CROP - WEED COMPETITION BETWEEN MAIZE (*ZEA MAYS* L.) AND *CONVOLVULUS ARVENSIS* L. IN SUBSTITUTIVE EXPERIMENTS

G. KAZINCZI[1] – J. HORVÁTH[2] – A. TAKÁCS[1] – M. NÁDASY[2]

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

Introduction

The main characteristic of a substitutive expriment is that the proportions of two species in mixture are varied while the overall densitiy the two species is maintained constant – a replacement series (de Wit 1960). *Convolvulus arvensis* is a vining perennial plant with adventitious buds on its root sytem, reproducing both vegetatively and to a lesser extent by seeds. *C. arvensis* is one of the most serious weeds infesting 32 crops in 44 countries, and it is listed as one among the 10 most serious weeds in the world. In Hungary, *C. arvensis* is considered to be the fifth most important weed in maize, although its percentage cover has decreased to previous years.
In our experiments competition between maize and *C. arvensis* was studied in a replacement studies.

Methods

Pot experiments under glasshouse conditions were set up in order to study crop-weed competition in a replacement studies. Plastic pots (45 cm in diameter) were filled with a soil mixure of sand (pH, 6.96, humus, 0.7 %): peat (pH, 6.78, humus,9.98 %) in a ratio of 1:1 in spring of 2004 year. Seeds of maize and *C. arvensis* were sown in pots. The following treatments (each in four replicates) were applied:

a, maize 100% (6 plants pot^{-1})
b, maize 66.6% (4 plants pot^{-1}) + *C. arvensis* 33.3% (2 plants pot^{-1})
c, maize 33.3% (2 plants pot^{-1}) + *C. arvensis* 66.6% (4 plants pot^{-1})
d, *C. arvensis* 100% (6 plants pot^{-1})

Sixty eight days after sowing dry weight of shoots and roots were measured and NPK content was also determined. The nitrogen (N), phosphorus (P) and potassium (K) content was determined after destruction with sulphuric acid by a photometer. K content was determined by a flame photometer.

DOI: 10.1556/CRC.34.2006.1.135

Results and discussions

Intraspecific competition between maize plants was strong, because biomass production considerably enhanced, as maize proportion decreased in the mixtures. It was well expressed both in the enhanced root and shoot dry weight. Opposite to this, the biomass production of *C. arvensis* was the highest, when plants were grown alone in pots. When *C. arvensis* and maize were grown together in pots, considerable reduction in shoot and root dry weight of *C. arvensis* had been observed (Fig.1).

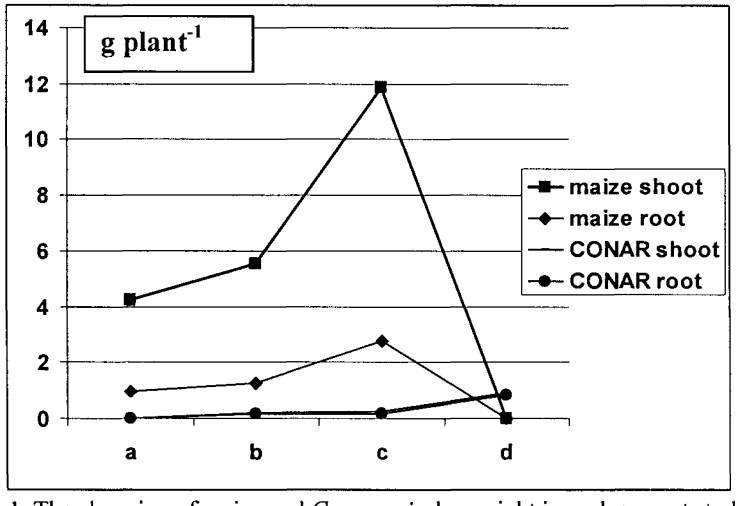

Fig.1. The changing of maize and *C. arvensis* dry weight in replacement studies. Maize:CONAR proportion (**a**, 6:0; **b**, 4:2; **c**, 2:4; **d**, 0:6)

Shoot:root ratio of plants did not change considerably in mixures, but was four times higher in maize plants, as compared to that of *C. arvensis* (4.35:1, 4.35:1, 4.27:1 for maize and 1.33:1, 1.63:1, 1.11:1 for *C. arvensis* by **a, b, c** and **d** treatments, respectively). It confirms the statement of Weaver and Riley (1982), suggesting that competitive abiliy of *C. arvensis* is due largely to its extensive root system, whreby competition for water and nutrients is especially intense.

The changing of NPK content of maize and *C. arvensis* can be seen in Tab. 1-3. Higher changes in NPK content of *C. arvensis* shoots and roots had been observed as the proportion varied in the mixtures, as compared to those of maize. Maize contributed to a greater extent to the total NPK content of plants in a pot, than *C. arvensis*. It can be explained by the higher biomass production of maize. Its whole biomass production in a pot more or less remained constant, indepedently of proportion in the mixtures. Oppostite to this, the higher the *C. arvensis* proportion the greater its biomass production (Fig.2).

