STRATEGIES OF CHEMICAL CONTROL OF THE SPECIES CONVULVULUS ARVENSIS L. IN GRAIN MAIZE

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Abstract: *This paper shows the efficacy of the control process of the species Convolvulus arvensis L., commonly called field bindweed, in maize, using a diversified range of post-emergent herbicides. Scientific research begins with the description of the general aspects of controlling weeds, in general, and the weed species Convulvulus arvensis L., in particular – a problem weed in crops, in general, and in maize, in particular. Within the trial, we tested 7 herbicides aiming at controlling weeds, in general, and the weed species Convulvulus arvensis L., in particular, in maize. As a result of our trials, we could point out the results concerning the total number of weeds/m^2 in the control (not treated) variant in maize, the efficacy of the tested herbicides in diminishing weeding degree, their selectivity to the cultivated maize hybrid cultivar, and maize yields in q/ha in both the control and treated variants. The authors identified, in maize, 11 species of weeds totalling 282 plants/m^2, of which 24.2 plants/m^2 were represented by field bindweed that shared 8.58% of the total weeds in maize. As for the exclusive control of the species Convolvulus arvensis L., the best results were in the variant treated with Buctril Universal (0.8-1 l/ha), the control percentage reached 85.97%, while the highest maize yield was also in the variant treated with Buctril Universal (0.8-1 l/ha), i.e. 81.48 q/ha.*

Keywords: *field bindweed, weed, herbicide, maize*

INTRODUCTION

At present, maize shares the most important share of agricultural crops in Romania; despite all this, mean yield is much below the biological potential of the cultivated hybrids. One of the reasons is the high weeding degree of maize crops and the high sensitivity of maize to weed presence, particularly during the first 5-6 weeks after sowing.

In general, areas cultivated with maize are strongly infested by annual and perennial monocot and dicot weeds, infestation that varies depending on specific climate and soil conditions, and on the cultivation technology practiced in time.

Maize is one of the most important crops in the world. The grains of this plant are used as food, in industry, and as feed. Maize grains are widely used in the alcohol, starch, dextrin, and glucose industry. From the germs, we extract high quality oil, much used in dietetic nutrition. Maize shares about 1.66 million tons (i.e. 3.7%) of the world production of edible vegetal oils. From 100 kg of maize grains we can get one of the following products: 77 kg of flour, 63 kg of starch, 71 kg of glucose, 50-60 kg of isomerose (inverted sugar manufactured on a large scale in Belgium, Holland, Germany, and England), or 44 l of alcohol. Maize embryos also produce 1.8-2.7 l of oil and 3.6 kg of grits. Maize grains are the most important concentrated feed for all animal species. According to F.A.O., 21% of the world maize production is sued as food, 72% are used as feed, and 7% are used in industry (IKERD 1993).

In the cereal economy of our country, maize shares the most important place: it shares the largest share of the total production, though the cultivated area represents about 49-52% of the area cultivated with cereals. Due to its ability of supporting monoculture along several years, maize can be cultivated in the most favourable areas.

There are, between weeds, soil types, pre-emergent crops, climate, water tables, and level of cultivation technology, certain relationships that, due to their cumulated impact, determine the level and quality of agricultural production.

Convolvulus arvensis L. is a weed species native from Europe and Asia; it belongs to the Family *Convulvulaceae* (NAGY et al. 2002, CIOCÂRLAN et al. 2004).

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

Field bindweed was introduced from North America where it is, here and there, an invasive species. The plant covers thus formed invade the crops and decrease yield; they estimate that losses caused by this plant in the U.S.A. are over 377 million U.S. dollars in 1998 alone (BERCA 2004).

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

In Romania, it grows everywhere, on all soil types, but particularly on warm and drier ones, light and permeable, along the roads, in vegetable gardens, where it suffocates younger plants, in nurseries and plantations, where it climbs the shrubs. In ornamental gardens, it climbs on roses and other decorative plants. On loosely grassy soles, it climbs on the grasses and hinders their growth (IONESCU SISEȘTI 1955).

It is a mesophilous plant that resists drought due to its deep root system, but it does not stand frost. It is a very damaging weed in crops (SCHALLER 1993).

Field bindweed is a perennial non-parasitic plant with strong vegetative multiplication.

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

Along the years, there have been significant progresses in the strategy of controlling weeds in maize, progresses engendered mainly by the synthesis and use of some new herbicides (MANEA, 2006).

Research presented in this paper aimed mainly at establishing the most efficient means of controlling chemically the problem weed species *Convolvulus arvensis* L. in maize with direct effects on yield.

