

## CONTROL OF THE SEGETAL SPECIES *POLYGONUM AVICULARE* L. (KNOTWEED) IN THE WINTER WHEAT CROP

Denisa Maria AIOANEI<sup>1</sup>, D. N. MANEA<sup>1</sup>, Anișoara Aurelia IENCIU<sup>1</sup>  
University of Life Sciences "King Michael I" from Timisoara, 300645, 119, Calea Aradului,  
Timisoara, Romania  
Corresponding author: manea\_dn@yahoo.com; ienciuani@yahoo.com

**Abstract.** The purpose of this study was to demonstrate the efficacy of the herbicide Resital Duo (SE) against the weed *Polygonum aviculare*, from a winter wheat crop. The observations were made in a wheat crop located in the western part of Romania, respectively in the Western Plain. Research has been conducted during the agricultural years 2022-2023, and included determinations on the effects of vegetation treatments with the herbicide product Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam.), applied in 4 variants and 3 different doses (unrated, 0.2 l / ha, 0.4 l / ha, 0.6 l / ha). Therefore, a monofactorial experience was set up in the field, placed according to the method of randomized blocks, in four repetitions. 15 days after application of Resital Duo (SE) (452.42 g / l 2.4-D 2-Ethylhexyl Ester EHE) + 6.25 g / l Florasulam), the most effective treatments in experience were variant 3 (0.4 l / ha) and variant 4 (0.6 l / ha), with an efficacy of 57.5%, respectively 77.5%. After 30 days of the application of the Resital Duo (SE) product, the most effective treatments in our experience were both variant 3 (0.4 l/ha) and variant 4 (0.6 l/ha), which accumulated an efficacy of 92.5%, respectively 99.5%. The applied product did not create any kind of phytotoxicity to our crop, at any of the 3 doses tested, and the vigor of the wheat was maintained at the level of 100%;

**Keywords:** *Polygonum aviculare*, herbicides, weeds, winter wheat

### INTRODUCTION

*Polygonum aviculare*, is also known as birdweed, prostrate knotweed, lowgrass, or pigweed. *P. aviculare* (Family Polygonaceae) is native to temperate regions, although it has adapted to high parts of the tropics, according to BURGER (1983). It has been reported in a number of countries, including the United States, Australia, Hawaii, Scotland, Spain, Central and South America. The semi-erect stem of common knotgrass, an annual herb, can reach heights of 10 to 30 cm. The leaves have short stalks and no hair (figure 2). The lower ones are few, linear, and stalkless, while the upper ones are longish-elliptic, with short stalks and rounded bases. The stipules unite to form an ochrea, a membranous, silvery translucent sheath that encloses the stem. Regularly shaped, green blooms with pink or white edges surround them. Each bears three fused carpels, five to eight stamens, and five overlapping perianth segments. The fruit is a three-edged, dark brown nut. This plant grows in disturbed soil where its seeds may have been dormant for years because the seeds require light to germinate (figure 2.) (CIOCĂRLAN, 2009; GIBBS RUSSELL and colab., 1987; LINDAU, 1894; [https://en.wikipedia.org/wiki/Polygonum\\_aviculare#Habitat](https://en.wikipedia.org/wiki/Polygonum_aviculare#Habitat); [http://www.efloras.org/florataxon.asp?flora\\_id=1&taxon\\_id=200006713](http://www.efloras.org/florataxon.asp?flora_id=1&taxon_id=200006713); VILLALOBOS and HERRERA, 2002)

The flavonols avicularin, myricitrin, and juglanin are found in *Polygonum aviculare* L. Additionally discovered are the lignan aviculin and the flavanoids astragalin and betmidin. Panicudine, a diterpene alkaloid, is an additional recognized component (KIM HYOUNG JA and colab., 1994; SALAMA HEDIAT and MARRAIKI, 2010; XU FUQUAN and colab., 2009).

