Scientific Papers. Series A. Agronomy, Vol. LXVIII, No. 2, 2025
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

THE IMPACT OF HERBICIDE TREATMENTS IN THE CONTROL OF WEED SPECIES PRESENT IN THE MAIZE CROP IN THE PEDOCLIMATIC CONDITIONS AT NARDI FUNDULEA

Mihaela CERGAN[1], Elena PARTAL[1], Gheorghe MATURARU[1], Mirela PARASCHIVU[2], Călin SĂLCEANU[2]

[1]National Agricultural Research and Development Institute Fundulea, 1 Nicolae Titulescu Street, 915200, Fundulea, Romania
[2]University of Craiova, Faculty of Agronomy, 19 Libertăţii Street, Craiova, Dolj, Romania

Corresponding author email: ela_partal@yahoo.com

Abstract

Maize (Zea mays) is the most valuable and important crop, the sown surfaces show a high degree of infestation with annual and perennial weeds. Weeds are usually characterized by rapid and abundant seed production, spread easily and grow quickly. They usually have very well developed root systems and are adapted to most pedoclimatic conditions. The researches were carried out in the experimental field from NARDI Fundulea, in the pedoclimatic conditions existing in the south of the country. The main objective of the work is to study the selectivity and effectiveness of herbicide treatments on the fight against annual and perennial weeds present in the maize crop. The use and application of herbicide treatments must be correlated with the degree of infestation, the spectrum and dominance of weed species and the pedoclimatic conditions in the research area.

Key words*: maize, weed, herbicide, efficacy, selectivity.*

INTRODUCTION

Maize (*Zea mays* L.) is the seed of a plant that is native to Central America but is widely cultivated around the world and has numerous health benefits.

Maize is the most important and valuable agricultural plant, occupying the third place in the world in area and the first in terms of production, being used in human nutrition, animal feed, raw material in industry and, more recently, for the production of fuels to replace gasoline and diesel.

In Romania, corn holds the most important place, having the largest contribution to the total grain grain production, the cultivated area represents approx. 49-52% of the area sown with cereals. Maize occupies the third place, in terms of importance, among the plants cultivated on the globe, and in Romania it is the most cultivated plant. The importance of corn cultivation is motivated by the following particularities:

- It has a high production capacity, about 50% higher than other cereals;
- It is a creeping plant, good forerunner for most crops;
- Supports monoculture for several years;
- Having a later sowing in the spring, allows a better stagger of agricultural works.

In Romania, the areas cultivated with corn show an extremely high degree of weeding, over 80%, with a varied range of annual and perennial monocotyledonous and dicotyledonous weeds, depending on the zonal pedoclimatic conditions. The most significant weed species are: mocotyledonates: *Setaria* sp., *Echinochloa crus-galli, Sorghum halepense (from seed and rhizomes), Digitaria sanguinalis, Elymus repens, Eriochloa villosa* and dicotyledonates: *Amaranthus retroflexus, Chenopodium album, Solanum nigrum, Xanthium strumarium, Polygonum* sp., *Sinapis arvensis, Raphanus raphanistrum, Stellaria media, Thlaspi arvensis, Hibiscus trionum, Datura stramonium, Abutilon theophrasti, Cirsium arvense, Convolvulus arvensis, Sonchus arvensis, Lepidium draba, Galinsoga parviflora, Capsella bursa - pastoris, Erigeron canadensis* (Popescu et al., 2009).

In the field of weed control in field crops, the main objective is to permanently eliminate weed competition below the damage threshold throughout the growing season, in order to reduce water and nutrient consumption by them, so that plants continue to grow. Culture to have a normal development, which will lead, in the

end, to obtaining high yields, qualitative and at the level of the biological potential of the hybrids and cultivated varieties (Popescu A., 2007).

Weeds have the greatest negative impact, around 37%, compared to insects (18%), fungi and bacteria (16%) and viruses (2%) (Oerke, 2006). Weeds have a negative effect on the level of production and its quality, the presence of a large number of weeds makes harvesting difficult, they also increase drying costs, they can have toxic effects on people and animals, and they can also favor the transmission of diseases and pests to plants (Chirilă, 2001).

The number and spectrum of weeds depends on different factors such as soil type, crop rotation, tillage, crop density, fertilization level, etc. (Hanzlik and Gerowitt, 2011; Partal et al., 2023).

The magnitude of the loss is related to the composition of the weed flora, weed emergence timing in relationship to the crop, weed density, intensity, and crop development stage in relation to the period of competition (Singh et al., 2016).

