J. Indian bot. Soc. 65 : 136-140, 1986

STUDIES ON A NEW STRAIN OF RADISH MOSAIC VIRUS CAUSING MOSAIC DISEASE OF RADISH (*RAPAHANUS SATIVUS* L.)[1]

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ABSTRACT

During a survey of vegetable diseases, a virus causing mosaic disease on radish (*Rapanus sativus* L.) was observed. The virus was found to be readily transmitted to young healthy seedlings of radish by mechanical inoculation. The symptoms of the disease appear in the form of small, faint chlorotic patches within 6-8 days of inoculation, followed by green mosaic. *Brevicoryne brassicae* L. and *Myzus persicae* Sulz. transmitted the virus. The virus in crude sap could tolerate an exposute of 60°C for 10 min but was inactivated within the same period at 65°C. The dilution end point was 10^{-4} and longevity in vitro at 25+5°C was 36h.

INTRODUCTION

Radish mosaic virus (RaMV) has been reported from U. S. A., Japan and Europe. It was first described by Gardner (1925) and rediscovered by Tompkins, 1939 and Campbell, 1964. In Japan it was isolated by Tochihara (1968), while in Yugoslavia it is most common virus in turnip (Stebance & Mamula, 1972) In India the virus has been reported by Raychaudhuri and Patahanian (1955). Indication of differences in host range and properties of the virus in plant sap from viruses reported to cause mosaic symptoms on radish led the authors to make reinvestigation.

MATERIALS AND METHODS

The pure culture of radish mosaic virus (RaMV) was maintained by manual sap inoculation on *Nicotiana tabacum* L. cv. Samsun NN using carborundum 500 mesh as an abrasive. All plants were raised in an insect proof glass-house in pots containing a mixture of soil, sand and compost (2:1:1) which was autoclaved before use.

Transmission studies : Aphid transmission-Cotton aphids (*Aphis gossypii* Glov.), green peach aphid (*Myzus persicae* Sulz.) and *Brevicoryne brassicae* L. were raised separately in different cages on cotton, cauliflower and brinjal plants respectively. After allowing the aphids to feed on virus sources for 24 h, they were transferred to young radish plants. After 24 h feeding the test plants were sprayed with 0.1 per cent malathion to kill the aphids.

Seed transmission : Seeds collected from diseased radish plants growing in the fields were planted in steam sterilized soil and compost mixture in wooden flats. After the emergence of seedlings in the glass-house, regular sparying of insecticides were given to prevent insect itransmission.

Sap transmission : Young leaves from the infected plants were macerated with

1. Accepted for publication on August 29, 1984.

0.1M phosphate buffer pH7.0 (5g : 10 ml) and the macerate was passed through 2 layers of cheese cloth. The extract thus obtained was inoculated to the leaves manually using carborundum (500 mesh) as an abrasive. The inoculated plants were gently washed with tap water immediately after inoculation. Seedlings inoculated with the sap from healthy leaves served as control. Inoculated plants were observed daily and symptoms developed were recorded.

