# CONTROL OF HORSE THISTLE (*CIRSIUM ARVENSE* L. SCOP.) IN WINTER WHEAT CROP

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***Abstract.*** *Because of weeding, crops diminish substantially and, with strong weeding, crops can be much compromised. Horse thistle is a problem-weed in straw cereals and one of the most widespread and damaging weed species in Romania. Research was carried out over two years (2012 and 2013) in the experimental field of the Weed Science Department of the Didactic Station in Timisoara, Romania, in which we tested the effect of 11 post-emergent herbicides on horse thistle in winter wheat. The winter wheat cultivar we used was Glosa. The setting of the experimental field was done after the randomised block method: it was a monofactorial experiment with 12 variants and 4 replicas. In the first experimental year, we identified, initially, 98.56 weeds/$m^2$, of which Cirsium arvense (L.) Scop. shared 7.91%, i.e. 7.8 plants/$m^2$. In the following year, we identified, initially, 79.20 weeds/$m^2$, of which Cirsium arvense (L.) Scop. shared 7.40%, i.e. 5.8 plants/$m^2$. Overall, in the two years, the most visible reduction of weeding was in the variants treated with Buctril Universal (92.52-94.18%), Arrat (86.73-92.42%), Ceredin Super (90.18-91.07%) and Dialen Super 464 SL (87.40-90.63%). As for the exclusive control of the weed species Cirsium arvense (L.) Scop., in 2012, the best results were in the variants treated with Lontrel 300 (95.20%), (Arrat (94.49%), Iudith (91.37%) and Dialen Super 464 SL (90.63%). In 2013, the herbicides with the best performances in the reduction of horse thistle sprouts were Lontrel 300 (97.05%), Buctril Universal (93.51%), (Arrat (91.28%), Iudith (91.37%) and Dialen Super 464 SL (88.73%). The herbicide Cerlit EC had no visible effect on horse thistle – this is why we do not recommend it in the fields invaded by this species. Thirty days after the treatment, and more visibly sixty days after the treatment, the plants of Cirsium arvense (L.) Scop. tended to regenerate in all the variants shooting new sprouts that could not really compete with winter wheat plants that had almost reached maturity. All the tested herbicides were very selective for the winter wheat cultivar Glosa, with no visible symptoms of phyto-toxicity. Winter wheat crops in the experimental field were influenced, on one hand, by the climate conditions of the two years and, on the other hand, they correlated positively with the performances of the herbicides in the total control of horse thistle.*

***Keywords:*** *Cirsium arvense L., weeds, winter wheat, herbicides, yields, selectivity*

## INTRODUCTION

On agricultural lands, weeds produce damage by reducing the amount and quality of the harvest, by making crop maintenance and harvest difficult, by increasing the costs of drying cereals, by the toxic effects on humans and animals, and by favouring and transmitting diseases and pests of crops (ALDA S., 2007; MANEAD.N. 2006).

Damage caused by horse thistle are numerous and they depend on the cultivated species, on the weeding degree, on climate conditions, on the ratio between the different weed species, on the natural soil fertility potential, on the rates of fertilisers applied, and on the maintenance works (MANEA D. N. ET AL., 2007; LILIANA GOGOLOIU, 2006).

Because of its wide ecological span (mesoxerophyte to mesohydrophite), horse thistle grows on all soil types, from sea level to altitudes of 1,400 m. it is a ruderal, segetal weed species resistant to drought due to its roots that grow deep into the soil (reaching up to 6 m) where it takes water and nutrients unreachable for most crops; in exchange, it does not resist

winter frosts because they destroy its rhizomes, roots and root buds in the frozen soil layer (PINTILIE et al., 1985).

*Cirsium arvense* (L.) Scop. is widespread in Europe, North Africa, Central and Western Asia, Northern India, Japan, China and Northern America, South Africa, New Zeeland, Tasmania and South-East Australia (WEBER E., 2003). In Romania, it grows in almost all crops and is one of the most damaging weed species. It is considered a problem-weed in almost every country of the country, sharing almost 65% of the tillage crops. In the latest years, this weed has become a natural calamity (and it is not the only one!) on uncultivated fields that have thus turned into horse thistle pure cultures (BERCA M., 2004).

The fundamental criterion of the "integrated weed management" consists in maintaining weeding below a damage threshold with minimum impact on the environment and socio-economic activities (LABRADA R., 2006).

In this context, the research presented in this paper aimed at establishing the most efficient ways of controlling chemically the weed species *Cirsium arvense* (L.) Scop. In winter wheat, with direct effects on yield.

