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# Biological Decline of *Solanum nigrum* L. Due to *Tobacco mosaic tobamovirus* (TMV) Infection. II. Germination, Seed Transmission, Seed Viability and Seed Production

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In the second part of our study we have examined the effect of *Tobacco mosaic tobamovirus* (TMV) infection on the germination, seed transmission, seed viability and seed production of *S. nigrum.* Transmission of TMV by seeds of *S. nigrum* was 0.3%. Average seed production of the virus infected plants was reduced by 52%, as compared to the healthy control, and TMV infection also delayed generative development. Virus infection did not influence the germination of the seeds. Viability of seeds derived from ripened (blue-black) berries, was significantly reduced by TMV infection.

Keywords: *Solanum nigrum, Tobacco mosaic tobamovirus,* seed, germination.

Besides the virus epidemiological role of weeds, the biological decline of weeds due to virus infection may be also important in the reduction of a weed population. Virophilous *Solanum nigrum* L. (black nightshade) is a very good modell species in this respect. It is known so far as natural hosts of more than 40, economically important viruses (Kazinczi and Horváth, 1998a), therefore it may be primary infection source in spreading of virus diseases. Recently a new *potexvirus, Pepino mosaic potexvirus* (PepMV) was identified from *S. nigrum,* collected around greenhouses in Spain (Jordá et al., 2001).

The aim of the first part of our study was to examine the effect of *Tobacco mosaic tobamovirus* (TMV) infection on the growth and nutrient uptake of *S. nigrum.* We have proved that the fresh and dry weight both of the shoots and roots and nutrient uptake of *S. nigrum* significantly reduced due to TMV infection (Kazinczi et al., 2001). In the second part of our study we have examined the effect of TMV infection on the germination, seed transmission, seed viability and seed production.

## Materials and Methods

Seeds of *S. nigrum* were sown in sterilized boxes in the virological glasshouse free of vectors. The seedlings were planted in plastic pots (28 cm in diameter), containing a soil mixture of sand (pH 6.96, humus%: 0.27): peat (pH 6.78, humus%: 9.98) in a ratio of 1:3. *S. nigrum* plants were inoculated at 6–8 leaves stage with U1 strain of *Tobacco mosaic tobamovirus* (TMV/U1). Previously the virus was propagated on *Nicotiana tabacum* L. cv.

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Samsun. There were four plant in a pot and eight replicates of control and TMV infected plants. Seventy days after planting unripened (green) and ripened (blue-black) berries and seeds were collected and counted on each plants. After cleaning seeds from green and blue-black berries were sown in pots and five hundred plants derived each from green and blue-black berries were grown. Infectivity was evaluated on the basis of symptoms and by DAS-ELISA serological method (Clark and Adams, 1977).

Germination tests were carried out under laboratory conditions at 25 °C in Petri dishes. The seedlings were counted and removed every day. Incubators were illuminated for 16 h a day. In order to determine germination in darkness the dishes were wrapped in black, double thickness linen bags and the evaluations were made under weak green illumination. In order to determine viability of seeds, triphenyl tetrazolium chloride (TTC) test was used after the standard of the International Seed Testing Association (ISTA) (Moore, 1985).

## Results and Discussion

No significant difference was observed between the healthy and virus infected plants, regarding to the number of green berries in a plant and the number of seeds in a berry. Higher seed production of the healthy plants was due to the great number of the blue-black (ripened) berries and more seeds in the ripened berries as compared to the unripened (green) ones. Average seed production of the virus infected plants was reduced by 52%, as compared to the healthy control ones. TMV infection also delayed the generative development of *S. nigrum,* which expressed in the higher proportion of the green berries *(Table 1).*

The extent of transmission of TMV by *S. nigrum* seeds 0.3%, independently on the origin. Seed transmission is very important in the virus epidemiology, because it provides a means for virus dispersal in space and time. In our previous studies the extent of transmission of *Sowbane mosaic sobemovirus* (SoMV) by *Chenopodium album* seeds was 6% while it varied 2–8% and 2–6% with species *C. quinoa* and *C. murale,* respectively (Kazinczi and Horváth, 1998b). The frequency of seed transmission is not a standard value not even in a given host-virus relation, but depends on a lot of factors. Even low extent of seed transmission may result great epidemiological importance (Tóbiás et al., 1996). Infectivity tests on separate embryos and seed coats of *Spinacea oleraea* showed that over 30% of the seed's embryos were infected and c. 80% of the seed-coats contained SoMV (Bos and Huijberts, 1996). No close correlation were observed between the extent of virus infectivity and seed transmission (Zink et al., 1956; Mink, 1993).

Seed viability was not influenced in case of seeds derived from green berries, while viability of those seeds derived from ripened (blue-black) berries was significantly reduced due to TMV infection. Maturity of the berries also influenced seed viability. In a previous study SoMV infection decreased viability of *Chenopodium* seeds by 1–23%, depending on species (Kazinczi et al., 2000). Seed production, germination and viability may greatly reduce by different pathogens (Horváth, 1969, 1980; Crowley and Buchanan, 1982; Harris and Hoffmann, 1985; Walkey et al., 1985).

**Table 1**

The effect of *Tobacco mosaic tobamovirus* (TMV) infection on germination characteristics of *Solanum nigrum* L. seeds*

| | Berries/plant | | Seed/berries | | Seed/plant | P | Seed viability | | Germination % | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | U | | R | |
| | U | R | U | R | | | U | R | L | D | L | D |
| Control | 46±11 | 75±10 | 22±5 | 36±2 | 3692±760 | 1:1.58 | 69± 7 | 98±1 | 7.5± 2.7 | 0±0 | 32.5±31 | 0.8±0.9 |
| TMV infected | 42±11 | 26± 8 | 22±1 | 32±3 | 1775±431 | 1.64:1 | 74±15 | 93±4 | 22.8±12.3 | 2±0.8 | 34±27 | 3±2 |
| $SD_{5\%}$ | 13 | 13 | 5 | 5 | 734 | | 6.56 | 3.49 | 19.9 | 19.9 | 19.9 | 19.9 |

*Abbreviations: D, dark; L, light; P, proportion of the green:blue-black berries in a plant; R, ripened (blue-black) beries; U, unripened (green) berries

Polimorphism also expressed in germination percentages as it had already been observed earlier (Kazinczi and Hunyadi, 1990). Germination of seeds derived from blue-black berries was higher than that of those ones derived from green berries. Higher germination was obtained in light, than in dark, suggesting the presence of phytochrome, as in other species (Kazinczi and Hunyadi, 1990). Virus infection has seemed not to influence the germination of *S. nigrum.* Opposite effect was observe in case of *C. album,* where SoMV infection caused an average 15% reduction in germination (Kazinczi et al., 2000), although it has been proved that autecological factors (temperature, light, storage conditions, etc.) affect germination characteristics to a greater extent than virus infection *(Table 1).*

Our results underline the fact that viruses unfavourably influence physiological processes (including germination characteristics) of the weeds, therefore – in indirect way – viruses may contribute to the reduction of a weed population.

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