Incidence of potato viruses S and X and potato leafroll virus in potatoes in Queensland

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Abstract

In 1986–87, enzyme-linked immunosorbent assay (ELISA) was used to test for potato virus S (PVS), potato virus X (PVX) and potato leafroll virus (PLRV) in certified potato 'seed' obtained from either Victoria or New South Wales. None of the viruses was found in the Victorian 'seed', but one out of three samples from New South Wales contained 10% PVS. In similar ELISA tests of tubers harvested from commercial crops in Queensland, PVS and PVX were found in about two-thirds of crops at an overall average level of 3–4%, whereas PLRV occurred in tubers of all crops tested at an average level of 9%. It is concluded that the level of PVS and PVX in certified 'seed' and commercial crops in Queensland is much lower than was found in a previous survey in 1977–78, and that PLRV is now the most common virus of potatoes in Queensland.

Introduction

Potatoes are an important crop in Queensland, with an annual production of nearly 120 000 tonnes from 6 000 ha. This represents 11.8% of the Australian production (Australian Bureau of Statistics, Crops and Pastures 1984/85). The main production areas are the Lockyer Valley and the Atherton Tableland, where 49% and 12%, respectively, of the Queensland crop are produced. In these areas, two main crops are grown each year. Most growers plant a 'spring' crop in May–August using certified 'seed' from Victoria or New South Wales. Tubers from this crop are saved and used to produce an 'autumn' crop which is planted in the following February–March.

In 1977–78 a survey of commercial potato crops in the Lockyer Valley, Queensland, showed that incidence of potato virus S (PVS) and potato virus X (PVX) averaged 57% and 15%, respectively, but that potato virus Y (PVY) was rare (6). The source of infection was considered to be Victorian and New South Wales certified 'seed'; incidence of PVS and PVX in Victorian 'seed' averaged 25% and 13%, respectively, due mainly to a few crops having a very high incidence of infection.

In 1986–87, a new survey of PVS and PVX in commercial crops and certified 'seed' was undertaken in Queensland. In addition, a survey for potato leafroll virus (PLRV), important in many countries (4,8), was also done. PVY was not included in this survey because it was rare in the previous survey (6), and observations since then have indicated that it continues to be so. Isolates of PVY from tomato, tobacco and capsicum crops in Queensland appear to systemically infect potato only rarely (5, J. E. Thomas unpublished data).

Methods

Sources of potato tubers, sprouts and leaves Certified 'seed' of cvv. Sebago, Sequoia and Pontiac originally obtained from Victoria or New South Wales was sampled in a randomized manner, the tubers placed in a darkened room at 4°C until dormancy was broken, and then allowed to sprout at room temperature (approximately 23°C) for 4–5 weeks. The tubers were then planted in a glasshouse, and grown for about 5 weeks to produce leaves. Usually both sprouts and leaves were tested for viruses by ELISA (1,2,8,11,12).

Commercial crops in the Lockyer Valley, S.E. Queensland, and on the Atherton Tableland in North Queensland were tested by taking tubers at random after harvest. The tubers were treated in the same way as the certified 'seed'.

To economize on work, tests were first done with composite sprout or leaf samples taken from groups of five plants and, when any composite sample was positive, each plant contributing to the composite sample was tested individually.

ELISA tests The antisera to PVS and PVX were previously prepared against Queensland isolates from potato by I. R. Holmes and D. S. Teakle, while that to PLRV was prepared against the 39D isolate of the 'tomato yellow top virus' by J. E. Thomas. 'Tomato yellow top virus' (13) is now considered to be a strain of PLRV (4) and this antiserum has been extensively tested against suspected PLRV in field-infected potatoes in Queensland. In hundreds of tests there has been a high correlation between typical primary or secondary virus leafroll symptoms and positive ELISA reactions with antiserum to the 39D isolate.

The methods used were similar to those of Clark and Adams (2), except that the extraction buffer for PLRV was 0.05 M sodium phosphate (pH 7.0) containing 0.01 M sodium diethyldithiocarbamate (5 ml buffer/g tissue) (9). Absorbance at 405 nm was read

with a Titertek Uniskan 1 spectrophotometer. Duplicate wells were used for each sample and the mean of absorbance values was calculated after subtracting the absorbance of wells to which buffer only had been added. In each plate the outside wells were not used, and healthy and infected plant sap were included as controls.

