CHEMICAL CONTROL STRATEGIES OF *RUBUS CAESIUS* L. IN GRAIN MAIZE

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Abstract*: The goal of this paper is to determine the efficacy of the control of Rubus caesius L., popularly called European dewberry, a weed of maize crops, using a diversified range of post-emergent herbicides. Research was carried out in the year 2009, at Sacoşul-Mic (Timiş County), where we set a mono-factorial trial in the field, after the randomised block method with four replications, each harvestable variant measuring 105 m^2. The maize hybrid used in the trial was DKC-5143, a semi-late hybrid developed by Monsanto and homologated in the year 2005, recommended to be cultivated particularly in the Romanian Western Plain and in Southern and South-Eastern Romania. We identified 11 species of weed in maize crops – 262 plants/m^2 – of which European dewberry represent 24.2 plants/m^2 or 8.58% of the total weeds. Compared to the number of weeds in the control variant, after applying the herbicide the number of weeds diminished with 141.5 weeds/m² in the variant treated with Cambio (2.5 l/ha), up to 274.3 weeds/m² in the variant treated with Dialen Super 464 SL (0.9 l/ha). As for exclusive weed control of the species Rubus caesius L., the best results were in the variants treated with Dialen Super 464 SL (0.9 l/ha), with a control percentage of 85.97%. The largest maize yields were in the variants treated with Dialen Super 464 SL (0.9 l/ha), Callisto 480 SC (2.5 l/ha) and Banvel 480 S (0.6 l/ha), with yields of 68.24 q/ha, 66.45 q/ha, and 62.78 q/ha respectively, with very significant positive differences compared to the average of the field. In all experimental variants, 30 days after herbicide application, and particularly 60 days after application, we could note the tendency of European dewberry shoots to not regenerate, but they no longer represent a serious competition for maize plants. There were no visible effects of phyto-toxicity in the maize hybrid cultivated as a result of the herbicide substances used.*

Keywords: *herbicide, Rubus caesius L., weed control, maize*

INTRODUCTION

At present, maize shares the largest area among agricultural crops in Romania; despite all this, average yields are much below the biological potential of the hybrids cultivated. One of the reasons is the high degree of weeding of maize crops and the high level of sensitivity of maize to weeds particularly in the first 5-6 weeks after sowing.

In general, areas cultivated with maize are strongly infested by monocots and dicots – both annual and perennial species – different from climate to climate and from soil to soil, but also depending on the cultivation technology applied in time.

Maize is one of the most important crops worldwide. The grains of maize are used in human food, in industry, and in animal feed. Maize grains are widely used in the spirits, starch, dextrin, and glucose industries. From the germs, they extract high quality oil that is highly used in diets. Maize shares about 1.66 million tons (3.7%) of the world edible vegetal oil (FAO 1995; MUREȘAN & ȘIPOȘ 1973).

Maize grains are the most important concentrated feed for all animal species. According to the FAO (BAICU 1988), about 21% of the world production of maize is used in human food, 72% is used in animal feed, and 7% is used in industry.

In Romania's economy, maize has the largest share with the largest contribution to the total production, though the cultivated area is about 49-52% of the total area cultivated with

cereals. Due to its capacity of being cultivated as monoculture for years on, maize can be cultivated in the most favourable areas.

There are certain relationships between weeds, soil type, pre-emergent crop, climate, water table, and level of cultivation technology which, due to their cumulated impact, determine the level and quality of agricultural production (CHIRILĂ *et al*. 2001).

One of the problem-weeds in maize is the species *Rubus caesius* L. (Family *Rosaceae*), a species with high variability.

It is a dicot perennial weeds, semi-woody, polycarpous, with mainly vegetative reproduction – from the buds on the roots and on the creeping stems – and less from the seeds.

The creeping stems lay down on the ground and, in contact with the soil, it pushes sprouts. The branches have weak, uneven spines.

The plant spread quickly in the field and it does not respond to control works because it sprouts quickly from the organs left in the ground (IONESCU-SIȘEȘTI 1955).

In time, they have recorded significant progress in the control of maize weeds particularly due to the synthesis and use of new substances as herbicides.

Research subjected to the present paper aimed at establishing the most efficient ways of controlling the problem-species *Rubus caesius* L. Chemically in maize crops, with direct effects on yield results.

MATERIAL AND METHODS

The maize hybrid used in the experiment was DKC-5143, a maize hybrid developed by Monsanto, a semi-late maize hybrid homologated in the year 2005, recommended to be cultivated particularly in the Romanian Western Plain and in Southern and South-Eastern Romania, with good results. With a wide genetic basis, it has a high ecological plasticity yielding high, constant yields (11-14 t/ha), even in particular climate conditions.

Research was carried out in the year 2009, in Sacoşul-Mic (Timiş County).

