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Relative efficiency of a number of aphid species in the transmission of potato virus Y^N in the Netherlands

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Abstract

This paper reports the results of live-trapping winged aphids in an Ashby (1976) trap in potato crops in the Netherlands from 1983-1987. During this period, a total of 122 aphid species were trapped. Although only four of those species were able to colonise potato, 26 of them were able to transmit PVY^N from potato to potato test plants. The transmission rates and relative efficiency factors (REF's) of those transmitters were determined.

Aphis sambuci, *Cryptomyzus galeopsidis*, *Dysaphis* spp., *Hyadaphis foeniculi*, *Hyalopterus pruni* and *Myzus cerasi* were recorded for the first time as vectors of PVY^N in the Netherlands.

The numbers of aphids per species caught per season differed very much, also the virus transmission results of some fluctuated from year to year, e.g. *Brachycaudus helichrysi*. The REF's in various reports differ greatly, thus the value of a universal REF is doubtful. Assessment of the rate of virus spread in a potato crop is discussed.

Additional keywords: winged aphids, conical net, REF.

Introduction

In seed-potato production in the Netherlands potato virus Y (PVY), especially strain PVY^N, is considered to be more harmful than potato leafroll virus (PLRV). Therefore most attention is given to spread of PVY.

Van Harten (1983) suggested a method of calculating vector pressure for PVY, using the flight activities (number of aphids monitored) of nine aphid species in combination with a so-called relative efficiency factor (REF) for each species. He assumed that the accumulated daily vector pressure would indicate the spread of PVY during a growing season. However, many aphid species can transmit PVY (Edwards, 1963; De Bokx & Piron, 1984, 1985; Harrington et al., 1986; Harrington & Gibson, 1989; Kostiw, 1980; Piron, 1986; Sigvald, 1986, 1987, 1989; Van Hoof, 1980) and the efficiency of a given species in transmitting PVY differs among reports, probably as a result of different climatic conditions, aphid biotype and testing methods.

In Sweden (Sigvald, 1984), in England (Harrington et al., 1986) and in the Netherlands (Van Harten, 1983; De Bokx & Piron, 1984; Piron, 1986) the REF's have been assigned to various vector species. The Swedish and the Dutch efficiency (Van Hoof, 1980) factors were mainly based on results obtained in laboratory and greenhouse, often only using apterous aphids and only a few species and clones were tested. Since alatae and

not apterae are the important transmitters of PVY in potato fields, De Bokx and Piron (1984) started transmission experiments under laboratory conditions using winged aphids caught in the field to obtain individuals representing a genetically diverse population. The results were used to calculate relative efficiency factors. Harrington et al. (1986), using a method of Halbert et al. (1981), trapped flying aphids on a net placed downwind of a PVY- infected potato crop and tested each aphid for carrying and transmitting PVY.

In the present study we continued the experiments for five seasons to obtain more information on variation in REF's between years.

The objectives of this research were to identify the most important aphid vectors of PVY, PVY^N in particular, in the Netherlands, to calculate their REF's and aphid vector pressure as some of the parameters to set up a model to forecast PVY spread in seed-potato fields (Sigvald, 1986).

Materials and methods

Aphid trapping. The trials were done in a plot of seed potatoes of 1.5 ha at the Research Institute for Plant Protection (IPO), the Netherlands from 1983-1987. The winged aphids were caught alive at daily intervals from the beginning of May until the end of July with an Ashby trap (Ashby, 1976).

The aphid trap of Ashby consists of a conical net made of plastic gauze, with an inlet diameter of 25 cm and an outlet diameter of 1.5 cm. The inlet is kept open by a wire hoop. The outlet of the net ends in a plastic bottle. Both ends of the net are attached to a boom which can turn around on a vertical pole so that the open end faces the wind. The collected aphids were identified according to Taylor (1980) and Stroyan (1984).

Virus transmission. In the laboratory, after a starvation time of several hours, the trapped winged aphids were allowed to feed on PVY-infected potato foliage for 20 sec. Each aphid was observed individually with a magnifying glass during probing. Subsequently each aphid which had probed was transferred in a small clip-cage to a leaf of a 2-3 weeks old one-stemmed healthy potato plant, cv. Bintje. After 2 h each aphid was killed with an aphicide and identified. All not probing aphids were killed and identified too. Three weeks later the foliage of the one-stemmed potato plants, grown in glasshouses at 20 °C, was checked for PVY by ELISA. Glasshouses were sprayed with Pirimor at regular intervals to exclude virus transmission by unwanted aphids.

