SHORT COMMUNICATION

Study of Semipersistent Transmission of Beet Yellows Virus by the Green Peach Aphid, *Myzus persicae* Sulz.

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Abstract

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The optimal conditions for beet yellows virus (BYV) acquisition and transmission by *Myzus persicae* Sulz. were studied. Maximum recorded retention of BYV in aphids was 48 h. Preacquisition starvation of aphids influenced positively transmission efficiency if the acquisition access feeding period was short (30 min to 2 h), but after a longer such period it was without influence. The efficiency of transmission also depended on the acquisition access feeding period. Maximum transmission efficiency of starved and nonstarved aphids occurred after 2 h (75%) and 4–6 h (65%) of acquisition, respectively.

Key word: beet yellows virus; *Myzus persicae*; transmission efficiency; preacquisition starvation

Sugar-beet yellows is one of the most important diseases of sugar beet *Beta vulgaris ssp. saccharifera* all over the world. In Europe, two taxonomically distinct viruses are responsible for the disease: beet yellows virus (BYV) and beet mild yellowing (BMYV) (SMITH & HINCKES 1987). Beet yellows virus (BYV) is the type member of the genus *Closterovirus* (BAR-JOSEPH & MURANT 1982). BYV can be transmitted semipersistently by 23 species of aphids (CANDRESSE 1994) to more than 150 plant species in 15 families (AGRANOVSKY *et al.* 1994). The most important vectors are green peach aphid (*M. persicae*) and bean aphid (*Aphis fabae*) (SYLVESTER 1956; RUSSEL 1965). The transmission efficiency of green peach aphid is greater than that of bean aphid (almost twice) (LIMBURG *et al.* 1997). The acquisition feeding of BYV by aphids is carried out in the phloem tissue. Aphid stylets need about 5 min to reach the phloem of a BYV infected plant. Once having reached a sieve element, aphids require at least an additional 5 min and 22 sec of fluid ingestion to become viruliferous (CHANG 1968). In semipersistent transmission the longer the feed, the greater the virus accumulation (up to the saturation point for a particular virus-vector-plant combination) and the longer the persistence of vector inoculativity (HARRIS 1990).

The efficiency of nonpersistent transmission can be positively influenced by pre-acquisition starvation of aphids. Recent studies with some potyviruses showed that aphids change their feeding behaviour because of starvation. Starved aphids usually make a greater number of sap-sampling probes, and take less penetrating time than non-starved aphids (LOPEZ-ABELLA *et al.* 1988; POWELL *et al.* 1995). Thus, starved aphids accumulate more virus and are more effective in transmission of nonpersistent viruses (POWELL 1993). Though the semipersistent transmission is carried out by the same mechanism of ingestion-egestion, HARRIS (1990) supposed that in this case the starvation of aphids has no such effect on transmission efficiency.

As we have started a more complex study of the mode of transmission of BYV by aphids, we first had to do several experiments to know the optimal conditions for virus acquisition and inoculation period under our conditions.

The transmission efficiency and the persistence of virus BYV in green peach aphids were studied in three experiments with 8, 18 and 21 aphids as follows. The aphids were maintained on chinese cabbage. From this they were transferred onto an infected beet plant, and after a 24 h acquisition access feeding period to healthy sugar beet seedlings. The viruliferous aphids (one aphid for one healthy seedling) were left free to inoculate the seedlings for 12 h of inoculation access feeding period and then they were transferred onto another healthy plant every 12 h up to 72 h. After two weeks these plants were tested by DAS-ELISA (polyclonal antibodies ex rabbit – Loewe Biochemica) for the presence of BYV.

In Table 1 we summarised the results of the three experiments. They show that the highest transmission efficiency occurs at the first 12 h of inoculation access feeding period, and that the aphids are capable to transmit BYV up to 48 h of inoculation feeding, and hence it also shows the persistence of virus in aphids. The decreasing number of plants over time in Table 1 is caused by the fact that some aphids were lost or died during the experiments. We have observed that some aphids transmitted BYV with a brake in inoculation, after which the transmission was resumed. In some previous studies with *M. persicae* the retention up to 72 h and the most effective inoculation during the first 6 h of inoculation access feeding period were reported (WATSON 1946; BENNETT 1960; SYLVESTER 1956). In recent experiments (LIMBURG *et al.* 1997), the maximum retention period of BYV in *M. persicae* and optimal inoculation access period were 24 h and 6 h, respectively. In our three experiments, only in one of them was the maximum retention period 48 h, whereas in the other two it was only 24 h. Thus, the persistence of BYV and the efficiency of transmission can be largely dependent upon the conditions of the experiment.

