

Occurrence of Banana Mosaic in South Gujarat Area and its Host—Range*

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ABSTRACT

Banana mosaic is widely distributed in the South Gujarat area. Heart-rot was found to be associated with mosaic, which appears to be a different syndrome of the same infection. Infected plants do not bear bunches and hence loss due to disease can be about 10 per cent. *Zinnia elegans* Jacq., *Chrysanthemum* sp. vis., *Centaurea cyanus* Druce, and *Dianthus barbatus* L. are found to be new hosts for the virus. As *Datura stramonium* L. is an efficient host, the same is proposed to be used as test plant. The virus is considered to be *Cucumis virus-1*. (Received on April 19, 1975).

INTRODUCTION

VIRUS diseases in banana are known to cause severe effect on their leaves (Wardlaw, 1961). Mosaic, heart-rot and bunchy top of banana do not allow bearing of the bunch on the affected plants. This is probably because the later 15 leaves, which contribute towards the yield of the crop, if damaged, normal yield is not expected (Brouhns, 1957).

Capoor and Verma (1968, 1970) reported that mosaic of banana in India is not associated with heart-rot and is not transmitted to solanaceous plants; while Magee (1940) reported association of heart-rot stage in Australia; and Silbertschmidt and Nobrega (1941) reported transmission of the disease to solanaceous hosts in Brazil. Hence, Capoor and Verma (1970) suggested the Indian

strain to be different. In Gujarat, definite heart-rot was observed to be associated with mosaic of banana and hence investigations were undertaken to establish its identity.

METHODS

Survey:

Five places in South Gujarat area, where banana is extensively grown, were selected for a systematic survey of virus diseases of the banana. In each of these centres, two villages in the immediate vicinity were chosen (i) Bardoli—Tan and Barasadi (ii) Gandevi—Sonvadi and Gadat (iii) Kadodra—Hari-pura and Umbhel (iv) Motavarachha—Mamadev and Utran (v) Puna—Kumbharia and Magob.

In each of these ten villages total forty plots of (four plots in one village)

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$\frac{1}{2}$ acre of 4-5 months old basarai banana plantations were selected at random. These forty plots together with two such plots on the college farm were examined for the intensity of banana mosaic. These were again visited after two months and observations were recorded.

Host Range Study:

Thoroughly cleaned infected leaves were cut into small pieces, weighed and triturated to a fine pulp after adding equal quantity of 0.12 M sodium sulphite solution, in mortar with pestle. The juice was extracted by passing it through double layers of fine muslin cloth and diluted by adding 1 c c of 0.12 M phosphate buffer. Four young plants in each case were inoculated and the same number of plants were maintained as control.

RESULTS

Survey:

In the initial observation the intensity of infection observed in the area was 0.3, 1, 1, 1.5, 1.5 per cent at Bardoli, Gandevi, Kadodra, Motavarachha and Puna, respectively. However, in

the second visit it was observed that at most of the centres cultivators had eradicated the infected plants. At places where farmers did not remove infected plants from the fields, the disease incidence was observed to be increasing five times within a period of a month. In such cases at the later stage the intensity of infection reached up to about 10%.

Though systematic survey could not be pursued at all the places, however, both mosaic and heart-rot were observed at all the places visited. Thus, the survey confirmed that mosaic of banana together with heart-rot is prevalent throughout the South Gujarat area. No other virus disease could be traced during survey from the area.

The symptoms of the mosaic disease observed in the fields during the survey were more or less similar as described by Capoor and Verma (1970) (fig. 1).