Results and Discussion

Typical absorbance readings were always below 0.1 for extracts of virus-free samples and higher than 1.8 for infected controls. All of the leaf or tuber sprout samples gave results either very close to the healthy controls or greater than 0.8. Healthy samples were thus readily distinguished from those that were infected.

The ELISA results with PVS, PVX and PLRV indicated that in screening potato 'seed' lots there was no significant difference between taking tuber sprouts and taking leaves from glasshouse-grown plants. The sprout test, however, had an advantage in allowing a saving of time, space and effort.

PVS was found in one of three samples of certified Sebago potatoes from New South Wales, but not in six samples from Victoria. PVX was not found in any of the nine samples of certified 'seed' (Table 1). These results support those of Moran *et al.* (10) who found only very low levels of PVX and PVS in Victorian certified 'seed' crops in 1979–80 and 1980–81. It appears that a considerable improve-

Table 1 Incidence of the potato viruses S, X and leaf roll in 1986 Victorian and New South Wales certified 'seed' (tested by ELISA)

Cultivar	District	State	No. of plants tested	No. of plants infected with		
				PVS	PVX	PLRV
Pontiac	Kinglake	Victoria	50	0	0	0
Sequoia	Thorpdale	Victoria	50	0	0	0
Sequoia	Thorpdale	Victoria	10	0	0	NT[A]
Sebago	Kinglake	Victoria	40	0	0	0
Sebago	Thorpdale	Victoria	10	0	0	NT
Sebago	Toolangi	Victoria	20	0	0	NT
Sebago	Crookwell	New South Wales	20	2	0	NT
Sebago	Guyra	New South Wales	20	0	0	NT
Sebago	Guyra	New South Wales	20	0	0	NT

[A]NT = not tested

Table 2 Incidence of the potato viruses S, X and leaf roll in tubers taken from commercial potato crops[A] in Queensland in 1986 and 1987 (tested by ELISA)

Cultivar	District[B]	No. of plants tested	No. of plants infected with		
			PVS	PVX	PLRV
Pontiac	Gatton	50	2	3	2
Sebago*	Gatton	50	1	1	7
Sebago	Gatton	50	1	1	4
Sebago	Gatton	50	2	1	5
Sebago	Gatton	50	1	1	4
Sebago*	Gatton	15	0	1	NT[C]
Sebago	Gatton	10	0	0	NT
Sebago	Killarney	10	0	0	NT
Sebago	East Barron	10	0	0	NT
Sebago	Tolga	50	4	5	6
Sebago	Evelyn	50	2	1	3

[A]All crops were grown from certified 'seed', except where noted*.
[B]Gatton and Killarney are in S.E. Queensland, while the other districts are in N. Queensland.
[C]NT = not tested

ment in the virus status of Victorian certified 'seed' has been achieved since the last Queensland survey in 1977–78 (6). Presumably this reflects maturation of the new Victorian Seed Potato Certification Scheme.

In tests of tubers produced under commercial conditions in Queensland, PVS was present in 7 and PVX in 8 out of 11 crops, respectively (Table 2). However, the incidence of infection averaged only 3.3% and 3.5% for PVS and PVX, respectively, compared to 57% and 15%, respectively, in 1977–78 (6). These results could indicate that PVS and PVX are often present in certified 'seed' at a very low percentage of infection (10), and that they reach detectable levels after spreading in the field under commercial growing conditions. Alternatively, newly planted 'spring' crops grown from certified 'seed' are sometimes located near, and overlap in time, maturing 'autumn' crops grown from saved 'seed'. Under these conditions the latter may act as a source of infection. Although contact with diseased potato plants appears to be a major method of transmission for PVS and PVX (3), the possible role of alternate hosts for these viruses (7) in Queensland is not known.

Although PLRV was not detected in the three samples of certified seed tested, it was detected in all of seven commercial potato crops in Queensland at an average level of 9% (Table 2). The PLRV in commercial crops could have resulted from spread from trace levels of infection in certified potato 'seed', though more likely by aphid transmission from external sources of infection around the newly planted potato crops. These sources could include overlapping, infected crops or alternate hosts. This aspect of the epidemiology of PLRV is currently under investigation. PLRV now appears to be the most prevalent virus of potatoes in Queensland and during recent outbreaks, levels of infection have reached 50–100% in crops grown from certified 'seed' (J. E. Thomas unpublished data).

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Manuscript received 16 June 1987, accepted 2 February 1988.