# ALLELOPATHY OF SOME IMPORTANT WEEDS IN HUNGARY

Gabriella KAZINCZI[1], Ferenc PÁL-FÁM[2], Erzsébet NÁDASY[3], András TAKÁCS[4], József HORVÁTH[5]

[1,2,5] Kaposvár University, Department of Botany and Plant Production, Kaposvár, Hungary
[3,4,5] University of Pannonia, Institute for Plant Protection, Keszthely, Hungary

## ABSTRACT

The change of weed flora of arable lands has been continuously followed in Hungary for more than 60 years. From the database of the Five National Weed Surveys the weed species detected in wheat, maize and on cereal stubbles are ranked in the order of their dominance. It is believed that allelopathy may play important role in their rapid spreading. This is especially true for invasive alien species (IAS), like *Ambrosia artemisiifolia*, *Sorghum halepense* etc. Out of these dominant weeds the allelopathic inhibitory effect only in case of a few weed species is not known. Based on the results of bioassay, pot and field experiments carried out in Hungary for more decades we can conclude the followings: Inhibitory effect of organic dissolvent plant extracts are generally stronger than that of water extracts. In bioassay laboratory experiments a dose –response relationship study is necessary, because the stronger inhibitory effect of the higher concentration extracts may be due not only to allelopathy but to the increased osmotic potential as well. In bioassays, inhibitory effect on seedling growth are generally stronger than that on germination rate. Inhibitory effect of allelochemicals greatly depends on donor, recipient (test) species, plant parts, the age of plant parts (living, dead), concentration and type of the dissolvents (water, organic) and physiological process affected (e.g. germination, growth). Bioassay, pot and field experiments generally give different results, suggesting that allelochemicals can be destroyed due to the biological decomposition with the time, especially under field conditions. Therefore in fields rather competition than allelopathy plays a greater role in plant-plant interactions. Today the term allelopathy has been extended, including not only plant-plant but – among others - plant-microorganism interactions also (e.g. some plant extracts can inhibit the virus concentration in the systemic plant hosts). Allelopathy is considered as an alternative way of biological control. Nevertheless an internationally excepted uniform standard method would be essential for allelopathic studies – similar to that of competition methods – because in the lack of this, results achieved in different places and in the different countries are not comparable.



**Key words**: plant-plant interaction, allelopathy, weeds, viruses

## 1 INTRODUCTION

The term allelopathy was used by Molish (1937) at the first time. Allelopathy is considered as a chemical interaction among higher plants, in which allelochemicals - released from the donor plants can greatly modify – generally inhibit - the development of the recipient (test) plants.

[1] PhD, Guba S. str. 40, H-7400 Kaposvár, Hungary
[2] PhD, ibid.
[3] PhD, Deák F. str. 16.H-8361 Keszthely, Hungary
[4] PhD, ibid.
[5] Acad., PhD, ibid.

Based on Five National Weed Surveys in Hungary (Novák *et al.*,, 2009) it is believed that the majority of the dominant arable weeds has allelopathic inhibitory effect. This fact can also contribute to their rapid spreading.

Today the term allelopathy has considerably broadened including not only plant-plant but plant – other organism (pathogens, pests etc.) as well. In earlier studies inhibitory effect of some plant extracts on the virus concentration in systemic host-virus relations was observed, while other substances considerably reduced the number of necrotic lesions in local-host virus relations (Kazinczi *et al.*,, 2002; Takács *et al.*,, 2004). Based on the results of the previous experiments, natural substances are not able to destroy viruses, therefore no viricides are available in the agricultural practice (Horváth, 1999). The reason of this is that viruses close strong biological unit with the plant host cell, therefore the death of viruses due to viricides coiexists with the death of the host plants. In spite of that some natural and artificial substances are known to inhibit virus replication and cell- to cell movement (Gáborjányi and Tóbiás, 1986; Baranwal and Verma, 1997; Vivanco *et al*., 1999; Macias *et al*., 2002).

In this paper we summarize the most important results and conclusions of allelopathic research achieved in Hungary of the last 20 years. Result of some model experiments are also described here.

## 2 MATERIALS AND METHODS

### 2.1 Bioassay experiments

Water extracts (earlier of alcoholic and acetonic ones) were made from the fresh plant parts of some donor species. After grinding, 25 g fress biomass was stirred into 100 ml distilled water and left for 24hours. Then the mixtures were filtered and denoted as a stock solution, 2-, 5- and 10-fold dilutions. Double filter paper was kept in Petri dishes, thereafter 8-8- ml leachate was added to for each Petri dish. On the top of filter paper 100 seeds of some test plant species were germinated at 22 °C in incubator in four replicates. Germination extent was recorded daily until no germination occurred. The radicle length of *Lepidium sativum* was measured after 48hs from the beginning of the experiments.



### 2.2 Pot experiments

Dried plant parts (0.5-0.9 kg) of the donor plants were mixed with 10 kg soil mixture of sand (pH: 6.96; humus: 0.27%) + peat (pH: 6.78, humus: 998%) in a ratio of 1:1. After 2-3 months of decomposition pots were filled with the soil mixture and sown with seeds of the test plants in 4-8 replicates. Pots filled a soil mixture without plant residues served as coontrol.

