

## Rai mosaic disease in Rai (*Brassica juncea*) and Radish (*Raphanus sativus*) in the Himalayan hilly regions of West Bengal

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Systemic yellow to light green mosaic known as rai mosaic on smooth leaf of mustard (*Brassica juncea*), commonly known as *rai*, which is used as a leafy vegetable, is prevalent in the Himalayan hilly regions of West Bengal. Incidence of rai mosaic in rai crop (mustard) was surveyed. Which varied from 6-95% during the year of 2000 and 2001. The virus is efficiently mechanically sap transmissible. Positive reaction by direct antibody coated enzyme linked immunosorbent assay (DAC-ELISA) with antiserum to potato virus Y (PVY) indicated that the virus associated with rai mosaic is a member of Poty virus group. Host range studies and characteristics symptoms in rai, radish, Chinese cabbage (*Brassica pokinensis*), stalk flower (*Mathiola juncea*), tobacco and *Chenopodium* species etc. also indicated that rai mosaic virus might be the strain of turnip yellow mosaic virus (TuMV).

**Key Words :** Mosaic, Brassicas, Radish, ELISA, TuMV, incidence, Kalimpong hills, resistance

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### INTRODUCTION

Many viral diseases are reported to have been caused in Brassica, radish and turnip etc in foreign countries by turnip mosaic virus (TuMV), radish mosaic comovirus (RaMV), cucumber mosaic cucurmo virus (CMV), turnip yellow mosaic tymo virus (TYMV), radish vein clearing poty virus (Ahlawat and Chenulu, 1984 ; Yamashita *et al.*, 1990 ; Foddai *et al.*, 1991 ; Cugsi *et al.*, 1992 ; Green and Deng, 1985). Amongst them TuMV, a definite member of genus Potyvirus, is the most important and widely distributed and causes mosaic diseases in cruciferous crops in India, Japan and Taiwan (Ahlawat and Chenulu, 1984 ; Yamashita *et al.*, 1990 ; Green and Deng, 1985).

Rai, and radish (*Raphanus sativus*) belonging to the family Cruciferae, are the popular leafy and root vegetables, in the North Eastern Himalayan hilly regions of India. These two crops are generally cultivated in this hill region throughout the year due to a cool weather condition prevailing round the year. Recently, it has been noticed that these two crops are getting highly infected by mosaic disease

and cause considerable loss both in quality and yield under field condition. Mosaic is the predominant virus disease in rai (*B. Juncea*) and radish (*R. sativus*) specially in Kalimpong hilly areas. This disease is mechanically sap transmitted, transmitted by aphid vectors like *Myzus persicae* and *Lipaphis erysimi* (Sharma 1973). Accordingly field survey on mosaic disease on rai, their serological detection and host range, screening of some resistant cultivars of radish against this disease were under taken as given in present investigation.

### MATERIALS AND METHODS

**Survey :** A field survey on rai mosaic disease was conducted to estimate the disease incidence in two successive years of 2000 and 2001 in different locations of Kalimpong hill regions at different altitudes. To assess the disease incidence to 4-5 plots in a particular area were randomly selected. The total plants including diseased and healthy from 10 rows in each plot were counted. Per cent incidence was recorded on the basis of visual symptom and it was obtained by counting the

number of diseased plant to total number of plants in plot multiplied by 100.

**Sap transmission and Host range :** Host range of rai mosaic virus was studied in green house condition in different cruciferous and other hosts (Table 2). The virus inoculum was prepared by grinding the infected young rai leaf tissues using phosphate buffer (0.1M and pH 7.5) containing 2-mercaptoethanol at 0.2% at ratio of 1 : 4 (w/v) in chilled pestle and mortar. Leaves of test plants were dusted with 600 mesh carborundum powder and then inoculum was rubbed by cotton pad. Inoculated plants were kept in insect proof green house for one month for observation of symptoms.

**Enzyme linked immunosorbent assay (ELISA) :** An antisera to potato virus Y (PVY) was used to detect virus in infected rai leaf samples collected from different locations. Direct antigen coated-ELISA (DAC-ELISA) was performed as described by Clark and Bar-Joseph (1984). Antigens for this virus were used as virus infected tissue extracts. For this study antigen, antisera and antirabbit IgG conjugated with alkaline phosphatase (Sigma, USA) were used in 1: 10, 1 : 1000, 1 : 2000 dilution, respectively. The color reactions were measured at 405 nm by Sunrise Tecan ELISA reader.

