INTERAKCIJE RASTLINA – RASTLINA V POVEZAVI Z INTERAKCIJAMI VIRUS – RASTLINA

Gabriella KAZINCZI[1], Joseph HORVÁTH[2],András Péter TAKÁCS[3]

[1, 3]Office for Academy Research Groups Attached to Universities and Other Institutions, Virological Group
[2]University of Veszprém, Georgikon Faculty of Agricultural Sciences, Keszthely, Hungary

IZVLEČEK

Poznamo več vrst sovplivnih (interferenčnih) interakcij med višjimi rastlinami. Nekatere opisujemo kot interakcije tekmovanja (kompetitivne), druge kot alelopatske interakcije (zaviralne ali vzpodbujevalne). Kadar v odnosih med rastlinami prevladuje primarni zaviralni alelopatski odnos, donatorska rastlina izloča snovi iz skupine drugotnih presnovnih izločkov (sekundarni metaboliti), ki imajo zaviralen učinek na razvoj rastline sprejemnice (recipientke) teh snovi. V sedanjem času v okvir alelopatskih odnosov ne uvrščamo zgolj interaktivnih odnosov med višjimi rastlinami, temveč tudi interaktivne odnose med mikroorganizmi in rastlinami. Namen naše študije predstavljene v tem prispevku je bil ugotoviti povezavo med alolopatskim učinkom izločkov nekaterih plevelov na poskusne rastline in odnosom med poskusno rastlino in virusom, s katerim je poskusna rastlina okužena. V našem primeru smo kot poskusni rastlini sprejemnici uporabili pasje zelišče (*Solanum nigrum*) in tobak (*Nicotiana tabacum* cv. Samsun), ki smo jih v stadiju 4 do 6 listov okužili z virusom ObPV (Obuda pepper virus). Poskusne rastline smo vsak dan škropili z vodnimi izvlečki pridobljenimi iz naslednjih plevelov: *Abutilon theophrasti* (baržunasti oslezovec, poganjki), *Asclepis syriaca* (sirska svilnica; poganjki, korenine ločeno), *Cirsium arvense* (njivski osat, poganjki) in *Convolvulus arvensis* (njivski slak; poganjki). Pet tednov po okužbi testnih rastlin v virusom smo s tehtanjem svežih rastlin določili njihovo maso. Za določitev virusov v testnih rastlinah smo uporabili seroloski test (DAS ELISA), za kvantifikacijo koncentracije virusa v soku testnih rastlin pa smo uporabili kar odčitke ekstinkcijskih vrednosti. Masa svežih rastlin pasjega zelišča se je ob dodajanju vodnih izvlečkov iz korenin svilnice in poganjkov slaka zmanjšala za 41 oziroma 45%. Dodajanje izvlečkov plevelnih rastlin ni vplivalo na koncentracijo ObPV virusa v testnih rastlinah pasjega zelišča. Koncentracija virusa v testnih rastlinah tobaka sorte Samsun se je pod vplivom dodajanja vodnih izvlečkov korenin svilnice in izvlečkov poganjkov njivskega slaka značilno zmanjšala. Razvoj poskusnih rastlin tobaka je bil občutno zavrt ob dodajanju izvlečkov iz poganjkov svilnice in oslezovca. Na podlagi preliminarnih rezultatov raziskave ugotavljamo, da med zaviralnim alelopatskim učinkom preučevanih plevelov na pasje zelišče in tobak in med odnosom gostitelj-virus, ni povezave.

Ključne besede: interferenca, rastline, alelopatija, *Solanum nigrum, Nicotiana tabacum, Abutilon theophrasti, Asclepis syriaca, Cirsium arvense, Convolvulus arvensis*, ObPV virusa

PLANT-PLANT AND PLANT-VIRUS INTERACTIONS

ABSTRACT

Interaction among higher plants is called interference. One type of it is called as competition, while the other type is called allelopathy. In case of predominance of allelopathy, donor plants excrete secondary metabolits, which always have inhibitory effect on the recipient (acceptor) species. Today the term allelopathy has been broadened, including not only plant-plant, but also plant-microorganisms interactions. The aim of our present work was to study the effect of

