

Some Data on Adsorption of Two Plant Viruses to Soil

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The degree of adsorption of tobacco mosaic virus (TMV) particles and turnip yellow mosaic virus (TYMV) particles to two types of soil (humic and sandy soil) was established by laboratory tests. Both types of soil adsorb in high percentage TMV (c. 95 %) as well as TYMV (nearly 100 %). Infectivity of the humic soil which contained the adsorbed TMV particles was completely reduced.

It is well known that the bentonite, a clay material, adsorbs proteins as well as virus particles and because of that it can be used in virus purification (Gibbs and Harrison, 1976). When virus particles get to the soil from a plant organism they can be adsorbed to soil components. Blanco-Sanches et al. (1986) have established that different types of soils adsorb tobacco mosaic virus (TMV) particles differently depending on the colloidal complex of each type of soil.

In the last several years it was demonstrated repeatedly that certain plant viruses could be isolated from the drainage water (Teakle, 1986) or from waters of lakes and rivers nearly over the world (Koenig, 1986; Koenig et al., 1988; Kontzog et al., 1988). In order to detect the plant viruses in water environments the water samples were concentrated either by ultracentrifugation (Tošić and Tošić, 1984; Koenig and Lesemann, 1985; Juretić et al., 1986; Horváth et al., 1986) or by virus concentrators (Tomlinson et al., 1983). However, Piazzola et al., (1986) have changed the procedure of isolation of plant viruses from water environments. They did not concentrate the virus from water by ultracentrifugation but by means of a low speed centrifugation (5000 g). In this manner they obtained the sediments which were infective. Besides TMV, the collected sediments contained cucumber mosaic virus (CMV) and also two other unidentified viruses. The authors supposed that these viruses were at least partially adsorbed to soil sediments occurring in water.

Above data inspired us to find out the degree of adsorption of two viruses to two specific types of soil.

Materials and Methods

Two viruses were used: tobacco mosaic virus (TMV, type strain) and turnip yellow mosaic virus (TYMV, strain 1). TMV was maintained in tobacco (*Nicotiana tabacum* cv. *Samsun*) and TYMV in turnip (*Brassica rapa* cv. *rapa*). The experiments were carried out with infective plant sap previously filtered through gauze and diluted with tap water (pH 7.2) at a ratio of 1:1000 for TMV and 1:100 for TYMV.

Experiments of adsorption of the viruses to soil were performed in two manners. In one case diluted infective sap was filtered through a moist soil-bed made in a column (25×1.5 cm). One type of sterilized soil consisted of 2 parts of common field soil, 1 part of compost and 10% sand (humic soil, pH 7.7) and the other type of used soil consisted of about 95 % sand and 5 % minute soil dust (sandy soil, pH 8.2). Infective samples (10 ml) were applied on the top of the column and eluted by 20 ml of water flow. The first 10 ml eluted liquid were tested on plants. In the other case diluted infective sap was homogenized with sterilized soil and steered 8 hr. After low speed centrifugation, the infectivity of the supernatant was tested on plants.

Following the treatments with soil, the infectivity of TMV preparations was assayed on half-leaves of *Chenopodium murale*, *Datura stramonium* and *Nicotiana glutinosa* as locally reacting hosts (Latin square design): four inocula were compared by randomizing them among halves of two leaves on four plants (*Datura stramonium* and *Nicotiana glutinosa*) or four leaves on four plants (*Chenopodium murale*) so that each inoculum was applied to one or two half-leaves of each plant. The infectivity of TYMV preparations was assayed on young exemplars of *Brassica rapa* cv. *rapa*. In these experiments whole plants were used as infectable units (systemically reacting host); each inoculum was applied to 50 plants allocated at random to each group.