Prostrate knotweed, a sign of compacted soils, is frequently observed growing in full sun on thin turf or beside overflowing driveways and sidewalks. Many of these areas would be covered in bare soil if it weren't for this weed (<https://hyg.ipm.illinois.edu/article.php?id=1122>).

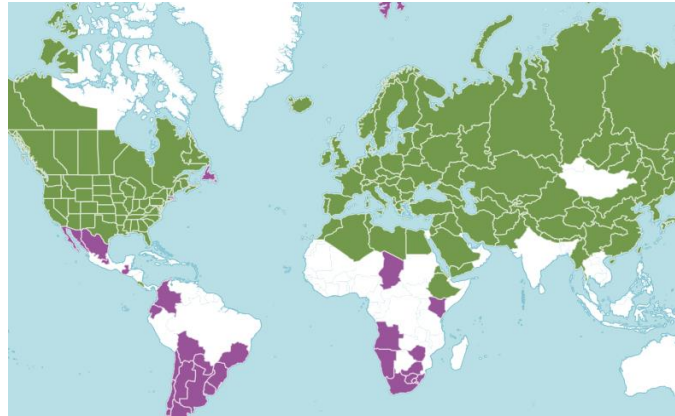


Figure 1. Distribution of *Polygonum aviculare* L. in the world (green -Native; magenta - Introduced) (<https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:695422-1#source-KBD>)



Figure 2. *Polygonum aviculare* L. in the winter wheat crop (original)

*P. aviculare* is a spring weed (TOTTMAN and WILSON, 1990). It is one of the few weeds that is equally numerous in cereals and broad-leaved crops, and it is a major or serious weed in a wide range of temperate crops (HOLM et al., 1997). It is also a significant weed of warm-weather crops such as soybean, sweet potato, cotton, sugarcane, and rice. Locally, it is common in orchards, particularly in Mediterranean climates, pastures, and nurseries. Finally, it is a common weed of amenity grass, especially in heavily-worn and compacted places like football fields. Because of its great competitiveness, high reproductive capacity (on average, it produces 4600 seeds/plant), adaptation to poor soils and water stress, *Polygonum aviculare* is a challenging weed to eradicate (MEERTS 1988). To avoid the accumulation of huge seed reserves in persistent seed banks, strict supervision is required. In order to eliminate it, there are three control methods divided into categories such as cultural control, chemical control and biological control. Regarding the cultural control, the suggested procedures are hoeing with or without chain harrowing in winter wheat (RAFII, 1993) or use of long straw wheat varieties

sown at high densities with high nitrogen (GRUNDY et al., 1997). They have been used effectively, but they are rarely sufficient on their own; they should ideally be paired with chemical control. *P. aviculare* is generally more resistant to chemical control when mature than as seedling. Chemical treatments that have had results contain: thiameturon-methyl + metsulfuron (ESPIR, 1987), thifensulfuron-methyl + metsulfuron-methyl (ARENDS and PEGG, 1990), pendimethalin + prometryn (BROWN et al., 1991), phenmedipham + desmedipham (STRIICKERS, 1992). Two natural enemies have been proposed as potential biological control agents: the chrysomelids *Entomoscelis orientalis* and *Gastrophysa polygoni*, both of which have been circumstantially reported to cause local decreases in *P. aviculare* abundance during specific years (HU et al., 1989; MAROCCHI, 1994). However, extensive field experiments appear to have never been carried out (VILLALOBOS and HERRERA, 2002)

## MATERIAL AND METHODS

The observations were made in a wheat crop, in the vicinity of the city of Arad, located in the western part of Romania, respectively in the Western Plain; the GPS coordinates of the experimental group are 46°10'42.5"N 21°02'39.6". Wheat is grown extensively across the globe, including within Romania (MANEA et al., 2016; ȘTEF R. et al., 2014, ȘTEF R. et al., 2020). The Western Plain is a space with a very high agricultural potential, offering very good pedo-climatic conditions, both for crops and for segetal species. General climatic conditions are characterized by a temperate-continental climate with slight sub-Mediterranean influences.

