Research Journal of Agricultural Science, 43 (2), 2011

CONTROLLING *CONVOLVULUS ARVENSIS* L. IN GRAIN MAIZE AND WINTER WHEAT IN BANAT (ROMANIA)

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Abstract: *In this paper we show the efficacy of controlling the weed species Convolvulus arvensis L., popularly called field bindweed, in grain maize and winter wheat, using a diversified range of post-emergent herbicides. The scientific research starts with a description of the general aspects of weed control in grain maize and winter wheat in general, and of Convolvulus arvensis L., in particular, a species considered a weed problem for crops. In our research, we have tested 7 herbicides controlling weeds in grain maize and winter wheat in general, and Convolvulus arvensis L., in particular. As a result of our research, w have obtained results concerning the total number of weeds/m^2 in the control variant in grain maize and winter wheat and the share percentage, as well as results concerning grain maize yield in q/ha in both control and treated variants. We have noted 15 weed species in grain maize and winter wheat, i.e. 238 weeds/m^2 in grain maize and 62 weeds/m^2 in winter wheat, while field bindweed was represented by 23.3 plants/m^2 and 13.11 plants/m^2, respectively. We can see that, as far as exclusive control of the species Convolvulus arvensis L. is concerned, the best results were in the variants treated with Buctril Universal (0.8-1 l/ha), with a control percentage of 85.97%, while the highest yields in grain maize were recorded in the variants treated with Buctril Universal (0.8-1 l/ha), with yields of de 81.48 q/ha.*

Key words: *field bindweed, weed, herbicide, grain maize, winter wheat.*

INTRODUCTION

Maize is one of the crops with multiple uses among which feed – not only as grains or silage, but also as fresh or fermented green fodder. In such cases, we speak of green maize fodder, i.e. silage maize. Using dried stems after harvesting the maize is an old practice in Romania, where it is used as feed for cattle and sheep in winter (BAICU 1988). Starting with the middle of the 20th century, these stems are cut and mixed with molasses water and ensilaged, and fed to the animals.

Maize is a plant with a fasciculate root system, well developed and made up of adventives roots. The stem, that can reach 250-400 cm, is made up of 7-15 internodes. The leaves are 50-80 cm long and up to 15 cm wide, alternatively set on the stem. It is a monoic unisexuate plant: the male inflorescence (panicle) is on the tip of the plant while female inflorescence (spadix) is at the leaves basis (CIOCÂRLAN et al. 2004).

From the point of view of the fodder, it is important that the leaves represent a large share and that the plant be tall. The best suited from this point of view are late hybrids. The other hybrids are used only if there are restrictions of vegetation duration.

In the cereal economy of Romania, maize ranks first, with the largest share of the total yield, though the area cultivated shares only 49-52% of the total area cultivated with cereals. Due to its good behaviour as monoculture for several years in a row, maize can be cultivated in the most favourable areas.

There are, between weeds, soil type, pre-emergent crop, climate, water table, and cultivation technology, certain relationships that, if cumulated, have an impact on the level and quality of the agricultural production.

Winter wheat is among the oldest crops: it is used to make "our daily bread" by more than half of the world's population. It has the most favourable ratio of carbohydrates and proteins, i.e. 6: 1. It is also used in industrial processing to obtain starch, dextrins, alcohol, or feed, and is important from an agricultural point of view.

Winter wheat shares the largest area worldwide, i.e. about 220,000,000 ha, with an average of 3,000 kg/ha.

In Romania, winter wheat has been cultivated lately on an area that has oscillated between 2,000,000 and 3,000,000 ha in 2006, and above 2,000,000 ha in 2005, with an average yield of about 2,400 kg/ha in 2005 and of about 3,000 kg/ha in 2004. Yield was very much influenced by climate.

The particular importance of winter wheat, as well as its distribution in over 100 countries of the world, has resulted in numerous researches in time and all over the world.

One of the most important aspects in winter wheat is weed control, in general, and problem weeds, in particular.

In this paper we present details concerning weed control in general, and the control of *Convolvulus arvensis* L., popularly called field bindweed (BERCA, 2004).

Convolvulus arvensis L. is a species native from Europe and Asia. Is belongs to the Family Convolvulaceae (NAGY et al. 2002, CIOCÂRLAN et al. 2004).