## MATERIAL AND METHODS

The winter wheat cultivar used in the experiment was Glosa. This is a precocious cultivar resistant to drought, heat, wintering and fall; it has a specific resistance to leaf diseases, to brown rot, yellow rot, mildew and septariosis; it has good resistance to sprouting in the kernel and good milling and bread making features. It is recommended in all wheat cultivation areas of Romania.

Research was carried out in two years, 2011-2012 and 2012-2013, in the experimental field of the Weed Science Department of the Didactic Station in Timisoara, Romania, where we tested 11 post-emergent herbicides on horse thistle in winter wheat with direct effects on yield. The setting of the experimental field for the control of horse thistle in winter wheat was done after the randomised block method; it was a monofactorial experiment with 12 variants and 4 replicas, on a harvestable area per variant of 36.25 $m^2$, and on a total area of 1,740 $m^2$.

The experimental variants were as follows:

$V_1$ – no herbicide;
$V_2$ – Arrat (Triasulfuron: 25% + Dicamba: 50%) – 150 g/ha;
$V_3$ – Buctril Universal (Bomoxinil: 280 g/l + Acid 2.4 D: 280 g/l) – 1 l/ha;
$V_4$ – Ceredin Super 40 SL (Acid 2.4 D: 28% + Dicamba: 10%) – 1 l/ha;
$V_5$ – Cerlit CE (Fluroxipin: 250 g/l) – 0.5 l/ha;
$V_6$ – Dialen Super 464 SL (Dicamba 120 g/l + 344 g/l acid 2.4 D) – 0.9 l/ha;
$V_7$ – DMA – 6 (Acid 2.4 D from diethyl amine salt: 660 g/l) – 1 l/ha;
$V_8$ – Iudith (Dicamba 480 g/l) – 1 l/ha;
$V_9$ – Lancet RV (Fluroxipir: 80 g/l + Acid 2.4 D: 450 g/l) – 1 l/ha;
$V_{10}$ – Lontrel 300 (Clopyralid 300 g/l) – 0.5 l/ha;
$V_{11}$ – Rival Super Star 75 PU (Tribenuronmethyl: 37.5% + Clorsulfuron 37.5%) – 20 g/ha;
$V_{12}$ – Sekator (Amidosulfuron: 5% + Iodosulfuron-methyl: 1.25%) – 0.3 kg/ha.

The post-emergent herbicides were applied during vegetation, when horse thistle was in the rosette state and wheat was tillering, at an air temperature of 15˚C. herbicides were applied with a portable sprayer. Calculating herbicide and water rates was done depending on the area of each experimental plot. Determining weeding degree was done using the quantitative-numerical method in each experimental variant.

After applying the herbicides, we made periodical observations of the treatment efficiency in the control of the different weed species and of the weed species *Cirsium arvense* (L.) Scop. (readings were done 15 days after the treatment and ERWS scale grades were allotted regarding the weed control). We also made careful observations of the herbicide selectivity for wheat plants. In each experimental variant, we weighed grain yield and compared to standard measurements. Yield results were processed through variance analysis.

## RESULTS AND DISCUSSIONS

Figure 1 presents weed species in the control variant (no herbicide) in winter wheat in 2012. The total number of weeds was 98.56 weeds/m$^2$, of which 7.80 plants/m$^2$ were plants of *Cirsium arvense*, with a share of 7.91%. Annual dicot species such as *Polygonum convolvulus*, *Galium aparine*, *Veronica hederifolia*, *Stellaria media*, *Papaver rhoeas*, *Stachys annua*, *Fumaria officinalis*, *Lamium purpureum*, *Viola arvensis*, *Sinapis arvensis* and *Capsella bursa-pastoris* shared 88.24%, while perennial dicot weed species such as *Cirsium arvense* and *Convolvulus arvensis* shared only 11.76%.