Tab. 1. The changing in N content of plants

	N(%)				N (g pot^{-1})				Total N (g pot^{-1})
Treat-ments	Maize		*C. arvensis*		Maize		*C. arvensis*		
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	
a	2.25	2.07	-	-	0.57	0.12	-	-	0.69
b	2.36	2.13	3.79	4.06	0.52	0.10	0.015	0.01	0.645
c	2.14	2.41	3.32	3.77	0.51	0.13	0.03	0.02	0.69
d	-	-	3.78	2.55	-	-	0.21	0.13	0.34
$LSD_{5\%}$	0.34	0.59	0.351	0.12	0.096	0.037	0.032	0.015	

Maize:CONAR proportion (**a**, 6:0; **b**, 4:2; **c**, 2:4; **d**, 0:6)

Tab. 2. The changing in P content of plants

	P(%)				P (g pot^{-1})				Total P (g pot^{-1})
Treat-ments	Maize		*C. arvensis*		Maize		*C. arvensis*		
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	
a	0.22	0.16	-	-	0.055	0.009	-	-	0.064
b	0.2	0.12	0.15	0.14	0.043	0.006	0.0006	0.0004	0.05
c	0.13	0.16	0.20	0.19	0.036	0.0088	0.002	0.0011	0.047
d	-	-	0.27	0.17	-	-	0.015	0.009	0.024
$LSD_{5\%}$	0.057	0.006	0.04	0.023	0.013	0.001	0.003	0.001	

Maize:CONAR proportion (**a**, 6:0; **b**, 4:2; **c**, 2:4; **d**, 0:6)

Tab. 3. The changing in K content of plants

	K(%)				K (g pot^{-1})				Total K (g pot^{-1})
Treat-ments	Maize		*C. arvensis*		Maize		*C. arvensis*		
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	
a	3.73	1.84	-	-	0.95	0.1	-	-	1.05
b	3.30	1.52	2.8	2.40	0.73	0.076	0.011	0.007	0.824
c	3.36	2.08	3.61	1.93	0.79	0.11	0.037	0.012	0.949
d	-	-	4.52	2.20	-	-	0.25	0.11	0.360
$LSD_{5\%}$	0.78	0.55	0.117	0.173	0.15	0.025	0.014	0.012	

Maize:CONAR proportion (**a**, 6:0; **b**, 4:2; **c**, 2:4; **d**, 0:6)

Conclusions

Higher biomass production of maize suggests, that its development is faster at the beginning of vegetation period, therefore maize has better competitive ability in maize - *C. arvensis* mixtures in the early competition as compared to *C. arvensis*. More detailed and exact conclusions could be obtained from field competition studies (plot experiments), where the development of plants could be observed during the whole vegetation period (Hadi 2004, Pakurar et al. 2004). From the results of replacement studies different competition indexes can be also calculated. On the basis of these values the competitive ability of different plant species can be easily compared (Harper 1977).

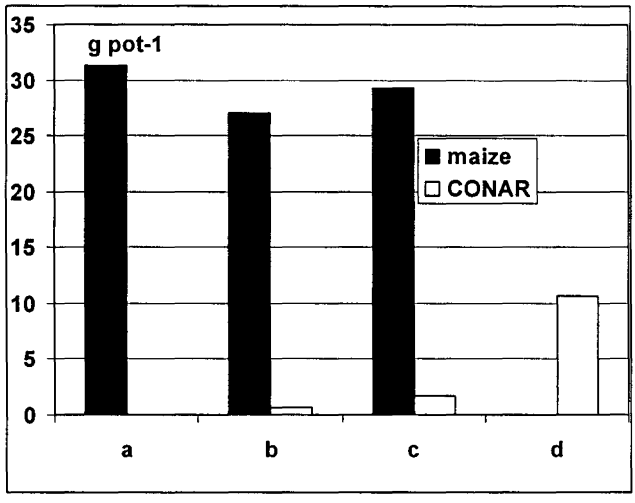

Fig. 2. Biomass production of maize and *C. arvensis* in substitutive experiments Maize:CONAR proportion (**a**, 6:0; **b**, 4:2; **c**, 2:4; **d**, 0:6)

Acknowledgements
Authors wish to express their thank the National Research Found (Project No. T049093) for their financial help.

References

de Wit, C.T. 1960. On competition. Verslag Landbouwkundige Onderzoek 66, 1-82.
Hadi, G. 2004. Effect of the length of the kernel filling period and the kernel filling rate ont he grain yield of maize under different water supply conditions. Cereal Research Commun. 32, 465-470.
Harper, J.L. 1977. Population Biology of Plants. Academic Press, London, 892pp.
Pakurar, M., Nagy J., Jagendorf, S. and Farkas, I. 2004. Fertilisation and irrigation effects on maize (*Zea mays* L.) grain production. Cereal Res. Commun. 32, 151-158.
Weaver, S.E. and Riley, W.R. 1982. The biology of Canadian weeds. 53. *Convolvulus arvensis* L. Can. J. Plant Sci. 62, 461-472.