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THE TRANSMISSION OF TWO STRAINS OF STRAWBERRY LATENT RINGSPOT VIRUS BY POPULATIONS OF *XIPHINEMA DIVERSICAUDATUM* (NEMATODA: DORYLAIMOIDEA)

by
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The type-British strain of strawberry latent ringspot virus (SLRV-T) was described by Lister (1964) who also reported its vector to be *Xiphinema diversicaudatum* (Micoletzky, 1927) Thorne, 1939. Subsequently, SLRV has been identified from diseased crop plants in several European countries and from Canada and New Zealand (Murant, 1974; Novak and Lanzova, 1975; Martelli, 1975, 1978; Vegetti *et al.*, 1979; Lamberti *et al.*, 1980; Nemeth, 1980; Cech *et al.*, 1981; Credi *et al.*, 1981). Strains of SLRV, serologically distinct from SLRV-T, have been isolated from parsley grown in the United States of America and raspberry in Italy (Hanson and Campbell, 1979; Belli *et al.*, 1981).

SLRV-T has been reported to be transmitted by populations of *X. diversicaudatum* in several European countries and New Zealand including a report of the recovery of arabis mosaic virus and SLRV-T from a bait-plant to which a single *X. diversicaudatum* had been given access (Harrison, 1967). Taylor and Thomas (1968) and Trudgill *et al.* (1981) reported that Scottish populations of *X. diversicaudatum* transmitted SLRV-T frequently but during a survey of the distribution of longidorid nematodes in the British Isles only two out of 325 (0.6%) populations of *X. diversicaudatum* transmitted SLRV (Taylor and Brown, 1976). Furthermore, Brown and Taylor (1981) and Brown and Trudgill (1983) reported that a French and an Italian population transmitted SLRV-T and a strain of SLRV from Italy only infrequently.

The transmission of SLRV-T by populations of *X. diversicaudatum*

obtained from Europe, and from New Zealand and the United States of America was investigated. These same populations were also used to investigate the apparent specificity with which Italian nematodes transmitted an Italian isolate of SLRV (Brown and Taylor, 1981; Brown and Trudgill, 1983) and the results from these studies are reported here.

Materials and Methods

The sources of the *X. diversicaudatum* populations used in the study are given in Table I. They were maintained in a heated glasshouse with *Rosa* sp., *Rubus idaeus* L. and *Fragaria* x *ananassa* Duch. as host plants and the populations were tested and found to be free of any detectable nepoviruses. The viruses used were the type-British strain of strawberry latent ringspot virus (SLRV-T; Lister, 1964) and a strain obtained from *Prunus persica* L. from Italy (SLRV-Ip; Brown and Trudgill, 1983). Both viruses were propagated by consecutive manual inoculations to *Chenopodium quinoa* Willd. plants maintained in a heated glasshouse.

Table I - *Origin of populations of* Xiphinema diversicaudatum *collected and maintained at the Scottish Crop Research Institute.*

Location	Country	Host
Kostinbrod	Bulgaria	*Ribes nigrum* L.
Aylesford	England	Scrubland
High Halstow	England	Deciduous woodland
Ilkley	England	*Lolium perenne* L.
Alexandra	New Zealand	*Prunus armeniaca* L.
Sandefjord	Norway	*Fragaria* X *ananassa* Duch.
Cazalegas	Spain	*Vitis vinifera* L.
Holzieken	Switzerland	*Triticum spelta* L.
San Diego	United States of America	*Prunus persica* L.

Virus transmission was studied by using a standard procedure designed to assess the efficiency of longidorid nematodes as virus vectors (Trudgill and Brown, 1978). Test plants were grown in 25 cc plastic pots which were maintained in temperature controlled cabinets (Taylor and Brown, 1974) at 18°C and with a minimum daylength of 16 hr. Details of the virus transmission procedures have been given

in full elsewhere and therefore are not repeated here (Trudgill and Brown, 1978; Brown and Trudgill, 1983; Trudgill *et al.*, 1983).

Chenopodium quinoa plants were used as the virus-source and as the bait plants. Groups of 35 virus-free *X. diversicaudatum* were given access to the virus-source plants and groups of two and five nematodes were used in the bait tests. The aerial parts of some of the bait plants were tested for the presence of systemically translocated virus and the identity of transmitted virus was confirmed serologically from selected *C. quinoa* assay plants. The maximum likelihood estimator of Gibbs and Gower (1960) was used to calculate the proportions of nematodes transmitting virus.

Results

Eight of the nine *X. diversicaudatum* populations readily transmitted SLRV-T. Only one population, from Spain, was inefficient with less than 8% of the nematodes transmitting virus (Table II) compared with *c.* 30-40% in seven of the other populations and *c.* 20% in the USA population.