In Romania, the species *Rubus caesius* (L.) has spread very much these years; the quick expansion of this weed in agricultural crops is due particularly to the lack of crop rotation and to the repeated application of selective herbicides.

In this context, we aimed at determining the efficacy of controlling the European dewberry in maize crops using a diversified range of post-emergent herbicides (Table 1).

Taking into account the fact that maize is weedened each year by a large number of monocot weeds and that we can assess the effect of post-emergent herbicides on the plants of *Rubus caesius* L., before maize sprouted we applied the pre-emergent herbicide Guardian.

We also monitored the effect of weed control on maize yield levels.

In order to establish the efficacy of herbicides in the control of European dewberry in maize was set in the field as mono-factorial trial set after the randomised block method (SĂULESCU & SĂULESCU 1967) with four replications, 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 20 days after herbicide application to allow assessment of the results of weed control in general and of European dewberry, in particular. All during maize vegetation, after applying the herbicide, we made observations concerning the selectivity of tested products on maize plants.

We monitored the following:

- the efficacy of controlling the perennial species *Rubus caesius* L. in maize of nine herbicides (Table 1) applied during vegetation, when the weed was 10-15 cm long, and maize had 3-5 leaves, at a temperature of 15ºC;
- maize grain yield in q/ha per control and treated variants.

Table 1.

Experimental variants

Variant	Active substance	Rate 1 kg/ha	Application time
V_1 – Not treated	-	-	-
V_2 – Buctril universal	Bromoxinil 280 g/l + acid 2.4D (ester) 280 g/l	0.8-1	Early post-emergent
V_3 – SDMA Super	Acid 2.4-D 600 g/l	1	Early post-emergent
V_4 – Dialen super	Dicamba 120 g/l + 2.4 D 344 g/l	0.9	Early post-emergent
V_5 – Premiant	Dicamba 100 g/l + 2.4D 300 g/l	1	Early post-emergent
V_6 – Excalibur	Bentazona 300 g/l + dicamba 90 g/l	2.5	Early post-emergent
V_7 – 480 S	Dicamba 480 g/l	0.6	Early post-emergent
V_8 – Merlin Duo	Isoxaflutol 37.5 g/l + terbutilazin 375 g/l	2	Early post-emergent
V_9 – Callisto 480 SC	Mesotrione 480 g/l	0.3	Early post-emergent
V_{10} – Cambio	Bentazon 320 g/l + dicamba 90 g/l	2-2.5	Early post-emergent

We present, in the paper, average results concerning the efficacy in controlling weeds in maize and particularly the species *Rubus caesius* L.

RESULTS AND DISCUSSION

After mapping the weeds in the control variant (V_1 – not treated), we determined, on the average, a weeding degree of 282 weeds/m^2 representing 11 different species. Data shown in Table 2 show that the species *Rubus caesius* L. was represented by 24.2 plants/m², with a participation share of 8.58% (Table 2).

Table 2.

Number of weed species in the control variant in maize

No.	Species	Weeds/m^2	% of participation	Botanical class
1.	*Setaria glauca*	86.4	30.64	M.a.
2.	*Sorghum halepense*	45.2	16.02	M.p.
3.	*Chenopodium album*	32.0	11.35	D.a.
4.	*Amaranthus retroflexus*	29.4	10.43	D.a
5.	*Echinochloa crus-gali*	27.8	9.86	M.a.
6.	***Rubus caesius L***	**24.2**	**8.58**	**D.p.**
7.	*Hibiscus trionum*	12.0	4.25	D.a.
8.	*Cirsium arvense*	10.7	3.79	D.p.
9.	*Polygonum convolvulus*	8.4	2.98	D.p.
10.	*Convolvulus arvensis*	3.3	1.17	D.p.
11.	*Cynodon dactylon*	2.6	0.92	M.p.
	Total	282.0	100	-

Annual dicot species such as *Hibiscus trionum*, *Chenopodium album*, and *Amaranthus retroflexus* had a share of 26.03%, while perennial dicot species such as *Rubus caesius* L., *Convolvulus arvensis* L., *Cirsium arvensis*, and *Polygonum convolvulus* shared 16.52%.

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

Compared to the number of weeds in the control variant (282 weeds/m²), after herbicide application the number of weeds diminished with 141.5 weeds/m² in the variant treated with Cambio (2.5 l/ha) and up to 274.3 weeds/m² in the variant treated with Dialen Super 464 SL (0.9 l/ha).

The total control percentage ranged between 50.17% in the variants treated with Cambio (2.5 l/ha) and 97.27% 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) – 97.27%, Banvel 480 S (1 l/ha) – 96.95%, Excalibur (2.5 l/ha) – 96.17%, Callisto 480 SC – 95.74%, Premiant – 95.17%. The lowest degree of weed control was in the variants treated with Buctril Universal (1 l/ha) – 89.93%, SDMA Super (1 l/ha) – 75.42% Merlin Duo (2 l/ha) – 66.06%, and Cambio (2.5 l/ha) – 50.17% (Table 3).