Relative efficiency factor (REF). Van Harten (1983) suggested a method of calculating vector pressure (VP) for PVY using the number of individuals of nine aphid species trapped in a suction trap and modifying it by the relative transmission efficiency, expressed as the REF. *Myzus persicae* is presumed to be the most efficient vector of PVY, therefore this species is assigned the REF of 1. The REF's of other species are lower, since they are poorer vectors. They are computed as relative values of the transmission rate of each species in relation to that of *M. persicae*.

The vector pressure (VP) is defined as

$$VP = \Sigma (N \times REF)$$

where N = number of specimens of each vector and REF = relative efficiency factor given to each species.

Results

During surveys from 1983-1987 in the central part of the Netherlands 122 aphid species or groups were recorded in a potato crop. Except *Aphis nasturtii*, *Aulacorthum solani*, *Macrosiphum euphorbiae* and *Myzus persicae* those species or species groups do not live on potato. Many of them did not transmit PVY^N (Table 1). The numbers of individuals of those species generally were very low (< 25), except for those of *Chaitophorus leucomelas*, *Phyllaphis fagi*, *Pterocallis alni*, *Sipha glyceriae* (Drepanosiphinae) and *Capitophorus horni*, *Cavariella aegopodii*, *C. pastinacae*, *C. theobaldi*, *Nasonovia ribisnigri*, *Ovatus insitus* (Aphidinae). It is assumed that those aphid species are non- or very poor transmitters of PVY^N.

Several aphid species not living on potato can transmit PVY, but with different degrees of efficiency (Table 2).

Of the trapped species or species groups 26 were able to transmit PVY from infected potato foliage to small potato test plants grown under laboratory conditions. Among them *Aphis sambuci*, *Cryptomyzus galeopsidis*, *Dysaphis* spp., *Hyadaphis foeniculi*, *Hyalopterus pruni* and *Myzus cerasi* were identified for the first time as vectors of PVY^N in the Netherlands.

The results of our transmission experiments, and the calculated relative efficiency factors under Dutch conditions are presented in Table 3 and compared with Swedish and British data. The data mentioned in various reports differ greatly, thus the value of a universal REF is doubtful.

Table 1. Total numbers of aphids caught throughout 5 seasons that did not transmit PVY^N from infected potato foliage to potato test plants and total numbers that did not probe.

Species	Numbers		Species	Numbers	
	probing without transmission	no probing		probing without transmission	no probing
Thelaxes dryophila	8	14	*Callipterinella minutissima*	5	1
Anoecia corni	10	88	*C. tuberculata*	1	
Eriosoma lanuginosum		1	*Chaitophorus beuthani*	10	2
E. ulmi	11	63	*C. leucomelas*	34	7
Kaltenbachiella pallida	1		*C. populialbae*	2	1
Pemphigus spp.		8	*C. salicti*	2	4
Tetraneura ulmi	10	15	*C. tremulae*		1
Thecabius affinis	1	2	*Drepanosiphum dixoni*	5	
Appendiseta robiniae	1		*D. platanoidis*	13	3
Betulaphis quadrituberculata	2		*Eucallipterus tiliae*		5
Calaphis basalis	13	2	*Euceraphis pilosa*	1	

Table 1. (Continued)