RESULTS

Host range and symptomatology : Seventy two species distributed in various families were inoculated. RaMV evoked symptoms only on 21 species and virus could be recovered on back inoculation in all except *Chenopodium amaranticolor, C. murale, Lycopersicon esculentum* cv. Pusa Ruby. *Solanum tuberosum, Trigonella foenum graecum, Tetragonia expansa* and *Vicia faba. Dahlia pinnata* and *Helianthus annus* were found to be symptomless carrier of the virus. No symptoms were caused on *Abelmoschus escul.entus* Moench., *Achyranthes aspera* L., *Ageratum conyzoides* L., *Amaranthus caudatus* L., *A. gracilis* Desf., *A. tricolor* L., *Ammi majus* L., *Antirrhinum majus* L., *Apium graveloens* Cham., *Aster indicus* L., *Beta vulgaris* L., *Boerhaavia diffusa* L., *Cajanus cajan* L., *Calendula officinalis* L., *Catharenthus roseus* L., *Chenopodium album* L., *C. ambrosioides* L., *Cineraria chinensis* Sprang., *Citrullus vulgaris* Schard., *Cosomos bipinnatus* Cav., *Citrullus vulgaris* Schard., *Chrysanthemum segetum* L., *Coccinia cordifolia* Cogn., *C. indica Wight* & Arn., *Coleus bleumi* Benth., *Crotalaria medicaginea* Lam., *C. spectabilis* Retz., *Commelina nudiflora* L., *Coriandrum sativum* L., *Cucumis melo* L., *C. sativus* L., *Cucurbita moschata* Duchens., *Datura metel* L., *D. stramonium* L., *Daucus carota* L., *Dolichos lablab* L. *Dianthus barbatus* L., *Gomphrena globosa* L., *Impatiens balsamina* L., *Lagenaria leucantha* (Duch) Rusby. *Launaea aspleniifolia* Hook., *Lens culinaris* Medic., *Mirabilis jalapa* L., *Peristrophe bicalyculata* Nees., *Phlox drummondii* Hook., *Sonchus asper* Hill., *Spinacia oleracea* L., *Tegetes erecta* L., *Trapaeolum majus* L., *Vigna sinensis* Endl., and *Verbena hybrida* Cogn

Transmission by aphids : *Brevicoryne brassicae* and *Myzus persicae* transmitted the virus whereas *Aphis gossypii* failed to transmit it.

Transmission by sap : Hundred per cent transmission was obtained by manual crude sap inoculation using *Nicotiana tabacum* cv. Samsun NN as test plant.

Transmission through seeds : No seed transmission was obtained in radish.

Thermal inactivation : The RaMV was inactivated after being heated for 10 minutes at a temperature of 65°C.

Tolerance to dilution : The virus in crude sap was found to be active at a dilution of 10^{-3} but not at adilution of 10^{-4}.

Longevity in vitro : The virus in crude sap was stored at room temperature (25 ± 5°C) and was found to have a longevity *in vitro* of 132 h but lost its infectivity after storage of 144 h.

DISCUSSION

The symptoms evoked by the RaMV of Aligarh on some hosts are more or less same as produced by radish mosaic virus reported by Tompkins (1934) and Cambell (1964). However, the Aligarh isolate was found to have a wide host range infecting 21 species of plants distributed in 7 families. *Chenopodium amaranticolor, C. murale, Tetragonia expanasa, Trigonella foenum-graecum* and *Vicia faba* were found to be good local lesion hosts for this isolate. *Dahlia pinnata. Helianthus annuus* and *Lycopersicon esculentum* act as symptomless carriers. *Petunia hybrida* which was reported

