

Current status of virus like diseases of root and tuber crops in West Bengal

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The Sweetpotato (*Ipomaea batatas*), Elephant Foot Yam (EFY) (*Amorphophallus paeoniifolius*) and Upland Taro (*Colocasia esculanta* var *antiquorum*) are the major commercial tuber crops other than potato, which are widely grown as staple crops in the gangetic plains of West Bengal. Nationally these crops are to play a big role as a food security and nutrition crops and are produced mostly through subsistence farming. Several biotic and abiotic factors limit the production of these crops and among these viral diseases pose significant damage of the crops. In the present investigation, occurrence of different virus and virus like diseases were indexed in the crops by symptomatology and serological methods. Eight differential symptoms and their combinations like chlorotic like spots, mosaic and mottle, vein clearing and feathery mottle were observed in the promising cultivars of sweetpotato and the diseases ranged widely among the cultivars. The serological tests using NCM-ELISA of virus suspected plants of sweetpotato showed predominance of the viruses like C6 virus, Sweetpotato Chlorotic Flecks Virus (SPCFV), Sweetpotato Cauliflower like Virus (SPCaLV) and Sweetpotato Feathery Mottle Virus (SPFMV). Mixed symptoms of more than one virus were also observed giving rise to sweetpotato virus disease syndrome. A moderate to severe mosaic and mottle symptoms were observed in taro and EFY. The intensity of the mosaic was very high in EFY rather than in taro which ranged 5 to 27.81% among different cultivars. The shoestring appearance and severe leaf distortion along with mosaic symptoms were also noticed in EFY plants.

Key Words : Virus diseases, sweetpotato, amorphophallus, taro, symptoms, NCM-ELISA

INTRODUCTION

The sweetpotato, aroids, cassava and yams are the most important crops belong to the group of tuber crops in India. All these crops excepting cassava are grown commercially in many areas of the West Bengal. Many biotic and abiotic factors limit the production of these crops in the state. Among the biotic agents, the crops are seriously affected by the microbial attack and several fungal, bacterial and viral diseases cause major damage of the crops. Among these, virus diseases of the root and tuber crops are the important biotic factors. In many developing countries, yield of root and tuber crops are significantly reduced due to diseases and pests

(Carey *et al.*, 1998) and virus diseases can pose significant constraint to sweetpotato production (Bryan, 2002). However, recent studies on the occurrence of the viruses of sweetpotato and other tuber crops in number of countries have achieved the global importance. Fourteen viruses are identified infecting sweetpotato and the International Potato Centre (CIP), Lima, Peru, has developed diagnostics of the viruses. To date, twenty sweetpotato viruses have been described and characterized (Stobbs *et al.*, 1991; NCBI, 2001). Dasheen mosaic virus of aroids also has been reported from many countries. But very little efforts have been made so far on the distribution, occurrence, characterization of viruses of tuber

crops and its management in West Bengal. Considering this fact, this work will focus on a preliminary study and indexing of the virus like diseases in the major tuber crops like sweetpotato, taros and elephant foot yam occurring in West Bengal.

MATERIALS AND METHODS

Field experiments to study the incidence of virus diseases in tuber crops were made at the Horticultural Experimental field, Mondouri, Bidhan Chandra Krishi Viswavidyalaya (B.C.K.V.) during 2002-2004. In this study observation was made in the germplasm and in trial plot. Field trials were arranged in randomized block design (RBD) with three replications. The incidence of the virus disease was also recorded from the farmer's fields at the respective cropping seasons. Preliminary indexing of the viruses of taros, elephant foot yam and sweetpotato was made on the basis of visual symptoms. Twelve cultivars of elephant foot yam (EFY) were field screened against the virus like diseases and the intensity of the disease was recorded. The sweetpotato viruses were monitored both by symptomatology and indexed by using Enzyme-Linked Immunosorbent Assay (NCM-ELISA) technique developed by the International Potato Centre (CIP), Lima, Peru. The observations on natural incidence of Sweetpotato Virus Diseases (SPVD) in different cultivars of sweetpotato were recorded during two cropping seasons. The variations in the symptom in different cultivars were critically examined and the symptoms were categorised on the basis of variable leaf symptoms. The attempt was taken to determine the possible member of the virus by NCM-ELISA. The fresh leaf samples showing variable symptoms were tested for the presence of seven viruses viz. Sweetpotato Feathery Mottle Virus (SPFMV), Sweetpotato Mild Mottle Virus (SPMMV), Sweetpotato Latent Virus (SwPLV), Sweetpotato Chlorotic Flecks Virus (SPCFV), Sweetpotato Mild Speckling Virus (SPMSV), C-6 virus and Sweetpotato Caulimo Virus (SPCaLV). Nitrocellulose membrane (NCM-ELISA) was obtained from the CIP Regional Office (South-West Asia), Pusa, New Delhi. The suspected samples of different cultivars of sweetpotato were collected from the

Horticultural Experimental Field, Mondouri, BCKV and Jhargram Farm, Govt. of West Bengal as well as from the farmers' fields at Balagarh, Hooghly district and immunoenzymatically indexed by NCM-ELISA.