Species	Numbers		Species	Numbers	
	probing without trans-mission	no probing		probing without trans-mission	no probing
Euceraphis group	16	1	*Hyadaphis foeniculi*		3
Juncobia leegei	1		*Hyalopteroides humilis*	2	
Myzocallis castanicola	9	4	*Hyalopterus pruni*		127
M. coryli	19	5	*Hyperomyzus lactucae*		8
Myzocallis spp.	1		*H. pallidus*	6	1
Periphyllus californiensis	1		*Liosomaphis berberidis*	11	3
P. hirticornis	1		*Lipaphis erysimi*	17	
P. testudinaceus	15		*Longicaudus trirhodus*	2	
Phyllaphis fagi	25	22	*Macrosiphoniella artemisiae*	1	
Pterocallis alni	41	11	*M. persequens*	4	2
Sipha glyceriae	51	17	*M. tapuskae*	1	
Subsaltusaphis spp.	2	4	*Macrosiphoniella* spp.	3	
Therioaphis riehmi		1	*Megoura viciae*	2	
Thripsaphis thripsoides	3	3	*Metopolophium dirhodum*		13
Tuberculatus annulatus	7	7	*M. festucae*	9	
T. borealis	20	14	*Microlophium carnosum*	5	1
T. querceus	2	1	*Myzaphis rosarum*	2	
Acyrthosiphon pisum		2	*Myzus ascalonicus*	20	
Amphorophora rubi	8		*M. cerasi*		2
Anthracosiphon hertae	1		*M. ornatus*	1	
Aphis fabae		21	*Nasonovia pilosellae*	1	
A. idaei	1		*N. ribisnigri*	43	1
A. pomi	3		*Ovatomyzus stachyos*	1	
Aphis spp.		16	*Ovatus insitus*	61	1
Aulacorthum palustre	1	1	*Phorodon humuli*		2
A. solani	20	3	*Pleotrichophorus glandulosus*	2	
Brachycaudus cardui	4		*Pterocomma pilosum*	5	6
B. helichrysi		16	*P. salicis*		1
B. rumexicolens	6		*P. steinheili*		1
Brachycaudus spp.		1	*Rhopalosiphum insertum*		85
Brevicoryne brassicae	18	1	*R. maidis*	3	
Capitophorus carduinus	10		*R. nymphaeae*	8	
C. elaeagni		1	*R. padi*		79
C. hippophaes		11	*Schizaphis graminum*	1	
C. horni	42		*S. pilipes*	1	
C. similis	1		*Sitobion avenae*		58
Cavariella aegopodii		57	*S. fragariae*		4
C. pastinacae	85		*Staegeriella necopinata*	4	
C. theobaldi	124	3	*Thuleaphis rumexicolens*		1
Ceruraphis eriophori	3		*Tubaphis ranunculina*	5	
Chaetosiphon potentillae	10		*Uroleucon* spp.		2
Coloradoa rufomaculata	2		*Wahlgreniella arbuti*	4	1
Cryptomyzus galeopsidis		2	*Cinara* spp.	2	18
Diuraphis spp.	5	3	*Eulachnus* spp.		6
Dysaphis spp.		1	*Trama troglodytes*	1	
Elatobium abietinum	3		*Adelges*	1	11
Hayhurstia atriplicis	5				

Table 2. Numbers of aphids caught throughout 5 seasons of species that transmit PVY^N from potato foliage to potato test plants.

Vector species	1983	1984	1985	1986	1987	Total
Acyrthosiphon pisum	2/2[1]	0/24		0/8	0/2	2/36
Aphis fabae group	3/27	0/15	0/40	2/39	0/12	5/133
A. nasturtii group		2/6	1/11	3/11		6/28
A. sambuci	0/1	0/1	0/1	3/14	0/8	3/25
Aphis spp.	5/61	2/181	2/30	1/16	0/28	10/316
Brachycaudus helichrysi	9/75	0/1	0/1	1/13	0/5	10/95
Brachycaudus spp.	1/10	19/83	0/5	0/5	1/7	21/110
Capitophorus hippophaes	2/10	0/17	0/59	2/53	0/1	4/140
Cavariella aegopodii	0/138	1/12	0/104	0/97	0/77	1/428
Cryptomyzus galeopsidis	3/11	0/9	1/11	0/5	0/6	4/42
C. ribis	1/3	2/21				3/24
Dysaphis spp.	0/7	0/14	0/3	1/2		1/26
Hyadaphis foeniculi	4/21	1/38		0/1		5/60
Hyalopterus pruni	4/20	1/17	1/38	0/61	0/33	6/168
Hyperomyzus lactucae	2/8	2/31	0/4	0/3	0/4	4/50
Macrosiphum euphorbiae	3/18	1/84	0/28	1/10	0/1	5/141
Metopolophium dirhodum	8/18	1/110	4/43	1/69	0/28	14/268
Myzus cerasi	0/3	0/4	0/1	0/4	1/6	1/18
M. certus	1/8	3/26	8/18	2/8	0/3	14/63
M. persicae	2/4	1/27	142/257	5/16	2/5	157/309
Phorodon humuli	4/17	0/55	0/3	0/3	2/10	6/88
Rhopalosiphum insertum	3/35	0/13	28/208	1/221	0/1	32/478
R. padi	3/10	6/124	26/195	3/186	0/11	38/526
Sitobion avenae	3/47	0/104	0/91	0/3	0/2	3/247
S. fragariae	0/4	0/3	1/7			1/14
Uroleucon spp.	2/17	3/44	0/8	0/4	0/4	5/77

