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Determination of the infection pressure of potato virus Y^N

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Abstract

In 1976 consecutive series of plants of *Nicotiana tabacum* 'White Burley' replaced weekly, were used as bait plants to determine the infection pressure of potato virus Y^N (PVY^N) in a crop of ware potatoes in the centre of the Netherlands. The first PVY^N – infected tobacco plants were found mid May. The course of infection of the tobacco plants was not correlated with the flight of *Myzus persicae*, which started towards the end of June. Aphid species other than *Myzus persicae* presumably are responsible for the infection observed early. *Rhopalosiphum padi* and *Acyrthosiphon pisum* flew much earlier than *Myzus persicae* and are vectors of PVY^N.

Introduction

During the last few years PVY^N in potato crops in the Netherlands as well as elsewhere in Europe has become more of a problem than it used to be. The infection pressure of this non-persistently transmitted aphid-borne virus not only depends on the type and prevalence of its sources of infection, but also on its spread from these sources. We have studied when plants of a potato crop first become infected in spring and whether aphid species other than *Myzus persicae* act as vectors of the virus.

Beemster (1954) emphasized the importance of aphids that start flying in May and June long before mature plant resistance to viruses develops (Beemster, 1958). Hille Ris Lambers (1972) pointed to *Rhopalosiphum padi* as a vector of PVY^N. He writes that this aphid species – which flies early and feeds on grasses and cereals – is not attracted by yellow and seldom caught in the Moericke trap.

Materials and methods

A field of ware potatoes 'Bintje', planted in the last week of March 1976 and situated in the centre of the Netherlands was used for experimentation. A strip of four rows wide and 20 m long, 30 m from the edge of the field, was left free of 'Bintje'. The two outer rows of this strip were planted on 31 March, each with 50 PVY^N – infected tubers of 'Gineke'. The resulting plants served as an early source of infection. They were removed on 5 July to avoid direct contact with consecutive series of tobacco plants, *Nicotiana tabacum* 'White Burley', growing in plastic 12 cm pots, filled with clay. These pots were dug in the two centre rows and left there for one week each to serve as bait plants, 100 at a time.

The tobacco plants had previously been grown in the greenhouse. They were transplanted about two weeks after potting. In spring they required more time to

reach a total plant diameter of 15–18 cm, since they were grown in an unheated glasshouse to induce tolerance to cool field conditions. The day before transplantation to the field, they were dipped in a 0.5% nicotine solution with wetting agent to avoid introduction of aphids into the experimental field.

After a week's exposure in the field the tobacco plants were returned to a glasshouse and sprayed with an aphicide. Symptoms of PVY^N generally developed within two weeks.

The data on aphid flights were obtained from the suction trap – situated at Colijnsplaat near Goes in the south-western part of the Netherlands – which belongs to the Rothamsted Insect Survey network. Dr Hille Ris Lambers, who identified the aphids, kindly permitted publication of the data obtained.

Results and discussion

The second set of tobacco plants, viz. that of 22–29 April, was killed by frost. The following sets could all be taken to the greenhouse. Sometimes plants were in a poor state because of night frost, high temperature or drought. The results of the observation for symptoms of PVY^N are shown in Table 1 in relation to the flight data of some aphid species. It should be kept in mind that the weekly data of the suction trap and those of the bait plants do not coincide. The first cover periods from Monday to

Table 1. Infection with PVY^N of sets of tobacco bait plants and flight data of some aphid species.

Tobacco bait plant		Aphids caught in suction trap Colijnsplaat[1]			
periods of exposure in the field	percentage of infection	*Myzus persicae*	*Rhopalosiphum padi*	*Acyrthosiphon pisum*	*Cavariella aegopodii*
29/4– 5/5	0	0	0	0	0
6/5–12/5	0	0	4	0	2
13/5–19/5	5	0	2	2	291
20/5–26/5	17	2	35	2	329
27/5– 2/6	25	2	8	11	1184
3/6– 9/6	82	3	23	5	413
10/6–16/6	100	2	98	4	554
17/6–23/6	98	4	170	3	49
24/6–30/6	98	146	2943	17	2730
1/7– 7/7	100	1230	2514	4	83
8/7–14/7	100	799	756	8	2
15/7–21/7	100	493	95	0	2
22/7–28/7	80	30	22	0	0
29/7– 4/8	44	1	20	0	1
5/8–11/8	73	0	8	0	0
12/8–18/8	30	3	23	0	0
19/8–25/8	8	0	7	0	0

[1] Data provided by Dr D. Hille Ris Lambers. Catch periods three days earlier than periods of field exposure of bait plants in first column.