RESULTS AND DISCUSSION

The preliminary study on the incidence of sweetpotato virus disease in the field was made on the basis of symptoms appearance. A wide range of mild to severe symptoms was noticed (Table 1). Ten different (S1-S10) types of symptoms comprising of chlorosis of leaf, vein clearing, stunting with severe leaf yellowing, and feathery mottle like symptoms were very predominant in the field. The intensity of the symptoms like purple feathery lesions, chlorotic spots and purple irregular ring spots was very high and frequent among the sweetpotato plants.

Table 1 : Differential symptoms of viruses infecting sweetpotato cultivars in the field

Code No.	Symptoms
SP1	Purple feathery discoloration along the veins and mottling of leaves.
SP2	Purple ring with irregular margin and green centre on the leaf surface and coalescing the rings to form the patches with zigzag pattern of the lesion.
SP3	Pinkish purple to deep purple, pinhead to 0.5 mm spots on the leaf surface, sometimes-uncountable numbers but the spots never coalesce.
SP4	Interveinal chlorosis with whitish yellow to greenish yellow discoloration of the leaves and green strings on the leaf surface.
SP5	Inward rolling of leaves to form puckering and stunted growth.
SP6	Vein clearing symptoms with yellow discoloration of veins to form net vein symptoms.
SP7	Chlorotic brown to red-brown spots on the leaves without any hallow. The symptoms mainly appeared from the junction of the petiole.
SP8	Chlorosis and severe mottling of the leaves and veins turn yellow colour and leaves become smaller in size.
SP9	Typical mosaic symptoms with interveinal chlorosis and stunting of the plants and mottling of leaves.
SP10	Yellow spots, may coalesce to form patches and chlorosis of leaf.

The serological tests by NCM-ELISA confirmed the viruses present in the cultivars and many of the samples infected with virus like symptoms did not show the positive to the test. Sweetpotato C-6 virus

had a severe infection in most of the cultivars and Sweetpotato Cauliflower like Virus (SPCaV) and Sweetpotato Chlorotic Flecks Virus (SPCFV) also had the severe effect in some samples. The serological indexing revealed a distinct variation on the presence of different viruses of sweetpotato in the test samples (Table 2). Most of the samples showed positive reaction to C-6 Virus and SPCaLV. Many of the samples with variable symptoms were found to be infected with single virus or mixed with other viruses. The leaf samples collected from Mondouri Farm had frequent infection to SPMMV, C-6 virus and SPCaLV (Table 2a), whereas the plants from Jhargram showed high intensity of C-6 virus, SPMSV and SPCaLV positive to its antibodies (Table 2b). But no samples gave positive reaction to the viruses like SPMMV and SwPLV.

The randomly selected 20, 18 and 16 vine samples of sweetpotato from Mondouri, Jhargram and Balagarh respectively were indexed by NCM-ELISA and confirmed the positive infection for

most of the viruses except SwPLV using NCM-ELISA (Table 3). Only one sample each from Mondouri and Jhargram Farms reacted for SPFMV and frequency of occurrence of SPCaLV was also high in all the samples collected from three locations. Moreover, combined infections of more than one virus were found in the samples tested by NCM-ELISA and few samples reacted positive to single infection with any of the viruses (Table 3).

The disease indices of virus like symptoms in elephant foot yam (EFY) are presented in the Table 4 and indicated that percentage of infection of the virus disease in EFY significantly varied among different cultivars. Among twelve cultivars of EFY, minimum incidence of leaf mosaic virus was observed in Santragachhi, Ranchi, Sree Padma, BCA-3, BCA-1 and BCA-2 and high incidence of virus disease was recorded in NDA-5, NDA-4 and NDA-9. The symptoms also varied greatly from mild mosaic to severe mosaic symptoms with mottling of leaves in the farmers' fields. In severe

Table 2 : Detection of sweetpotato viruses by NCM-ELISA in some cultivars of sweetpotato expressing variable and mixed symptoms.