Table II - *The transmission of the type-British strain of strawberry latent ringspot virus by groups of two and five* Xiphinema diversicaudatum *from nine populations.*

Population	Number of transmissions		Estimated proportions of nematodes transmitting virus (1)	
	numbers of nematodes per replicate			
	2	5	2	5
Bulgaria	12/25 (2)	4/5	0.28	0.28
England				
Aylesford	15/25	9/10	0.37	0.37
High Halstow	22/25	6/7	0.65	0.32
Ilkley	16/25	9/10	0.40	0.37
New Zealand	15/25	6/6	0.37	0.30
Norway	10/25	9/10	0.23	0.37
Spain	3/20	2/10	0.08	0.04
Switzerland	14/25	8/10	0.34	0.28
United States of America	9/25	6/9	0.20	0.20

(1) Estimated proportions of nematodes transmitting virus calculated using the equation of Gibbs and Gower (1960).

(2) Numerator is the number of bait plants infested, denominator is the number tested.

The SLRV isolate from Italy was not transmitted by six of the populations (Table III). Only one of ten groups of five nematodes from the High Halstow and from the Cazalegas populations and one of 23 groups of two nematodes from the USA population transmitted SLRV-Ip. The aerial parts of those bait plants from whose root systems SLRV-Ip had been recovered were found to be systemically infested.

Table III - *The transmission of a strain of strawberry latent ringspot virus, recovered from* Prunus persica *in Italy, by groups of two and five* Xiphinema diversicaudatum *from nine populations.*

Population	Number of transmissions		Estimated proportions of nematodes transmitting virus(1)	
	numbers of nematodes per replicate			
	2	5	2	5
Bulgaria	0/19(2)	0/4	<0.03	<0.06
England				
Aylesford	0/25	0/10	<0.02	<0.02
High Halstow	0/24	1/10	<0.02	0.02
Ilkley	0/25	0/10	<0.02	<0.02
New Zealand	0/22	0/10	<0.02	<0.02
Norway	0/24	0/8	<0.02	<0.03
Spain	0/20	1/10	<0.03	0.02
Switzerland	0/20	1/10	<0.03	<0.02
United States of America	1/23	0/10	0.02	<0.02

(1) Estimated proportions of nematodes transmitting virus culculated using the equation of Gibbs and Gower (1960).
(2) Numerator is the number of bait plants infected, denominator is the number tested.

Discussion

In this study, previously virus-free populations of *X. diversicaudatum* from diverse natural biotopes all proved capable of transmitting SLRV-T. Therefore most, if not all, populations of *X. diversicaudatum* probably are able to transmit SLRV-T and it is likely that those populations not carrying SLRV have not had access to the virus.

SLRV-Ip was transmitted only rarely by three of the nine populations, which supports the evidence of Brown and Taylor (1981) and Brown and Trudgill (1983) that only *X. diversicaudatum* from Italy

may consistently transmit this virus. Nematodes from France, Italy and Scotland given access to SLRV-Ip did not contain virus particles at sites of virus retention within their feeding apparatus (Brown and Trudgill, 1983) and it is possible that the lack of transmission of SLRV-T in the present study is similarly due to virus not being retained by the nematodes.

The small proportions of nematodes from the Spanish population estimated to have transmitted SLRV-T and SLRV-Ip were similar to those reported for nematodes from the French and Italian populations (Brown and Taylor, 1981; Brown and Trudgill, 1983). These three populations also transmitted two serologically distinguishable strains of arabis mosaic virus infrequently compared with other populations of *X. diversicaudatum* (Brown, 1986a). The morphometrics of the Spanish nematodes differed from those of 23 other populations of *X. diversicaudatum* including the French and Italian nematodes (Brown and Topham, 1985). Furthermore, female Spanish nematodes produced many fewer progeny under *Fragaria* x *ananassa* Duch. host plants than did females from ten other populations, including those from France and Italy (Brown, 1986b). Females from nine of the ten populations, when mated with males from a Scottish population, produced many reproductively viable progeny whereas only a few crossbred progeny were produced by females from the Spanish population. The Spanish nematodes, therefore, seem to be an atypical population of *X. diversicaudatum* but probably do not represent a separate species.

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SUMMARY

The ability of nine populations of *Xiphinema diversicaudatum* to transmit two strains of strawberry latent ringspot virus (SLRV) was examined in the laboratory. Eight of nine populations were relatively efficient vectors of SLRV type-British strain (SLRV-T), only a Spanish population infrequently transmitted the virus. A strain of SLRV from *Prunus persica* growing in Italy (SLRV-Ip) was rarely transmitted and then only by three of the nine populations used in the

study. It seems likely that most populations of *X. diversicaudatum* have the ability to transmit SLRV-T but that most populations do not have access to the virus. Furthermore it seems likely that only *X. diversicaudatum* from Italy may consistently transmit SLRV-Ip.

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