Tabel 1. Infectie met het PVY^N van groepen tabak-vangplanten en vluchtgegevens van enkele bladluissoorten.

Fig. 1. Infection with PVY^N of sets of tobacco bait plants (left axis and bold line) and flight data of some aphid species (right axis).

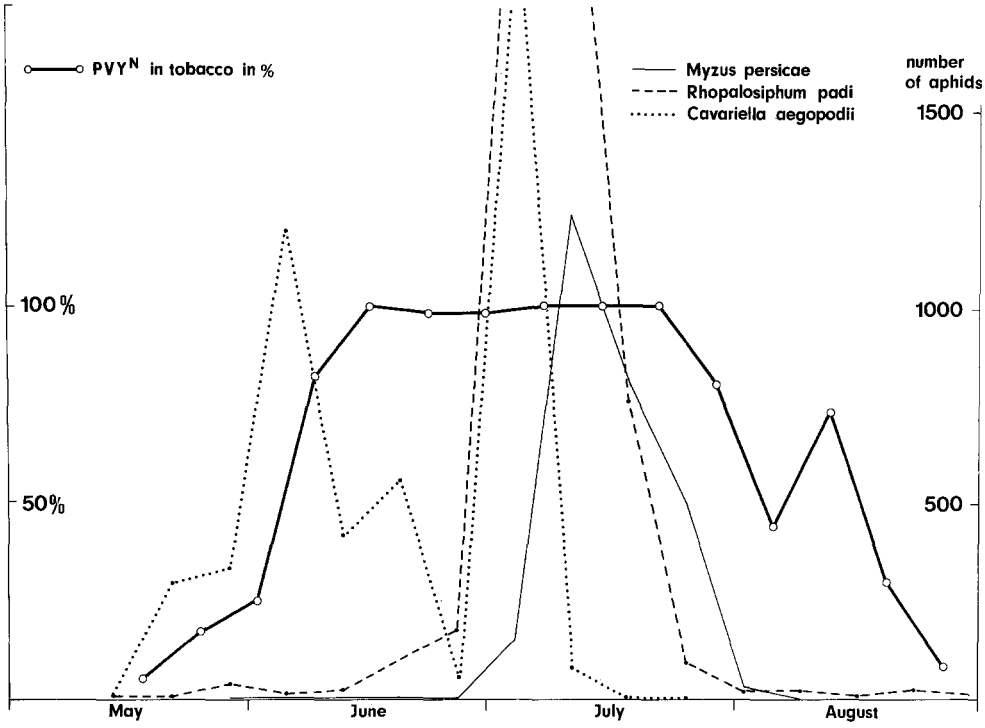

Fig. 1. Infectie met het PVY^N van groepen tabak-vangplanten (linker as en vette lijn) en gegevens omtrent de vlucht van enkele bladluissoorten (rechter as).

Monday, the latter from Thursday to Thursday. Moreover, the suction trap was separated from the trial field by 160 km. At Colijnsplaat aphids fly normally one week earlier than in the centre of the Netherlands (Hille Ris Lambers, 1972). In Fig. 1 these differences are taken into account.

Both Table 1 and Fig. 1 show that in 1976 spread of PVY^N started extremely early. There was no correlation between virus spread and numbers of *Myzus persicae*. However, *Cavariella aegopodii*, an early flying aphid, occurred in tremendous numbers and there is a marked coincidence between the flight of this aphid and the spread of the virus. No information is available as yet on its efficiency as a vector of PVY^N. Separate tests confirmed the results of Hille Ris Lambers (1972) and of Völk (1959), could be confirmed that *Rhopalosiphum padi* and *Acyrthosiphon pisum*, respectively, transmitted this virus. However, there may be more aphid vectors. In Poland Gabriel (1961) found *Aphis nasturtii* to be a much more important vector of PVY than *Myzus persicae*.