**Screening of resistance :** The field experiment for screening resistance in different cultivars of radish was conducted in the experimental farm of Indian Agricultural Research Institute, Regional Station, Kalimpong. The eight radish cultivars viz., Pusa Reshmi, Chinese Pink, Japanese White, local Lines collected from 8 mile, 12<sup>th</sup> mile 13 mile, 14 mile and 16 mile were used. Seeds were sown in 2<sup>nd</sup> week of September in the small field plot with rows apart from 45 cm and plant to plant distance was 8-12 cm. Recommended agricultural practice was followed for this crop throughout the growing season. Disease incidence was recorded 45 days after sowing.

## RESULTS AND DISCUSSION

**Survey :** Various patterns of mosaic symptoms were observed on rai leaves in Kalimpong hill regions. The main symptoms of rai mosaic noticed

were systemic yellow to light green with mottling and with or without stunting. Along with mosaic symptoms other symptoms like vein clearing, deformed leaves, chlorotic spots were also observed.

The incidence of mosaic disease in rai field varied from area to area in different altitudes in Kalimpong hill regions. Incidence of this disease in different locations during the two successive years of 2000 and 2001 were recorded from 6 to 85% and 8 to 95%, respectively (Table 1). Data revealed that disease incidence in both the years are more or less similar. In rai fields at higher altitudes of 1200 to 1350 meters, per cent infections were found to be from 8-30%. In the rai fields under lower altitudes of 800 to 1200 meters infection ranged from 8-95%. However at IARI and 8<sup>th</sup> mile area the disease incidence (6-39%) was low during both the years.

**Table 1 :** Incidence of rai mosaic in rai (*Brassica juncea*) in Kalimpong hills of West Bengal

Altitude (meter)	Area	Range of incidence (%) in different plot		Serology with Ab to PVY (A405)*
		2000	2001	
800-1000	Poshyor area	15-85	12-95	0.70-0.94
900-1000	Relly road area	8-62	6-85	Not tested
1100-1200	Chibbo busty	8-75	18-60	0.67-0.85
1100-1200	IARI & 8 <sup>th</sup> mile	6-30	16-39	0.56-0.79
1150-1200	BCKV farm area	15-78	8-85	0.40-0.71
1200-1300	11 mile area	8-18	15-30	0.68-1.2
1300-1350	Pedong area	15-18	8-10	Not tested

\* OD values of buffer and healthy control are 0.15-0.16 and 0.24-0.25 respectively and the values tabulated for the samples of 2001.

Mosaic infected leaf samples collected from different areas were tested by ELISA with antisera of PVY. Infected samples reacted positively with antiserum against PVY (Table 1) suggesting the association of the virus in rai mosaic disease antigenically related to PVY. The A405 values varied from 0.4 to 1.2 suggesting variations of virus concentration in the samples tested.

**Mechanical transmission and host range :** The virus is transmitted by mechanical sap inoculation to different commercial and local lesion host plants like rai, radish, Chinese cabbage, stalkflower (*Mathiola incana*) and poppy (Table 2). Per cent infections in these ranged from 30 to 60%. Three species of tobacco, namely *Nicotiana tabacum* var.

White Burley, *N. tabacum* var Xanthi and *N. glutinosa* and one species of *Chenopodium*, *C. quinoa* were used as indicator host, *C. quinoa* showed local lesion. Rai mosaic virus induced systemic mosaic symptoms on all other hosts and developed the symptoms within 10-25 days after sap inoculation.

