



Infection Pattern of PVY and PLRV in Potato Tubers Obtained from Potato Plants Infected with Both the Viruses*

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Abstract

Experiments were conducted to study the plant growth and tuber yield of the seed potato collected from PVY and PLRV infected plants. The seed potatoes were graded as under size (<28 mm), A grade (28-40 mm), B grade (41-55 mm) and over size (>55 mm) which were planted following RCBD in the field. Third generation seed potatoes of Diamant variety were used. The incidence of viruses was confirmed by DAS-ELISA. The incidence of PVY and PLRV was 100% in the plants raised from under size tubers. The lowest plant height, stem number/hill, tuber weight /hill was recorded in plants raised from under size tuber. It was observed that some of the plants raised from tubers A grade, B grade and oversize tubers remained virus free even when the tubers were collected from virus infected plants.

Keywords: Grade, tuber, PVY, PLRV, growth and yield.

1. Introduction

Remarkable yield loss of potato is attributed to various diseases. Potato is known to be infected by as many as 25 virus diseases (Hooker, 1987). Among them, *Potato leaf roll virus* (PLRV) and *Potato virus Y* (PVY) are of immense importance (Ali and Khan, 1990). PVY and PLRV affect the yield and quality of potatoes (Hossain *et al.*, 1994). The occurrence of PVY and PLRV in all the potato growing countries has been recognized as a severe menace of potato cultivation in all potato growing regions of the world. (Hooker, 1981; Bhandal and Naik, 1991). Both the viruses are tuber-borne resulting degeneration (Brunt *et al.*, 1990).

PVY and PLRV can reduce potato yield up to 60-75% (Gupta *et al.*, 1985). Hoa *et al.* (1991) reported moderate infection and severe infection due to PVY and PLRV, respectively, causing 49% and 61% yield loss in the Philippines. Yield

loss due to PVY raised up to 95% with severe infection in Bangladesh (Hossain and Ali, 1992). With 100% infection of PLRV yield loss was 78% (Hossain *et al.*, 1994) and only 30% infection with PVY in variety Cardinal may cause 35% yield loss (Hossain and Ali, 1993) in Bangladesh.

The degeneration of potato seed tubers due to PVY and PLRV is considered to be the most severe constraint of potato cultivation (Singh *et al.*, 1982). The degeneration became faster when the vector aphids remained above the critical level throughout the cropping season (Sawicka, 1994). These two viruses have also been reported to be highly prevalent in Bangladesh (Rashid *et al.*, 1986).

Yield reduction is the result of fewer tuber production or the production of small size tuber or both. The reduction in size of potato may due

to infection of viruses like PVY and PLRV, and also by genetical and physiological factors (Hossain, 1999). In general, diseased plants form fewer tubers of healthy plants. The yield loss in potato was reported to be common in PVY and PLRV infected plants in which reduction of number of tubers per plant was considered to be an important factor (Hossain, 1999).

PVY and PLRV infected plants may produce tubers having infection with the respective viruses. A study was, therefore, undertaken to evaluate the performance of seed tubers under different grades harvested from PVY and PLRV infected plants, in respect of virus incidence, plant growth and tuber production.

2. Materials and Methods

Third generation seed tubers of potato variety Diamant were planted in the field of BSMRAU and BADC during 2004-05. PVY and PLRV infected plants were identified based on foliar symptoms. The infection was confirmed by indicator plant test (Hill, 1984) and DAS-ELISA test using specific antiserum (PathoScreen Kit, supplied by Agdia Incorporated, USA) following the fundamental protocol outlined by Clark and Adams (1977) and modified by Akanda *et al.* (1991). Symptoms appeared on infected plants were compared with standard symptoms of PVY and PLRV (Hooker, 1981). Seed tubers were collected from the PVY and PLRV infected plants after harvest. The tubers were graded on the basis of size as undersize (<28), A- grade (28-40), B-grade (41-55) and oversize (>55 mm) following the procedures recommended by BADC (Anon., 2003).

Two independent experiments were conducted during 2005-06 at the research farm of BSMRAU, Gazipur. In one experiment PVY infected seed tubers and in another experiment PLRV infected tubers of four different grades were used. The unit plot size was 3.0mX1.8m where 30 tubers were accommodated at

60cmX30cm spacing. Randomized Complete Block Design (RCBD) was followed with four replications. Recommended fertilizers were applied at 350-250-270-120-120-106 kg/ha of urea, TSP, MP, gypsum, magnesium sulphate, zinc sulphate and borax, respectively (Anon., 2004). One half of urea and full dose of all other fertilizers were applied at the time of planting. Other half of urea was applied as side dressing after 35 days of planting. During land preparation cowdung was applied at 10 t/ha.

