

**Mechanical Transmission of Beet Yellows Virus
to *Chenopodium quinoa* WILLD.
and *Chenopodium foliosum* (MOENCH) ASCH.**

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Abstract. Beet yellows virus (BYV) was mechanically transmitted by sap from sugar-beet plants, infected with BYV, to the plants of *Chenopodium quinoa* WILLD. and of *Chenopodium foliosum* (MOENCH) ASCH. Mechanical transmission of BYV to the plants of *Tetragonia expansa* MURR. failed. Infectious material was homogenized in phosphate buffer with veronal and EDTA, pH 7.8. Experimental plants were darkened three days before infection and kept at a temperature of 5° C. Plants of *C. quinoa* WILLD. were decapitated. Back transmissions from *C. quinoa* WILLD. and *C. foliosum* (MOENCH) ASCH. infected with BYV, to sugar-beet plants were carried out by the aphid *Myzus persicae* SULZ. These transmissions were positive. Filamentous particles of BYV, of an average length 1275 nm, were found in plants of *C. quinoa* WILLD. and *C. foliosum* (MOENCH) ASCH., infected with BYV.

Beet yellows virus is difficult to be transmitted mechanically. However mechanical transmission of this virus is especially important when its strains are studied. The main importance belongs to the indicator plants reacting to mechanical infection by BYV with formation of local lesions. BYV was mechanically transmitted to beet for the first time by KASSANIS (1949) who had used an abrasive to facilitate the transmission. He also made use of the BAWDEN's and ROBERT's (1948) knowledge, namely that the sensitivity of plants kept in the dark before inoculation increases. COSTA and BENNETT (1955) transmitted BYV mechanically to sugar beet plants and to *Chenopodium murale* L. reacting with both local and systemic infection. MUNDRY and ROHMER (1958) transmitted BYV mechanically to *Chenopodium foliosum* (MOENCH) ASCH. which reacted with local lesions and sometimes with systemic infection. Experiments with mechanical transmission of BYV to *Chenopodium murale* L., MURR., *Chenopodium amaranticolor* COSTE et REYN., *Chenopodium capitatum* (L.) ASCH. and sugar beet plants were carried out in USA on a large scale by BENNETT (1960). All the named species reacted to the mechanical infection with BYV by the formation of local lesions, rarely by systemic symptoms.

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In our experiments, we succeeded in transmitting of BYV mechanically to *Chenopodium foliosum* (MOENCH) ASCH. and for the first time to *Chenopodium quinoa* WILLD.

Material and Methods

Virus and Plant Materials

We worked with a very virulent virus isolate of BYV found in the surroundings of Praha. This isolate was manifested even in the field by severe clearing of veins — chlorotic netting and severe yellowing, freckling and necrosis on lower leaves. The indicator plants, *Chenopodium quinoa* WILLD., *Chenopodium foliosum* (MOENCH) ASCH. and *Tetragonia expansa* MURR. were darkened during three days before inoculation and kept at a temperature of 5°. Plants of *C. quinoa* WILLD. were decapitated.

Virus Transmission

In our previous experiments, we tried to transmit BYV mechanically by the inoculation of both upper and lower side of the leaves of sugar-beet seedlings with crude sap (expressed from sugar-beet plants infected with BYV). The results were negative. For this reason, we made use of MUNDRY's and ROHMER's (1958) knowledge. These authors had modified the preparation of the phosphate buffer using veronal and EDTA, for mechanical transmission according to LINDNER et al. (1955). The sugar-beet leaves with severe symptoms of yellows were homogenized at a temperature of 2–4° in a mortar with the respective phosphate buffer in the ratio 1 ml of the buffer to 1 g of the leave tissue. Composition of the applied buffer: phosphate buffer, pH 7·8, 0·007 M; EDTA 2·6 g/l, 0·007 M; veronal (sodium diethylbarbiturate) 2·22 g/l, 0·01 M. The ready solution was adjusted with some drops of 1 M NaOH to pH 7·8. A small quantity of Celite was added to the sap obtained by expressing the homogenate through a silon cloth. The sap was immediately used for inoculation of the leaves of experimental plants. 12 plants of *C. quinoa* WILLD. (4 leaves on each plant), 16 plants of *C. foliosum* (MOENCH) ASCH. and 20 plants of *T. expansa* MURR. were inoculated. As control, additional 6, 8 and 10 plants of *C. quinoa*, *C. foliosum* and *T. expansa* respectively were inoculated with sap obtained in the same way from healthy sugar-beet plants.