The infected plants can be traced easily in the fields, as the leaves are of erectile habit with an uneven size and they are comparatively dwarf. In severely infected plants the leaves were

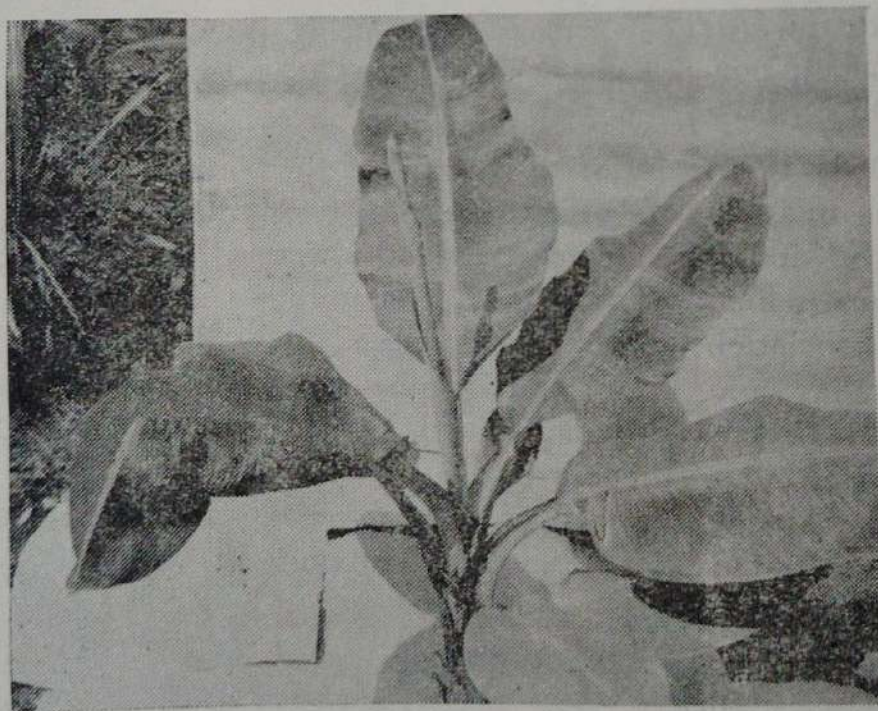


Fig. 1: Mosaic symptoms observed in field.

narrow with mosaic symptoms and the entire plant remained more or less stunted. The plant did not bear a bunch.

One prominent character, invariably associated in all the plants infected with mosaic disease was the partial rotting of the rhizomes. Horizontal cuts of the rhizomes of infected plants showed typical necrosis, gradually reducing from the bottom of the rhizomes towards the

growing region, while the rest of the portion would be healthy.

Basarai banana plants showing severe mosaic symptoms later develop heart-rot symptoms, normally during late monsoon and in early winter. In this case, initially, water soaked black coloured, necrotic area was observed at the bottom of the newly emerging leaf (fig. 2). As the disease progresses the entire heart leaf may rot. The rotting proce-



Fig. 2: Rotting observed at the bottom of the newly emerging leaf shows initiation of heart-rot.

eds upto rhizome. In a verticle section of such pseudostem, central portation would show severe necrosis (fig. 3). The disease brings about the death of the pseudostem but not that of the rhizome. Next season such rhizomes give out new suckers, which normally would be expressing typical mosaic symptoms.

Host Range Study:

Host range study was undertaken particularly to test solanaceous crops and also to know any other crop plants, might be acting as hosts for this virus.

The crops which proved to be the hosts are given in Table 1.

TABLE—1

Sap-transmission test, by the juice extracted from mosaic infected banana plant, to various other host crops.

Hosts	Total Nos. of plants	
	Inoculated	Infected
Caryophyllaceae:		
<i>Dianthus barbatus</i> L.	4	1
Compositae:		
<i>Centaurea cyanus</i> Druce.	4	4
<i>Chrysanthemum</i> sp. vis.	4	2
<i>Zinnia elegans</i> jacq.	4	4
Cucurbitaceae:		
<i>Cucumis sativa</i> L.	4	4
Pepilionaceae:		
<i>Phaseolus vulgaris</i> L.	4	2
<i>Vigna sinensis</i> Saviex Hassk	4	4
Solanaceae:		
<i>Datura stramonium</i> L.	4	4



Fig. 3: Central portion of the pseudostem severely necroted, with band of black discoloration advancing towards rhizome end.

Thus under the investigation eight hosts were found to be susceptible to banana mosaic virus.

The symptoms expressed by *Cucumis sativa* L.; *Phaseolus vulgaris* L. and *Vigna sinensis* Saviex Hassk; are more or less similar as described by Capoor and Verma (1968, 1970). The symptoms expressed on new host plants are described as under:

1. *Dianthus barbatus* L.: The plants remain quite stunted and green for little longer time. The leaves are bunched together and show erect habit of growth as compared to controls (fig. 4).