The competition with maize in the stage of 5 fully expanded leaves has the most negative interference to the crop, since it is in this phase that the components related to grain yield are established (Duarte et al., 2002).

Herbicides will remain in future agriculture an efficient tool for control of weeds as part of an integrated weed control. The application of herbicides requires only a quarter of the fuel used than one passage over the same surface with a row crop cultivator (Hanna, 2001, cited by Gianessi, L., 2013).

First, there is a growing concern at national and international level for the development of integrated management of weed control in agriculture. This involves taking a holistic approach to weed problems and using multiple and complementary methods to effectively control them. The main objective is to reduce the negative impact of weeds on agricultural production, while respecting the principles of sustainability and environmental protection. Regarding the existing state of research, significant progress has been made in identifying and developing effective methods of weed control.

The aim of the research was to identify technological solutions to control the weeds present in the maize crop by using the herbicide treatments, aiming to broaden the control spectrum, synergism, persistence and without negative impact on the environment. The main objective of this paper focused on the study of selectivity and effectiveness of the application of herbicide treatments in the control the weeds from the maize crop.

MATERIALS AND METHODS

The research was carried out in the period 2022-2023, at the National Institute for Agricultural Research and Development - Fundulea, being studied the application of the herbicide treatments at the maize crop. The research was carried out in the experimental field, the experiment being located on a soil of cambic chernozem type (3.2% organic matter, 37% clay, 6.5 pH), using the Felix maize hybrid created by the institute from Fundulea.

The Felix hybrid is a hybrid with high production potential, with good production stability in various climatic conditions, with a fast rate of water loss from the grains at harvest and a high starch content.

The organization of the experiment was done according to the method of randomized blocks, with a plot area of 25 m^2, in 3 replications and the amount of water used was 300 l/hectare.

In this experiment, we observed the degree of selectivity of maize plants and the degree of control of annual and perennial monocotyledonous and dicotyledonous weeds by applying herbicide treatments (table 1): Principal plus (50 g/kg dicamba + 92 g/kg nicosulfuron + 23 g/kg rimsulfuron) + Trend (adjuvant); Diniro (prosulfuron 40 g/kg + dicamba 400 g/kg + nicosulfuron 100 g/kg) + Trend (adjuvant); Radial 40 (40 g/l nicosulfuron) + Dicopur Top (344 g/l 2.4 D acid from DMA salt and 120 g/l dicamba); Radial 60 (60 g/l nicosulfuron) + Hudson (fluroxypyr 200 g/l).

The control of treatments with herbicides applied post-emergence (the growth and development stage of the corn being 4-6 leaves, BBCH 14-16) depends on the degree of weed infestation, the spectrum and dominance of the species present in the culture, the dose applied and last but not least the pedoclimatic conditions characteristic of each year from Fundulea.

Table 1. The herbicide treatments applied in the maize crop Experimental variants

No var.	Herbicides treatments	Active ingredient	Dose g,l /ha	Time of application
1	Untreated	-	-	
2	Principal plus + Trend (Adj.)	50 g/kg dicamba + 92 g/kg nicosulfuron + 23 g/kg rimsulfuron	440 g + 0.25 l	Postem BBCH 14-16 (maize 4-6 leaves)
3	Diniro + Trend (Adj.)	40 g/kg prosulfuron + 400 g/kg dicamba + 100 g/kg nicosulfuron	500 g + 0.25 l	
4	Radial 40 + Dicopur Top	40 g/l nicosulfuron + 334 g acid 2.4 D from salt of DMA + 120 g/l dicamba	1.0 l + 1.0 l	
5	Radial 60 + Hudson	60 g/l nicosulfuron + 200 gr/l fluroxypyr	0.7 l + 1.0 l	

The herbicide treatments were applied in the post-emergence (growth and development stage of maize cultivation: BBCH 14-16, 4-6 leaves) and weed development stage (monocotyledons: BBCH 11-14 and dicotyledons: BBCH 12-15). After the application of herbicide treatments, the observations of selectivity (%) for the maize plants were made at different intervals (7 -14- 28 days after the application of treatments) and the degree of control (%) of weeds at different intervals (14-28 days from the application of treatments).

The climatic conditions (Figure 1) recorded during the research period were extremely different, especially the amount of precipitation recorded. The average sum of precipitation (mm) for the 2022 year was 258.4 mm and for the 2023 year was 423.4 mm.

