

# studies on some sugar beet virus diseases

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I- A beet mosaic virus (BMV) strain isolated from naturally infected sugar-beet plants with mosaic symptoms, was studied. Host range and transmission studies show that most species susceptible to our strain of BMV, occurred in the family Chenopodiaceae, with some others in the Solanaceae, Leguminosae, Amaranthaceae and Aizoaceae. Our strain induced local lesions followed by systemic symptoms in mechanically inoculated plants of *Chenopodium quinoa* Willd. and *Beta patellaris* Moq. It was transmissible by sap-inoculation and by aphid (*Myzus persicae* Sulz.) in the non-persistent manner. The purified preparations of our BMV-strain, obtained from sugar-beet extracts clarified by Triton X-100 followed by two cycles of differential centrifugation, showed filamentous particles with a mean length of 720 nm. The capsid protein isolated from purified preparations consists of a single component with an estimated molecular weight of 38,401 daltons. Our strain induces cytoplasmic inclusions in the infected cells. The purified cylindrical and amorphous inclusion proteins each consisted of a single component with respective estimated molecular weights of 70,000 and 51,000 daltons, when electrophoresed in 10% polyacrylamide gels containing sodium dodecyl sulfate (SDS). Also our study shows the possible identification of BMV infection in plants after partial purification and electrophoretic separation of proteins associated with virus infection, even when a small quantity of infected tissues is used to start the extraction procedure. Hence, analysis of extracts from BMV-infected plants by polyacrylamide gel electrophoresis reveals the presence of two polypeptide components, in addition to the capsid protein. These polypeptides corresponded to the proteins of the cytoplasmic cylindrical inclusions (CCI) and the amorphous inclusions (AI). The single-stranded genomic RNA of our BMV-strain, obtained from purified virus preparations, exhibits one single component with an estimated molecular weight of  $3.1 \times 10^6$  daltons.

II- A beet yellows virus (BYV) strain, isolated from naturally infected sugar beet plants with yellowing symptoms, was also studied. The host range and transmission studies show that, most species susceptible to our BYV strain occurred in the family Chenopodiaceae, with some in the Solanaceae, Aizoaceae, Amaranthaceae and Portulacaceae; it was transmissible by aphid (*Myzus persicae*) in the semi-persistent manner, and also by mechanical inoculation from beet to beet or *Ch. quinoa*. The percentage of systemically infected sugar beet plants after mechanical inoculation was increased by adding DIECA, or DIECA plus EDTA (acting as stabilizing agents) to the phosphate buffer used for inoculation. The electron microscope preparations made from crude sap extracted from leaves of infected *Claytonia perfoliata* and negatively stained particles with a mean length of 1270 nm. The capsid protein of our BYV-strain, isolated from purified virus preparations obtained from *C. perfoliata* extracts clarified by Triton X-100, followed by two cycles of differential centrifugation, is stable and migrates in 10% SDS-polyacrylamide gel as a single component with an estimated molecular weight of 22,536 daltons. Analysis of the single-stranded genomic RNA of our BYV-strain, by electrophoresis in 2.4% polyacrylamide gel, showed only one component of very low electrophoretic mobility with an estimated molecular weight of  $4.5 \times 10^6$  daltons. Stained with 2% uranyl acetate, revealed thread-like RNA. Our study revealed the presence of a major double-stranded RNA (RF) with a molecular weight of about  $9 \times 10^6$  daltons, together with several lower molecular weight ds-RNAs, in the tissues of BYV-infected plants. It also confirmed the value of ds-RNA analysis as a diagnostic tool for BYV infection.

III- The response of eight sugar-beet varieties to BMV and to BYV inoculation was studied under glasshouse conditions. For BMV, the virus was either inoculated by aphid (*Myzus persicae* Sulz.) or mechanically, whereas for BYV, the

virus was transmitted by aphids only. For BMV, we observed that beet varieties exhibited different reactions to virus infections. Some varieties, such as V1 and V9 were less affected than the others among which V4 and V8 were highly affected. Varieties V2, V3, V10 and V11 were slightly affected. Also, there was a correlation between the number of plants showing severe symptoms after either aphid or mechanical inoculation of BMV. If beet plants escaping infection after the first aphid transmission were subjected to a second one, some varieties, such as V1, V2 and V10 reacted mostly with mild symptoms, while V9, V3, and V11 showed more symptomless plants than the others. A correlation was observed between the number of plants with mild symptoms in either aphid or mechanical transmission of BMV. With regard to the relative concentration of BMV in different sugar-beet varieties, based on the numbers of local lesions produced on *Chenopodium quinoa*, our results showed a correlation between symptoms intensity and relative virus concentration. Crude juice extracted from the highly affected varieties produced a significantly higher number of local lesions than the other varieties. With respect to the effect of BMV infection on root yield of different sugar beet varieties, the results showed that within the different sugar beet varieties tested, plants with mild symptoms produced higher root yield than plants with severe symptoms, and lower yields than the uninoculated (control) plants. The difference was not significant in all cases, except for V8 (one of the highly affected varieties) and V10 (one of the slightly affected varieties). In all varieties, the yield of inoculated plants was less than that of uninoculated plants and the difference was not significant in the case of V1 (one of the less affected varieties) or V3 (one of the slightly affected ones). It was significant at the 0.05% level for V2, V9, V10, or V11 (scored as slightly affected) and was highly significant (0.01% level) for V8 (one of the highly affected varieties). Generally, the sugar-beet varieties showing severe symptoms after BMV-inoculation yielded higher virus concentrations and had lower root yields than the ones with less symptoms. This correlation between the symptoms of BMV-infected sugar beet varieties and the relative concentration of the virus and/or the root yield of these varieties obtained in our study, could be used for selecting BMV-resistant or tolerant sugar beet variants. For BYV, the results obtained indicated that: all sugar beet varieties tested showed symptoms after BYV infection. However, some varieties such as V2 and V4 were less affected than the others; varieties V1 and V3 might be considered as slightly affected while varieties such as V8, V9, V10 and V11 could be considered as highly susceptible to our strain of beet yellows virus (BYV). With concern to the concentration of the partially purified BYV extracted from infected leaves of the different sugar beet varieties tested, our results indicated different concentration of BYV in the leaves of different varieties. In general, more affected varieties yielded higher virus concentration. With regard to the effect of BYV infection on root yield, the results showed that the reduction of root yield was correlated with symptoms intensity. Our study showed a general correlation between symptoms on sugar beet varieties infected by our strain of BYV, virus concentration recovered from these varieties, and/or the root yields of the infected plants. The highly symptomatic varieties yielded more virus and had lower root yields than the ones with less symptoms and this behaviour could be used for selecting BYV-tolerant or resistant sugar beets. As for micropropagation by tissue culture technique encouraging results were reached but further investigations are needed due to the internal bacterial contamination.