In an other provocative experiments under glasshouse conditions systemic hosts of Óbuda pepper virus (ObPV) were treated weekly with the donor plant extracts mentioned above (see 2.1. chapter above) from their 2-4 leaf stages (BBCH: 12-14) until the end of experiments. At the same time recipient plants were mechanically inoculated with ObPV. The plant's reactions on virus infection were evaluated by DAS ELISA serological tests were used after Clark and Adams (1977) five weeks from the beginning of the experiments. At the same time shoot fresh weight of the recipient plants was also determined.

## 3 RESULTS AND DISCUSSION

### 3.1 Bioassay experiments

It is generally believed that the inhibitory effect of plant extracts made with the use of organic solvents are stronger, as compared to that of water solutions (Figure 1). Generally under field conditions the rainfall can dissolve effectively the inhibitory plant extracts from the shoots (Béres, 2011).

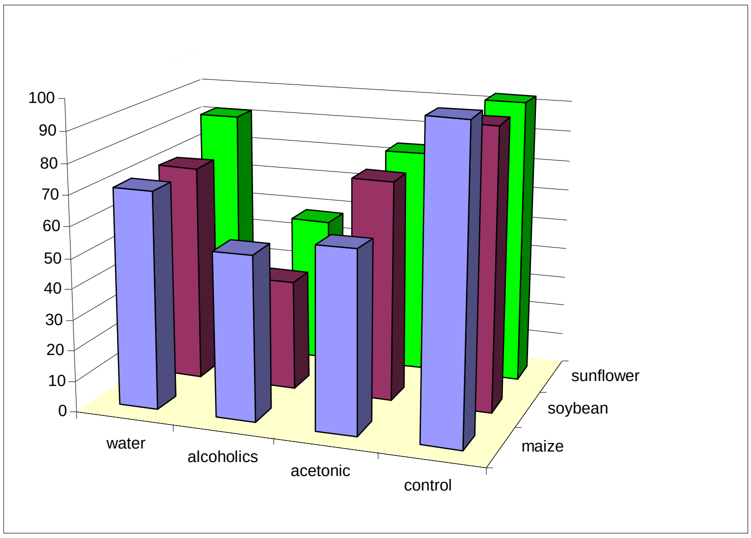
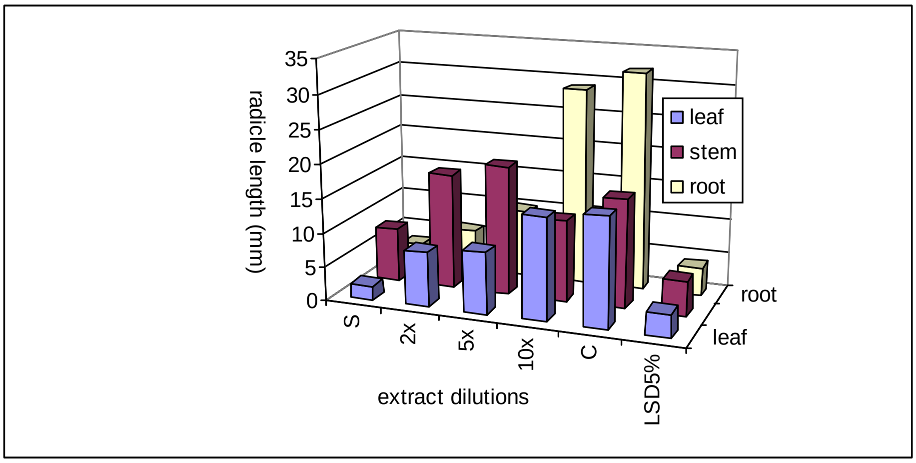



Figure 1: The effect of different extracts from *A. artemisiifolia* leaves on the germination of some crops in laboratory bioassay studies (after Béres *et al.*, 2002)





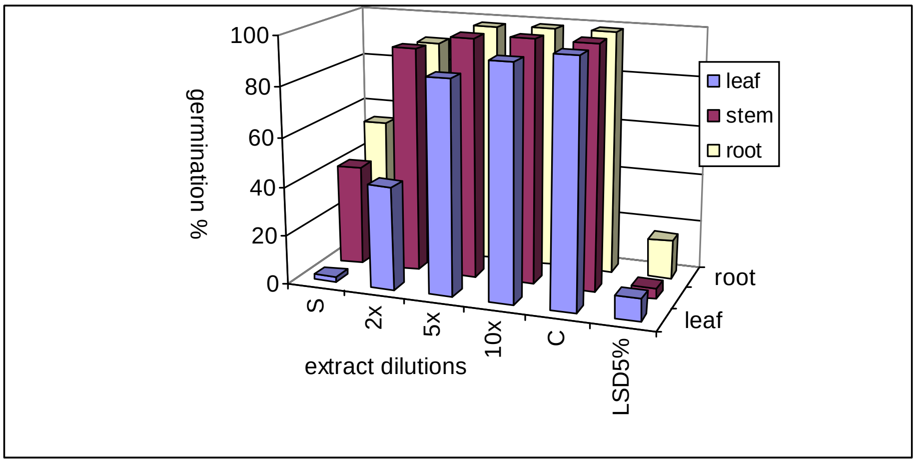




Figure 2: The effect of *Asclepias syriaca* water extracts on the radicle length (above) and germination % (down) of *Lepidium sativum* (S, stock solution; 2x=two-fold dilution; 5x=five-fold dilution; 10x=ten-fold dilution; C=control)

It is generally believed that inhibitory effect on radicle length is stronger, than that on germination. Beside this, the different plant parts (root, shoot, stem) also influenced the reaction of test plants (Figure 2).

