Nematol. medit. (1986), 14: 173-180.

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SEASONAL TRANSMISSIBILITY OF STRAWBERRY LATENT RINGSPOT VIRUS BY *XIPHINEMA DIVERSICAUDATUM*

by
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Strawberry latent ringspot virus (SLRV) is widespread in the peach growing area of Borgo d'Ale in the province of Vercelli, in northern Italy, where it is the causal agent of peach rosetting, a serious disease in peach plantations in that area (Roca *et al.*, 1986).

Xiphinema diversicaudatum (Micoletzky) Thorne, the natural vector of various strains of SLRV (Brown, 1985) is consistently found in the rhizosphere of plants showing symptoms of the disease at Borgo d'Ale (Roca *et al.*, 1986).

Various authors (Taylor and Thomas, 1968; Trudgill *et al.*, 1981; Brown, 1985; Roca *et al.*, 1986) reported that *X. diversicaudatum* is an efficient vector of SLRV, but conversely Brown and Taylor (1981) and Brown and Trudgill (1983), stated that a French and an Italian population of this species only infrequently transmitted the British type strain (SLRV-T) (Lister, 1964) and an Italian strain of the virus.

In a survey of longidorid nematodes in the British Isles, Taylor and Brown (1976) reported that only two out of 325 populations of *X. diversicaudatum* that they collected transmitted SLRV. Transmission of SLRV by populations of nematodes collected from Borgo d'Ale at different times of the year gave inconsistent results. Therefore an investigation was made over a two year period on the efficiency of transmission of SLRV by populations of *X. diversicaudatum* from Borgo d'Ale, and the results are reported here.

Materials and Methods

Xiphinema diversicaudatum were obtained at monthly intervals (between the 15th and the 20th of each month) from November 1982 to October 1984 from four different sites in the territory of Borgo d'Ale in peach groves and from the rhizosphere of plants with clear symptoms of the disease and where high populations of the nematode had been found in a preliminary survey. The soil was taken in plastic bags to Bari and stored at 7°C until extraction by the Cobb's wet sieving technique, and this was always done within one week from the date of collection. Immediately after extraction groups of five female *X. diversicaudatum* were hand picked and placed near the roots of a cucumber *(Cucumis sativus* L.) seedling cv. Delicatezza bait plant, growing in sand in 25 cc plastic pots and maintained in a temperature controlled cabinet at 18°C. There were 10 bait plants per site per month. One month after inoculation the surviving nematodes were extracted from each pot by Cobb's wet sieving technique. Virus transmission was assessed by washing the root system of each cucumber seedling free of soil, comminuting it in a mortar with 0.1M pH 7.2 phosphate buffer and inoculating to two *Chenopodium quinoa* Willd. test plants. The virus in plants showing symptoms of infection was serologically checked by double diffusion in agar plates against antisera to an Italian and the type strain of SLRV.

Results and Discussion

The populations of *X. diversicaudatum* from the four different sites were similar in their viability, as judged by recovery of individuals from the pots, and in their efficiency of transmission of SLRV (Table I).

A mean transmission rate of 17.5% in November 1982 dropped to nil in December 1982 and January 1983. Transmission recovered in February and March 1983 (5 and 10% respectively), dropped again to nil in April and increased to 7.5% in May. No transmission was obtained with the nematodes collected in June and July 1983 but was resumed in August (17.5%) and October (32.5%) 1983; data for September 1983 were not available because of a fault in the controlled temperature cabinet. From November 1983 to February 1984 transmission of SLRV was relatively efficient, but again was followed by no transmission in March and April 1984. Transmission resumed in May and June but ceased in July and August and resumed again in September and October 1984.

