

THE EFFECTS OF TUBER PERPETUATED PVY AND PLRV ON YIELD AND QUALITY OF SHEPODY AND RUSSET NORKOTAH POTATOES

by

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Seed born potato viruses are a chronic problem for both seed and commercial growers. Both PVY and PLRV have been associated with yield and quality losses in potatoes. However, the effects of these viruses on newer varieties has not been fully documented. In recent years varieties have been released that exhibit varying degrees of resistance to PVY and PLRV. This makes it difficult for seed growers to rogue infected plants, furthering potential losses in subsequent generations. With the wide spread acceptance of Shepody and Russet Norkotah, both of which exhibit mild symptoms from current season PVY infections, a substantial acreage could be affected from seed contamination. Information presented here measured the effects of tuber perpetuated PVY in Shepody and Russet Norkotah and the effects of tuber perpetuated PLRV in Russet Norkotah. This project also measured possible compensatory contributions of adjacent plants that might have benefited from reduced competition.

METHODS

1994:

On June 1, two commercial fields, one each with Shepody and Russet Norkotah potatoes was scouted and plants showing symptoms of PVY or PLRV were selected. Only those plants with visually healthy plants on both sides were selected. Because of earliness of symptoms, infections were assumed to be from tuber (seed piece) infections. To confirm observations, leaf samples were taken from the infected plants as well as from the symptomless plants on either side and tested by ELISA. Selected hills required virus free plants (HEALTHY A) on both sides. Replications for each virus and cultivar varied from 18 to 21. Plants were harvested individually on July 21. A third plant adjacent (HEALTHY B) to the healthy plant was also harvested. Weight, tuber number, and air-water weights were gathered for each hill.

1995:

Tubers saved from 1994 were eye index with ELISA to confirm virus infection and then used as seed. For Shepody, a second source of seed, grown at the Hermiston Agricultural Research and Extension Center, was also used.

This resulted in two trials with Shepody (different seed sources), and two trials with Russet Norkotah (PVY & PLRV viruses). On April 17 plot areas were planted using five rows of certified virus free seed for both Shepody and Russet Norkotah. Individual plots were established by replacing three tubers, one virus infected tuber followed by two virus free tubers. All plots were completely surrounded by plants grown from certified seed. Replications for the four trials varied from 20 to 24. All plot plants were ELISA tested shortly after emergence (May 24) to verify their virus status. All healthy plants were again ELISA tested on June 20 to determine seasonal infection of adjacent plants. Standard cultural practices typical of the growing area were followed. A severe hail storm on July 9 shortened the growing season by two weeks. Where regrowth was sufficient, a final ELISA was conducted. All surviving growth was arrested on July 19 with an application of Enquik at 20 gallons per acre. Hills were harvested on August 1 and August 9. Information for each hill was gathered as in 1994. In addition, yield of tubers over 85 grams was measured.

Results And Discussion:

Shepody, PVY:

In 1994 and both trials in 1995, total yield was reduced in plants with tuber perpetuated PVY compared to the second adjacent virus free plant (HEALTHY B), and in 1995 was significantly lower than the first adjacent virus free plant (HEALTHY A) (table 1). The large differential in yield over years is attributed to the hail shortened season in 1995. Total yield between HEALTHY A and HEALTHY B hills was not different. This would indicate that no compensatory effect due to the healthy plant being adjacent to the less competitive virus infected plant occurred. All plants in the 1995 trials became infected with PVY by seasons end (Table 2).

This is likely the situation for 1994 as well. Seasonal infection of these plants could reduce their production potential and account for a lack of compensatory effect. Yield of tubers over 85 grams was measured in 1995 to provide a better indication of marketable yield. By that measurement marketable yield (tubers over 85 grams) was reduced substantially more than total yield with TP-PVY in Shepody.

