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Transmission of potato spindle tuber viroid by aphids

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Abstract

Aulacorthum solani (Kaltenbach), *Macrosiphum euphorbiae* (Thomas) and *Myzus persicae* (Sulzer) were used for transmission experiments in laboratory and glasshouse. As inoculum served PSTV-containing tomato foliage and artificial diets containing purified PSTV. It is concluded that *M. euphorbiae* can transmit PSTV in a non-persistent way.

Additional keywords: Aulacorthum solani, Macrosiphum euphorbiae, Myzus persicae.

Introduction

Potato spindle tuber viroid (PSTV) has been reported from North America, Australia, Soviet Union and South Africa, countries with mainly a high temperature during the growing season (Diener and Raymer, 1971). Recently the presence of PSTV in Peru has been established (Anon., 1978).

The viroid has not been reported from Western Europe. However, to develop a reliable detection method for quarantine purposes and to be informed on the potential spread, we performed trials with PSTV in our institute.

The pathogen can be transmitted mechanically. Transmission by insect vectors has been reported since 1923 (Folsom, 1923; Schultz and Folsom, 1925; Werner, 1926), but because of the ease of mechanical transmission doubt surrounded those reports.

However, with tomato cvs Rutgers and Sheyenne in our experiments as test plants for the detection of PSTV the impression was obtained that aphids could transmit the viroid. Therefore in 1977, 1978, 1979 and 1980 it was investigated whether some aphid species could transmit PSTV from infected te healthy tomato plants. Moreover, to exclude the possibility of mechanical transmission by handling aphids during transfer from infected to healthy leaflets, transmission of the viroid by aphids was tried from PSTV-containing artificial diets to tomato plants.

Materials and methods

Rearing of aphids. Clonal cultures of *Aulacorthum solani* (Kaltenbach), *Macrosiphum euphorbiae* (Thomas) and *Myzus persicae* (Sulzer) were kept on healthy plants of potato and radish at 20°C and a photoperiod of 16 h.

Transmission experiments with apterous aphids were made from systemically in-

fected tomato plants cv. Sheyenne or from diet solutions containing purified PSTV, to healthy 'Sheyenne' plants in 1-2 leaf stage. The aphids were starved for at least 4 h before they were placed on the viroid-containing source. Five aphids were allowed to feed for 20 sec after their stylets first penetrated the epidermis of the leaves or the membrane (parafilm) enclosing the artificial diet. Then they were immediately transferred to healthy seedlings on which they remained for 4 h.

Viroid and plant material. For research on PSTV under special safeguards a license was obtained from the Netherlands Plant Protection Service. A severe isolate of PSTV, provided by Dr P. J. Howell (Agricultural Scientific Services, East Craigs, Scotland) was used (Harris and Browning, 1980).

Inoculated plants were kept in a glasshouse with a temperature between 25 and 35°C, and a light intensity of c. 60 W m^{-2} measured at plant height, using artificial illumination for 16 h a day.

Extraction of PSTV was according to the method of Morris and Smith (1977) modified by Mosch et al. (1978).

Artificial diet was as described by Harrewijn (1973).

Results

In 1977 three transmission experiments with each of the aphid species were performed, using infected tomato foliage as PSTV-inoculum. The test plants were observed during 4 weeks after inoculation. When *A. solani* and *M. persicae* had been used as transmitters no symptoms of PSTV were observed. Nor could PSTV be detected by mechanical back inoculation to tomato.

However, when *M. euphorbiae* was used 4 out of 9, 0 out of 10 and 1 out of 10 plants, respectively, became infected with PSTV.

Therefore in further experiments performed in 1978, 1979 and 1980, *M. euphorbiae* was used as a transmitter only.

The experiments carried out in 1978 and 1979 showed the following results: 0 positive out of 20, 1 positive out of 16 and 2 positive out of 7.

In 1980 results were obtained from transmission of PSTV from infected tomato plants and from an artificial diet containing purified PSTV to tomato plants.

The rate of transmission from plant to plant was about equal to that in previous experiments, viz. 1 positive out of 20.

The uptake of liquid containing viroid from an artificial diet or sucrose (15%) solution was performed with difficulty. Even after a starvation period aphids did not start feeding as readily as they did on detached tomato leaves.

Since aphids were very restless on the artificial diet with a PSTV-fraction the number of tomato plants included in the experiment was very small. From a total of 8 plants, 4 showed severe PSTV-symptoms after aphids from the artificial diet were allowed to feed on them.

Aphids which were left on the artificial diet for 12 h produced larvae, whereas those on a sucrose solution did not.

However, when groups of 5 aphids which remained for 12 h on the artificial diet, were transferred to healthy tomato plants none of these became infected with PSTV.

From these results it can be concluded that PSTV can be transmitted in a non-persistent way at least by *M. euphorbiae*.

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Samenvatting

De overdracht van aardappelspindelknolviroïde door bladluizen

Aardappelspindelknolviroïde (PSTV) wordt tot een vrij 'nieuwe' groep van pathogenen, de viroïden, gerekend. De ziekte, die er door wordt veroorzaakt, wordt sedert 1923 waargenomen in Noord-Amerika en is meer recentelijk ook aangetroffen in Afrika, Australië, Sowjet-Unie en Zuid-Amerika maar tot dusver niet in West-Europa.

PSTV kan gemakkelijk mechanisch worden overgebracht. De overdracht door bladluizen was nog niet betrouwbaar vastgesteld. De bladluissoorten *Myzus persicae* (Sulzer), *Aulacorthum solani* (Kaltenbach) en *Macrosiphum euphorbiae* (Thomas) zijn daarom in overdrachtsproeven betrokken, waarbij als inoculum met PSTV geïnfecteerd blad en een door een membraan afgesloten gezuiverde PSTV-bevattende suspensie is gebruikt. Het laatstgenoemde type inoculum is gebruikt, om een mogelijke mechanische overdracht bij het overzetten van bladluizen van de viroïdebron naar de toetsplant tomaat cv. Sheyenne uit te sluiten. Er is vastgesteld, dat *M. euphorbiae* PSTV op non-persistente wijze kan overbrengen.

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