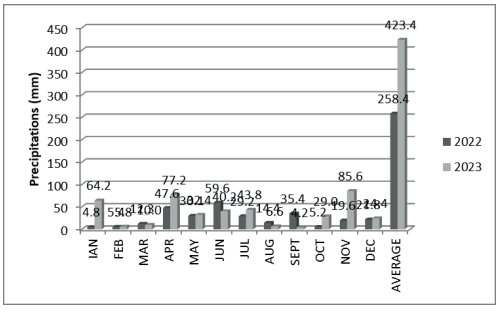

Figure 1. The climatic conditions (precipitations) of 2022-2023 years

The difference of precipitations (2022, 2023) was - 165.0 mm.

The average temperature (°C) in 2022 was 13.3°C and in the year 2023 was 14.3°C.

RESULTS AND DISCUSSIONS

In the maize experience carried out in the experimental field, the culture presented an average infestation degree – 90%, with mono-cotyledonous and dicotyledonos weeds, extremely diversified, depending on the predecessor plant, the local climatic conditions. The most representative (Figure 2) weed species were monocotyledons: *Setaria viridis, Echinochloa crus-galli, Sorghum halepense*, annual dicotyledonous: *Amaranthus retroflexus, Chenopodium album, Xanthium strumarium*, and perennial: *Cirsium arvense*.

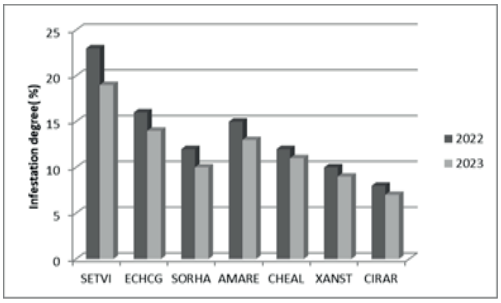

Figure 2. The infestation degree (%) with annual and perennial weeds from the untreated maize plots.

Monocotyledons: *Setaria viridis* is an annual grassy weed that forms sparse bushes. It prefers soils low in calcium, light, rich in nutrients, in warm regions. The flowering period is summer - early autumn.

Echinochloa crus-galli is a heat-loving annual grassy weed. This species is found on moist, humiferous soils, rich in nutrients, loamy -

sandy. The germination period is at the beginning of summer (it germinates in the heat). The flowering period is July - October.
Sorghum halepense weed that forms rhizomes and prefers warm areas. The stem is straight, glabrous, with slightly hairy nodes and up to 200 cm high. The germination period is spring and summer. The flowering period is summer - autumn.

Annual dicotyledonous
Amaranthus retroflexus is an annual seed-borne weed that is widespread, especially on permeable soils rich in humus and nutrients. Late germination period, typical summer germination. Flowering period June - September.
Chenopodium album - Annual weed, monoecious, propagated by seeds, with many forms. The root is pivoting and strong. It ispopularly called wild spinach. The young leaves (cotyledons) are covered with a whitish dust. It can be found on any type of soil, but it prefers loose, nitrogen-rich, humiferous, usually clayey and sandy soils. Germination time is late spring - autumn. Flowering period in full summer – autumn.
Xantium strumarium - Annual seminifera weed, present on heavy soils, rich in nutrients, in areas with hot summers. Germination time is spring. Flowering period late summer-autumn.

Perennial dicotyledonous
Cirsium arvense is a perennial weed with a deep taproot, vertical at first, then horizontally branched, nitrogen-loving. Germination time being spring, germination in the superficial soil layer. The flowering period is summer.
In the experimental field, all the selectivity observations made for the cultivated maize hybrid- Felix, not recorded phytotoxic phenomena (EWRS scale = 0).
In the maize crop, the herbicide treatments applied post-emergence (BBCH 14-16, maize 4-6 leaves) had a good control effect, highlighting their effectiveness through a single application. By applying the treatment with herbicides, good results were obtained regarding the effect of combating annual and perennial weeds, depending on: the climatic conditions, the degree of infestation, the spectrum and the dominance of the species present in this crop.
Figure 3 shows the average efficacy results (%) recorded after the postemergence application of the treatment with Principal plus (440 g/ha) + Trend (0.25 l/ha). This herbicide is absorbed through the leaves and is quickly systemically distributed in all the organs of the plant and is specially designed to combat monocotyledonous and dicotyledonous weeds in the maize crop.
In the 2 years of research, the results obtained show a good control effect (96- 97%) for annual monocotyledons: *Setaria viridis*, *Echinochloa crus-galli* and *Sorghum halepense*.
Following this treatment for the annual dicotyledonous species, a good degree of control was obtained, respectively *Amaranthus retroflexus, Chenopodium album* - 96% and *Xanthium strumarium* - 93%. The perennial dicot *Cirsium arvense* presented a good efficacy - 95%.