Table I - *Efficiency of transmission of strawberry latent ringspot virus by* Xiphinema diversicaudatum *collected from the field at different times.*

SITES	Percentage / Month																								
	Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		Ma.		Jn.		Jl.		Aug.		Sept.		Oct.		Av.
	1982	'83	'82	'83	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	'83	'84	
																					(1)				
A. Nematode recovery	50	40	70	50	24	36	32	76	38	68	52	64	58	52	40	72	42	42	20	38	ND	60	76	56	50.3
Transmission	0	40	0	30	0	50	0	20	0	0	0	0	20	10	0	30	0	0	0	0	ND	20	40	40	13.0
B. Nematode recovery	38	52	34	32	52	40	30	62	36	72	48	50	4	42	10	76	54	46	50	36	ND	24	64	54	43.4
Transmission	0	40	0	0	0	50	20	0	30	0	0	0	0	60	0	0	0	0	10	0	ND	10	20	40	12.2
C. Nematode recovery	16	42	40	72	50	36	50	62	50	60	40	50	10	78	2	46	24	36	18	40	ND	36	76	68	43.6
Transmission	10	40	0	50	0	10	0	20	10	0	0	0	0	30	0	30	0	0	30	0	ND	10	30	40	13.5
D. Nematode recovery	50	36	36	32	6	32	44	50	50	54	32	70	62	72	8	68	42	50	48	30	ND	22	64	68	44.6
Transmission	60	70	0	10	0	50	0	10	0	0	0	0	10	40	0	0	0	0	30	0	ND	0	40	60	16.5
Overall means																									
Nematode recovery	38.5	42.5	45.0	46.5	33.0	36.0	39.0	62.5	43.5	63.5	43.0	58.5	33.5	61.0	15.0	65.5	40.5	43.5	34.0	37.0		35.5	70.0	61.5	
Transmission	17.5	47.5	0	22.5	0	40.0	5	12.5	10	0	0	0	7.5	35.0	0	15.0	0	0	17.5	0		10.0	32.5	45.0	

(1) Not determined because of a technical problem with the controlled temperature cabinet.

These trends clearly indicate that the maximum rate of virus transmission by populations of *X. diversicaudatum* from the area of Borgo d'Ale occurs in October-November. The efficiency of transmission is affected by climatic factors, most probably mainly by temperature as illustrated in fig. 1.

Data from eighteen observations were positively correlated with the average temperature of the fourth and third month preceding transmission (P=0.001; r=.828; r=.713 respectively), suggesting that temperature shows its effect in a three - four month delay.

