangula* (L.) Roxb.] (ridge gourd), *Cucumis pepo* L.(squash), *Legenaria segeraria* (Molina.) Standl. (bottle gourd) have showed virus infection. None of the other plant species including weed species were showed any symptoms (Table 2 and Plate 2). Among the different plant species only three plant species *viz.*, *Luffa acutangula* (L.) Roxb.] (ridge gourd), *Cucumis pepo* L. (squash), *Legenaria siceraria* (Molina.) Standl. (bottle gourd) have showed virus infection (Plate 2). None of the other plant species including weed species were showed any symptoms. This showed that the virus mainly confined to important cucurbitaceous species only. Similarly Muniyappa *et al*. (2003), studied forty-three crop plants, including 11 ornamental and 13 weed species belonging to 16 families to test their susceptibility to PYVMD. Of all the plants tested few cucurbits *viz*., summer squash (100%), winter squash (100%), bottle gourd (96%) and *N. tabacum*, varieties like White Burley and Xanthi., were infected with 7 % and 42% respectively.

Healthy pumpkin plant

Infected pumpkin plant

Plate 2. Symptoms of PYVMV on artificially inoculated pumpkin seedlings of cv. Ashoka.

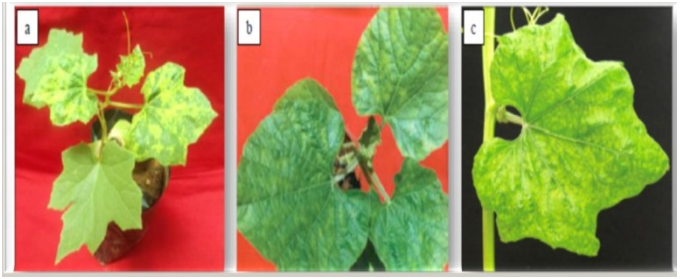

Plate 3. Symptoms of pumpkin yellow vein mosaic virus on different plant species after inoculation through *Bemisia tabaci,* a. *Luffa acutangula*, b. *Lagenaria siceraria*, c. *Cucumis pepo.*

Table 2: Host range of yellow vein mosaic disease of pumpkin assessed by symptoms expression after virus inoculation by adult *Bemisia tabaci* under glass house conditions.

Sr. No.	Plant species	Common name	Variety	Family	Infected/ inoculated	Incidence (%)*	Symptoms
1.	*Solanum lycopersicon* Mill.	Tomato	Arka Rakshak & Arka Sourabh	Solanaceae	0/10	0	No symptoms of infection
2.	*Capsicum annum* L.	Chilli	Arka Lohit	Solanaceae	0/10	0	No symptoms of infection
3.	*Solanum tuberosum*	Potato	-	Solanaceae	0/10	0	No symptoms of infection
4.	*Nicotiana rustica*	Tobacco	-	Solanaceae	0/10	0	No symptoms of infection
5.	*Abelmoshus esculentus* Moench.	Okra	Arka Anamica	Malvaceae	0/10	0	No symptoms of infection
7.	*Glycine max* L.	Soya bean	Local	Leguminaceae	0/10	0	No symptoms of infection
8.	*Phaseolus vulgaris* L.	French bean	Arka Suvidha	Leguminaceae	0/10	0	No symptoms of infection
9.	*Vigna radiata* (L.)Wilczek.	Green gram	Local	Leguminaceae	0/10	0	No symptoms of infection
10.	*Vigna mungo*	Black gram	Local	Leguminaceae	0/10	0	No symptoms of infection
11.	*Luffa cylindrica* L. Roem.	Sponge gourd	-	Cucurbitaceae	0/10	0	No symptoms of infection
12.	*Cucumis sativus* L.	Cucumber	Sheethal	Cucurbitaceae	0/10	0	No symptoms of infection
13.	*Citrullas lanatus* (Thumb). Munsf.	Water melon	Arka Manik	Cucurbitaceae	0/10	0	No symptoms of infection
14.	*Luffa acutangula (L.) Roxb.]*	Ridge gourd	Arka Sujat Naga	Cucurbitaceae	5/10	50	Yellow patches on leaves, clearing of veins, severe mosaic on leaves, stunted growth and death of veins
15.	*Momordica charantia*, L.	Bitter Gourd	Arka Harit	Cucurbitaceae	0/10	0	No symptoms of Infection
16.	*Cucumis pepo* L.	Squash	Arka Jeet	Cucrbitaceae	10/10	100	Initially mosaic symptoms at early stage, later curling, vein clearing and stunted
17.	*Legenaria siceraria* (Molina.) Standl.	Bottle gourd	Arka Bahar	Cucurbitaceae	8/10	80	Yellow patches on leaves, clearing of veins, severe mosaic on leaves, stunted growth and death of veins
Weed hosts							
18.	*Acalypha indica* L.	-	-	Euphorbiaceae	0/10	0	No symptoms of infection
19.	*Euphorbia geniculata* Orteg.	-	-	Euphorbiaceae	0/10	0	No symptoms of infection
20.	*Chenopodium amaranticolor*	-	-	Chenopodiaceae	0/10	0	No symptoms of infection
21.	*Datura metel* L.	-	-	Solanaceae	0/10	0	No symptoms of infection
22.	*Parthenium hysterophorus* L.	-	-	Asteraceae	0/10	0	No symptoms of infection

CONCLUSION

It is concluded that the PYVMV is prevalent in all the districts surveyed with the disease incidence up to 38.10 per cent. The symptoms of yellow veins in the initial stages followed by yellow mosaic and yellowing are the common symptoms and among the different plant species tested three crop plants *viz*., *Luffa acutangula* (L.) Roxb.] (ridge gourd*), Cucumis pepo* L.(squash), *Legenaria siceraria* (Molina.) Standl. (bottle gourd) are the reservoirs of the virus. There is a need for continuous monitoring of the virus related to it's host range both the crop varieties and the weed hosts for effective management of the disease.

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Conflict of Interest: None.

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