[1] Numerator = number of aphids transmitting PVY^N; Denominator = number of trapped aphids tested

Discussion

Vectors. Of the 122 aphid species or species groups (Table 1) 26 were found to be PVY^N transmitters (Table 2). A similar number, although not covering identical species, was identified by Harrington and Gibson (1989). The latter mentioned *Aphis pomi*, *Cryptomyzus ballotae*, *Myzaphis rosarum*, *Myzus myosotidis* and *Metopolophium festucae* to be also PVY transmitters, whereas we found six which they did not record as vectors, viz. *Brachycaudus* spp., *Capitophorus hippophaes*, *Cryptomyzus galeopsidis*, *Hyadaphis foeniculi*, *Hyalopterus pruni* and *Myzus certus*. Little meaning can be attached to the calculated efficiency factors of aphid species caught in low numbers, e.g. *C. ballotae*, *Myzus cerasi*, *M. myosotidis* and *Sitobion fragariae*.

Aphis sambuci, *C. galeopsidis*, *Dysaphis* spp., *H. foeniculi*, *H. pruni* and *M. cerasi* were recorded for the first time in the Netherlands as vectors.

It is likely that a number of aphid species not detected or caught in very low numbers might also be able to transmit PVY^N from potato to potato.

Table 3. Relative efficiency factors (REF) or transmissions in % (TR) of PVY^N for some aphid species as described by various authors.

Vector species	De Bokx/Piron		REF[1]	REF[2]	TR[3] (%)
	TR (%)	REF			
Acyrthosiphon pisum	5.6	0.11	0.05	0.80	3.8
Aphis fabae group	3.8	0.07	0.10	0.20	7.6
A. nasturtii group	21.4	0.42		0.30	50
A. sambuci	12.0	0.24			4.3
Aphis spp.	3.2	0.06			5.9
Brachycaudus helichrysi	10.5	0.21	0.01		5.9
Brachycaudus spp.	19.1	0.37			
Brevicoryne brassicae		0.00		0.01	
Capitophorus hippophaes	2.9	0.06			
Cavariella aegopodii	0.2	0.00			0.2
Cryptomyzus ballotae					100
C. galeopsidis	9.5	0.19			
C. ribis	12.5	0.25			14
Dysaphis spp.	3.8	0.07			
Hyadaphis foeniculi	8.0	0.16			
Hyalopterus pruni	3.6	0.07			
Hyperomyzus lactucae	8.0	0.16			0.4
Macrosiphum euphorbiae	3.5	0.07	0.10		7.7
Metopolophium dirhodum	5.2	0.10	0.01		0.5
M. festucae					0.4
Myzaphis rosarum					10
Myzus cerasi	5.6	0.11			3.2
M. certus	22.2	0.44			
M. myosotidis					100
M. persicae	50.8	1.00	1.00	1.00	8.4
Phorodon humuli	6.8	0.13	0.15		4.9
Rhopalosiphum insertum	6.7	0.13	0.05		0.8
R. padi	7.2	0.14	0.02	0.10	2.4
Sitobion avenae	1.2	0.02		0.01	0.1
S. fragariae	7.1	0.14			0.5
Uroleucon spp.	6.5	0.13			0.5
Other species				0.2	

[1] Van Harten, 1983.
[2] Sigvald, 1986.
[3] Harrington & Gibson, 1989.

The data from Harrington and Gibson (1989), obtained in one season, are not expressed as REF's, since transmission percentages of *M. persicae* are exceptionally low and only 1 or 2 aphids of *A. nasturtii*, *C. ballotae*, *M. myosotidis* are involved in transmission experiments.

Number of aphids caught, transmitting PVY^N. Over a period of 5 years *Cavariella aegopodii, Hyalopterus pruni, Metopolophium dirhodum, Myzus persicae, Rhopalosiphum insertum, R. padi, Sitobion avenae* and *Aphis* spp. were caught in relatively large numbers (> 275) in our traps. Limits of numbers were arbitrarily chosen. *Brachycaudus helichrysi, Brachycaudus* spp., *Capitophorus hippophaes* and *Macrosiphum euphorbiae* were caught in moderate numbers (> 100 and ≤ 274) and e.g. *Aphis nasturtii, Myzus certus* and *Phorodon humuli* in low numbers (≤ 99). Thus about one third of the potential PVY^N transmitters was caught in relatively large numbers during the season.