The Family Convolvulaceae covers plants with voluble stems, grassy or woody lianas, often with tuberised roots. The leaves, simple, whole or lobate without stipels, are alternate (KELLY 1999). The flowers, solitary or grouped in cymous or racemous inflorescences, are bisexuate, actinomorphous, of the type 5 (CIOCÂRLAN et al. 2004). The perianth is made up of 5 free or united sepals and a corolla made up of 5 united petals. The androecium has 5 stamens on the corolla, with a nectariferous intra-stamen disc. The sincarpous upper gynaecium comes from 2-5 carpels. The fruit is a capsule (SARPE et al. 1998).

It was introduced to North America where, here and there, is an invasive species. The covers it makes up invade the crops and decrease the yield; they estimate losses caused by this plant in the U.S.A. are above 377,000,000 US$ in 1998 alone (BERCA, 2004).

Though it produces attractive flowers, it is often considered a weed because it growth rapidly and it suffocates the crops (BAICU, 1988).

In Romania, it is found everywhere, on all soils, and particularly on warm, drier, light and permeable soils, on road sides, in vegetable gardens, where it suffocates young seedlings, in nurseries and plantations, where it clings on shrubs. In ornamental gardens, it clings to roses and other decorative plants. On loose grassy soles, it clings to gramineae and hinders their growth (IONESCU SISEȘTI, 1955).

It is a mesophilous plant drought-resistant due to its deep root system, but it cannot stand frost. It is a very damaging weed for crops (SCHALLER, 1993).

Field bindweed is a non-parasitic perennial weed that multiplies rapidly vegetatively.

The corm and aerial parts of field bindweed, called *herba convolvuli*, have medicinal properties (BERCA, 2004).

In time, they have been extremely successful in controlling weeds in maize due particularly to the synthesis and use of new herbicides (MANEA, 2006).

The research presented in this paper aimed mainly at establishing the most efficient ways of controlling chemically the problem weed *Convolvulus arvensis* L. in grain maize with direct effects on yield results.

MATERIAL AND METHODS

The winter wheat cultivar we have used in our experiment was Lovrin 50, developed at the SCA Lovrin and homologated in 1996 to be cultivated in the plain area of western and southern Romania, while the grain maize hybrid we used in the experiment was DKC-5143, a hybrid developed by Monsanto, a semi-late hybrid homologated in 2005, and recommended for cultivation particularly in the Western Plain and in southern and south-eastern Romania, with good results. With a wide genetic base, it has a high ecological plasticity, yielding much and constantly (11-14 t/ha), even in particular climate conditions.

Research was carried out in 2009 and 2010 on the experimental field of the Department of Herbology of the Didactic Station in Timişoara, where we tested 7 post-emergent herbicides in the control of field bindweed in grain maize and 11 herbicides in the control of the same weed in winter wheat.

Chemical control of field bindweed is done with herbicides that are selective for certain crops. In Romania, the species *Convolvulus arvensis* L. has expanded very much lately; its quick expansion was caused mainly by the lack of crop rotation and to repeated application of selective herbicides.

In this context, our goal was to determine the efficacy of controlling field bindweed in grain maize and winter wheat using a diversified range of post-emergent herbicides.

Taking into account the fact that he two species are weedened every year by a large number of monocot weeds and that we need to appreciate more accurately the effect of post-emergent herbicides on the plants of *Convolvulus arvensis* L., we applied, before the plant sprouted, the pre-emergent herbicides Guardian (Acetoclor 900 g/l).

We also monitored the effect of controlling weeds on yield level in grain maize and winter wheat.

In order to establish the efficacy of herbicides in controlling field bindweed in grain maize and winter wheat, we set a monofactorial field experiment after the randomised block method with four replicates, each harvestable variant measuring 105 m^2 with a total area of 4,200 m^2.

We mapped weeds *through the quantitative numerical method) to find out the initial weeding degree in the control variant and later, 20 days after applying herbicides, during vegetation, to assess the results of weed control, in general, and of field bindweed, in particular. During the entire period of vegetation of both crops, after applying herbicides, we made measurements concerning the selectivity of the tested products on grain maize and winter wheat plants.

We monitored the following parameters:

- the selectivity of the tested herbicides in grain maize and winter wheat;
- the efficacy of controlling the perennial weed *Convolvulus arvensis* L. in grain maize and winter wheat of 7 herbicides (Table 1) applied during vegetation, when field bindweed was 10-15 cm and grain maize had 3-5 leaves, at an air temperature of 15ºC;
- grain maize yield in q/ha in the control variant and in the treated variants;
- winter wheat yield in q/ha in the control variant and in the treated variants;
- the control degree of the species *Convolvulus arvensis* L. in %: readings were made 15 days after treatment and weed control in winter wheat was assessed according to the EWRS scale.

