

AN IMPROVED INDEXING PROCEDURE FOR SOME STRAWBERRY VIRUSES IN A HOT CLIMATE AREA

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Abstract

Two aphid-borne viruses, strawberry mild yellow-edge (MYEV) and strawberry mottle (SMV), and one seed-borne virus, tobacco streak (TSV), have been detected in strawberry in Israel since 1980. Indexing was done by leaf grafting to standard *Fragaria* indicators grown in a greenhouse below 25°C. However, maintaining these indicators in a vigorous state and free of the "heat spot" symptom met with difficulties during the long summer season mainly with the clone UC-6 but occasionally also with 'Alpine'. Therefore *D. indic* a was evaluated as an indicator for the three strawberry viruses. *D. indic* a plants readily produced obvious symptoms following leaf graft inoculation with SMV, and were superior to the *Fragaria* indicator clones UC-5 and 'Alpine'. *D. indic* a was a symptomless host for MYEV and TSV. This phenomenon allows detection of SMV in plants infected with both MYEV and SMV during all seasons, without the use of UC-6. *D. indic* a plants were easily maintained throughout the year in good physiological condition and were not adversely affected by high intensity light. This indicator is presently included in Israel in the indexing procedure for strawberry viruses.

1. Introduction

A study of strawberry plants for the presence of viruses was started in Israel in 1980. Since then, two aphid-borne viruses, strawberry mild yellow-edge (MYEV) (Spiegel and Frank, 1982) and strawberry mottle (SMV) (Spiegel et al., 1984), and one seed-borne virus, tobacco streak

(TSV) (Spiegel and Cohen, 1985), were detected. Diagnosis of MYEV and SMV was done by leaf graft procedures, using the indicators *Fragaria vesca* (clones UC-4, UC-5, and UC-6), 'Alpine' seedlings (*F. vesca* var. *sempervirens*) and *F. virginiana* (clone UC-11) (Frazier, 1974). TSV was detected reliably by serological methods (Spiegel and Cohen, 1985).

A prerequisite for reliable virus detection by leaf graft procedures is the maintenance of indicators in a vigorous state of growth before and after grafting. Moderate temperatures and light intensities are key factors in growing good indicators. In Israel, maintaining the indicator clones UC-6 and 'Alpine' in a vigorous state met with difficulties through the long summer and "heat spots" (Smeets and Wassenaar, 1956) were often observed on UC-6 plants and occasionally on 'Alpine' seedlings. Therefore, *Duchesnea indica* (Andr.) Focke (Maasen, 1959; Greber, 1979) a genus closely related to *Fragaria*, was evaluated as an indicator for the three strawberry viruses in comparison with some other indicators.

2. Materials and Methods

The established indicators UC-4, UC-5 and 'Alpine', and the experimental indicator *D. indica*, were used for leaf graft indexing in this study. *D. indica* plants were propagated from seeds and in order to avoid any possible variation all plants used as indicators in this study were runners collected from one mother plant.

Two leaves on each indicator were grafted and the ungrafted leaves were removed. Indicators were maintained before and after grafting below 25°C and were examined for virus symptoms at regular intervals for 2 months (Converse, 1979). Growing of UC-6 was discontinued, as plants were either weak or showed "heat spot" symptoms and were therefore unsuitable for indexing work.

3. Results and Discussion

Duchesnea indica plants and 'Alpine' seedlings were graft-inoculated with leaflets from strawberry plants infected with SMV, MYEV or TSV. Frequencies of detection of these viruses are presented in Table 1. Typical symptoms of the three viruses were observed

on 'Alpine' seedlings. in *D. i n d i c a*, SMV caused severe mosaic and leaflet twisting (Fig. 1). First symptoms appeared 13-23 days after grafting and lasted for 14-30 days (range calculated from 25 plants). Symptoms then gradually faded and the new growth appeared normal. TSV caused stunting and mild chlorosis in graft-inoculated *D. i n d i c a* plants. The first symptoms appeared 20-25 days after grafting and the plants remained stunted and hardly produced runners. Serological detection of TSV (Spiegel and Cohen, 1985) was obtained with these plants even 12 months after grafting. *D. i n d i c a* was a symptomless host for MYEV in Australia (Greber, 1979) and reacted in the same manner to the MYEV found in Israel. Of the three viruses, only MYEV reproduced symptoms when backgrafted from *D. i n d i c a* to UC-4 or 'Alpine'.

The strong reaction of *D. i n d i c a* to SMV and the lack of symptoms in reaction to MYEV provide a means of detecting SMV in plants mixedly infected with these two viruses without using UC-6. In order to establish the reliability of this indicator for detecting SMV it was compared directly with the indicators UC-5 and 'Alpine'. This evaluation was done over the period of one year. At any given time, all three indicators were graft-inoculated with leaflets from the same known infected plant. Following the necessary incubation time, indicators were rated for symptoms. Results summarized in Table 2 show that *D. i n d i c a* was a more sensitive indicator than 'Alpine' and that UC-5 was a poor indicator for the SMV found in Israel. These results suggest that SMV can be detected by *D. i n d i c a* throughout the year.

D. i n d i c a plants are insensitive to summer high intensity light, are easily maintained in a vigorous state throughout the year, and are a poor host for *C h a e t o s i p h o n f r a g a e f o l i i* (Maasen, 1959).

D. i n d i c a is presently included in Israel in the indexing procedure for strawberry viruses and is used for maintenance of MYEV and TSV isolates. This improvement in grafting procedures and the reliable serological detection of TSV (Spiegel and Cohen, 1985) allow continuous indexing work for strawberry viruses regardless of the season of the year.

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Table 1 - Detection of three viruses in known infected plants by 'Alpine' and D. i n d i c a

Virus	'Alpine'	D. i n d i c a
	positive/indexed	positive/indexed
SMV	29/40	34/40
MYE	27/35	15/20 ^a
TSV ^b	7/10	6/8

^aInfection was determined by backgrafting to 'Alpine' plants and observation of symptoms.

^bInfection was determined by symptoms and ELISA (Spiegel and Cohen, 1985).

Table 2 - An evaluation of two F r a g a r i a clones and D u c h e s n e a i n d i c a for the diagnosis of strawberry mottle virus (SMV)

Rating of indicators for symptoms	Detection of SMV in indicators		
	'Alpine'	UC-5	D. i n d i c a
Strongly positive	6	2	9
Weakly positive	3	3	3
Negative.	4	8	1
Total no. of indicators	13	13	13

Fig. 1 - see next page.



Figure 1 - Leaf symptoms on *Duchesnea indica* graft-inoculated with leaflets from strawberry plants infected with strawberry mottle virus (SMV).