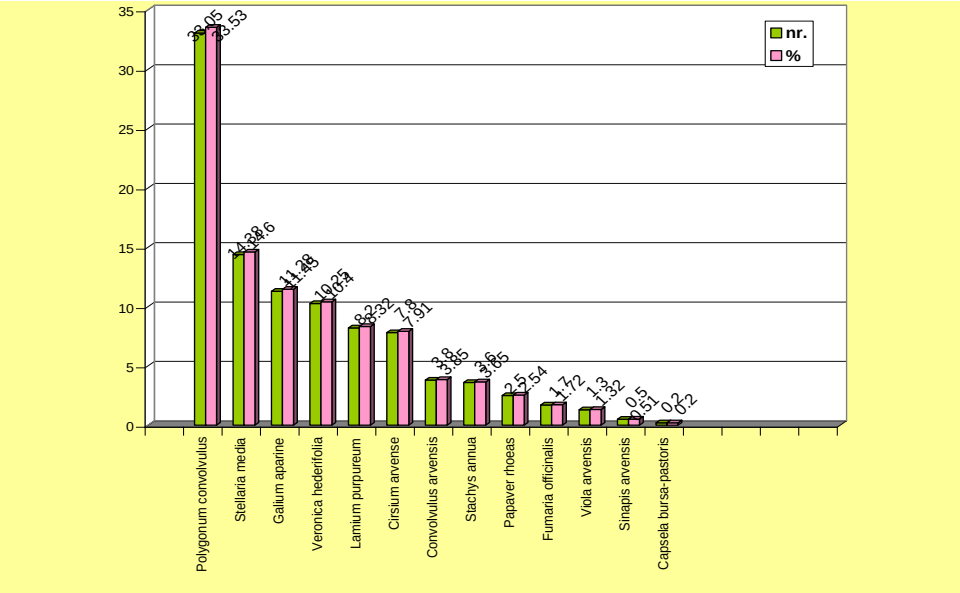


Figure 1. Number of weed species in the control variant in 2012

After the treatment with herbicides, the number of weeds diminished with 66.73 weeds/m² in the variant treated with Cerlit 6 (0.5 l/ha) to 92.82 weeds/m² in the variant treated with Buctril Universal (1 l/ha). The control percentage ranged between 67.71% and 94.18%, respectively. There was also weed control of over 90% with the herbicides Arrat (150 g/ha), Ceredin Super (1 l/ha) and Dialen Super 464 SL (0.9 l/ha). That year, the herbicides with the best performances in the reduction of the number of horse thistle sprouts were Lontrel 300 (95.20%), Arrat (94.49%), Iudith (91.37%), and Dialen Super 464 SL (90.63%). We thus had the proof that the herbicide Cerlit EC had no effect whatsoever on horse thistle (Table 1).

*Table 1*

Reduction of the number of weeds in winter wheat in 2012

| Herbicide | Rate | EWRS grades | Weeds controlled (N) | Weed control (%) | | Significance of the difference |
|---|---|---|---|---|---|---|
| | | | | Total | *Cirsium arvense* (L.) | |
| $V_3$-Buctril Universal | 1 l/ha | 2 | 92.82 | 94.18 | 88.75 | XXX |
| $V_2$- Arrat | 150 g/ha | 3 | 91.09 | 92.42 | 94.49 | XXX |
| $V_4$-Ceredin Super SL | 1 l/ha | 3 | 89.76 | 91.07 | 84.80 | XXX |
| $V_6$-Dialen Super 464 | 0.9 l/ha | 3 | 88.93 | 90.23 | 90.63 | XXX |
| $V_9$- Lancet RV | 1 l/ha | 4 | 86.19 | 87.45 | 80.72 | XXX |
| $V_{11}$-Rival Super Star 75 PU | 20 g/ha | 4 | 85.85 | 87.10 | 73.60 | XXX |
| $V_8$-Iudith | 1 l/ha | 4 | 85.09 | 86.33 | 91.37 | XXX |
| $V_{12}$-Sekator | 0.3 kg/ha | 5 | 82.39 | 83.59 | 64.75 | XXX |
| $V_{10}$-Lontrel 300 | 0.3 kg/ha | 6 | 74.54 | 75.63 | 95.20 | XXX |
| $V_7$-DMA 6 | 1 l/ha | 6 | 70.00 | 71.02 | 82.53 | XXX |
| $V_5$-Cerlit CE | 0.5 l/ha | 6 | 66.73 | 67.71 | 0.00 | XXX |
| $V_1$-control (no herbicide) | - | **9** | **Control** | **0.00** | **0.00** | - |

$DL_{5\%}$= 3.90 weeds/m² $DL_{1\%}$ = 5.14 weeds/m² $DL_{0.1\%}$= 8.35 weeds/m²

Data presented in Table 2 show that the highest yields in winter wheat in 2012 were in the variants treated with Dialen Super 464 SL (0.9 l/ha) – 58.86 q/ha and Arrat (150 g/ha) – 57.10 q/ha, the differences between the mean of the field being very significantly positive.