Electronmicroscopy

Electron microscopic examination of experimental plants was carried out on a Tesla BS 242 electron microscope. Preparations were made according to the BRANDES's deeping method (1957) from leaves of *C. foliosum* (MOENCH) ASCH. systemically infected with BYV and from local lesions which appeared after infection of *C. quinoa* WILLD. leaves with BYV. Shadow casting was carried out on a PP Mikro apparatus with pure Au at an angle of 30°. The length of particles was measured in comparison with latex (DOW) particles of an average length 796 nm.

Results and Discussion

Minute local lesions appeared on the leaves of *C. quinoa* WILLD. plants inoculated with BYV after 20 to 23 days. Local lesions of a diameter 1 to 2 mm were chlorotic at first and were getting successively necrotic from the centre (Fig. 1). At the end phase, the whole leaf became yellowish and necrotic dry and fell off from the stem. Primary infection did not spread and systemic infection did not occur in any case. Local lesions appeared on the leaves of all inoculated plants. We succeeded in transmitting BYV from these lesions by the aphid *Myzus persicae* SULZ, to the sugar-beet seedlings of the variety Dobrovická A. Typical symptoms of yellows appeared in the course

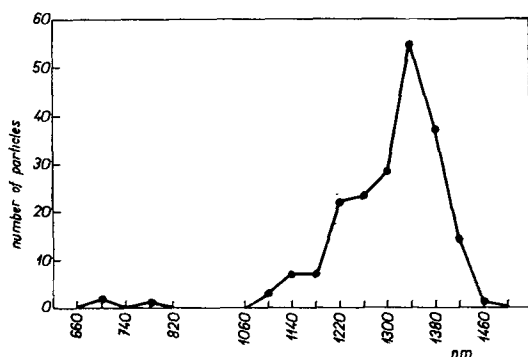


Fig. 2. Distribution of the particle length of BYV.

of 12 days after transmission. So, transmission of BYV to *C. quinoa* WILLD. was proved in this way. At the same time, 200 particles from local lesions on the *C. quinoa* WILLD. leaves were measured in an electron microscope and the average length was found to be 1275 nm. The distribution of the lengths of particles is given in Fig. 2, the form of particles is evident from the electron microgram (Fig. 3). The form and the length of particles correspond with the data given by BRANDES and ZIMMER (1955), viz 1250 nm for BYV.

Plants of *C. foliosum* (MOENCH) ASCH. did not manifest the primary symptoms. Systematic symptoms appeared in the course of 25 to 29 days after infection. Veins of the top leaves became clear (Fig. 4), newly growing leaves remained dwarf, sometimes deformed, later a necrosis of veins and leaf tissue appeared and decline and dying of the top took place (Fig. 5). 25% of the whole number of infected plants exhibited these symptoms. BYV was transmitted from the diseased plants of *C. foliosum* (MOENCH) ASCH. by the aphid *Myzus persicae* SULZ. back to sugar-beet seedlings of the variety Dobrovická A. The symptoms of yellows appeared in the course of 12 days after transmission. When the diseased plants of *C. foliosum* (MOENCH) ASCH. were examined in an electron microscope, particles corresponding with BYV according to their form and length were found.

The plants of *Tetragonia expansa* MURR. did not show any symptoms after mechanical inoculation with BYV even after 55 days. Transmission by the aphid *Myzus persicae* SULZ. from these plants to sugar-beet seedlings of the variety Dobrovická A failed.

Plants of *C. quinoa* WILLD., *C. foliosum* (MOENCH) ASCH. and *T. expansa* MURR. inoculated with the sap from healthy sugar-beet plants did not show any symptoms in the course of 55 days after infection.