MATERIALS AND METHODS

The maize hybrid we used in the trial was DKC-5143, a maize hybrid developed by Monsanto; it is a semi-late maize hybrid homologated in 2005 and recommended for cultivation particularly in the Western Plain, in Southern and South-Eastern Romania, where it has been cultivated with good results. Due to its wide genetic basis, it has a high ecological plasticity, yielding high, constant yields (11-14 t/ha) even in unusual climate conditions.

Research was carried out in 2010 on the experimental field of the Department of Weed Science of the Didactic Station in Timişoara, where we tested 7 post-emergent herbicides in the control of field bindweed in maize.

Chemical control is done with herbicides that are selective for certain crops. In Romania, the weed species *Convolvulus arvensis* L. has spread very much the latest years; the quick spreading of this weed in crops was caused particularly by the lack of crop rotation and by the repeated application of selective herbicides.

In this context, in this paper we present the efficacy of controlling field bindweed in maize using a wide range of post-emergent herbicides.

Taking into account the fact that maize is weedened each year by a large number of monocots and because we needed to assess as accurately as possible the effect of post-emergent herbicides on the plants of *Convolvulus arvensis* L., we applied the pre-emergent herbicide Guardian (Acetochloride 900 g/l) before maize sprouted.

We also monitored the effect of controlling weeds on yield level in maize.

In order to establish the efficacy of herbicides in the control of field bindweed in maize, we set in the field a monofactorial trial set after the randomised block method with four replicas, each harvestable variant measuring 105 m^2, with a total area of 4,200 m^2.

We mapped the weeds (through the numerical quantitative method) to find out the initial degree of weeding in the control variant and later, 20 days after the application of the herbicides during vegetation, to assess the results of total control of weeds in general, and of field bindweed, in particular. During maize vegetation, after applying herbicides, we made observations concerning the selectivity of the tested products on the maize plants.

We monitored the following aspects:

- the efficacy of 7 herbicides in the control of the perennial weed *Convolvulus arvensis* L. in maize (Table 1) applied during vegetation, when field bindweed measured 10-15 cm and maize had 3-5 leaves in an air temperature of over 15ºC;
- selectivity of tested herbicides to the cultivated maize hybrid;
- maize grain yield in q/ha in both control (not treated) and treated variants.

Table 1.

Trial variants

Variant	Active substance	Rate kg/ha	Time of application
V_1 –Control	-	-	-
V_2 – Banvel 480 S	dicamba 480 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

RESULTS AND DISCUSSIONS

After mapping weeds in the control variant (V_1 – not treated), we determined, on the average, a weeding degree of 282 weeds/m^2 belonging to 11 different weed species. Data presented in Table 2 show that the weed species *Convolvulus arvenis* L. reached 24.2 plants/m² sharing 8.58%.

Annual dicot species such as C*henopodium album*, *Amaranthus retroflexus*, *Hibiscus trionum* and *Xanthium strumarium* share 29.01%, while perennial dicot species such as *Convolvulus arvensis* L., *Rubus caesius* L. and *Cirsium arvense* shared 13.54% (Figure 1).

From the point of view of the number of weeds per m^2, monocot weeds counted 162 weeds/m², while dicots counted 120 weeds/m^2.

Compared to the number of weeds existing in the control variant (282 weeds/m^2), after applying the herbicides the number of weeds decreased with 102.1 weeds/$\mathbf{m^2}$ in the variant treated with Mustang (0.4-0.6 l/ha) to 274.3 weeds/$\mathbf{m^2}$ in the variant treated with Buctril universal (0.8-1.0 l/ha).

Table 2.

Number of weeds per species in the control variant in maize

Nr.	Species	Weeds/m^2	Share %	Botanical class
1.	*Setaria glauca*	86.4	30.64	a.m.
2.	*Sorghum halepense*	45.2	16.02	p.m.
3.	*Chenopodium album*	32.0	11.35	a.d.
4.	*Amaranthus retroflexus*	29.4	10.43	a.d.
5.	*Echinochloa crus-galli*	27.8	9.86	a.m.
6.	***Convolvulus arvensis L***	**24.2**	**8.58**	p.d.
7.	*Hibiscus trionum*	12.0	4.25	a.d.
8.	*Cirsium arvense*	10.7	3.79	p.d.
9.	*Xanthium strumarium*	8.4	2.98	a.d.
10.	*Rubus caesius*	3.3	1.17	p.d.
11.	*Cynodon dactylon*	2.6	0.92	p.m.
	Total	**282.0**	**100**	-

a.d.-annual dicots; p.d.-perennial dicots; a.m.-annual monocots; p.m.-perennial monocots