The seeds were planted on November 30, 2005 and the crop was harvest on March 12, 2006. Nimbicidine was applied at 2 litre per hectare to control insect (aphid). Spraying was started from the day of emergence and continued up to haulm pulling at 7 days interval. Haulm pulling was done after 90 days of planting and 10 days before harvesting with a view to avoid the spread of viruses and for hardening of tuber skin.

The plants were observed regularly. PVY and PLRV infected plants were recorded. Incidence of the two viruses was expressed in percentage. Data on plant height and stem number per hill were recorded before haulm pulling and number and weight of tubers per hill were recorded just after harvest.

3. Results and Discussion

All the potato plants grown from tubers of <28 mm were infected by PVY when the seed tubers were collected from PVY infected plants. Similarly, incidence of PLRV was 100% when seed tubers of same size were collected from PLRV infected plants. The incidence of PVY was 94.17, 73.33 and 60.83%, respectively under the A-grade, B-grade and overgrade seed tubers collected from PVY infected plants. The incidence was 93.33, 65.00 and 55.00% under the above three grades, respectively in case of seed tubers collected from PLRV infected plants. The differences in incidence of both the viruses under different grades of seed tubers were significant (Fig. 1).

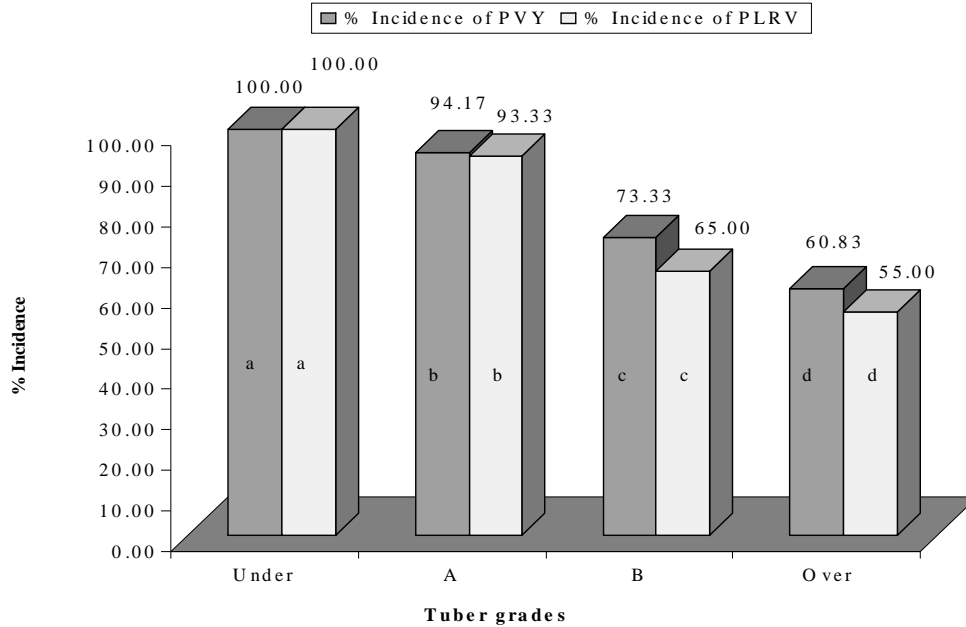


Fig. 1. Incidence of PVY and PLRV in plants grown from tubers of different grades.

Under, A, B and oversize tubers of PVY infected plants gave plant of height respectively 39.43, 42.46, 44.46 and 47.11 cm (Table 1). However, these were 40.72, 44.06, 46.75 and 48.82 cm in case of PLRV. The number of stem was 2.49, 3.18, 3.74 and 4.19 per hill in case of PVY and 2.95, 3.67, 3.91 and 4.45 in PLRV infected plants when seed tubers were collected from undersize, A-grade, B-grade and oversize, respectively. Tuber number per hill ranged from 4.89-7.15 and 4.89-7.22 under different grades of seed potato collected from PVY and PLRV infected plants, respectively. The ranges of tuber weight were 78.50-226.50 g and 102.00-264.50 g per hill under PVY and PLRV infected seed tubers, respectively. Plant height, stem number, number and weight of tubers per hill were significantly different ($P \leq 0.05$) under different grades of seed tubers (Table 1). It was found that all the tubers tested were infected by the

respective virus when seed tuber size was <28mm. But some healthy tubers were obtained from tubers where sizes of seed tubers were more than <28 mm.

Undersize tubers of infected plants produced virus infected plants and infected tubers. The seed size was reduced due to infection of the viruses. This result confirmed the positive effect of virus infection on degeneration (Bari *et al.*, 1998; Chandla *et al.*, 2001). Plants grown from the small tubers did not yield any tuber free from PVY or PLRV infection. The highest number of healthy plants was obtained when oversize (>55 mm) tubers were planted, which was followed by grades B and A.

These findings indicate that it is possible to recover healthy seed tubers from PVY or PLRV infected plants in the immediate next generation, if seed size is 28 mm to more than 55 mm.