2. *Centaurea cyanus* Druce: In this host, the symptom development is exactly similar to that on *Zinnia elegans* Jacq.. The tips of the infected leaves

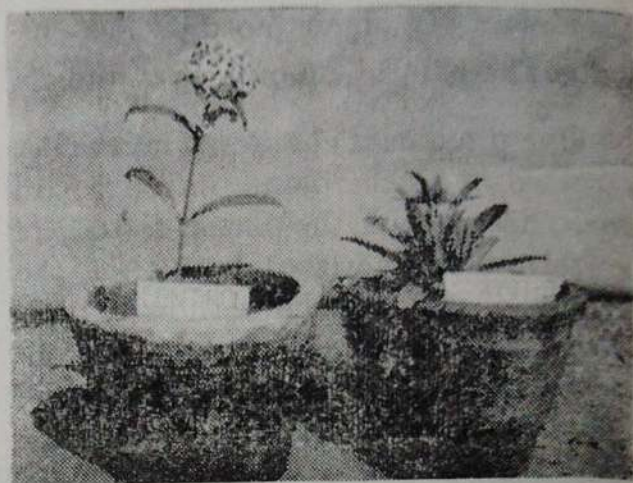


Fig. 4 : *Dianthus barbatus* L.

Left : Healthy plant with normal flower inflorescence.

Right : Stunted plant showing erect growth of the leaves delayed flowering.

showed bronzing. This slowly proceeds towards petiole but never reaches upto half the length of the leaves.

3. *Chrysanthemum* Sp.: Inoculated leaves show initial symptoms after about three weeks. The leaves are slightly thickened and develop very mild mosaic symptoms. The plants are slightly reduced in growth as compared to healthy uninoculated controls.

4. *Zinnia elegans* Jacq.: The infected plants remain dwarf as compared to controls. After 20 days, the first sign of symptoms are visible. Initially, leaves are found to be slightly chlorotic with very mild mosaic mottling. Later, the leaves reduced in size, slightly curved and deformed. It takes much longer time to produce floral heads, which are also reduced in the size and shape as compared to control. The colour of the flowers appear to be faded in infected plants (fig. 2).

5. *Datura stramonium* L.: Initially, the leaves start showing mild mosaic mottling within ten days. Gradually the margin of the infected leaves beco-

mes totally curved upward and inward. It also develops severe mosaic mottling together with reduction in leaf size (fig. 5).

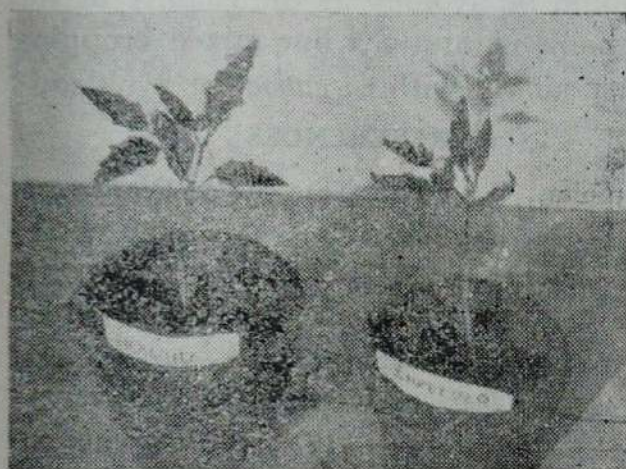


Fig. 5 : *Datura stramonium*

Left: Healthy control.

Right: Infected. Severe mosaic mottling leaf margin curved upward and inward.