Table 1.

Experimental variants in grain maize

Variant	Active substance	Rate l (kg/ha)	Period of application
V_1-Not treated	-	-	-
V_2-Banvel 480 S	Dicamba 80 g/l	0.6 l/ha	Early post-emergent
V_3-Buctril Universal	Bromoxinil 280 g/l + 280 g/l acid 2,4D	0.8-1 l/ha	Early post-emergent
V_4-Cambio	Bentazon 320 g/l + dicamba 90 g/l	2-2.5 l/ha	Early post-emergent
V_5-Dialen super	Dicamba 120 g/l + 2,4 D 344 g/l	0.9 l/ha	Early post-emergent
V_6-Mustang	Florasulam 6.25 g/l + 300 g/l acid 2,4 D EHE (2-ethylhexil – ester)	0.4-0.6 l/ha	Early post-emergent
V_{7-} Patrol	Dicamba 300 g/l	1 l/ha	Early post-emergent
V_8-SDMA Super	600 g/l acid 2,4 D	1 l/ha	Early post-emergent

The experimental variants in winter wheat were as follows:

V_1 – control (not treated);

V_2 – Rival Star 75 PU (Tribenuron – methyl: 75%) – 20 g/ha.

V_3 – Damine (Acid 2,4D from dimethyl amine salt: 600 g/l) – 1 l/ha.

V_4 – Lintur 70WG (Triasulfuron: 4.1% + Dicamba: 65.9%) – 150 g/ha.

V_5 – Sekator (Amidosulfuron: 5% + Iodosulfuron-metil Na: 1.25%) – 300 g/ha.

V_6 – Buctril Universal (Bomoxinil: 280gr/l + Acid 2,4D: 280 g/l) – 1 l/ha.

V_7 – Aril super (Acid 2,4D: 28% + Dicamba: 10%) – 1 l/ha.

V_8 – Tomigan 250 EC (Fluroxipin: 250 g/l) – 0.5 l/ha.

V_9 – Banvel 480 S (Dicamba 480 g/l) – 0.6 l/ha.

V_{10} – Mustang (Florasulam: 6.25 g/l + Acid 2,4D: 300 g/l) – 0.5 l/ha.

V_{11} – Lancet RV (Fluroxipir: 80 g/l + Acid 2,4D: 450 g/l) – 1 l/ha.

V_{12} – Dialen super 464 SL (Dicamba 120 g/l + 344 g/l acid 2,4D) – 0.9 l/ha.

In this paper, we present average results concerning the efficacy of weed control in grain maize and winter wheat, in general, and of *Convolvulus arvensis* L., in particular.

RESULTS AND DISCUSSIONS

After mapping the weeds in the control variant (V_1 – not treated), we could measure, on the average, a weeding degree of 238 weeds/m^2, belonging to 15 different species. Data in Table 2 show that the species Convolvulus *arvensis* L. was represented by 23.3 plants/m², with a share percentage of 7.17% in grain maize and by 13.11 plants/m², with a share percentage of 17.96% in winter wheat.

Table 2.

Mean of number of weeds in the variant not treated in grain maize and winter wheat

Weed species	Mean of the number of weeds/m^2		% share		Botanical class
	grain maize	winter wheat	grain maize	winter wheat	
Amaranthus retroflexus	27.4	-	10.43	-	A.d.
Chenopodium album	29.1	-	11.35		A.d.
Cirsium arvense	8.07	1.95	3.79	2.01	P.d.
Convolvulus arvensis	**23.3**	**13.11**	**7.17**	**17.96**	**P.d.**
Cynodon dactylon	1.6	-	0.92	-	P.m.
Hibiscus trionum	12.9	-	4.25	-	A.d.
Lamium purpureum	-	11.13	-	15.90	A.d.
Papaver rhoeas	-	0.30	-	0.38	A.d.
Rubus caesius	4.2	4.69	1.58	6.03	P.d.
Setaria glauca	86.4	-	30.64	-	A.m.
Sorghum halepense	45.2	-	16.02	-	P.m.
Stachys annua	-	2.47	-	4.50	A.d.
Stellaria media	-	15.48	-	22.63	A.d.
Veronica hederifolia	-	13.20	-	18.49	A.d.
	238.0	**62.00**	**100**	**100**	

A.d. = annual dicots; P.d. = perennial dicots; A.m. = annual monocots; P.m. = perennial monocots

Table 2 shows that in the control variant there were 238.0 weeds/m^2 in grain maize, of which 23.3 plants/m^2 represent *Convolvulus arvensis* L., with a share percentage of 7.17%, and in the control variant in winter wheat there were 62.00 weeds/m^2 of which 13.11 plants/m^2 represent *Convolvulus arvensis* L., with a percentage share of 17.96%.