In contrast, Rasocha (1966) in Czechoslovakia noted a correlation between the occurrence of potato virus Y in tobacco bait plants and the flight of *Myzus persicae* but not that of *Aphis nasturtii*. He performed his trials in the years 1962, '63 and '64

and replaced the tobacco plants – which were planted in between potato plots – every fortnight.

Lifting of the infector plants of 'Gineke' on 5 July did not influence the intensity of virus spread to the tobacco plants. At that time, apparently sufficient virus sources were present in the 'Bintje' field. Infestation of this field was determined on 3 August by application of the A6-leaf test to 50 haulms collected at random, 36 of which proved to be infected with PVY^N.

No data are available on the susceptibility of potato to PVY^N compared with that of tobacco. Tobacco plants are one-stemmed, potato plants or hills multi-stemmed. The light-green tobacco leaves may well be more attractive to aphids than the dark-green potato leaves. This broken uniformity of the field with respect to colour may also have affected the flight pattern of the aphids. Moreover, the tobacco plants were always of the same age, when brought into the field, whereas the potato plants gradually developed mature-plant resistance. A fair comparison therefore is not possible.

The potato field showed 72% of infection in the beginning of August. Thus, the initial number of virus sources must have been high. The 100 artificially infected 'Gineke' plants have further added to this number. The experiment was to determine the infection pressure of PVY^N under extreme circumstances and especially to find out when virus spread starts. This set-up did not represent a normal field of ware potatoes and is certainly incomparable with a crop of highly qualified seed potatoes where infection sources are practically absent. Although the natural infection pressure of PVY^N in the actual field was not determined, the results show that the tobacco bait plant method described here is an efficient way to determine the infection pressure in a potato crop.

Samenvatting

Bepaling van de infectiedruk van het aardappelvirus Y^N

In 1976 werden in een veld consumptie-aardappelen in midden-Nederland opeenvolgende groepen wekelijks vervangen planten van *Nicotiana tabacum* 'White Burley' gebruikt als vangplanten om de infectiedruk van het aardappelvirus Y^N (PVY^N) te velde vast te stellen. De infectie van de tabak begon half mei en bleek niet gecorreleerd te zijn met de vlucht van *Myzus persicae* (Tabel 1, Fig. 1). De aantallen van enige bladluissoorten werden bepaald met de zuigval in Colijnsplaat bij Goes. Geconcludeerd wordt, dat andere, vroeger vliegende bladluissoorten voor de waargenomen vroege verspreiding van het PVY^N verantwoordelijk moeten zijn. Van deze soorten kunnen tenminste *Rhopalosiphum padi* en *Acyrthosiphon pisum* dit virus overbrengen.

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Book review

R. A. Robinson: Plant pathosystems. Springer Verlag, Berlin, Heidelberg, New York, 1976. 184 pp; 15 figures; 4 pp. of references; subject index. Price DM 48, or US $ 19.70, clothbound.

In his career of more than twenty years in crop protection in Africa, Dr Robinson has been mainly concerned with breeding for resistance. His present book describes the dynamic host/parasite interaction as a pathosystem, which is part of the entire crop ecosystem. The author now defines crop protection in terms of pathosystems management. Its methods aim at breeding for high levels of permanent resistance to all locally important parasites to avoid the repetitive plant breeding of the 'boom and bust cycle' due to vertical or race-specific resistance.

Chapter 1 describes the systems concept, and properties, analysis and management of systems, and the multidisciplinary approach. Chapter 2 discusses plant pathosystems in their various contexts, such as agriculture, genetics, epidemiology, histology, zoology and pathology. Later chapters deal with an analysis of vertical (Chap. 3) and horizontal pathosystems (Chap. 5) and their respective management (Chaps. 4 and 6), polyphyletic pathosystems (Chap. 7), crop vulnerability (Chap. 8), and final evaluations (Chap. 9). An extensive glossary (Chap. 10) lists the many terms used in the book alphabetically and defines them.

The author claims his approach to be 'holistic', "emphasizing the entire system rather than its components" (definition on p. 156). This leads us to the philosophical core of the problem: the