[1]P.O.Box 71, H-8361 Keszthely
[2]P.O.Box 71, H-8361 Keszthely
[3]P.O.Box 71, H-8361 Keszthely

some allelopathic weeds on the development on recipient species and virus concentration. Donor species (*Solanum nigrum, Nicotiana tabacum* 'Samsun') were sprayed or watered daily with the water extracts of *Abutilon theophrasti, Asclepias syriaca, Cirsium arvense, Convolvulus arvensis* shoots, and those of *A. syriaca* roots. Test plants were inoculated at 4-6 leaf stage with *Obuda pepper virus* (ObPV). Five weeks after inoculation the fresh weight of the test plants were measured. Virus infection was evaluated by DAS ELISA method, and virus concentration in hosts was determined on the basis of extinction values. Fresh weight of *S. nigrum* was reduced by 41 and 43%, due to *A. syriaca* root and *C. arvense* shoot extracts. Plant water extracts did not reduce virus concentration in *S. nigrum*. Virus concentration in *N. tabacum* 'Samsun' was significantly reduced due to *A. syriaca* root, and *C. arvense* shoot extracts. Development of *N. tabacum* 'Samsun' plants was considerably inhibited due to *A. syriaca* and *A. theophrasti* shoot extracts. On the basis of our results no relation was observed between allelopathic inhibitory effect on the test plants and host-virus relations.

Key words: allelopathy, growth, inhibitors, plant extracts, viruses

1. INTRODUCTION

The term allelopathy was introduced by Molish (1937) at the first time. Earlier it was considered as a type of interference among higher plants, where products of secondary metabolism inhibit (less promote) the development and physiological processes of neighbourhood plants (Rice 1984). The term allelopathy has been extended recently including not only plant-plant, but also plant - microorganism intertactions (Macias *et al.*, 2002), and is considered as a new alternative way for biological weed control (Duke *et al.*, 2002, Dikic *et al.*, 2003).

Plant viruses make up about 15-30 % out of the whole plant diseases. Virus particles create extremely close biological units with the host cell. The biosynthesis of viruses is done by the organelles of the host cell. Therefore chemical protection against viruses is unsuccesful *in vivo* and causes the death of the plant host cell at the same time. In spite of this, some natural substances are known to inhibit the replication and cell- to cell movement of viruses and to reduce virus concentration (Moraes 1974; Baranwal and Verma 1997; Manickam and Rajappan 1998; Vivanco *et al.*, 1999). The mode of action of natural substances is not yet known exactly, but it can be presumed, that these substances may modify special receptor places on the plant cell surface, therefore adhesion of virus particles can not be happened (Ragetli and Weintraub 1974, Gáborjányi and Tóbiás 1986).

The aim of our investigations was to study the effect of allelopathic weed extracts on host-virus relations.

2. MATERIALS AND METHODS

Fresh shoots and roots of *Asclepias syriaca*, while shoots of *Abutilon theophrasti, Cirsium arvense* and *Convolvulus arvensis* were collected at the beginning of flowering near Keszthely, in 2004. The roots and shoots were cut into small pieces in a grinder. After grinding, 25 g fresh biomass was stirred into 100 ml distilled water and left for a day. Then the mixtures were filtered through filter paper (MN 640w), and the water extracts were used to spray or water (50 ml water extract pot^{-1}) daily the test plants from their 2-4 leaf stage until the end of experiments. *Nicotiana tabacum* 'Samsun' and *Solanum nigrum* as test plants were mechanically inoculated with *Obuda pepper virus* (ObPV).

In order to evaluate virus inhibitory effect of plant extracts in their systemic hosts, DAS ELISA serological method was used five weeks after inoculation (Clark and Adams 1977) and the fresh weight of the test plants were also measured at the same time. Extinction values were measured 20 minutes after adding the substrate at 405 nm wavelength by Multiscan ELISA reader. The higher the concentration of viruses in the plant samples, the higher extinction values were measured, therefore from the extinction values one could conclude to the virus concentration. Test samples were considered resistant to virus infection if their extinction values did not exceed two times those of the negative (uninfected) control ones. Analysis of variance (ANOVA) has been done with susceptible, virus infected plant samples (where the extinction values were more than two times higher than the extinction values of the negative control samples), in order to determine the effect the extracts on the virus concentration in hosts as compared to the positive control samples. Virus infected plants without extract using served as positive control.

3. RESULTS AND DISCUSSION

It has been seemed that in systemic host-virus relations root and shoot extracts of weeds did not inhibit virus infection, because extinction values were more than two times higher than those of the negative control samples. In a previous study, some plant extracts significantly reduced the number of the local lesions (Takács *et al.*, 2004). Sprayed plant water extracts did not reduce significantly ObPV concentration in *S. nigrum,* although considerable, 41 and 43 % reduction in fresh weight had been observed due to *A. syriaca* root and *C. arvense* shoot extracts, respectively (Fig 1. and 2.).Virus concentration in *N. tabacum* 'Samsun' host was significantly reduced due to *A. syriaca* root, and *C. arvense* shoot extracts. Development of *N. tabacum* 'Samsun' plants was considerably inhibited due to *A. syriaca* and *A. theophrasti* shoot extracts (Fig 3. and 4.). When plant extracts were used for watering the pots differences neither in virus concentration nor in fresh weight had been observed, as compared to control samples.

