PLANT RESEARCH INTERNATIONAL
WAGENINGEN UR

Determination of aphid transmission efficiencies for N, NTN and Wilga strains of *Potato virus Y*

Martin Verbeek, Paul Piron, Annette Dullemans, Chris Cuperus, Gé van den Bovenkamp* and René van der Vlugt

Introduction

In the 1980's, Van Harten introduced the Relative Efficiency Factor (REF) to facilitate quantification of the aphid's efficiency in transmitting *Potato virus Y* (PVY, genus *Potyvirus*). It indicates the transmission efficiency of a certain aphid species in relation to that of the green peach aphid (*Myzus persicae*), generally regarded the most efficient transmitter of PVY. REFs are used in the Dutch PVY control system to calculate vector pressure and determine the haulm destruction date. Given the worldwide problems with PVY infections, especially in relation to the new recombinant strains a project was initiated to redetermine REFs for PVY^{N} and to determine them for the recombinant strains PVY^{NTN} and $PVY^{N\text{-}Wi}$ for the most important PVY transmitting aphids.

Figure 1: A) Transferring aphids from the source leaf to Physalis floridana *seedlings, B) Three weeks post inoculation: infected seedlings are easily recognised and counted*

REF determination

REFs were determined for reared aphids from three different biotypes of 17 aphid species in combination with 1 isolate of PVY^{N}, 3 of PVY^{NTN} and 2 of $PVY^{N\text{-}Wi}$. Per PVY isolate 50 adult wingless aphids were transferred to an infected potato leaf and allowed to probe for 2.5 minutes. Subsequently the aphids were transferred individually to seedlings of *Physalis floridana* and each plantlet was covered with a small cage. The next day aphids were killed using insecticides. Three weeks post inoculation the number of *P. floridana* seedlings showing symptoms of PVY infection were assessed (Fig. 1). In experiments like this it remaines difficult to compare results. Especially differences in virus titre in and between source plants influence the transmission efficiency.
We dealt with this problem using *M. persicae* biotype Mp2 as in internal control. 50 Mp2 adults were transferred in each experiment to the same potato leaf as used for the aphid biotype to be tested and transferred individually to *P. floridana* seedlings. The REFs for all different aphid biotypes / PVY isolates tested were calculated as follows:

$$REF\,[biotype] = \frac{number\ of\ infected\ plants\ [biotype]}{number\ of\ infected\ plants\ [Mp2]}$$

Results

Aphid species	REF 1980s [1]	Average REF per PVY strain		
		PVY^{N} (1 isolate)	PVY^{NTN} (3 isolates)	$PVY^{N\text{-}Wi}$ (2 isolates)
Myzus persicae [2]	1.00 (1.00)	1.00	1.00	1.00
Acyrthosiphon pisum	0.05 (0.11)	0.08	0.07	0.11
Aphis fabae	0.10 (0.07)	0.03	0.04	0.13
Aphis frangulae	- (0.42[4])	0.42	0.19	0.32
Aphis nasturtii	- (0.42[4])	0.46	0.50	0.69
Aphis spp [5]	- (0.06)	0.01	0.03	0.08
Aulacorthum solani	- (-)	0.00	0.01	0.00
Brevicoryne brassicae	- (0.00)	0.00	0.00	0.00
Cavariella aegopodii [3]	- (0.00)	0.00	0.00	0.00
Hyperomyzus lactucae	- (0.16)	0.00	0.00	0.00
Macrosiphum euphorbiae	0.10 (0.07)	0.00	0.00	0.01
Metopolophium dirhodum	0.01 (0.10)	0.02	0.00	0.01
Myzus ascalonicus	- (-)	0.01	0.00	0.01
Phorodon humuli	0.15 (0.13)	0.22	0.23	0.30
Rhopalosiphum padi	0.02 (0.14)	0.00	0.01	0.04
Schizaphis graminum [3]	- (-)	0.00	0.05	0.00
Sitobion avenae	- (-)	0.00	0.00	0.00

Table 1: Average Relative Efficiency Factors of aphid species tested

[1] REF as used in the current Dutch PVY control system and determined by Van Harten (1983) and between brackets De Bokx & Piron (1990) for PVY^{N}, - : REF was not determined

[2] REF of Myzus persicae *is set to 1.00*

[3] Only one clone available and tested

[4] De Bokx and Piron (1990) determined a REF for the A. nasturtii *group, including also* A. frangulae

[5] Aphis species other than A. fabae, A. frangulae *and* A. nasturtii *were grouped as* Aphis *spp.*

Conclusions

A reliable system was set up to determine REFs for aphid species in combination with different PVY strains. Overall, REFs determined in our experiments for PVY^{N} and PVY^{NTN} matched those determined for PVY^{N} in the 1980s. $PVY^{N\text{-}Wi}$ was transmitted better than the two other strains by the species *A. fabae, A. nasturtii, A. spp and P. humuli.*

References

Van Harten A. (1983) The relation between aphid flights and the spread of Potato virus Y^{N} (PVY^{N}) in the Netherlands. *Potato Research, 26, 1-15*

De Bokx J.A., P.G.M. Piron (1990) Relative efficiency of a number of aphid species in the transmission of Potato virus Y^{N} in the Netherlands. *Netherlands Journal of Plant Pathology, 96, 237-246*

Verbeek, M., P.G.M. Piron, A.M. Dullemans, C. Cuperus and R.A.A. van der Vlugt (2010) Determination of aphid transmission efficiencies for N, NTN and Wilga strains of *Potato virus Y. Annals of Applied Biology 156: 39-49*

Plant Research International
PO Box 69, 6700 AB Wageningen, the Netherlands
Telephone: + 31 317 48 06 29 – Telefax: +31 317 48 10 07
E-mail: martin.verbeek@wur.nl

* **Nederlandse Algemene Keuringsdienst (Dutch General Inspection Service, NAK)**
PO Box 1115, 8300 BC Emmeloord, the Netherlands