COMPETITION BETWEEN CROPS AND WEEDS IN ADDITIVE EXPERIMENTS

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ABSTRACT

Small plot experiments were set up in order to study the effect of velvetleaf (*Abutilon theophrasti*) and Jimsonweed (*Datura stramonium*) density (1, 2, 5 and 10 plants m^{-2}) on sunflower and maize yield, respectively. It was concluded that competition between *A. theophrasti* and sunflower was not considerable, not even at the highest weed density**.** Slight (4-7 %), no significant yield losses were observed in sunflower due to 1-10 *A. theophrasti* m^{-2}**.** *A. theophrasti* decreased significantly maize yield (by 15 %), only at a weed density of 2 individuals m^{-2}**.** Competitive ability of *D. stramonium* was much more stronger. Increasing density of *D. stramonium* the maize yield proportionally decreased. *D. stramonium* at densities of 1, 2, 5 and 10 plant m^{-2} caused 31, 43, 59 and 63 % reduction in maize yield, respectively. It is believed that sunflower had stronger competitive ability than maize, while *D. stramonium* had a stronger competitive ability than *A. theophrasti*.

Key words: competitive ability, additive experiments, crops, weeds

1 INTRODUCTION

Competition is considered as a type of interference among higher plants (Harper, 1977). Under field conditions a lot of environmental factors can influence interspecific competition between crops and weeds (Bleasdale, 1960). Most competition studies in agriculture are based on the additive experiments, where two species are grown together. The density of a crop is maintained constant and that of weed species is changed. Additive experiments are commonly used to establish the economic thresholds in a crop. Additive designs are suitable for determination of weed cost in terms of yield loss, and to know what weed(s) is(are) most competitive in a particular crop, or what is the effect of a management practice (Zimdahl, 2004).

The origin of velvetleaf (*Abutilon theophrasti* Medik.) is in China and Tibet. It is widespread in Asia, Balkan countires, North Africa, South and North America and Australia (Holm *et al.*, 1991). It is a principal weed in Canada and USA and causes major yield losses in soybean and cotton (Eaton *et al.* 1976; Oliver, 1979). Its intensive spreading started in Hungary from the middle of the seventies. At present it is among the 20 most important weeds of maize in Hungary (Novák *et al.*, 2009). The centre of genetic diversity for Jimsonweed (*Datura stramonium* L.) is in America. It can cause long term problems for farmers when it appears. Due to its agressive growth and population expansion it can entirely inhibit the growth of crops. Based on the results of National Weed Surveys in Hungary, *D. stramonium* was

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considered to be an important weed species with more than 1 cover percent even 12 years ago and its importance did not change significantly in the last decade (Novák ***et al.***, 2009).
The aim of our investigations was to study the interaction between crops and weeds (***A. theophrasti, D. stramonium***) in additive experiments under field conditions.

2 MATERIALS AND METHODS

Small plot (33 m^2) experiments in randomized blocks in three replicates were set up on Ramann brown forest soil with clay illuvation, on the western part of Hungary (Keszthely) in spring of 2008 year. Maize and sunflower seeds were sown at the end of April.

The following treatments were applied (Figure 1):

1. untreated weedy control
2. weed-free control
3. *A. theophrasti/D. stramonium* one plant m^{-2}
4. *A. theoprasti/D. stramonium* 2 plants m^{-2}
5. *A. theophrasti/D. stramonium* 5 plants m^{-2}
6. *A. theophrasti/D. stramonium* 10 plants m^{-2}

Hand hoeing was continiously applied to maintain weed-free control plots. Pots of the treatments 3 to 6 were kept free from weed species – except *A. theophrasti* and *D. stramonium* – and weed density was continiously checked. At the time of harvest the crop yield was calculated to the 14 and 8 % wet content for maize grain and sunflower achenes, respectively. Analysis of variance was used to evaluate the results statistically with an error of 5 %.

Figure 1: Weed densities of *D. stramonium* in maize (upper left: 1 weed individual m^{-2}; upper right: 2 weed individuals m^{-2}; down left: 5 weed individuals m^{-2}; down right: 10 weed individuals m^{-2}).

3 RESULTS AND DISCUSSIONS

Highest yield loss occurred on weedy control plots both in sunflower and maize crops (Figure 2, 3).
Increasing density of *D. stramonium* the maize yield proportionally decreased. The yield of maize was decreased by 31, 43, 59 and 63 % at weed densities of 1, 2, 5 and 10 plants m^{-2} of *D. stramonium*, respectively as compared to weed-free control (Figure 2).

