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The efficiency of the bulb and potato aphid *Rhopalosiphoninus latysiphon* (Davidson) as a vector of potato virus V

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Summary

Experiments to test the ability of *Rhopalosiphoninus latysiphon* to transmit potato virus V showed a transmission rate of 16 per cent after only two weeks; this was maintained for a further two weeks, beyond which time the rate rose rapidly. A comparison of the mode of inoculation of PVV by *R. latysiphon* and *Myzus persicae* suggested that the mechanism may be similar for both species.

Introduction

Several species of aphid may colonise the sprouts of potatoes in store, but in Northern Ireland *Rhopalosiphoninus latysiphon* (Davidson) has occurred most frequently. Its ability to act as a vector of non-persistent potato viruses has been in doubt for a long time. Rademacher (1949) showed that *R. latysiphon* could be an occasional vector of the persistent potato leaf roll virus (PLRV) and of a non-persistent mosaic virus, although his results were obtained from plants grown in the field where other vectors could not be excluded. Subsequent work proved that PLRV could be transmitted at a low efficiency by this aphid species (Roland, 1952; Wenzl, 1956; Heinze, 1957). Recently Bell (1982) has shown that it can transmit potato viruses A, Yn and V during eight weeks of migration from infected to healthy potato sprouts. This paper reports studies on its ability to spread PVV, a mild rugose mosaic virus first observed in Northern Ireland in 1978 (Calvert) and classified as PVYc(AB), but subsequently re-classified as PVV (Fribourg & Nakashima, 1984).

Materials and methods

Twenty healthy sprouted tubers (cv. Arran Banner) were placed in a plastic, ventilated, aphid-proof test container with five sprouted tubers infected with potato virus V. Fifty adult apterous *R. latysiphon* had been established on the infector sprouts two weeks before the introduction of the healthy tubers. There were five replicate test containers and two control containers from which aphids were omitted, all stored at 14 °C in a room with diffused lighting. After two, four, six and eight weeks five test tubers were

removed from each container and dipped for ten seconds in two per cent thiabendazole to disinfest the sprouts. The ratio of infector to test tubers in each container was maintained at, or close to, 1:4 throughout the experiment. Test tubers which had been removed were planted in pots and grown for six weeks in an aphid-free glasshouse. Leaf samples were then taken and the sap tested for the presence of PVV using ELISA (Clarke & Adams, 1977).

In a second experiment, groups of five apterous *R. latysiphon* were confined on individual sprouts of infected potato tubers for 24 hours. They were then disturbed with a fine paint brush and each group transferred to an excised sprout of a healthy tuber for 1, 6, 24 or 48 hours to permit inoculation of acquired virus; *R. latysiphon* fed more readily if the sprout was covered by a light-proof hood during feeding periods. One sprout was removed from each healthy tuber before the feeding period and grown to confirm the initial absence of virus. There were twenty replicate sprouts for each period of exposure and all aphids were removed from the sprout afterwards. Leaf samples were taken after six weeks growth and the sap tested by ELISA. For comparison, the experiment was repeated with ten replicate sprouts using *Myzus persicae* (Sulzer), which is usually an efficient vector of PVV.

Results

The results (Table 1) of exposing healthy 'Arran Banner' tubers to an infestation of *R. latysiphon* for different periods, show a transmission rate of 16 per cent after only two weeks exposure, which thereafter increased rapidly. The percentage transmissions of PVV to healthy sprouts by *R. latysiphon* and *M. persicae* (Table 2) show that longer exposure times reduced transmission by both species.

Table 1. Transmission of PVV by *R. latysiphon* to healthy tubers of 'Arran Banner' with varying exposure times to infestation.

Exposure to infestation (weeks)	2	4	6	8
Infected tubers (N = 25) in %	16	16	64	80

Table 2. Percentage transmission of PVV by *R. latysiphon* and *M. persicae* from infected sprouts to healthy sprouts at different exposure times.

Exposure times	*R. latysiphon*	*M. persicae*
1 h	25 %	20 %
6 h	20 %	20 %
24 h	5 %	0 %
48 h	5 %	0 %

Discussion

In the first experiment, where *R. latysiphon* was free to move from an infection source

to healthy sprouts, 16 per cent of healthy tubers were infected after two weeks. This level remained constant for a further two weeks and then the rate increased rapidly suggesting that the pattern of transmission is linked to the build-up of aphid numbers on the sprouts. Increased aphid numbers would lead to more movement of apterae and alatae, resulting in more virus transmission.

The reputation of *R. latysiphon* as a poor vector of non-persistent viruses may be due to its relatively sessile behaviour, a suggestion supported by the second experiment where it transmitted PVV after an exposure time of only 1 hour. Experiments in our laboratory to test its vector ability using conventional aphid transfer procedures for a non-persistent virus have proved fruitless; unlike *M. persicae* it will not feed readily on an infection source within a few minutes. We have had most success when light is excluded from the sprout upon which it is feeding, a behaviour consistent with the finding that infestations of *R. latysiphon* in potato stores are usually in areas where the lighting is poor or diffuse.

The second experiment suggests that the mechanism of PVV transmission by *R. latysiphon* and *M. persicae* may be similar. The transmission rates are remarkably similar for the 1 h and 6 h exposure times, longer feeds resulting in lower or no transmission. It is difficult to explain this phenomenon. One possibility is that some component of aphid saliva has anti-viral properties, as suggested by Hamilton (1935) to explain interspecific variation in vector efficiency. At first, feeding on a healthy source by a viruliferous aphid would inoculate the virus, but prolonged feeding would result in a weakening of the infection process due to the supposed action of the saliva at the feeding site.

Our results show that *R. latysiphon* can be an effective vector of PVV under conditions that occur in potato stores, where infestations by this aphid could spread virus infection and result in a higher incidence of virus in the field in the following year.

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