Tubers per hill were reduced in both 1995 trials in TP-PVY plants compared to HEALTHY A or HEALTHY B plants. Average tuber weight was lower in 1994 and in one 1995 trial. Reduced tuber weight would explain why usable yield is reduced more than total yield when comparing TP-PVY plants with healthy plants.

Specific gravity was unaffected by TP-PVY in Shepody. The lower specific gravities in 1995 compared to 1994 are likely due to the hail arrested growth prior to the crop reaching peak gravities.

Russet Norkotah, PVY:

Tuber perpetuated PVY reduced total yield both years compared to HEALTHY A and HEALTHY B plants (table 3). Total yield of HEALTHY B was equal to or significantly greater than that of the HEALTHY A plant. As with Shepody, this indicates that no compensatory yield was measured from a healthy plant that was next to a virus infected plant. In fact, in the 1995 trial, total yield and yield of tubers over 85 grams was significantly less for HEALTHY A plants than for HEALTHY B plants.

The trend was similar for total yield in the 1994 trial. This was likely due to the HEALTHY A plant becoming PVY infected early enough in the season to interfere with production. As with Shepody, the magnitude of difference between the TP infected plant and HEALTHY A/B plants was even greater when marketable yield (tubers over 85 grams) was measured.

In 1995, there were fewer tubers per plant from TP-PVY plants compared to healthy plants. A similar trend was noted in 1994. Tuber weight, in 1994, was also lower in TP-PVY plants compare to HEALTHY A/B plants. In 1995, tuber weights were not significantly different among treatments. However, this may be due to a hail shortened growing season which would likely affect healthier plants more than disease stressed plants.

Though the specific gravity trend was similar both years, it was significantly lower for TP-PVY plants compared to HEALTHY A/B plants only in 1994. The specific gravity maturation may have been disrupted by the hail damage in 1995.

Russet Norkotah, PLRV:

Total yield was reduced in TP-PLRV compared to HEALTHY A or B plants in both 1994 and 1995 (table 4). When yield of tubers over 85 grams was measured in 1995, the differential between TP-PLRV and HEALTHY A/B plants was even greater than that seen with total yield. This was similar to the effects seen with TP-PVY in Russet Norkotah and Shepody.

In both trials, TP-PLRV plants had fewer tubers per hill than HEALTHY A/B PLANTS. The higher tuber numbers in 1995 may be due to using physiologically older seed than in 1994.

TP-PLRV plants also had smaller tubers than HEALTHY A or HEALTHY B plants. This could explain the higher percent yield loss between infected and non-infected plants when comparing usable yield to total yield.

In 1994, an increase in specific gravity was higher in HEALTHY A/B plants than TP-PLRV plants. No difference in specific gravity was measured in 1995 (table 4). The lower gravities in 1995 may be associated with the hail shortened growing season, killing vines before maximum specific gravities were achieved.

Conclusions:

The evidence identifies tuber perpetuated PVY significantly reduces yield and yield factors as well as quality in Shepody and Russet Norkotah potatoes. Further, yield and quality are reduced in Russet Norkotah plants grown from tuber perpetuated PLRV seed. No compensatory effects were measured in plants adjacent to the virus infected plants. Actually, yields of adjacent plants (Healthy A) were often less than HEALTHY B plants. Table 5 outlines the loss expected for each % of seed infected with these viruses when planted in the Columbia Basin. When this data is used to estimate actual dollar loss per acre, a 1 % seed infection results in a dollar loss per acre of \$120 using 1995 fresh market prices, \$56/A in 1996 (Table 6). Losses are much greater as percent infection increases. The evidence of these trials shows that, even in varieties that show minimal symptoms of tuber perpetuated infections with PVY, substantial yield and quality losses will result from the virus being forwarded in the seed. These results emphasize the need for seed growers to plant only virus free seed and to vigilantly rogue for these viruses.

Further, the evidence clearly shows the importance of seed buyers to carefully choose seed lots for purchase that contain the least amounts of PVY and PLRV infection.