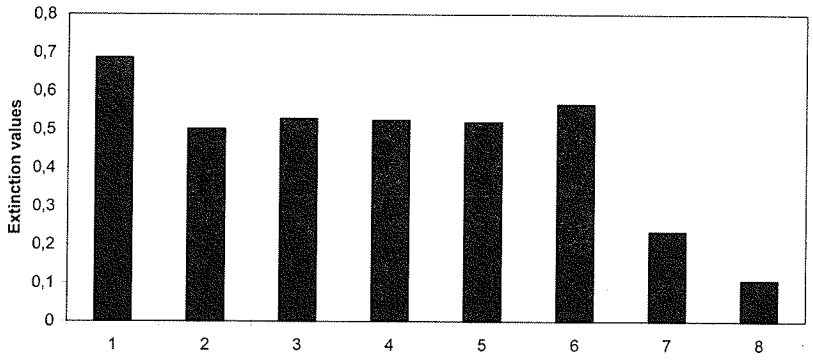

Fig. 1

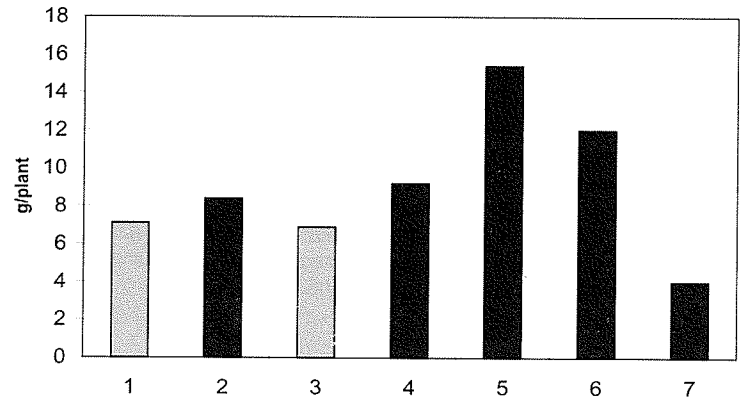

Fig. 2

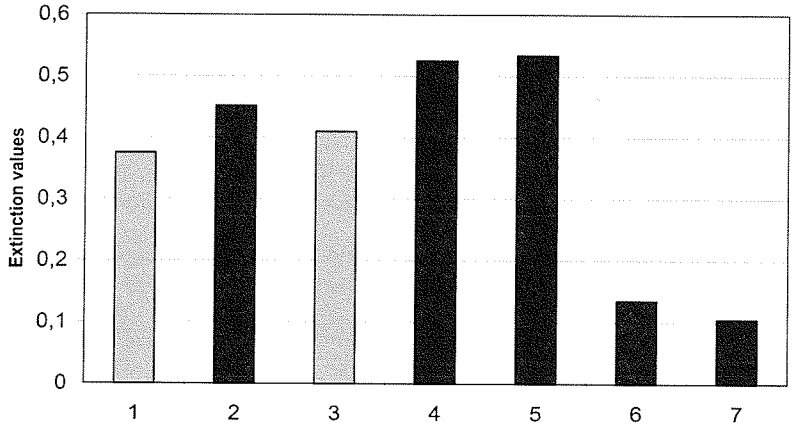

Fig. 3

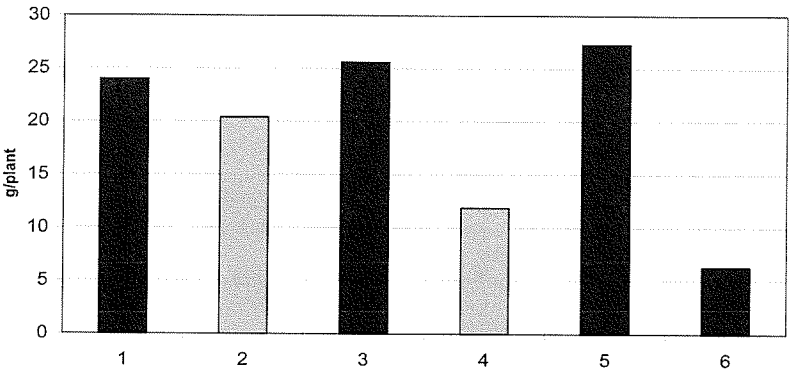

Fig. 4

4. CONCLUSIONS

Plant extracts had a stronger inhibitory effect on the development of the test plants, than on the virus concentration in the hosts. These results coincide with the known allelopathy effect of *A. syriaca, C. arvense* and *A. theophrasti* (Kazinczi *et al.*, 1991, 1999, 2004). *A. syriaca* root and *C. arvense* shoot extracts reduced fresh weight of *S.nigrum*, but not that of *N. tabacum* 'Samsun'. Nevertheless these extracts significantly reduced ObPV concentration in *N. tabacum* 'Samsun', but not in *S. nigrum*. Our preliminary results show that there is no relation between allelopathic inhibitory effect of weeds on the development of test plants and virus inhibitory effect in the hosts. Better results were obtained from those experiments, where target was to study the virus inhibitory effect of some herbicides in the hosts (Kazinczi *et al.*, 2002, 2003).

5. ACKNOWLEDGEMENT

The authors thank the Hungarian Scientific Resarch Found (OTKA) for their financial support (Grant No. T037 819).

6. REFERENCES

Baranwal, V.K., Verma, H.N. 1997. Characteristics of a virus inhibitor from the leaf extract of *Celosia cristata*. Plant Pathol. 46: 523-529.

Clark, M.F., Adams, A.N. 1977. Characteristics of the microplate method of enzyme-linked immunosorbent assay for the detection of plant viruses. J. Gen. Virol. 34: 475-483.

Dikic, M., Muminovic, S., Gadzo, D. 2003. Allelopathy as a new way of biological weed control. Herbologia 4 (1): 121-132.

Duke S.O., Rimando, A.M., Baerson, S.R., Scheffler, B.E., Ota, E., Belz, R.G. 2002. Strategies for the use of natural products for weed management. J. Pesticide Sci. 27: 298-306.

Gáborjányi R., Tóbiás I. 1986. Inhibitors of virus infection and virus replication in plants. Növénytermelés 35: 139-146.