A. Mondouri Farm, BCKV

Symptoms	Sweet Potato Viruses						
	SPFMV	SPMMV	SwPLV	SPCFV	C-6	SPMSV	SPCaLV
S9					++		
S10		+		+	+		+
S7				+	+	+	+++
S1				+			
S1		+			+		
S2, S7		+					
S1, S7					+		
S12					+		
S5		+		+	+++		
S9, S10					+++		
S2		+					
S9		+			+++		+
S1, S3		+			+		
S9		+					
S5		+			+++		
S3		+				+	
S1		+		+	+++	+++	+++
S10		+		+			

B. Jhargram Reaearch Farm, W.B.

Symptoms	Sweet Potato Viruses						
	SPFMV	SPMMV	SwPLV	SPCFV	C-6	SPMSV	SPCaLV
S8					+	+	+
S1					++		+
S9					+	+	++
S9					+	+	++
S7, S10				++	++	++	+++
S9					++	+	+
S9					+++	+	+++
S9					+++	+	+
S9					+	+	++
S3					+	++	+
S7, S10					+	++	
S1					+	+	
S10					++	+	++
S10					+++	++	++
S11					+++	+	+
S7, S10	+++				++	++	++
S9					++	+	+
S7, S10					+++	+	
S10					+++	++	+

Table 3 : Frequency of detection of sweetpotato viruses surveyed at various sites of West Bengal

Location	Sweetpotato viruses						Status of infection	
	SPFMV	SPMMV	SPCFV	C-6	SPMSV	SPCaLV	Single	Mixed
Mondouri Farm	1/20	2/20	3/20	1/20	-	3/20	8/20	3/20
Jhargram Farm	1/18	-	2/18	10/18	3/18	7/18	5/18	7/18
Balagarh, Hooghly	-	1/16	-	11/16	5/16	9/16	5/16	8/16

infection the plants got stunted growth and deformation of leaves. Sometimes the symptoms manifested with shoe string appearance of the leaves. A chlorotic blotching and/or mosaic symptoms was observed in many of the commercial cultivars of taro in the experimental as well as in the farmers' fields. The intensity of the disease was found to be less intense in the experimental as well as in the farmers' fields.

The severe symptoms were various combinations of leaf strapping, vein clearing, puckering and stunting and thus ascribed the disease symptoms as sweetpotato virus diseases (SPVD) (Yang *et al.*, 1993). Several researchers had reported on the incidence and detection of sweetpotato viruses in different countries (Gibson *et al.* 1998, Yang *et al.* 1993). Schaefer and Terry (1976), Stobbs *et al.* (1991), Marinho and Dusi (1995), and Cohen *et al.* (1997) noticed a wide range of variation in symptoms produced by the different viruses in sweetpotato. In the present investigation the intensity of C-6 virus was found to be very high in most of the samples collected from different places of West Bengal and occurrence of SPCaLV would give a new dimension in future research of sweetpotato viruses for its characterization and genetic make up to other strains available in this crop. International Potato Centre also has given the thrust to produce antisera and detection of sweetpotato viruses in different regions (Castillo, 1990). Ten different types of virus symptoms among which sweetpotato feathery mottle virus, and sweetpotato leaf spot virus had a severe effect, whereas some were seldom affected by sweetpotato chlorotic leaf spot virus and C₂ virus (Moyer *et al.*, 1978). The symptoms expression with chlorotic spotting and vein mottling in the variety 'Georgia Red' (Aritua *et al.*, 2000) and small leaves with excessive branching and short internodes combined

with vein clearing in different sweetpotato cultivars were noticed (Tarafdar *et al.*, 2003). Identification and detection of viruses infecting twenty promising cultivars of sweetpotato had been reported (Li *et al.*, 1999). The present investigation also predicted that the variations in symptoms and presence of viruses in the leaf titre might also vary with the cultivar, geographical region, time and the strain of the viruses. The comparable variation on the symptoms, severity *vis-a-vis* indexed viruses of sweetpotato also had been detected through out the year in West Bengal (Tarafdar *et al.*, 2004).

Table 4 : Incidence of virus diseases in the cultivars of Amorphophallus (EFY)

Name of the cultivars	Symptoms	Average incidence of Virus disease (%)
BCA-1	Mosaic, shoe string	20.0 (26.56)
Singur	Mosaic yellowing	13.33 (21.39)
BCA-3	Mosaic mottling	18.51 (25.48)
Sree Padma	Mild mosaic	8.51 (16.95)
BCA-2	Severe mosaic with leaf distortion	20.53 (20.53)
NDA-4	Severe mosaic, mottling and stunting	26.08 (33.66)
Ranchi	Mosaic stunting	5.0 (2.92)
NDA-5	Severe mosaic leaf distortion	27.81 (31.44)
Santragachhi	Yellow mosaic	3.91 (11.39)
NDA-9	Yellow mosaic with patches	21.67 (27.69)
Midnapore	Mosaic mottling	15.77 (23.34)
Midnapore 4	Yellow mosaic mottling	5.88 (13.94)
SEM±		1.55
C.D.(P=0.05)		4.53

The present study on the taro virus lends the previous observations made by some workers. In the early, some researchers reported the dasheen

mosaic virus in taros (Jordan *et al.*, 2000) and in other plant like orchid (Pearson *et al.*, 1999). Rhabdo virus infection in taro in pacific region was also noticed. Very few works had been done so far on the incidence of virus like diseases in elephant foot yam (EFY) in this state.