TABLE 1. The effect of tuber perpetuated PVY on yield, tuber numbers, tuber weight, and specific gravity in Shepody potatoes.

<u>....yield....</u>					
	total	>85 gms	tubers/plant	tuber weight	specific gravity
1994:gms.....				gms	
TP-PVY	1183		8.2	148	1.072
HEALTHY Plant A	1518		7.4	208	1.076
HEALTHY Plant B	1660		8.9	195	1.074
LSD _(.05)	345'		ns	35''	ns
1995-A:					
TP-PVY	448	228	6.4	74	1.063
HEALTHY Plant A	706	401	8.6	85	1.066
HEALTHY Plant B	760	516	8.6	94	1.065
LSD _(.05)	160''	186'	1.8'	ns	ns
1995-B:					
TP-PVY	347	89	7.3	50	1.064
HEALTHY Plant A	728	10	10.9	75	1.066
HEALTHY Plant B	659	433	8.6	85	1.063
LSD _(.05)	147''	118''	2.3'	22''	ns

TABLE 2. Number of Shepody plants positive for PVY by ELISA testing at two dates, Hermiston, OR, 1995.

Test date	TP-PVY	HEALTHY Plant A	HEALTHY Plant B
.. no. positive plants ..			
5/24	32	0	0
7/18	32	31	31

TABLE 3. The effect of tuber perpetuated PVY on yield, tuber numbers, tuber weight, and specific gravity in Russet Norkotah potatoes.

<u>.... yield....</u>					
	total	>85 gms	tubers/plant	tuber weight	specific gravity
1994: gms			gms	
TP-PVY	1057		8.2	129	1.070
HEALTHY Plant A	1647		9.7	187	1.077
HEALTHY Plant B	1941		11.6	185	1.076
LSD _(.05)	335'		ns	36''	.003'
1995:					
TP-PVY	438	187	6.1	73	1.067
HEALTHY Plant A	672	312	10.1	73	1.070
HEALTHY Plant B	855	536	10.5	91	1.070
LSD _(.05)	159''	181'	3.2'	ns	ns

TABLE 4. The effect of tuber perpetuated PLRV on yield, tuber numbers, tuber weight, and specific gravity in Russet Norkotah potatoes.

<u>.... yield</u>					
	total	> 85 gms	tubers/ plant	tuber weight	specific gravity
1994:					
TP-PLRV	689		6.8	102	1.068
HEALTHY					
Plant A	1751		9.5	209	1.074
HEALTHY					
Plant B	1964		11.5	187	1.074
LSD _(.05)	357"		2.4"	51"	.002"
1995:					
TP-PLRV	310	60	7.4	41	1.070
HEALTHY					
Plant A	968	549	13.2	78	1.070
HEALTHY					
Plant B	884	518	11.9	80	1.069
LSD _(.05)	161"	182'	2.9"	15"	ns

TABLE 5. Rule of thumb yield loss for each 1% infected seed due to PVY and PLRV on Shepody and Russet Norkotah potatoes in the Columbia Basin.

Cultivar	Virus	% Yield Loss			Total
		Seed Piece	Current Season		
Shepody	PVY	.56-.79	?	.56-.79	
Russet Norkotah	PVY	.65	.84(2x Adjacent Plant)	1.49	
Russet Norkotah	PLRV	.88	None	.88	

TABLE 6. Estimated dollar loss in commercial fields due to seedborne PVY infections in Russet Norkotah when grown in the Columbia Basin.

Virus Level(%)	Yield(CWT)	Yield Loss(%)	Yield Loss (CWT/A)	Dollar Loss/Acre	
				1995	1996
1	500	1.5	7.5	120	56 ¹
5	500	7.5	38.5	616	289
10	500	15	75.0	1200	578
15	500	22.5	112.5	1800	844

¹Dollar loss estimated using 1995 and 1996 fresh market prices when potato seed infection level was 1% with a yield of 500 CWT/A.