Kazinczi, G., Béres, I., Hunyadi, K., Mikulás, J., Pölös E. 1991. Study of the allelopathic effect and competitive ability of velvetleaf (*Abutilon theophrasti* Medic.). Növénytermelés 40: 321-331.

Kazinczi, G., Béres, I., Mikulás, J., Nádasy, E. 2004. Allelopathic effect of *Cirsium arvense* and *Asclepias syriaca*. Z. PflKrankh. PflSchutz Sonderh. 19: 301-308.

Kazinczi, G., Horváth, J., Béres, I., Takács, A.P., Lukács, D.2002. The effect of pendimethalin (STOMP 330) on some host-virus relations. Z. PflKrankh. PflSchutz Sonderh. 18: 1093-1098.

Kazinczi, G., Horváth, J., Takács, A.P. 2003. Interaction of viruses and herbicides on host plants. 6th Slovenian Conference on Plant Protection Zrece (Slovenia) 2003. pp.270-274.

Kazinczi, G., Mikulás, J., Horváth, J., Torma, M., Hunyadi, K. 1999. Allelopathic effects of *Asclepias syriaca* roots on crops and weeds. Allelopathy Journal 6: 267-270.

Macías, F.A., Vinolo, V.I., Oliveros, A., Galindo, J.C. 2002. New approach in allelopathy, challenge for the next millenium. 3rd World Congress on Allelopathy, Tsukuba (Japan) 2002. p.38.

Manickam, K., Rajappan, K. 1998. Inhibition of antiviral activity of certain leaf extracts against tomato spotted wilt virus in cowpea. Ann. Plant Prot. Sci. 6: 127-130.

Molish, H. 1937. Der Einfluss einer Pflanze auf die andere. Allelopathie. Fischer, Jena 1937.

Moraes, W.B., Martins, M.F., Conti, E., Oliveira, A.R. 1974. The inhibitory activity of extract of *Abutilon striatum* leaves on plant virus infection. I. Isolation and some properties of the inhibitor. Phytopath. Z. 81: 145-152.

Ragetli, H.W., Weintraub, M. 1974. The influence of inhibitors on the reaction of indicator plants. 2nd Internat. Congr. Plant Pathol., Minneapolis 1974. pp. 1-14.

Rice, E.L. 1984. Allelopathy. Academic Press, Orlando 1984.

Takács, A., Horváth, J., Mikulás, J. 2004. Inhibitory effect of *Chelidonium majus* extracts. Z. PflKrankh. PflSchutz Sonderh. 19: 285-292.

Vivanco, J.M., Querci, M., Salazar, L.F. 1999. Antiviral and antiviroid activity of MAP-containing extracts from *Mirabilis jalapa* roots. Plant Dis. 83: 1116-1121