Figure 1. Weeding degree in the control variant

The total control percentage ranged between 36.17% in the variants treated with Mustang (0.4-0.6 l/ha) and 97,27% in the variants treated with Buctril Universal (0.8 l/ha). The variants in which wed control was over 90.00% are as follows: Buctril Universal (0.8 l/ha) 97.27%, Bavel 480 S (0.6 l/ha) 96.95%, Dialen Super 464 SL (0.9 l/ha) 96.84% and Patrol (1 l/ha) 96.17%. A lower degree of weed control was in the variants treated with SDMA Super (1 l/ha) 75.42%, Cambio (2-2.5 l/ha) 50.17% and Mustang (0.4-0.6 l/ha) 36.17% (Table 3)

Table 3.

Diminution of the number of weeds in grain maize

Herbicide	Rate	Weed control EWRS grades	Number of weeds controlled	Control percentage	
				Total	***Convolvulus arvensis* L.**
V_3 – Buctril Universal	0.8-1 l/ha	5	274.3	97.27	85.97
V_2 – Bavel 480 S	0.6 l/ha	3	273.4	96.95	71.65
V_5 – Dialen Super 464 SL	0.9 l/ha	3	273.1	96.84	70.35
V_7 – Patrol	1 l/ha	8	271.2	96.17	63.52
V_8 – SDMA Super	1 l/ha	6	212.7	75.42	55.73
V_4 – Cambio	2- 2.5 l/ha	8	141.5	50.17	42.63
V_6 – Mustang	0.4-0.6 l/ha	3	102.1	36.17	25.7
v_1 – control (not treated)	-	9	**Mt**	0.00	0.00

As for the exclusive control of the species *Convolvulus arvensis* L. the best results were in the variants treated with Buctril Universal (0.8 l/ha), Bavel 480 S (0.6 l/ha), Dialen Super 464 SL (0.9 l/ha), and Patrol (1 l/ha).

Data presented 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) and Banvel 480 S (0.6 l/ha), with yields of 81.48 q/ha, 76.33 q/ha and 74.11 q/ha, respectively, with very significantly positive differences compared to the field average. The significantly positive difference compared to the average of the field was in the variant treated with Patrol (1 l/ha), i.e. 70.85 q/ha.

Table 4.

Trial results concerning maize yield

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	130,01	+18,81	xxx
V_5 – Dialen Super 464 SL	0.9 l/ha	76.33	121,79	+13.66	xxx
V_2 – Bavel 480 S	0.6 l/ha	74.11	118,25	+11.44	xxx
V_7 – Patrol	1 l/ha	70.85	113,05	+8.18	xx
V_6 – Mustang	0.4-0.6 l/ha	63.17	100,79	+0.50	-
Mean	**-**	**62.67**	**100.0**	**Mt**	**-**
V_4 – Cambio	2-2.5 l/ha	54.44	86.86	-8.23	0
V_8 – SDMA Super	1 l/ha	52.80	84.25	-9.87	00
v_1 - control (not treated)	-	29.17	46.54	-33.50	000

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

Yields in which the difference compared to the field average was not significant were in the variant treated with Mustang (0.4-0.6 l/ha). The variants treated with Cambio (2.5 l/ha) or SDMA Super (1 l/ha) ensured lower yields compared to the field average.

The lowest yield was in the control variant (not treated), i.e. 29.17 q/ha, the difference compared to the field average being very significantly negative.

CONCLUSIONS

1. The number of weeds in maize in the control variant was, in 2010, 282.0 weeds/m^2 of which 24.2 plants/m^2 was field bindweed sharing 8.58%.

2. The best results in total weed control , i.e. over 90%, were in the variant treated with Buctril Universal (0.8 l/ha) 96.91%, Bavel 480 S (0.6 l/ha) 96.95%, Dialen Super 464 SL (0.9 l/ha) 96.84% and Patrol (1 l/ha) 96.17%.

3. As for the exclusive control of the species *Convolvulus arvensis* L. the best results were in the variants treated with Buctril Universal (0.8-1 l/ha with a share of 85.97%;

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

5. None of the tested herbicides had any phyto-toxic effects whatsoever on the maize hybrids tested.

6. In all trial variants, 30 days after application and particularly 60 days after application, field bindweed tended to regenerate without representing a threat to maize plants.

7. The highest maize yields were in the variants treated with Buctril Universal (1 l/ha), Dialen Super 464 SL (0.9 l/ha) and Banvel 480 S (0.6 l/ha), ranging between 81.48 q/ha, 76.33 q/ha and 74.11 q/ha, with very significantly positive differences compared to the field average.

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