Principal component analysis and hierarchical cluster analysis have

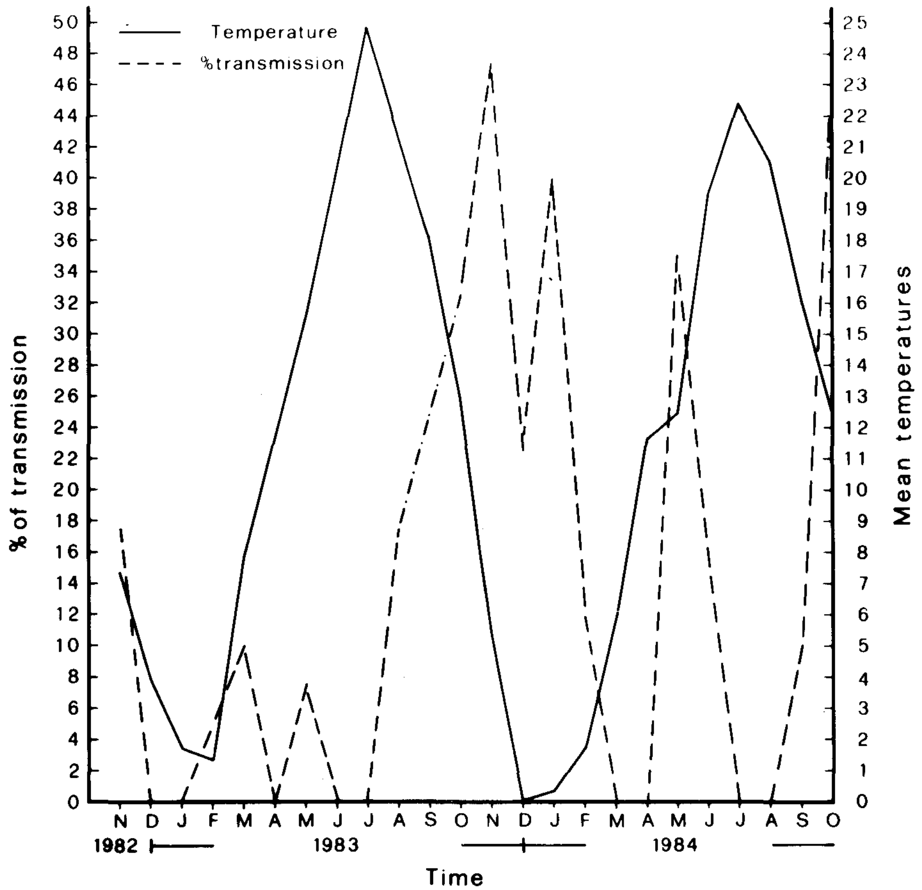

Fig. 1 - Means air temperatures and percent of transmission of SLRV by *Xiphinema diversicaudatum* at Borgo d'Ale.

been performed on data relating to transmission efficiency, the temperature of the same month and temperatures from the first to the fifth month preceding observation.

The three first factors explain 98.79% of variance; correlations with variables indicate that although the two first factors can be interpreted as seasonal trends, the third factor can be related to transmission efficiency (Table II).

Hierarchical cluster analysis based on the method of average linkage shows two distinct groups joined at the higher level (Fig. 2), easily identified on the factorial plan realized by the first and the third factors (Fig. 3). The average value for transmission in the groups is respectively 37.6% for the first group, comprising the cold months and 5.2% for the second one, comprising the warmer months.

The results indicate an influence of temperature on transmission and can be explained by the fact that virus concentration in plant tissues follows plant growth but in a three-four month delay thus affecting the probability of virus acquisition by the nematode.

Table II - *Principal component analysis: correlation among variables and factors.*

	Correlation						
	Transmission	T4	T3	T2	T	T5	T1
Transmission	1	.8287	.7138	.4666	-.3796	.6082	.0427
T4	.8287	1	.8466	.5596	-.4629	.8094	.0454
T3	.7138	.8466	1	.8895	.0268	.4311	.5244
T2	.4666	.5596	.8895	1	.4215	.0452	.8243
T	-.3796	-.4629	.0268	.4215	1	-.8734	.8378
T1	.6082	.8094	.4311	.0452	-.8734	1	-.4899
T5	.0427	.0454	.5244	.8243	.8378	-.4899	1
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Transmission	.4567	-.0484	.8666	-.1430	.0274	.0247	.1269
T4	.5102	-.0655	-.1494	.5449	.4784	-.3431	-.2634
T3	.4703	.2318	-.1728	.3525	-.5694	.4966	-.0005
T2	.3418	.4298	-.1989	-.4703	-.2895	-.5918	-.0596
T	-.1936	.5387	.0987	.3903	.1085	-.1856	.6811
T5	.3856	-.3702	-.3788	-.3043	.2239	.1493	.6368
T1	.0816	.5722	-.0622	-.3036	.5480	.4774	-.2036