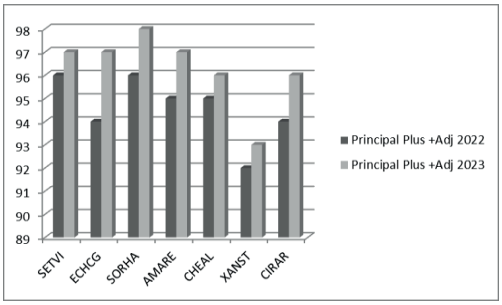

Figure 3. The efficacy (%) of the herbicides Principal plus (440 g/ha) + Trend (0.25 l/ha) for the weeds control from the maize crop

Figure 4 shows the average effectiveness results recorded after the post-emergence application of the treatment with Diniro (500 g/ha) + Trend (0.25 l/ha - adjuvant).
The activity of the product is based on two different modes of action: prosulfuron and nicosulfuron are sulphonylurea herbicides whose activity is based on blocking cell division in the growth tips, while dicamba is a growth regulator. Due to the application of this herbicide, a high degree of control was obtained for the following species: *Setaria viridis* - 96%, *Echinochloa crus-galli* - 95% and *Sorghum halepense* - 92%. Regarding the annual dicot species: *Amaranthus retroflexus* - 95%, *Xanthium strumarium* - 94% and *Chenopodium album* - 92%, the control was very good.
On the other hand, in the plots under this treatment the weed species *Cirsium arvense*

(perennial dicotyledon), the average effectiveness was 94%.

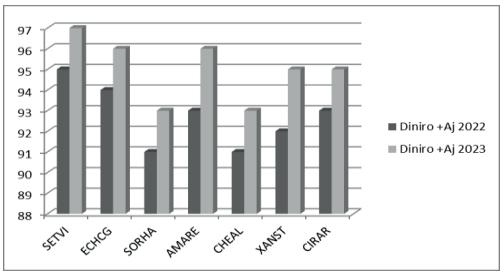

Figure 4. The efficacy (%) of the herbicides Diniro (500 g/ha) + Trend (0.25 l/ha) for the weeds control from the maize crop

The next variant treated was with the combination of Radial 40 (1.0 l/ha) and Dicopur top herbicides (1.0 l/ha). Radial 40 is applied only post-emergence and is quickly absorbed especially by the leaves, but also by the roots of the weeds. The weeds stop growing, then after they turn red, etiolate and necroses appear. Dicopur top is a combination of two active substances, it is a selective and systemic herbicide that acts on weeds through absorption, both at the level of the leaves and at the root level. Following the application of this treatment, a good control effect was recorded for the weed species *Setaria viridi - 92%*, *Echinochloa crus-galli - 90%* and the species *Sorghum halepense* it showed a good effect of 88%.

In the plots where this treatment was applied, a good control effect of was obtained for the annual dicotyledon - *Amaranthus retroflexus* 95%, *Chenopodium album* - 96%. For the other species *Xanthium strumarium* - annual dicotyledon 94% and *Cirsium arvense* - perennial dicotyledon, the control effect was 95% (Figure 5).

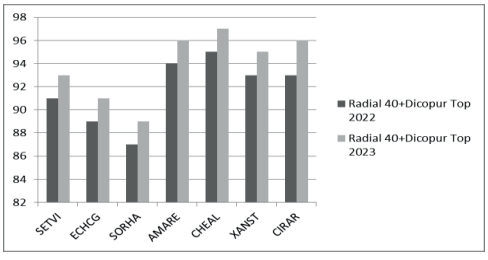

Figure 5. The efficacy (%) of the herbicides Radial 40 (1.0 l/ha) + Dicopur Top (1.0 l/ha) for the weeds control from the maize crop

Figure 6 shows the average efficacy results recorded after postemergence (BBCH 14-16, stage of growth and development of maize 4-6 leaves) applications of the herbicide combination Radial 60 (0.7 l/ha) + Hudson (1.0 l/ha). Hudson is absorbed in plants through the leaves and is quickly translocated throughout the plant. Sensitive weeds stop growing, discolor and die).