**Table 2 :** Host range of Rai mosaic by mechanical sap inoculation

Host	Symptoms	Days taken to appear symptoms	No. plant infected/total no. plant inoculated
Rai ( <i>Brassica juncea</i> )	SM, VC, LD, CS, St	10-15	10/10
Radish ( <i>Raphanus sativus</i> var Chinese Pink)	SM, VC, LD	15-20	7/10
Radish ( <i>R. sativus</i> var Japanese White)	SM, VC, LD	15-20	7/11
Stalk flower ( <i>Mathiola incana</i> )	SM, LD	15-20	5/10
Poppy ( <i>Papaver rhoeas</i> )	SM, LD	15-20	4/4
Ornamental cabbage ( <i>B. pekinensis</i> )	SM, VC	18-20	6/10
<i>Chenopodium</i>	LL	18-25	9/10
<i>Nicotiana tabacum</i> var. White Barley	SM, CS	20-25	5/10
<i>N. tabacum</i> var. Xanthi	SM, CS	20-25	3/8
<i>N. glutinosa</i>	SM	14-25	8/10

SM : Systemic Mosaic ; LL : Local lesion, VC : Vein clearing, LD : Leaf deformation, CS : Chlorotic spot, St : Stunting

**Table 3 :** Screening of rai mosaic in radish cultivars under field and glass house condition in Kalimpong hill region.

Cultivars	Incidence percentage		Days taken to symptoms development	
	Field	Glass House	Field	Glass House
Pusa Reshmi	21.6	70.0	18-25	14-21
Chinese Pink	17.1	80.0	18-30	14-18
Japanese White	13.9	70.0	17-28	14-20
Local from 8 <sup>th</sup> mile	8.6	40.0	20-25	14-20
Local from 12 <sup>th</sup> mile	2.1	20.0	25-30	21-25
Local from 13 <sup>th</sup> mile	3.8	16.3	26-30	21-25
Local from 14 <sup>th</sup> mile	0.0	20.0	28-25	25-30
Local from 16 <sup>th</sup> mile	0.0	6.0	28-35	25-30

**Screening resistance :** Incidence of rai mosaic varied from cultivars to cultivars of radish under glass house and natural field conditions (Table 3). Three commercial cultivars with bigger root size viz., Pusa Reshmi, Chinese Pink and Japanese

White were found to be very much susceptible than the local cultivars having thinner root size. Two cultivars collected from 14<sup>th</sup> and 16<sup>th</sup> mile could not show any visible symptoms. Low incidence of disease under field condition may be due to lack of virus source or lower vector population but when the plants under glass house condition were inoculated by sap inoculation method higher rate of disease transmission was observed. Based on the screening test, it is noted that the local varieties of radish had lower percentage of infection than the three commercial cultivars. Under field condition usually the plant required longer time to express the disease symptoms.

Sap inoculation and subsequently production of different characteristic symptoms in different host plants (Table 2) indicated that the present rai mosaic virus is mechanically sap transmitted. In DAC-ELISA positive reaction of mosaic infected samples with antiserum against PVY (Table 1) confirmed the present virus is a definite member of poty virus group. Mosaic and mottling disease in radish and oil yielding brassicas in India has been reported earlier by Ahlawat and Chenulu (1984) and they mentioned that the disease is caused by a strain of TuMV belonging to poty virus, which is sap, seed and aphid transmissible (Lal and Sing, 1988 ; Ahlawat and Chenulu, 1984). Under field condition disease was found to spread on radish by aphid vectors.

Incidence of rai mosaic in different location of Kalimpong hills varied in both the years of observations. In some farms disease incidence was very high ; which might be due to frequent harvesting of leaves supporting spreading of the disease by contaminated hands or implements. The virus is efficiently sap transmissible from rai to rai leaf and rate of infection in this plant is of about 100% and seen with 10 to 15 days after inoculation suggesting that the symptoms induced in rai plant was very fast (Table 2). Low incidence of disease in some fields might be due to the absence of aphids or presence of low aphid population. In lower altitude area like Poshyor village, the rate of infection of this disease was high up to 95% suggesting presence of high aphid population in this area due to high temperature and which influenced

the aphid population. In the area like 11 mile and Pedong under higher altitude where temperature was comparatively low, aphid population was low hence disease incidence was low.

This investigation have suggested that commercial cultivars, Pusa Reshmi, Chinese Pink and Japanese White with bigger root sizes are susceptible to rai mosaic virus where as the local cultivars having thinner root are resistant or free from this diseases. The two local cultivars collected from 14<sup>th</sup> and 16<sup>th</sup> mile of Kalimpong are free from this disease. These local cultivars may be exploited as the source of resistance of rai mosaic in the breeding programme.

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