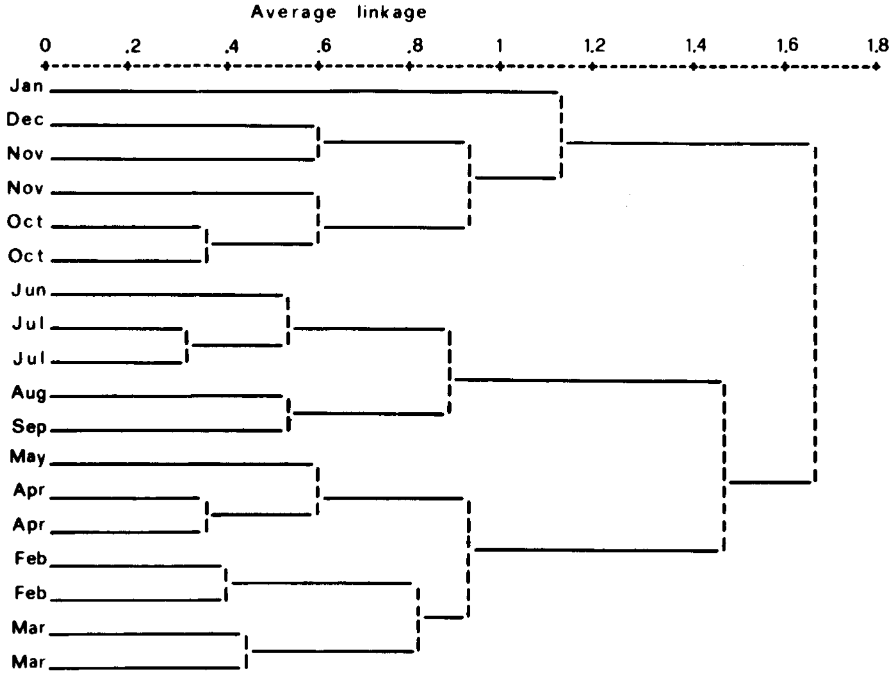

Fig. 2 - Dendrogram from hierarchical cluster analysis showing group formations.

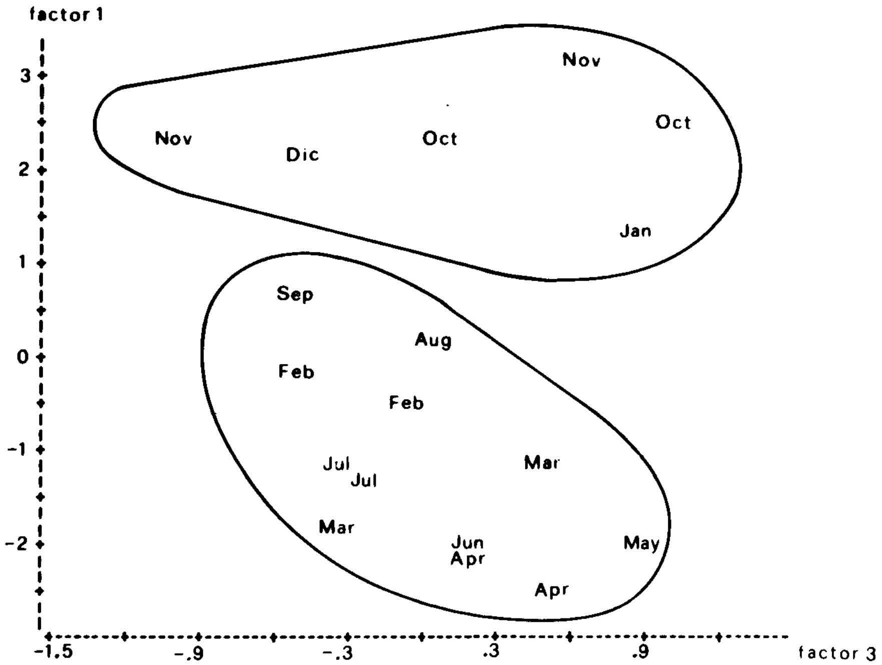

Fig. 3 - Group representation on the factorial plan showing distribution of observations relative to axes 1 and 3 of principal component analysis.

Finally, no correlation was observed between percentage of recovery of *X. diversicaudatum* at the end of the transmission tests and the rate of transmission of SLRV.

SUMMARY

The ability of *Xiphinema diversicaudatum* to transmit strawberry latent ringspot virus in different seasons was tested in the period November 1982-October 1984. Four nematode populations from Borgo d'Ale, in the province of Vercelli, were equally efficient as virus vectors. The maximum rate of transmission occurred in October and November and transmission was nil in December 1982 and January 1983, in June and July 1983, in March and April 1984 and in July and August 1984. This trend in transmission is considered to be related to seasonal temperatures. There was no correlation between the recovery of nematodes at the end of each transmission test and the rate of transmission.

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Accepted for publication on 11 February 1986.