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Unusually mild symptoms of potato leafroll virus in the progeny of late-infected mother plants

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Summary

In a field experiment in which the date of potato leafroll virus (PLRV) inoculation was controlled, progeny plants derived from late infection of mother plants in the previous year showed much milder symptoms than progeny plants derived from mother plants that became infected earlier in the season. Plants with these milder symptoms contained as great a concentration of PLRV as progeny plants with more obvious symptoms derived from early primary infections.

Introduction

In Scotland potato leafroll virus (PLRV) is mostly spread in potato crops by aphids which acquire virus from plants with secondary PLRV infection in the same crop. In many cultivars such plants begin to express symptoms of 'secondary leaf roll' in June. Because Scottish seed potato crops are normally not colonised by the vector aphids *Myzus persicae* and *Macrosiphum euphorbiae* becore late June, roguing by growers in early July of plants with virus symptoms is adequate in most years to prevent any increase in incidence of PLRV in these stocks. The removal of infected plants, and a progressive lowering of the tolerances for virus incidence at field inspection in seed crops entered for classification have been the main way of controlling PLRV spread in Scotland. In the Scottish Seed Potato Classification Scheme, crops are inspected on two or three occasions, usually between mid-July and the first week of August, to ensure that the incidence of various diseases and disorders falls below very low limits. Field inspection of growing crops is still the principal method of assessing seed potato quality in Scotland although the sensitive serological test, enzyme-linked immunosorbent assay (ELISA), now plays an increasing role in detecting virus infection.

Knutson & Bishop (1964) reported that the date of expression of secondary leafroll symptoms in potato in Idaho was related to the date of primary infection but no definitive information of this kind has been reported for British cultivars growing in Scotland. However, Woodford & Barker (1986) noted that late-developing symptoms of secondary leafroll occurred somewhat more frequently in plants grown from tubers harvested from crops in which the haulms had been burned down in late August or early September than in crops where the haulms had been destroyed 2–3 weeks earlier. This paper describes a field experiment in which the effect of inoculation date on the expression of secondary leafroll symptoms in the following year was

examined with the leafroll-susceptible cultivar Maris Piper and the resistant cultivar Pentland Crown.

Materials and methods

Production of PLRV-infected tubers

The plants in which symptoms of secondary infection were studied were grown to assess the incidence of infection of mother plants in the previous year and came from a field experiment to test the effect of inoculation date on the susceptibility of potato cvs. Maris Piper and Pentland Crown to aphid-borne PLRV in 1984. A standard isolate of PLRV (Barker & Harrison, 1985), maintained in potato cv. Maris Piper, was used for inoculum. For each inoculation, aphids were reared on fresh PLRV-infected glasshouse-grown Maris Piper plants. Apterous viruliferous *Myzus persicae* were collected and caged on field-grown single stemmed potato plants (7 or 21 aphids per plant) and after 7 days were killed by spraying with nicotine sulphate (2 % aqueous solution of XL ALL Insecticide; Synchemicals). At each inoculation date (inoculation 1, 6–13 June; inoculation 2, 5–12 July; inoculation 3, 2–10 August), 24 plants of each cultivar were inoculated. Their progeny tubers were harvested in late September and stored at 4 °C until April 1985, when they were planted in field plots.

Assessment of infection

Tubers were planted by hand in mid-April spaced at 0.5 m in drills about 0.76 m apart in sandy loam soils receiving compound fertiliser, containing 18.7 % N, 18.7 % P and 26.2 % K, at a rate of 1250 kg/ha. In other respects the crops were grown according to normal commercial practice. Progeny plants were inspected first in early June and subsequently every 2–3 weeks until the end of August. ELISA was used to confirm visual assessments of infection with PLRV, and to estimate the PLRV content of tissue extracts, as described by Barker & Harrison (1985).

Results and discussion

In Maris Piper, progeny plants derived from mother plants inoculated with PLRV in June or July of the previous year developed severe symptoms which were identified by the second week of June, whereas progeny plants derived from mother plants inoculated in August developed only mild symptoms (Table 1) which could not be identified with confidence until the beginning of July. The expression of secondary leafroll in cv. Pentland Crown was rather different. Progeny plants derived from mother plants infected in June and July of the previous year were stunted and easily identified by the second week of June but showed only mild leafrolling whereas plants derived from progeny of mother plants inoculated in August were virtually symptomless (Table 1). PLRV was detected in these apparently symptomless plants only by ELISA. Plants of both cultivars were more resistant to infection later in the season, particularly those of Pentland Crown (Table 1), but the date of inoculation had no effect on the number of progeny tubers. Symptoms of secondary infection in progeny plants from the three inoculations seemed not to be affected by the size of tuber planted. These differences in symptom expression could be seen from shortly after emergence until the end of July, after which more severe leafrolling developed in infected plants of both cultivars.