The results obtained show a superior control effect (96-98%) for the monocotyledonous species *Setaria viridis, Echinochloa crus-galli and Sorghum halepense*.

Following this treatment for the annual dicotyledonous species: *Amaranthus retroflexus* - 96% and *Chenopodium album* - 97%, a higher degree of control was obtained. For the other species *Xanthium strumarium* - annual dicotyledon, the effect was 92%.

This herbicide combination had a moderate efficacy of 69% on *Cirsium arvense*, this perennial dicotyledonous weed shows a certain degree of resistance to this herbicide combination.

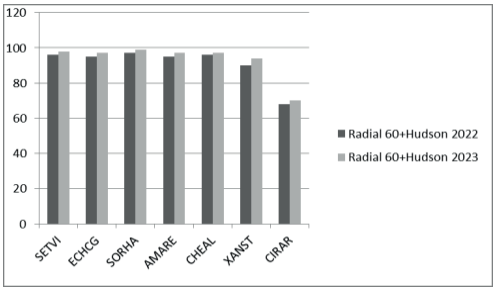

Figure 6. The efficacy (%) of the herbicides Radial 60 (0.7 l/ha) + Hudson (1.0 l/ha) for the weeds control from the maize crop

The chemical control of the weed species existing in the maize culture, on the type of cambic chernozem soil (3.2% organic mater, 37% clay, 6.5 pH) from Fundulea, represents an especially important and necessary technological measure.

In our country, special attention is paid to the control of annual and perennial monocotyledonous and dicotyledonous weed species by using and applying new herbicide treatments due to the degree of weeding, dominant and diversified spectrum of annual and perennial weeds present in the corn crop.

CONCLUSIONS

The maize crop showed a high degree of weeding and diversified with characteristic monocotyledonous weed species: *Setaria viridis, Echinochloa crus-galli, Sorghum halepense* and annual and perennial dicotyledons: *Amaranthus retroflexus, Chenopodium album, Xanthium strumarium,* and *Cirsium arvense.*

Treatments with post-emergence herbicides applied (BBCH 14-16, stage of growth and development of corn 4-6 leaves) did not register phytotoxic phenomena for the cultivated maize hybrid – Felix.

In the 2022-2023 research years, the use and application of new treatments with post-emergent applied herbicides (BBCH 14-16, stage of growth and development of corn 4-6 leaves) had a good control effect, highlighting their effectiveness through a single application. The degree of control of herbicide treatments depends on the level of infestation, dominance, weed spectrum, applied dose and climatic conditions.

REFERENCES

Chirila, C., (2001). *Weeds biology, Organography, chronology, dynamics, importance*. Ed. Ceres Bucureşti, ISBN 973-40-0516-2.

Duarte, N. F., Silva, J. B., Souza, I. F. (2002). Compatição de plantas daninhas com a cultura do milho no municipio de Ijaci., Mg. *Ciência e Agrotecnologia*, 26, 983-992.

Gianessi, L. P., (2013). The increasing importance of herbicides in worldwide crop production. *Pest management science*, 69(10), 1099-1105.

Hanzlik, K., Gerowitt, B., (2011). The importance of climate, site and management on weed vegetation in oilseed rape in Germany. *Agr. Ecosyst Environ Agriculture,* 141: 323-331.

Oerke, E. C. (2006). Crop losses to pests. *Journal of Agricultural Science,* 144, pp. 31-43. https://doi.org/10.1017.

Partal, E., Oltenacu, C.V., Paraschivu, M., Cotuna, O., Dima, M., Contescu, L. (2023). Effects of different soil tillage on soil moisture, weed control, yield and quality of maize (*Zea mays* L.). *Romanian Agricultural Research,* 40:475-482.
https://doi.org/10.59665/rar4044.

Popescu, A. (2007). Rezultate experimentale privind combaterea chimică a buruienilor din culturile de câmp - *Anale I.N.C.D.A. Fundulea, VOL. LXXV*, Volum Jubiliar (In Romanian).

Popescu, A., Bodescu, F., Ciobanu, C., Bârlea, V., Păunescu, G., Fritea, T. (2009). Noi erbicide combinate în combaterea buruienilor anuale din cultura porumbului. *An. INCDA Fundulea, Vol. LXXVII*: 137-146.

Singh, K., Kaur, T., Bhullar, M. S., & Brar, A. S. (2016). The critical period for weed control in spring maize in North-West India. *Maydica,* pp.61, 1-7.