Four experiments were performed to study the influence of preacquisition starvation on semipersistent transmission. One group of aphids was starved for 2 h before acquisition of virus, while another group was not starved. After 30 min of acquisition on the infected sugar beet plant we took eight aphids from both groups and transferred them to young healthy sugar beet plants (one aphid per individual plant). In this way we continued for 1 h, 2 h, 4 h, 6 h and 12 h of acquisition period. After an inoculation access feeding period of 24 h all plants were sprayed with Pirimor and left in the greenhouse. After 2 weeks these plants were tested by DAS-ELISA for the presence of BYV.

In Table 2 we summarised the results of the four experiments. They show that the transmission efficiency of starved aphids is higher after a short acquisition access feeding period (up to 2 h) than that of nonstarved aphids. With a longer acquisition access feeding period (4 h and more) the efficiency of transmission is almost the same for both groups. These results were tested by the "significance test of the difference between two sample relative frequencies" and for the short acquisition the test criterion $u = 2.13$. It means that differences between starved and nonstarved groups of aphids are statistically significant at the 95% level. For the acquisition access period of 4 h and more $u = 1.03$, so that differences between the two groups are not significant. Thus, in contrast to the opinion of HARRIS (1990), it could be concluded that preacquisition starvation of aphids may have the same effect for semipersistent transmission as for nonpersistent transmission. The most probable explanation for this is the change of feeding behaviour of starved aphids (LOPEZ-ABELLA *et al.* 1988).

In our experiments we have noticed some differences in the efficiency of transmission between experiments, probably because they were done with different plant material and under different weather conditions. The experiments done during spring and summer generally showed a higher transmission efficiency than those of late summer or autumn. In one experiment we observed 100% transmission efficiency of starved aphids already after 30 min of acquisition. The maximum efficiency of transmission of starved aphids occurred after 2 h (75%), and of nonstarved ones after 4 and 6 h (65%) (average of four experiments). After this period the transmission

Table 1. Efficiency of transmission and retention of BYV in *Myzus persicae* Sulz.

Inoculation access feeding period	12 h	24 h	36 h	48 h	60 h	72 h
BYV positive plants/number of plants in the experiment	26/47	10/43	2/35	3/26	0/20	0/12
% transmission	55.32	23.25	5.7	11.54	0	0

Table 2. Efficiency of transmission of BYV by nonstarved and starved *Myzus persicae* Sulz.

Acquisition access feeding period		30 min to 2 h	4 h to 12 h
Nonstarved aphids	BYV positive plants/number of plants in the experiment	31/88	62/96
	% transmission	35.23	64.58
Starved aphids	BYV positive plants/number of plants in the experiment	45/88	55/96
	% transmission	51.14	57.29

efficiency decreases more (starved aphids) or less (non-starved aphids) rapidly. These results are similar to those of BENNETT (1960) and LIMBURG *et al.* (1997), but WATSON (1946) reported ma-ximum acquisition of BYV between 10 and 24 h.

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Souhrn

KUNDU J. K., RYŠÁNEK P. (1999): **Semiperzistentní přenosu viru žloutenky řepy mšicí broskvoňovou** *(Myzus persicae* Sulz.). Pl. Protect. Sci., **35**: 30–32.

Studovali jsme optimální podmínky pro akvizici a přenos viru žloutenky řepy (BYV) mšicí broskvoňovou (*Myzus persicae* Sulz.). Maximální zjištěná doba retence BYV ve mšicích byla 48 hodin. Hladovění mšic před akvizicí pozitivně ovlivnilo účinnost přenosu při kratší době akvizice (30 min až 2 h), zatímco při delší akviziční době nemělo hladovění mšic žádný efekt. Schopnost mšic přenést virus byla závislá na době akvizice. U hladověných mšic byl maximální přenos (75%) zaznamenán po dvou hodinách akvizice, u nehladověných mšic po 4 až 6 hodinách akvizice (65%).

Klíčová slova: beet yellow virus; *Myzus persicae*; účinnost přenosu; hladovění před akvizicí

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