Transmission rates and efficiency factors. *Aphis nasturtii, A. sambuci, Brachycaudus* spp., *Cryptomyzus ribis, Myzus certus* and *M. persicae* transmitted PVY^N more often than other species (REF ≥ 0.20). The other species can be considered as poor transmitters of PVY^N (Table 3).

With the procedure we followed the potential ability of aphid species to transmit PVY^N from potato to potato was investigated. Acquisition and inoculation of virus were done under artificial circumstances. In this way aphids that had not landed on infected potato in the field could be tested for their ability to probe on potato. The transmission capability of non colonisers could be tested. Non colonisers, having landed on a potato crop, are less likely to stay in the crop than colonisers. In search for food non colonisers will be more restless and probe more plants in a field than colonisers do. It is likely that they may spread PVY^N considerably.

Even after starvation some aphid species would not probe after giving access to potato foliage. It is known that some aphid species can select their hosts, e.g. by odour, before they start probing. Even relatively big aphid eyes have a poor resolution (Harrewijn, 1990). In many aphid species host plant recognition can only occur after alighting. Aphidinae seem to put their proboscis on the surface of the leaf, followed by probing. Others, like members of the Thelaxinae, Callaphidinae, Anoeciinae, Pemphiginae and Drepanosiphinae hardly probed on potato. In these species odour perception or tarsal reception may be involved in the process of host plant recognition. According to the hypothesis mentioned above it could be that tree-living aphids are non-transmitters of PVY^N due to their recognition capability (Table 1). In agreement with the findings of Harrington and Gibson (1989), PVY^N transmitters belong to the Aphidinae only.

From Table 2 it can be seen that the numbers of aphids per species caught per season differ very much, also the transmission rates of some fluctuate from year to year, e.g. of *Brachycaudus helichrysi.* The results of Bell (1983) who found *B. helichrysi* to be a very efficient transmitter of PVY are in agreement with our results computed over a period of 5 years.

This work shows that observations must be carried out during a number of seasons to calculate reasonably accurate transmission percentages. Computing standard deviations of the REF's results in values of questionable significance, as a number of unknown factors may have affected transmission behaviour throughout the years.

The results presented by Harrington and Gibson (1989), as shown in Table 3, show a similar tendency. Differences in transmission rates and REF's as produced by various authors, might be due to applied methodologies, use of different strains of PVY and to short-term observations, which do not exclude the effect of different biotypes which may alter in composition in the long run.

Observations during short periods of one growing season may also affect the calculation of transmission rates. Although numbers of aphids caught were low there was a tendency that the transmission rate of aphids caught in spring was higher than of those trapped later in season. Since all experiments were carried out in the laboratory and greenhouse with young plants under the same conditions the effect of plants could be excluded. It is therefore assumed that aphid's physiology changes during the season.

Physiologically young potato plants were used in the transmission experiments since they can be handled readily in the laboratory. For acquisition of the virus, however, physiologically old virus-infected foliage was applied. Thus this was comparable to field conditions. The transmission experiments with young potato plants did not represent completely field conditions later in the season.

Generally the transmission rates and REF's calculated by various researchers (Van Harten, 1983; Sigvald, 1984; Harrington & Gibson, 1989) differ from ours (Table 3).

Forecasting virus spread. Virus spread is determined by susceptibility of the potato cultivar to virus, the number of virus sources (the amount of virus inoculum) and the number of vectors (aphids) that can transmit virus. When plants age they become less susceptible to virus infection, so-called mature-plant resistance, consequently translocation of virus from the foliage to the tubers will be slower (Beemster, 1987; Sigvald, 1985). Virus-carrying aphids will do less harm on crops late in growing season than early in spring. However, mature- plant resistance is not complete. Depending on the developing stage of the potato plants in the field, like regrowth of the foliage, virus translocation from infected foliage to the tubers will continue until lifting.