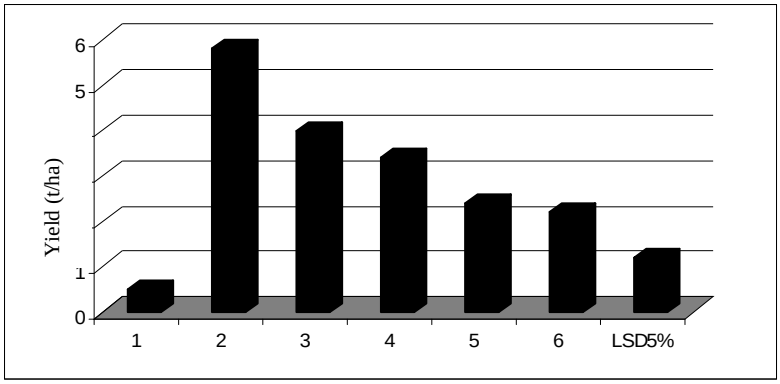

Figure 2. The effect of *D. stramonium* on yield of maize (1. weedy control; 2. weed-free control; 3. 1 weed individual m^{-2}; 4. 2 weed individuals m^{-2}; 5. 5 weed individuals m^{-2}; 6. 10 weed individuals m^{-2})

Slight (4-7 %), no significant yield losses were observed in sunflower due to 1-10 *A. theophrasti* m^{-2}**.** *A. theophrasti* decreased significantly maize yield (by 15 %), only at a weed density of 2 individuals m^{-2} (Figure 3.).

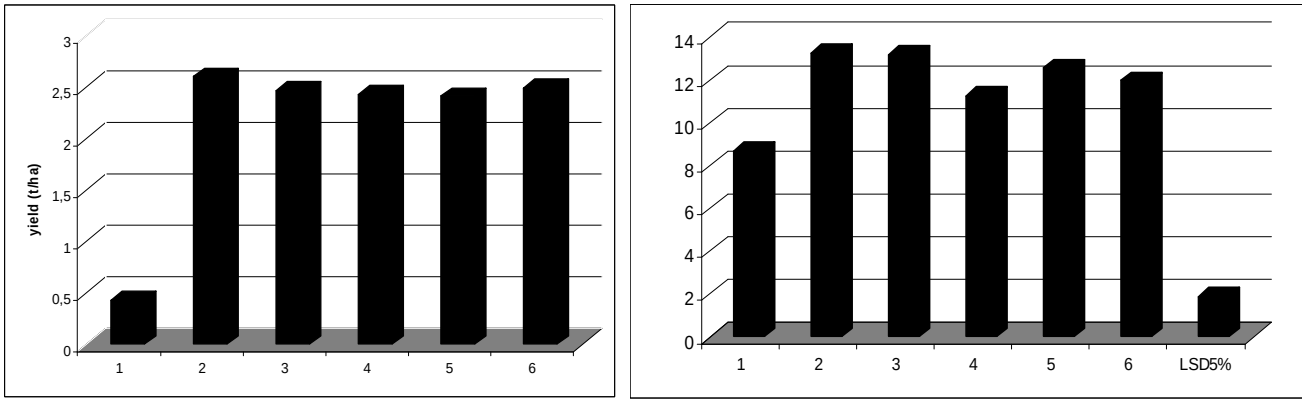

Figure 3. The effect of *A. theophrasti* on yield of sunflower (left) and maize (right) (1. weedy control; 2. weed-free control; 3. 1 weed individual m^{-2}; 4. 2 weed individuals m^{-2}; 5. 5 weed individuals m^{-2}; 6. 10 weed individuals m^{-2}).

4 CONCLUSIONS

Based on the results of experiments it is believed that sunflower had stronger competitive ability than maize, while *D. stramonium* had a stronger competitive ability than *A. theophrasti*.
Based on similar additive experiments carried out in maize the weed species followed the order according to their agressivity: *Xanthium italicum* > *D. stramonium* > *Ambrosia artemisiifolia* > *A. theophrasti*. *X. italicum* seemed to cause the highest yield losses. When one individual occurred for a squre metre 90 % yield loss happened. Competitive ability of *A.*

theophrasti was the lowest, because this species caused only slight yield losses as compared to other weed species (Kovács *et al.,* 2006). At higher weed densities strong intraspecific competition was observed with species of *A. theophrasti* and *A. artemisiifolia* which was stronger than competition between maize and weeds (Kazinczi *et al.,* 2007, 2009a,b).
It is considered that beside weed density, other factors, such as relative leaf area, relative emergence time may be also important influencing crop yield. Results of different years and locations may differ due to the different climatic an edaphic conditions even inside in similar experiments (Kropff and Spitters, 1991; Varga, 2000).

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