Mechanical transmission of BYV to the indicator plant *C. quinoa* WILLD. has not yet been described. But this plant is mentioned by ROLAND and TAHON

(1961) in the survey of 115 plant species sensitive to BYV. Systemic symptoms on *C. quinoa* WILLD. after transmission by the aphid *Myzus persicae* SULZ. were described by GÖTTE (1958). In our experiments, only primary symptoms appeared on *C. quinoa* WILLD. after mechanical inoculation with BYV.

MUNDRY and ROHMER (1958) using mechanical transmission of BYV to *C. foliosum* (MOENCH) ASCH. obtained primary symptoms (local lesions), while systemic infection appeared sporadically. On the other hand, primary symptoms were not manifested in our experiments. This difference can be explained by diverse external conditions during mechanical transmission of BYV and by different isolates of BYV.

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J. POLÁK, O. KLÍR, Ústřední výzkumný ústav rostlinné výroby, Praha: Mechanický přenos viru žloutenky řepy na *Chenopodium quinoa* WILLD. a *Chenopodium foliosum* (MOENCH) ASCH. — *Biol. Plant.* **11** : 366–369, 1969.

Virus žloutenky řepy (beet yellows virus—dále BYV) byl přenesen mechanicky šťávou z rostlin cukrové řepy, infikovaných BYV, na rostliny *Chenopodium quinoa* WILLD. a *Chenopodium foliosum* (MOENCH) ASCH. Na rostliny *Tetragonia expansa* MURR. se BYV nepodařilo mechanicky přenést. Infekční materiál byl homogenizován ve fosfátovém pufru s veronalem a EDTA o pH 7,8. Pokusné rostliny byly před infekcí 3 dny zatemněny při teplotě 5° C. Rostliny *Chenopodium quinoa* WILLD. byly dekapitovány. Z rostlin *Chenopodium quinoa* WILLD. a *Chenopodium foliosum* (MOENCH) ASCH., infikovaných BYV byly provedeny zpětné přenosy na rostliny řepy cukrové mšiči *Myzus persicae* SULZ. Tyto přenosy byly pozitivní. V rostlinách *Ch. quinoa* WILLD. a *Ch. foliosum* (MOENCH) ASCH. infikovaných BYV byly zjištěny vláknité částice BYV průměrné délky 1275 nm.

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Fig. 1. Local lesions on the leaf of *Chenopodium quinoa* WILLD. after mechanical infection with BYV.



Fig. 3. Electron microgram of BYV particles isolated from *Chenopodium quinoa* WILLD. (Magnification: 26 000 \times .)

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Fig. 4. Systemic symptoms on *Chenopodium foliosum* (MOENCH) ASCH. leaves after mechanical infection with BYV.

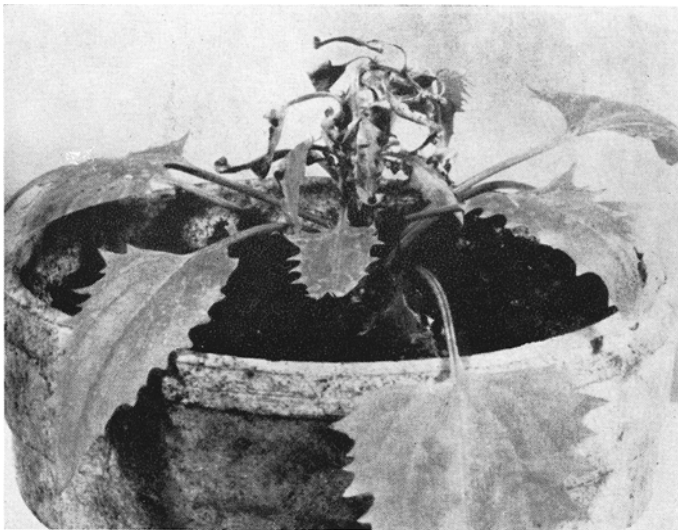


Fig. 5. Decline of the top and dying of the *Chenopodium foliosum* (MOENCH) ASCH. plant after mechanical infection with BYV.