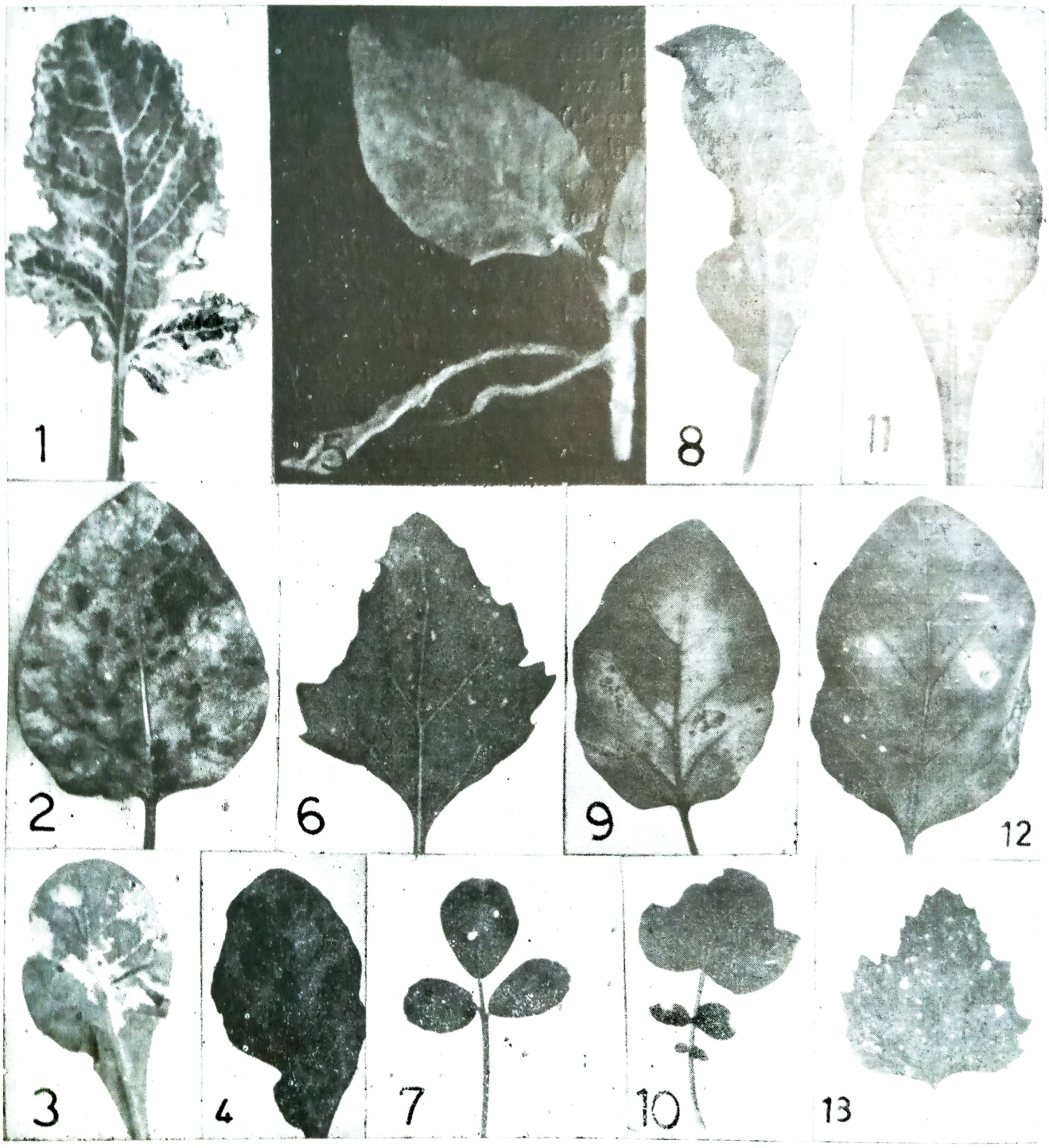

Fig. 1—13

Fig. 1. *Raphanus satinus* L. Showing mosaic mottling, leaf deformation and raised green areas. Fig. 2. *Nicotiana tabacum* cv. *Turkish xanthi* Showng mosaic in the form of raised green areas. Fig. 3. *Nicotiana tabacum* L. cv. White Burely showing mosaic mottling in the form of line-pattern and deformation of leaves. Fig. 4. *N. tabacum* Samsun NN showing dark green mosaic and deformation of leaves. Fig. 5. *N. glutinosa* L. Mosaic, deformation and reduction in lamina, Fig. 6. *Chenopodium murale* L. Showing local lesions. Fig. 7. *Trigonella foenum graecum*. Showing chlorotic lesions. Fig. 8. *N. tabacum* L. cv. Showing mosaic mottling, deformation and reduction of lamina. Fig. 9. *Solanum melongena* L. Necrosis of leaves. Fig. 10. *Solanum tuberosum* L. Showing mosaic and distortion of leaves. Fig. 11. *Beta vulgaris succharifera* L. Showing mosaic and Necrotic patches. Fig. 12. *S. melongena* L. Leaves show severe necrosis. Fig. 13. *Chenopodium amaranticolor* Coste & Reyne. Showing local lesions.