As for the exclusive control of the species *Rubus caesius* L., the best results were in the variants treated with Dialen Super 464 SL, Callisto, Banvel 480 S, and Excalibur.

Table 3.

Diminution of the number of weeds in grain maize crops

Herbicide	**Rate**	**Weed control EWRS grades**	**Number of weeds controlled**	**Control percentage**		**Significance of the difference**
				Total	***Rubus caesius* L.**	
V_4 – Dialen Super 464 SL	0.9 l/ha	3	274.3	97.27	85.97	***
V_7 – Banvel 480 S	0.6 l/ha	3	273.4	96.95	71.65	***
V_6 – Excalibur	2.5 l/ha	3	271.2	96.17	63.52	***
V_9 – Callisto 480 SC	2.5 l/ha	3	270.0	95.74	72.60	***
V_5 – Premiant	1 l/ha	4	268.4	95.17	20.31	***
V_2 – Buctril Universal	1 l/ha	5	253.6	89.93	35.67	***
V_3 – SDMA Super	1 l/ha	6	212.7	75.42	55.73	***
V_8 – Merlin Duo	2 l/ha	7	186.3	66.06	51.50	***
v_{10} – Cambio	2.5 l/ha	8	141.5	50.17	42.63	***
v_1 – control (not treated)	-	9	Mt	0.00	0.00	-

$DL_{5\%}$ = 8.37 weeds/m^2; $DL_{1\%}$ = 11.46 weeds/m^2; $DL_{0.1\%}$ = 15.73 weeds/m^2

Data in Table 4 show that the highest yields in maize were in the variants treated with Dialen Super 464 SL (0.9 l/ha), Callisto 480 SC (2.5 l/ha), and Banvel 480 S (0.6 l/ha), i.e. 68.24 q/ha, 66.45q/ha, and 62.78 q/ha, respectively, with very significantly positive differences compared to the average of the field in the variant treated with (2.5 l/ha).

Yields in which the difference compared to the average of the field was not significant were in the variants treated with Buctril Universal (1 l/ha), Premiant (1 l/ha), and Cambio (2.5 l/ha). The variants treated with Merlin Duo (2 l/ha) and SDMA Super (1 l/ha), yielded lower yields compared to the average of the field.

The lowest yield was in the control variant (not treated), i.e. 18.48 q/ha, the difference compared to the average of the field being significantly negative.

Table 4.

Experimental results concerning the maize crop

Herbicide	Rate	Absolute yield (q/ha)	Relative yield (%)	Difference in yield (q/ha)	Significance of the difference
V_4 – Dialen Super 464 SL	0.9l/ha	68.24	142.02	+20.36	xxx
V_9 – Callisto 480 SC	2.5l/ha	66.45	138.78	+18.57	xxx
V_7 – Banvel 480 S	0.6l/ha	62.78	131.11	+14.90	xxx
V_6 – Excalibur	2.5l/ha	54.26	113.32	+6.38	x
V_2 – Buctril Universal	1l/ha	48.21	100.68	+0.33	-
Media	**-**	**47.88**	**100.0**	**Mt**	**-**
V_5 – Premiant	1l/ha	45.05	94.24	-2.83	-
v_{10} – Cambio	2.5l/ha	42.87	89.53	-5.01	-
V_8 – Merlin Duo	2l/ha	40.12	83.79	-7.76	0
V_3 – SDMA Super	1l/ha	32.34	67.54	-15.54	000
v_1 – control (not treated)	-	18.48	38.60	-29.4	000

$DL_{5\%}$ = 5.81 q/ha; $DL_{1\%}$ = 8.40 q/ha; $DL_{0.1\%}$ = 13.55 q/ha

CONCLUSIONS

1. The number of weeds in the maize crop in the control variant in the year 2009 was 282.0 weeds/m^2, of which 24.2 weeds/m^2 were represented by the European dewberry, with a share of 8.58%;

2. The best results in the diminution of the total weeding degree ranged between 95.74% and 97.27% in the variants treated with Dialen Super 464 SL (0.9 l/ha) – 97.27%, Banvel 480 S (1 l/ha) – 96.95%, Excalibur (2.5 l/ha) – 96.17%, Callisto 480 SC – 95.74%, and Premiant – 95.17%;

3. As for the exhaustive control of the species *Rubus caesius* L., the best results were in the variants treated with Dialen Super 464 SL (0.9 l/ha), i.e. 85.97%;

4. None of the pre-emergent herbicides had any effect whatsoever on the plants of *Rubus caesius* L. sprouted from the root;

5. In all experimental variants, 30 days after herbicide application and particularly 60 days after herbicide application we could notice the shoots regenerate, but they were no menace for the maize plants;

6. Maximum maize yields were in the variants treated with Dialen Super 464 SL (0.9 l/ha), i.e. 68.24 q/ha.

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