Results

1. Adsorption of TMV to soil

Three specimens of TMV infective sap were tested after their treatment with soil. Together with the control specimen four samples in total were assayed. They were: sample A – untreated infective plant sap, sample B – infective sap homogenized with the humic soil, sample C – infective sap homogenized with the sandy soil, and sample D – infective sap filtered through humid soil. The results obtained are presented in the Figure 1. The curve in the Figure 1 is a resultant of the number of lesions appearing on all half-leaves of three test plants. In relation to the control (specimen A), the infectivity of all treated sap specimens (B, C, D) was essentially reduced. The average number of lesions in the three repeated experiments was: A = 1684, B = 340, C = 89, D = 92. The number of lesions varied depending on test plant species. However, the relative relations in the number of lesions produced by particular specimens were similar at all three test plant species (*Nicotiana glutinosa*, *Datura stramonium*, *Chenopodium murale*). The most susceptible test plant was *Datura stramonium* and the other two plants reacted similarly.

2. Adsorption of TYMV to soil

The adsorption of TYMV to the humic and the sandy soil was similar to that of TMV. However, as it can be seen from the Figure 1 the adsorption of virus particles of the specimens C and D was complete. Namely, from 50 inoculated plants the specimen A infected 50 plants, the specimen B 1 plant, the specimen C no plant and the specimen

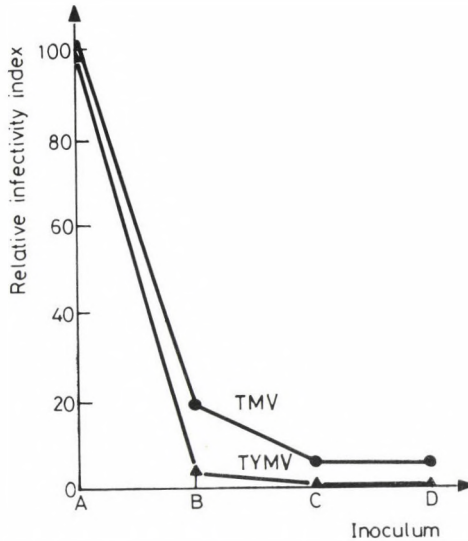


Fig. 1. Adsorption of TMV and TYMV to two types of soil: A – untreated infective plant sap, B – infective sap homogenized with the humid soil, C – infective sap homogenized with the sandy soil, D – infective sap filtered through humic soil. TMV samples were diluted with water 1 : 1000 and TYMV samples 1 : 100

D again no plant. These experiments with TYMV were done in the same manner as the experiments with TMV but in this case the infectivity tests were performed by *Brassica rapa cv. rapa* as a test plant systemically reacting to TYMV.

3. Infectivity of the soil adsorbing virus particles

To reveal the degree of the infectivity of the soil adsorbing virus particles, the following assays were done. The humid soil with adsorbed TMV was dried by standing at room temperature for 48 hr. After that, soil was homogenized with a small quantity of water and the mixture was stirred for 4 hr. After low speed centrifugation the supernatant was inoculated to test plants (*Datura stramonium*, *Nicotiana glutinosa*). However, in three repeated tests no infectivity was detected. The results showed that our humic soil had a great capacity of inactivating the virus (cf. Blanco-Sanches et al., 1986).

Discussion

Obviously, the soils used are highly charged materials with a large surface area. Because of that they are good adsorbens for virus particles. It means that the soils contained much colloid matrices. Blanco-Sanches et al. (1986) established that their

carbonate soil adsorbed much more TMV particles than sandy soil did. Paradoxical datum obtained in our experiments that the sandy soil used adsorbed virus particles similarly as the humic soil did, could be explained by the fact that the sandy soil had relatively enough minute pulverized soil which probably contained colloidal components responsible for the adsorption of virus particles.

It can be concluded that a large part of the plant viruses occurring in surface waters reach the soil and accumulate in its upper layers where they are adsorbed to colloid matrices. When a virus reaches underground water which passes through the soil, it can be adsorbed to soil colloids. Therefore, the virus inflow to rivers or lakes in this way is limited. The viruses found in rivers probably originate from surface waters. Our results agree with the finding of Piazzola et al. (1986) that plant viruses can be adsorbed in river waters to their sediments which have their origin in the soil components.

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