## 3.2 Pot experiments

Based on the results of some experiments the effect of inhibitors on the growth of the test plants was stronger, than that on virus concentration. No correlations between inhibitory effect on the plant growth and virus concentrations could be observed (Figure 3).

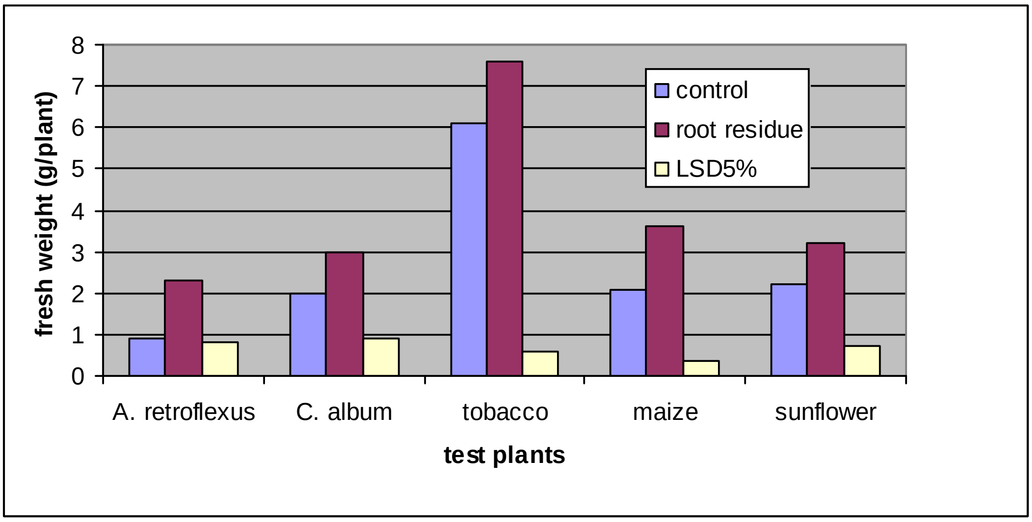





Figure 3: The effect of root residues of *Asclepias syriaca* on the biomass production of test plants

Water extracts which significantly retarded the biomass production of the test plants, did not influence considerably virus concentration and the opposite was also true: plant extracts with virus inhibitory effect did not influence significantly the growth of the test plants. e.g. *A. syriaca* root extract significantly reduced ObPV concentration in systemic host plants, but did not influence their fresh weight (Kazinczi *et al*., 2005a,b). Nevertheless significant growth reduction was observed with other test plants due to the *A. syriaca* root residues (Kazinczi *et al*., 1999) (Figure 3).

## 4 CONCLUSIONS

Based of our allelopathic research of some years (Mikulás *et al*., 1990, Kazinczi *et al*., 1991, 1997, 1999, 2001a,b, 2004a,b, 2005a,b 2007; Hunyadi *et al*., 1998; Béres-Kazinczi 2000; Béres *et al*., 2002; Suma *et al*., 2002 Horváth *et al*., 2006; Buzsáki *et al*., 2008) we can conclude the followings:

- Inhibitory effect of organic dissolvent plant extracts are generally stronger than that of water extracts. In bioassay laboratory experiments a dose –response relationship study is necessary, because the stronger inhibitory effect of the higher concentration extracts may be due not only to allelopathy but to the increased osmotic potential as well. In bioassays, inhibitory effect on seedling growth are generally stronger than that on germination rate.
- Inhibitory effect of allelochemicals greatly depends on donor, recipient (test) species, plant parts, the age of plant parts (living, dead), concentration and type of the dissolvents (water, organic) and physiological target process observed.

- Bioassay, pot and field experiments generally give different results, suggesting that allelochemicals can be destroyed due to the biological decomposition with the time. Therefore it is believed that in fields rather competition than allelopathy plays a greater role in plant-plant interactions.
- Today the term allelopathy has been extended, including not only plant-plant but – among others - plant-microorganism interactions also.
- An internationally excepted uniform standard method would be essential for allelopathic studies.
- Allelopathy has considerable reserves for the agricultural practice which can be well fit into the integrated weed management systems.
- Inverse (promoting) effect of allelochemicals on some invasive plants (e.g. *Ambrosia artemisiifolia*) may have a potential to promote the weed's dominance under field conditions (Kazinczi *et al*., 2008).

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