Table 3 shows that the total control percentage ranges between 57.36% in the variants treated with Tomigan 250 EC (0.5 l/ha) and 96.81% in the variants treated with Dialen Super 464 SL (0.9 l/ha). The variants in which the control degree was above 90% are as follows: Dialen Super 464 SL (0.9 l/ha) 96.81%, Bavel 480 S (1 l/ha) 96.54%, Aril Super (1 l/ha) 96.40%, Lancet RV (1 l/ha) 92.44%, Rival Super Star 75PU (20 g/ha) 91.85% and Bucril Universal (1 l/ha) 91.25%. The lowest weed control degree was when the crop was treated with

Mustang (0.1 l/ha) 65.75%, Damine (1 l/ha) 64.01% and Tomigan 250 EC (0.5 l/ha) 57.36% (Table 3).

Figure 1. Weeding degree in the variant v_1 (not treated)

Table 3.

Weed control degree in winter wheat

Herbicide	Rate	Weed control EWRS grades	Number of weeds controlled	Control percentage		Significance of the difference
				Total	*Convolvulus arvensis* L.	
v_{12}-Dialen Super 464 SL	0.9 l/ha	4	74.55	96.81	91.90	***
v_9-Bavel 480 S	1 l/ha	4	74.34	96.54	91.25	***
v_7-Aril Super	1 l/ha	4	74.23	96.40	93.52	***
v_{11}-Lancet RV	1 l/ha	4	71.18	92.44	76.60	***
v_2-Rival Super Star 75PU	20 g/ha	4	70.73	91.85	22.31	***
v_6-Buctril Universal	1 l/ha	5	70.27	91.25	95.87	***
v_5-Sekator	300 g/ha	5	65.13	84.58	25.73	***
v_4-Lintur 70WG	150 g/ha	5	59.72	77.55	61.70	***
v_{10}-Mustang	0.5 l/ha	6	50.32	65.35	63.23	***
v_3-Damine	1 l/ha	6	49.29	64.01	57.51	***
v_8-Tomigan 250 EC	0.5 l/ha	7	44.17	57.36	0.00	***
v_1-control (not treated)	-	9	Mt	0.00	0.00	-

$DL_{5\%}$ = 2.56 weeds/m² $DL_{1\%}$ = 4.16 weeds/m² $DL_{0.1\%}$ = 6.35 weeds/m²

As for the exclusion control of the species *Convolvulus arvensis* L., the best results were in the variants treated with Dialen Super 464 SL, Bavel 480 S, and Aril Super.

Data shown in Table 4 shows that the highest yields in grain maize were in the variants treated with Buctril Universal (1 l/ha), Dialen Super 464 SL (0.9 l/ha), with yields ranging between 81.48 q/ha and 76.33 q/ha, with very significantly positive differences compared to the field average, as well as in the variants treated with Dialen Super 464 SL and Bavel 480 S, with yields ranging between 76.33 q/ha and 74.11 q/ha. There was an insignificantly negative difference in the variant treated with Patrol, with yields reaching 22.17 q/ha.

Table 4.

Weed control degree in grain maize

Herbicide	Rate	Number of weeds controlled	Control percentage	
			Total	*Convolvulus arvensis* L.
V_3-Buctril Universal	0.8-1 l/ha	274.3	97.27	85.97
V_2-Bavel 480 S	0.6 l/ha	273.4	96.95	71.65
V_5-Dialen Super 464 SL	0.9 l/ha	273.1	96.84	70.35
V_7-Patrol	1 l/ha	271.2	96.17	63.52
V_8-SDMA Super	1 l/ha	212.7	75.42	55.73
V_4-Cambio	2- 2.5 l/ha	141.5	50.17	42.63
V_6-Mustang	0.4-0.6 l/ha	102.1	36.17	25.7
v_1-control (not treated)	-	Mt	0.00	0.00

The yields in which the difference compared to the mean of the field was insignificant were in the variants treated with Buctril Universal (1 l/ha), Rival Super Star 75PU (20 g/ha) and Sekator (300 g/ha). The variants treated with Lintur 70WG (150 g/ha), Mustang (0.5 l/ha), Damine (1 l/ha) or Tomigan 250 EC (0.5 l/ha) ensured lower yields compared to the mean of the field.