Table 1. Effect of inoculation date of mother plants on detection of potato leafroll virus in progeny plants.

Inoculation date of mother plants	Number of infected mother plants[a]	Number of infected progeny plants[b]	Symptoms[c]		Virus content (A_{405})[d]
			leafrolling	stunting	
Maris Piper					
6 – 13 June	24 (9.2)	220 (100)	severe	severe	1.1
5 – 12 July	24 (9.6)	227 (98)	severe	severe	1.2
2 – 10 August	21 (9.9)	171 (83)	mild	very little	1.25
Pentland Crown					
6 – 13 June	12 (8.9)	107 (100)	mild	severe	0.45
5 – 12 July	8 (7.1)	56 (88)	mild	severe	0.47
2 – 10 August	5 (7.6)	27 (71)	none	none	0.51

[a] 24 plants inoculated at each date. Figures in parenthesis are means of numbers of tubers harvested from infected mother plants.
[b] Figures in parenthesis are percentages of virus-containing progeny derived only from infected mother plants. Progenies from uninfected mother plants have been excluded.
[c] Symptoms assessed up to end of July.
[d] ELISA values (A_{405nm}) were recorded 2 hours after addition of substrate. Extract of uninfected leaves gave A_{405} of 0.12. Figures are means of values for 10 – 16 extracts of young fully expanded leaves from plants tested in early June.

Table 2. Effect of inoculation date on concentration of potato leafroll virus in tissue extracts of progeny plants of Maris Piper.

Tissue	Inoculation date of mother plants	
	6 – 13 June[a]	2 – 10 August[b]
Leaves	475[c]	435
Petioles	900	820
Stem	1955	1530
Stolons	2600	2430
Roots	575	800
Tubers[d]	1300	1350

[a] Progeny plants had severe symptoms.
[b] Progeny plants had mild symptoms.
[c] Values (ng/g tissue) are for pooled samples taken from three stems on each of three plants at end of July.
[d] Heel end tissue from new tubers.

In neither cultivar were these differences in symptom expression associated with any difference in PLRV antigen concentration of leaf extracts, assessed by ELISA (Table 1). The possibility was considered that the differences in symptom severity were caused by differences in virus content in tissues other than the leaf. However

more detailed observations made on PLRV concentration in tissues from infected progeny plants of cv. Maris Piper showed that the date of primary infection had little if any influence on the concentration of PLRV in progeny plants, despite the difference in symptom severity (Table 2). Possibly the date of primary infection affects the physiological state of the tubers and the subsequent growth of the progeny plants. Previous work has shown that Maris Piper is a better source of PLRV for transmission by *M. persicae* than Pentland Crown (Barker & Harrison, 1986). The results reported here suggest that this difference is probably independent of differences in symptom severity in either cultivar that arise as the result of differences in inoculation date in the previous year.

Our experimental evidence shows that progeny plants derived from mother plants of cvs. Maris Piper and Pentland Crown infected in August develop either mild or no symptoms respectively of secondary leafroll, and severe symptoms develop only late in the season. These observations may explain the problems experienced in assessing the extent of infection in the progeny from our large scale field trials where haulm destruction was delayed (Woodford & Barker, 1986), because there was an increased probability of infection late in the season in the mother plants in these trials. The practical importance of our findings is hard to assess. The results from field trials to measure the spread of PLRV show that at the Scottish Crop Research Institute over 95 % of secondarily infected Maris Piper plants express recognisable symptoms by the end of June, well before the usual first date of field inspections (Woodford & Barker, 1986). If the second inspection of the Seed Potato Classification Scheme is done in the first week of August, plants with late-developing symptoms are likely to be identified. However, infected plants with mild or no symptoms early in the season would be difficult to identify for roguing and could constitute an appreciable source of virus for aphids because such plants have virus contents similar to those with more severe symptoms.

References

Barker, H. & B. D. Harrison, 1985. Restricted multiplication of potato leafroll virus in resistant potato genotypes. *Annals of Applied Biology* 107: 205–212.

Barker, H. & B. D. Harrison, 1986. Restricted distribution of potato leafroll virus antigen in resistant potato genotypes and its effect on transmission of the virus by aphids. *Annals of Applied Biology* 109: 595–604.

Knutson, K. W. & G. W. Bishop, 1964. Potato leafroll virus – effect of date of inoculation on percentage infection and symptom expression. *American Potato Journal* 41: 227–238.

Woodford, J. A. T. & H. Barker, 1986. Problems of detecting potato leafroll virus following late infection. In: 'Crop protection of sugarbeet and crop protection and quality of potatoes', part II. *Aspects of Applied Biology* 13: 325–331.