*Table 2*

Experimental result in winter wheat in 2012

| Herbicide | Rate | Absolute yield (q/ha) | Relative yield (%) | Difference in yield (q/ha) | Significance of the difference |
|---|---|---|---|---|---|
| $V_6$-Dialen Super 464 SL | 0.9 l/ha | 58.86 | 119.3 | +9.48 | XXX |
| $V_2$-Arrat | 150 g/ha | 57.10 | 115.6 | +7.71 | XXX |
| $V_3$-Buctril Universal | 1 l/ha | 55.62 | 112.63 | +6.24 | XX |
| $V_{11}$-Rival Super Star 75 PU | 20 g/ha | 55.10 | 112.64 | +5.72 | XX |
| $V_4$-Ceredin Super | 1 l/ha | 51.73 | 104.76 | +2.35 | - |
| $V_8$-Iudith | 1 l/ha | 50.60 | 102.47 | +1.22 | - |
| Mean | - | **49.38** | **100.0** | - | - |
| $V_9$-Lancet RV | 1 l/ha | 48.41 | 98.04 | -0.97 | - |
| $V_{12}$-Sekator | 0.3 kg/ha | 45.78 | 92.71 | -3.60 | - |
| $V_{10}$-Lontrel 300 | 0.3 kg/ha | 45.13 | 91.39 | -4.25 | 0 |
| $V_7$-DMA 6 | 1 l/ha | 43.90 | 88.90 | -5.48 | 00 |
| $V_5$-Cerlit CE | 0.5 l/ha | 42.37 | 85.80 | -7.00 | 00 |
| $V_1$-control (no herbicide) | - | 37.25 | 75.43 | -12.13 | 000 |

$DL_{5\%}$=3.65/ha $DL_{1\%}$=5.36/ha $DL_{0.1\%}$=7.62/ha

There were distinctly significant positive differences compared to the mean of the field in the variants treated with Buctril Universal (1 l/ha) – 55.62 q/ha or Rival Super Star (20 g/ha) – 55.10 q/ha.

The productions in which the difference to the mean of the field was not significant were in the variants treated with Ceredin Super (1 l/ha) and Iudith (1 l/ha). The variants treated

with Lancet RV (1 l/ha), Sekator (0.3 kg/ha), Lontrel 300 (0.3 l/ha), DMA 6 (1 l/ha) or Cerlit EC (0.5 l/ha) ensured lower yields than the mean of the field.

The lowest yield was in the control variant (no herbicide), where it reached 37.25 q/ha, with a very significantly negative difference to the mean of the field.

In 2013, there were, in the control variant, 79.20 weeds/$m^2$ of which 5.80 plants/$m^2$ were plants of *Cirsium arvense*, with a share of 7.40%. Annual dicot species such as *Lamium purpureum*, *Stellaria media*, *Veronica hederifolia*, *Stachys annua*, *Polygonum convolvulus*, *Papaver rhoeas*, *Viola arvensis*, *Galium aparine*, *Polygonum aviculare*, *Consolida regalis and Fumaria officinalis* shared 85.87%, while perennial dicot species such as *Cirsium arvense*, *Convolvulus arvensis* and *Rubus caesius* shared only 14.13% (Figure 2).