However, results similar to previous reports in other countries on sweetpotato viruses had been found in this state. Plants produced variable symptoms expression of sweet potato virus diseases (SPVD) under field conditions. In addition, C-6 virus, SPCaLV, SPMMV and SPCSV had been occurring with moderate to low incidence. Leaf extracts of sweetpotato with varying symptoms from different places did not react with some or all the antibodies used in this study. It was possible that some of the leaf extracts, which reacted with one virus might have also contained other viruses as mixed infection. It was also noticed that the moderate to severe mosaic virus infecting taros and EFY were also predominant in this state.

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REFERENCES

- Aritua, V., Adipala, E., and Gibson, R.W. 2000. Preliminary check list for viruses in Uganda. *African Potato Assoc. Conf. Proc.* **5** : 399-403.
- Bryan, A. D. 2002. *Impact of sweetpotato feathery mottle virus and micro propagation of yield, root quality and virus incidence in commercial sweetpotato production system*. M.Sc. Thesis, North Carolina State University, USA.
- Carey, E. E., Gichuki, S. T., Mwangi, R. O. M., Kasule, S., Fuentes, S., Macharia, C. and Gibson, R. W. 1998. Sweet potato viruses in Uganda and Kenya : Results of a survey. In : Akoroda, M. O and I. J. Ekanayake (eds). *Proceedings of the 6th triennial symposium of the international society of tropical root crops – Africa branch held 22 to 28 Oct. 1995 in Lilongwe, Malawi, sponsored by Government of Malawi and International Institute for Tropical Agriculture*. (IITA), Ibadan, Nigeria. p. 475-461.
- Gibson, R. W., Mpembe, I., Aalicali, T., Carey, E. E., Mwangi, R.O.M., Seal S.E. and Vatten. H. J. 1998. Symptoms, aetiology and serological analysis of sweet potato virus diseases in Uganda. *Plant Pathology*, **47** : 95-102.
- Jordan, R., Guàragna, M. A. Kinard, G. and Lynn S. 2000. In : ISHS Acta Horticulturae X International Symposium on Virus Diseases of Ornamental Plants, Vol : 1.
- Li, R. H., and Zettler, F. W. 1999. Differentiation of dasheen mosaic potyvirus isolates based on variability in the apparent size of the capsid protein in Western blots. *Jour of Phytopathol Berlin*. **147**(6) : 359-364.
- Moyer, J.W. and Kennedy, G. G. 1978. Purification and properties of sweetpotato feathery mottle virus. *Phytopathology*, **69** : 994-1004.
- NCBI. 2001. In : National Centre for Biotechnology Information, sequence database, [http : ncbi. nlm. nih. gov/](http://ncbi.nlm.nih.gov/)
- Pearson, M. N., and Jackson., G. V. H. 1999. Evidence for two rhabdoviruses in taro (*Colocasia esculenta*) in the Pacific region. *Aust Plant Pathology* **28**(3) : 248-253.
- Schaeffers, G. A. and Terry, E. R. 1976. Insect transmission of sweetpotato virus disease agents in Nigeria. *Phytopathology*, **66** : 642-645.
- Stobbs, L. W., Cerkauskas, R. F., Reynolds, L. and Mckeown, A. W. 1991. Occurrence of an aphid transmissible Sweet Potato Feathery Mottle virus in Ontario, Canada. *Plant Disease*, **75** : 4
- Tarafdar, R., Mandal., S. Sinha., B. Puste., A. M. Sahu P. K. and Sen, H. 2003. Morphological and biochemical investigation of some promising Indian sweetpotato cultivars for understanding interrelationship and occurrence of sweetpotato viruses among the cultivars. In : 13th International Meet of ISTRC, Arusa, Tanzania.
- Tarafdar, J; Sinha, Bireswar; Roy Choudhury, P; Attaluri, S and Ilgantileke, S. 2004. A preliminary indexing of sweet potato viruses in West Bengal by symptom expression and using NCM-ELISA. *CIP SWCA, Newsletter*. p7.
- Yang, Y. J., Xin, Y. J., Wu, Y. J. and Lu, G. Q. 1993. Preliminary study of sweet potato virus diseases in China. *Proceeding of the Asian Sweet Potato Germplasm Network Meeting, Guangzhou, China, 25 February 2 March 1991*, p. 130-134.

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