The lowest yield was recorded in the control variant (not treated), i.e. 32.00 q/ha, the difference compared to the mean of the field being very significantly negative (Table 5).

Table 5.

Experimental results concerning the mean yield in winter wheat

Herbicide	Rate	Absolute yield (q/ha)	Relative yield (%)	Difference in yield (q/ha)	Significance of the difference
v_7-Aril Super	1 l/ha	53.01	120.8	+9.13	xxx
v_9-Bavel 480 S	1 l/ha	52.43	119.4	+8.55	xxx
v_{12}-Dialen Super 464 SL	0.9 l/ha	51.08	116.4	+7.2	xxx
v_{11}-Lancet RV	1 l/ha	48.54	110.6	+4.66	x
v_6-Buctril Universal	1 l/ha	46.70	106.4	+2.82	-
v_2-Rival Super Star 75 PU	20 g/ha	45.05	102.6	+1.17	-
Mean	-	43.88	100.0	Mt	-
v_5-Sekator	300 g/ha	42.60	97.0	-1.82	-
v_4-Lintur 70WG	150 g/ha	40.16	91.5	-3.72	0
v_{10}-Mustang	0.5 l/ha	39.88	86.3	-4	0
v_3-Damine	1 l/ha	37.65	85.8	-6.23	0
v_8-Tomigan 250 EC	0.5 l/ha	37.44	85.3	-6.44	00
v_1-control (not treated)	-	32.00	72.92	-11.88	000

Table 6.

Experimental results concerning the mean yield in grain maize

Herbicide	Rate	Absolute yield (q/ha)	Relative yield (%)	Difference in yield (q/ha)	Significance of the difference
V_3-Buctril Universal	1 l/ha	81.48	144.75	+25.19	Xxx
V_5-Dialen Super 464 SL	0.9 l/ha	75.33	133.82	+19.04	Xxx
V_2-Bavel 480 S	0.6 l/ha	69.11	122.77	+12.82	Xxx
V_7- Patrol	1 l/ha	57.85	102.77	+1.56	-
Media	-	56.29	100.0	Mt	-
V_6-Mustang	0.4-0.6 l/ha	54.17	96.23	-2.12	-
V_4-Cambio	2-2.5 l/ha	51.44	91.38	-4.85	0
V_8-SDMA Super	1 l/ha	38.80	68.92	-17.49	000
v_1-control (not treated)	-	22.17	39.38	-34.12	000

$DL_{5\%}$ = 4.78 q/ha; $DL_{1\%}$ = 7.52 q/ha; $DL_{0.1\%}$ = 10.80 q/ha

The variants treated with Cambio (2.5 l/ha) and SDMA Super (1 l/ha) ensured lower yields compared to the mean of the field. The lowest yield was in the variant not treated (control), where yield reached 22.17 q/ha, the difference in yield compared to the mean of the field being very significantly negative.

CONCLUSIONS

Field bindweed is a rural, segetal, drought resistant weed with a wide ecological span. In Romania, it is present practically in all the crops, year after year, in all areas, and it is considered a problem-weed and one of the most damaging weed species.

The soil, a cambic chernozem, on which the experiments were set, has a good fertility and, at the same time, it has very good conditions for the growth and spread of field bindweed.

None of the pre-emergent herbicides had any effect whatsoever on the plants of *Convolvulus arvensis* L. sprouted from the roots.

None of the tested herbicides produced phyto-toxic effects on the grain maize hybrid.

In all the experimental variants, 30 days after treatment, and particularly 60 days after treatment, there was a trend in field bindweed sprouts to regenerate, but they no longer represented a serious competition for the plants of winter wheat and grain maize.

We initially identified a total number of 238 weeds/m^2 weeds in the control variant in grain maize and of 62 weeds/m^2 in winter wheat, of which *Convolvulus arvensis* L. shared 7.17%, i.e. 23.30 plants/m^2; in winter wheat, the share was 17.96, i.e. 13.11 weeds/m^2.

In all the variants treated with herbicides, 30 days after treatment and mainly 60 days after treatment, the plants of *Convolvulus arvensis* L. tended to regenerate shooting new sprouts, but they no longer represented a competition for winter wheat that almost reached maturity.

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