Thus the calculated REF's are part of the total system to be used. The values presented by the various authors are produced under artificial conditions. Probably values of virus transmission rates to be used should be modified, because an important factor like aphid activity in the field has not yet been included in the calculation of REF's (De Bokx & Piron, 1989; Harrington & Gibson, 1989). Further research is needed, especially for those aphid species that play a role in virus transmission during the growing season of potato. However, mobility of aphid species is difficult to measure.

From trials carried out in south-east Scotland during 11 successive years it was learned that from 19 aphid species *Myzus persicae* was the most important aphid transmitting potato viruses. The correlation between catches of *M. persicae* and spread of PVY^O was very high (Turl & MacDonnald, 1987). They concluded that it would be sufficient to use the catches of *M. persicae* alone for forecasting the spread of PVY^O and most probably that of PVY^N, since *M. persicae* seems to transmit both virus strains equally readily. Because non colonising vectors, like *R. padi*, generally appear in large numbers and much earlier than *M. persicae*, this conclusion is not true for the Dutch seed potato growing.

Further research is needed to investigate whether the Dutch system in which the numbers and REF's of nine aphid species are applied can be simplified, e.g. by taking into account only aphid species which appear in large masses and species with a high REF. This would be a system in which the catches of the species *Aphis fabae* group, *Aphis nasturtii*, *Brachycaudus* spp., *Macrosiphum euphorbiae*, *Myzus certus*, *M. persicae* and the *Rhopalosiphum* group (= *Rhopalosiphum insertum* + *R. padi*) are taken into account only. In spite of 13% of *R. padi* not probing (Table 1), this species has to be involved too in the Dutch system. As Sigvald (1989) found this species can be

a more important vector than *M. persicae*. *R. padi* is less efficient than *M. persicae* but it is migrating early in large numbers when the potato plants are very susceptible to PVY^N.

To assess the rate of virus spread in a potato crop throughout the season in the Netherlands more information is needed on virus pressure, initial virus inoculum, crop growth, mature-plant resistance and aphid activity.

Samenvatting

De relatieve efficiëntie van een aantal bladluizen bij de overdracht van aardappelvirus Y^N in Nederland

Van de in Nederland voorkomende aardappelvirussen wordt het aardappelvirus Y^N (PVY^N) als het meest schadelijke bij de pootgoedproduktie beschouwd. Dit virus kan op non-persistente wijze door een aantal bladluissoorten worden overgebracht. De groene perzikluis, *Myzus persicae* wordt geacht dit het meest efficiënt te kunnen doen.

In de periode 1983-1987 is onderzocht welke bladluissoorten, geregistreerd in aardappelpercelen te Wageningen, Y^N-virus kunnen overbengen. In deze periode werden 122 gevleugelde bladluissoorten met behulp van een Ashby-val levend gevangen en op hun vermogen om Y^N-virus van aardappel naar aardappel over te brengen getoetst. 26 soorten hiervan zijn potentiële Y^N-virusoverbrengers. De relatieve efficiëntiewaarden (REF) voor elk van deze soorten werden opnieuw berekend.

De REF-waarde voor *Brachycaudus helichrysi* werd berekend op 0,21, in afwijking van de waarde (0,01) die Van Harten (1983) aan deze toekende na waarnemingen gedurende slechts één seizoen.

40% van het totaal aantal geregistreerde bladluizen bestond uit *Cavariella aegopodii*, *M. persicae*, *Metopolophium dirhodum*, *Rhopalosiphum insertum*, *R. padi* en *Sitobion avenae*. Minder talrijk (6,5%) was de groep *B. helichrysi*, *Brachycandus* spp. en *Macrosiphum euphorbiae*. De groep *Aphis nasturtii*, *Myzus certus* en *Phorodon humuli* had een aandeel van 3,2% in de totale vangst. Behalve *C. aegopodii* zijn de genoemde soorten in staat het PVY^N over te brengen van aardappel naar aardappel. Van de rest zijn echter ook een aantal soorten in staat PVY^N over te brengen maar die zijn slechts in geringe mate gevangen.

A. nasturtii, *Brachycaudus* spp., *M. certus* en *M. persicae* besmetten vaker dan andere soorten aardappelplantjes met PVY^N. Van de soorten *Aphis sambuci*, *Cryptomyzus galeopsidis*, *Dysaphis* spp., *Hyadaphis foeniculi*, *Hyalopterus pruni* and *Myzus cerasi* werd voor de eerste keer in Nederland overdracht van PVY geconstateerd.

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