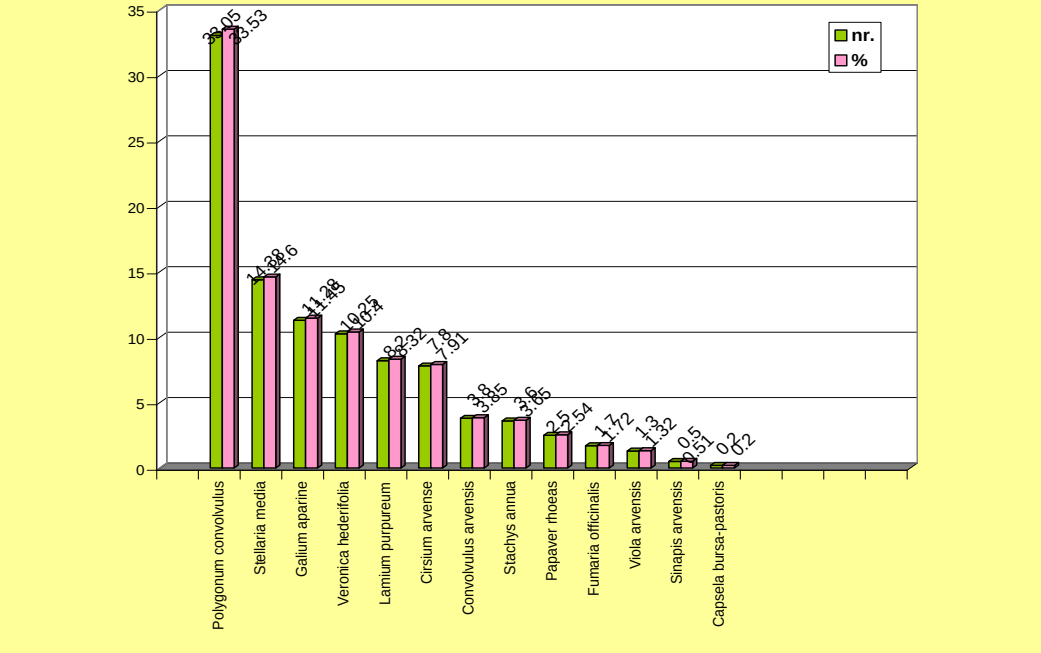


Figure 2. Number of weed species in the control variant in 2013

In 2013, due to the treatments applied, the number of weeds diminished with 35.20 weeds/m² in the variant treated with Cerlit EC (0.5 l/ha) to 55.01 weeds/m² in the variant treated with Dialen Super 464 SL (0.9 l/ha). The total weed control percentage ranged between 64.32% in the variant treated with Cerlit EC (0.5 l/ha) and 92.52% in the variant treated with Buctril Universal (1 l/ha). The variants that ensured a high weed control degree (above 86%) were Ceredin Super (1 l/ha) 90.18%, $V_6$-Dialen Super 464 SL (0.9 l/ha) 87.40%, Arrat (150 g/ha) 86.73% and Iudith (1 l/ha) 86.02%. As for the exclusive control of the weed species *Cirsium arvense* (L.) Scop., the best results were in the variants treated with Lontrel 300 (97.05%), Buctril Universal (93.51%), Arrat (91.28%) and Dialen Super 464 SL (88.73%) (Table 3).

The highest winter wheat yield in 2013 was in the variant treated with Buctril Universal (1 l/ha) 67.30 q/ha, with a very significant positive difference compared to the mean

of the field, and with a positive correlation between yield and weed control. In the variants treated with Dialen Super (0.9 l/ha) or Arrat (150 g/ha), the differences to the mean of the field were very significant positive. The products Ceredin Super (1 l/ha) or Lancet RV (1 l/ha) resulted in lower yields with distinctly significant and significantly positive differences to the mean of the field, respectively (Table 4).

By applying the herbicides Rival Super Star (20 g/ha), Iudith (1 l/ha), or Lontrel 300 (0.3 kg/ha), we obtained 58.83 q/ha, 58.54 q/ha and 56.65 q/ha, respectively, with insignificant differences to the mean of the field since winter wheat yields in these variants were very close to the mean of the field. The lowest yields were in the variants treated with Cerlit CE (0.5 l/ha) 49.78 q/ha and DMA 6 (1 l/ha) 53.40 q/ha, the difference to the mean of the field being distinctly significant and significantly negative, respectively. In the control variant (no herbicide) also (41.85 q/ha), the difference to the mean of the field was very significantly negative.

*Table 3*

Reduction of the number of weeds in winter wheat in 2013

| **Herbicide** | **Rate** | **EWRS grades** | **Weeds controlled (N)** | **Weed control (%)** | | **Significance of the difference** |
|---|---|---|---|---|---|---|
| | | | | **Total** | ***Cirsium arvense* (L.)** | |
| $V_3$-Buctril Universal | 1 l/ha | 4 | 73.27 | 92.52 | 93.51 | XXX |
| $V_4$-Ceredin Super | 1 l/ha | 4 | 71.42 | 90.18 | 85.30 | XXX |
| $V_6$-Dialen Super 46 SL | 0.9 l/ha | 5 | 69.22 | 87.40 | 88.73 | XXX |
| $V_2$-Arrat | 150 g/ha | 5 | 68.69 | 86.73 | 91.28 | XXX |
| $V_8$-Iudith | 1 l/ha | 5 | 68.13 | 86.02 | 86.55 | XXX |
| $V_9$-Lancet RV | 1 l/ha | 5 | 65.93 | 83.25 | 82.10 | XXX |
| $V_{10}$-Lontrel 300 | 0.3 kg/ha | 6 | 62.93 | 79.46 | 97.05 | XXX |
| $V_{11}$-Rival Super Star 75 PU | 20 g/ha | 6 | 61.85 | 78.10 | 69.47 | XXX |
| $V_{12}$-Sekator | 0.3 kg/ha | 6 | 57.80 | 72.98 | 59.82 | XXX |
| $V_7$-DMA 6 | 1 l/ha | 7 | 54.12 | 68.33 | 79.60 | XXX |
| $V_5$-Cerlit CE | 0.5 l/ha | 7 | 50.95 | 64.32 | 0.00 | XXX |
| $V_1$-control (no herbicide) | - | **9** | **Control** | **0.00** | **0.00** | - |