Table 1. Effect of potato seed tubers of PVY and PLRV infected plants on growth and tuber yield

Grades	Plant height (cm)		Stem number per hill		Tuber number per hill		Tuber weight (g/hill)	
	PVY	PLRV	PVY	PLRV	PVY	PLRV	PVY	PLRV
Under	39.43 d	40.72 d	2.49 d	2.95 d	4.89 c	4.89 c	78.50 d	102.00 d
A	42.46 c	44.05 c	3.18 c	3.67 c	5.80 b	5.84 b	117.50 c	158.20 c
B	44.46 b	46.75 b	3.74 b	3.91 b	6.16 b	6.34 b	164.20 b	204.40 b
Over	47.11 a	48.82 a	4.19 a	4.45 a	7.15 a	7.22 a	226.50 a	264.50 a
CV (%)	0.84	0.82	2.08	1.57	2.68	4.76	6.33	3.99

Means within the same column with a common letter(s) do not differ significantly (P=0.05).

Grades:

Under = <28mm
 A = 28-40mm
 B = 41-55mm
 Over = >55mm

Table 2. Effect of PVY and PLRV infected seed tubers of four grades on number and weight of potatoes

Grade	Virus	Grade by number (%)				Grade by weight (%)			
		Under	A	B	Over	Under	A	B	Over
Under	PVY	66.23 a	40.23 a	0.00 d	0.00 d	22.05 a	77.94 a	0.00 c	0.00 c
	PLRV	51.01a	48.64 a	24.06 a	0.00 d	17.84 a	81.18 a	0.96 c	0.00 c
A	PVY	55.83 ab	40.17 a	3.12 c	0.84 c	16.57 b	67.60 b	10.01 b	5.80 b
	PLRV	45.63 b	42.89 b	25.50 a	2.58 c	11.00 b	55.00 b	20.51 b	13.47 b
B	PVY	50.37 bc	37.15 b	10.09 b	3.44 b	12.56 c	50.85 c	25.65 a	18.55 a
	PLRV	39.25 c	39.53 c	26.94 a	4.62 b	9.14 bc	44.79 c	29.65 a	21.02 a
Over	PVY	43.36 c	36.63 b	14.40 a	4.80 a	8.81 d	40.35 d	28.70 a	21.03 a
	PLRV	35.91 c	38.76 c	28.01 a	5.96 a	7.22 d	39.15 d	32.49 a	24.21 a

Mean followed by same letter in same column within each virus do not differ significantly at 1% level by DMRT Data were transformed following square root transformation before analysis.

Higher number of healthy plants and yield of healthy tubers were obtained from larger seed tubers collected from PVY or PLRV infected plants. These findings, however, are not in agreement with those reported by Sanger *et al.* (1994) who reported that tubers less than 40 g in weight were better as a source of virus free seed tubers than those of 40-60 g and more than 60 g.

Based on findings of the present study it may be concluded that healthy tubers may be obtained from immediate next generation from the larger size seed tubers collected from potato plants infected with PVY and PLRV. Seed size positively influences the plant growth, tuber yield and recovery of virus free seed tubers, where higher seed size gives better plant growth,

higher yield and higher recovery of healthy tubers.

Yield reduction was higher when small tubers were planted. Tubers of 28-40 mm (Grade A) and 41-55 mm (Grade B) size gave higher yield. The plants grown from tubers of size <28 mm of PVY and PLRV infected tubers produced the lowest amounts of small size tuber (<28 mm), followed by the size 28-40 (Grade A), 41-55 (Grade B) and >55 mm (Table 2).

The reduction in tuber yield has been reported to be different for different varieties and viruses (de Bokx and van der Want, 1987; Hossain, 1999). The findings of the present investigation are in agreement with those of the other investigators. The production of different sized tubers in different grades was found to be significant. Similar trend has been reported by Sangar *et al.* (1994), Islam (1998), Halim (1999) and Hossain (1999).

4. Conclusions

The results of the present study indicates that all the tubers yielded by the virus infected plants might not be infected by the virus. The highest incidence of the viruses but lowest plant height, stem number, tuber number and tuber weight per hill were recorded under smallest size seed tuber (<28 mm), which was followed by A-grade, B-grade and oversize seed tuber. About 40% plants were free from PVY infection and 45% plants were free from PLRV infection, where oversize seed tubers were planted. Size ranged from 41-55 mm (B) tubers were found to have low percentage of PVY and PLRV infection when the plants were grown from virus infected tubers. Such type of potato might be used to clean the PVY and PLRV from virus infected plants. The virus free plants grown from virus infected seed tubers produced virus free tubers. It may be concluded that if large size seed tubers are collected from PVY or PLRV infected plants and planted in the next season, there is possibility to obtain virus free seed tubers.

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