The virus could not be transmitted mechanically to *Callistephus flavescens* Nees; *Tagetes* sp. L.; (Compositae), *Beta vulgaris* L. (Chenopodiaceae), *Lagenaria siceraria* Standl.; *Luffa egyptica* Roxb.; *Cucumis melo* E.C. 50385 L. (Cucurbitaceae); *Althea rosea* Cav. (Malvaceae); *Azadirachta indica* A.; (Meliaceae); *Musa cavendishi* Lamb. (Musaceae); *Medicago sativa*, L. E.C. 87657 and 87658; (Pepilionaceae), *Capasicum frutescence* L.; *Datura metel* L.; *Solanum melongena* L.; *Lycopersicon esculentum* Mill; *Nicotiana glutinosa* L.; *N. rustica* var Mohorka; *N. sylvastris*; *N. tabacum* L. Var Harri-sons, Varticks, Var white Burley, Var xanthi; (Solanaceae), and *Daucus carota* L.; (Umbellifereae).

DISCUSSION

The survey on prevalence of virus diseases indicated that mosaic of banana associated with heart-rot was distributed throughout South Gujarat area.

No other virus disease was found present. Thus, as reported by Kamat and Patel (1951) the bunchy top was not found prevalent in the survey, in South Gujarat area. Capoor and Verma (1968, 1970) reported occurrence of mosaic in South Gujarat area but did not find the occurrence of heart-rot symptoms with mosaic. In the investigation, mosaic and heart-rot were observed to be the two syndromes of the same type of infection. Unlike the report by Capoor and Verma (1970), the investigations revealed that mosaic of banana present in India is transmissible to solanaceous host *Datura stramonium*.

The disease reported from Brazil by Silbertschmidt and Nobrega (1941) is transmissible to species of *Nicotiana* together with *Datura stramonium* and *Petunia* sp.; one reported by Magee (1940) from Australia is transmissible to cucumber, tomato, tobacco, together with canna and abaca. The virus under this investigation is transmissible to hosts like *Datura stramonium* and *Cucumis sativa*; which are reported to be the hosts for banana mosaic virus in Brazil and Australia, respectively. The symptoms described are exactly similar. Therefore, virus reported in this study is probably the same as reported from these two countries. As reported by Capoor and Verma (1970) the virus could not be mechanically transmitted from banana to banana. The virus under present investigation is also transmitted to all the three hosts, *C. sativa*, *V. sinensis* and *P. vulgaris* as reported by Capoor and Verma (1970).

The symptoms produced on all the hosts are more or less similar, moreover, mosaic symptoms reported on banana are also exactly similar. Hence, it indicates that all these four viruses are identical.

Dianthus barbatus, *Centaurea cyanus*, *Chrysanthemum* sp. and *Zinnia elegans* are recorded to be the new hosts for the virus. So far, *Datura stramonium* was not recorded as the host for the Indian strain of banana mosaic virus. Previous workers have used *C. sativa* as test plant, to workout the different characteristics and nature of the virus. We propose here that instead of *C. sativa*, *Datura stramonium* would be a better test plant. This is because *D. stramonium* not only gives very pronounced symptoms but it also produces symptoms quite quickly. It takes less than 10 days to show infection while *C. sativa* takes more than three weeks.

Many workers have reported this to be the Cucumis virus-1 (Magee, 1940; Silbertschmidt and Nobrega, 1941; Vanhoof, 1962; Waite 1961; Yot-Dauthy *et al*, 1966; Out of the hosts reported for the Cucumber virus; *C. sativa*, *D. stramonium*, *Vigna sinensis*, *Phaseolus vulgaris*, *Lycopersicon esculentum*, *Zinnia elegans*, *Nicotiana glutinosa*, *N. rustica*, *Petunia* sp. and *Musa textilis* are now reported to be the hosts for the banana mosaic virus. The symptoms on these hosts produced by Cucumis virus are also in conformity with what had been described by Magee (1940) and Silbertschmidt and Nobrega (1941). Therefore, banana mosaic virus is considered to be caused by Cucumis virus-1.

Khandesh area of Maharashtra is known to be the source of fresh suckers for planting in South Gujarat area. The disease must, have been introduced from Khandesh. Importing the planting material from Khandesh, must therefore, be avoided. Fresh and healthy suckers should be obtained from disease-free area.

Mixed cropping is quite a common practice in the potential area of banana in South Gujarat, hence it is suggested that not only above narrated host crops should be avoided in the vicinity of the banana plantations but mixed cropping particularly with *C. sativa* be avoided.

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