TABLE I

HOST RANGE OF A NEW STRAIN OF RADISH MOSAIC VIRUS CAUSING MOSAIC DISEASE OF RADISH (*Rahanus sativus* L.)

Families/Name of species inoculated	Symptoms		Back inoculation test
	Local	Systemic	
Aizoaceae			
Tetragonia expansa Murr.	LL	—	—
Chenopodiaceae			
Chenopodium amaranticolor Coste & Reyn.	LL	—	—
C. murale L.	LL	—	—
Beta vulgaris saccharifera L.	NLL	—	+
Compositae			
Dahlia pinnata Cav.	—	—	+
Helianthas annuus L.	—	—	+
Cruciferae			
Brassica campestris L.	—	VC, MOS, LD, S	+
B. oleracea L. cv. botrytis	—	VC, MOS, DC, S	+
B. oleraceaa L. cv. capitata	—	VC, MOS, DC, S	+
B. rapa L.	—	IC, OS, RGA, S	+
Rapanus sativus L.	—	VC, CR, MMOS, LD, RGA, S	+
Cucurbitaceae			
Benincasa hyspida Cogn.	—	VY, MOS, LTT, S	+
Trichosenthes anguina L.	—	VY, MOS, S	+
Leguminoseae			
Trigonella foenum graecum L.	LL	—	—
Vicia faba L.	LL	—	—
Solanaceae			
Lycopersicon esculentum L. cv. Pusa Ruby	—	—	+
Nicotiana clevelandii A. Gray.	—	VY, MOS, BP, SM, S	+
N. glutinosa L.	—	VC, MMOS, RGA, S	+
N. tabacum LL cv. Turkish	—	VC, LP, SM	+
N. tabacum cv. Samsun NN	—	VC, M, MOS, S	+
N. tabacum cv. Xanthi nc	—	VC, MMOS, S	+
Petunia hybrida Vilm.	—	VY, LNF, S	+
Solanum melongena L.	CP	VC, MOS, S	+
Solanum tuberosum L.	LL	—	—

+and—indicate positive and negative results on back inoculation. The abbreviation are : LD=leaf deformation, DC=downward curling, CL=chlorotic rings, CP=chlorotic patches, LL=local lesion, NLL=necrotic local lesion, M=mottling, MMOS=mosaic mottling, MOS=mosaic, RGA=raised green areas, S=stunting, LTT=leaf thick in texture, LP=line pattern, LNF=local necrotic fleck, VC=vein clearing and VY=vein yellowing.

a symptomless carrier for the virus described on radish by Tochihara (1968) was found to be a very good systemic host for Aligarh isolate. Moreover, *D. pinnata*, *H. annus* and *L. osculentum* were not reported symptomless carriers for radish mosaic virus by earlier workers. The present isolate causing mosaic disease of radish resembles the virus decribed by Tompkins in several respects. Both the viruses infect many common hosts in Solanaceae and Crucifereae. Dilution end point and thermal inactivation point of both the viruses are about the same but they differ markedly as for as ageing *in vitro* is concerned. Furthermore, Aligarh isolate is aphid transmitted whereas the virus described by Tompkins could not be transmitted by aphids.

The mosaic disease of radish described by Raychaudhuri and Pathanian (1955) is different from the one found in Aligarh. The former is confined to family Crusiferеae and differs markedly in its physical properties in plant sap. Radish enation mosaic virus Tochihara (1968) calls for no comparison as it is beetle transmitted whereas the present isolate is aphid transmitted. The virus described from radish by Joshi (1962) was identified as a strain of cabbage black ring spot virus. It produced symptomless local infection on *N. glutinosa* and *N. rustca* whereas these hosts were reported to be good systemic hosts for the Aligarh isolate.

The isolate from Aligarh causing mosaic disease of radish has much resemblance to the virus described by Tompkins and may be a new strain of RaMV which needs further elucidation.

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