$DL_{5\%}$=5.64 weeds/m² $DL_{1\%}$ =8.02 weeds/m² $DL_{0.1\%}$=11.38 weeds/m²

*Table 4*

Experimental result in winter wheat in 2013

| Herbicide | Rate | Absolute yield (q/ha) | Relative yield (%) | Difference in yield (q/ha) | Significance of the difference |
|---|---|---|---|---|---|
| $V_3$-Buctril Universal | 1 l/ha | 67.30 | 115.85 | +9.21 | XXX |
| $V_6$-Dialen Super 464 SL | 0.9 l/ha | 65.71 | 113.12 | +7.62 | XXX |
| $V_2$-Arrat | 150 g/ha | 64.90 | 11.72 | +6.81 | XXX |
| $V_4$-Ceredin Super | 1 l/ha | 64.05 | 110.26 | +5.96 | XX |
| $V_9$-Lancet RV | 1 l/ha | 61.29 | 105.51 | +3.20 | X |
| $V_{11}$-Rival Super Star 75 PU | 20 g/ha | 58.83 | 101.27 | +0.74 | - |
| $V_8$-Iudith | 1 l/ha | 58.54 | 100.77 | +0.45 | - |
| Mean | - | **58.09** | **100.00** | **Control** | - |
| $V_{10}$-Lontrel 300 | 0.3 kg/ha | 56.65 | 97.52 | -1.44 | - |
| $V_{12}$-Sekator | 0.3 kg/ha | 54.76 | 94.27 | -3.33 | 0 |
| $V_7$-DMA 6 | 1 l/ha | 53.40 | 91.93 | -4.69 | 00 |
| $V_5$-Cerlit CE | 0.5 l/ha | 49.78 | 85.69 | -8.31 | 000 |
| $V_1$-control (no herbicide) | - | 41.85 | 72.04 | 16.24 | 000 |

$DL_{5\%}$= 3.17 q/ha $DL_{1\%}$= 4.38 q/ha $DL_{0.1\%}$= 6.75 q/ha

## CONCLUSIONS

- In the first experimental year, we identified initially 98.56 weeds/$m^2$, of which *Cirsium arvense* (L.) Scop. shared 7.91%, i.e. 7.8 plants/$m^2$ ;
- In the second experimental year, we identified initially 79,20 weeds/$m^2$, of which *Cirsium arvense* (L.) Scop. shared 7.40%, i.e. 5.8 plants/$m^2$ ;
- Overall, in the two experimental years, the most visible reduction of weeding was in the variants treated with Buctril Universal (92.52-94.18%), Arrat (86.73-92.42%), Ceredin Super (90.18-91.07%) and Dialen Super 464 SL (87.40-90.63%);
- As for the exclusive control of the weed species *Cirsium arvense* (L.) Scop., in 2012, the best results were in the variants treated with 300 (95.20%), (Arrat (94.49%), Iudith (91.37%) and Dialen Super 464 SL (90.63%);
- In 2013, the most performing herbicides in the reduction of the number of horse thistle shoots were Lontrel 300 (97.05%), Buctril Universal (93.51%); Arrat (91.28%), Iudith (91.37%) and Dialen Super 464 SL (88.73%);

- The herbicide Cerlit EC had no visible effect on horse thistle; therefore, we do not recommend it in the field invaded by this weed species;
- Thirty days and more visibly sixty days after treatment, the plants of *Cirsium arvense* (L.) Scop. tended, in all treated variants, to produce new shoots, but they could not really compete winter wheat plants that had almost reached maturity;
- All tested herbicides were very selective for the cultivated winter wheat cultivar Glosa, with no visible symptoms of phyto-toxicity;
- Winter wheat yields in the experimental field were influenced, on one hand, by the climate conditions of the two experimental years and, on the other hand, they correlated positively with the performances of the herbicides in the reduction of the number of weeds, in general, and of horse thistle, in particular.

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