Research has been conducted during the agricultural years 2022-2023, and included determinations on the effects of vegetation treatments with the herbicide Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam.), applied in 3 different doses, to wheat cultivation, for the purpose of controlling the native species *Polygonum aviculare* L. (knotgrass). These treatments were:

Variant 1: Untrated (control);

Variant 2: Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam) – 0.2 L/ha;

Variant 3: Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam) – 0.4 L/ha;

Variant 4: Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam) – 0.6 L/ha.

In order to establish the efficiency of herbicides in combating the knotgrass in the wheat crop, a monofactorial experiment was set up in the field, laid out according to the randomized block method, in four repetitions, each experimental variant having an area of 36.25 m<sup>2</sup> (10 meters long and 3.625 meters wide), the total harvestable surface being 580 m<sup>2</sup>, as can be seen in the sketch from figure 3.

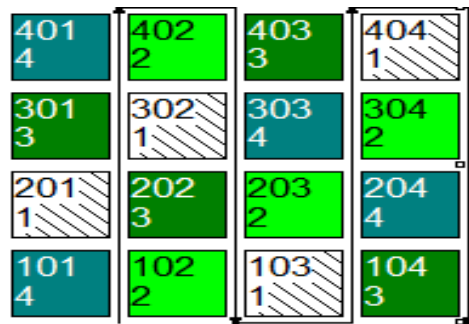


Figure 3. Sketch of field experience

The first observations included readings on weeds in the crop before applying herbicide treatments, determining the number of weeds per square meter and the degree of soil coverage.

The second round of observations included readings of *Polygonum aviculare* plants, 15 days after applying the treatments, to determine the effectiveness of the herbicide, administered in different doses. Also in this observation, phytotoxicity to wheat plants and the vigor of the crop were evaluated.

The third round of observations was made 30 days after the application of the treatments, to determine the degree of effectiveness of the herbicide. Also on the same occasion, the phytotoxicity and vigor of the wheat crop was evaluated. The effects of various doses of herbicide on weed plants were quantified in grades on a linear percentage scale from 0 to 100, depending on the degree of effectiveness of the herbicide studied, specified in EPPO PP 1/50 (4) (European and Mediterranean Plant Protection Organization) (<https://pp1.eppo.int/standards/PP1-152-4>).

The autumn wheat variety was Glosa, a variety created at INCDA Fundulea. It is an early wheat variety, with good resistance to fall, winter, drought and heat. The Glosa wheat variety is moderately susceptible to powdery mildew, susceptible to leaf septoria and moderately susceptible to brown rust. The Glosa wheat variety belongs to the group of varieties with good baking properties. A combination of herbicide ingredients, Resital Duo (SE) herbicide can be applied post-emergence to efficiently control a variety of weeds. There are two active ingredients: 452.42 g/l 2,4-D 2-Ethylhexyl Ester (EHE) + 6.25 g/l Florasulam. Suspo-emulsion (SE) is the formulation used. A broad-spectrum herbicide with both systemic and contact action is called Resital Duo. All types of corn, wheat, and barley can be treated with Resital Duo. When applied topically to broad-leaved weeds, Resital Duo stops the weed's nutrition right away. Within a day or two, death signs (yellowing, wilting) manifest. The weed's lifespan varies between 7 and 14 days based on its condition and the temperature. It doesn't leave any trace in the ground. Resital Duo doesn't reduce yield and is safe for use with all types of wheat. Rain has no effect on its effectiveness beginning two hours after application. It is advised to use in cereals (wheat, barley) from the time weeds fully emerge until the end of the cereal's tillering process (<https://hektas.com.tr/en/urun/resital-duo-2/>).

## RESULTS AND DISCUSSIONS

The main factors that can influence the degree of weeding (increase or reduce the degree of weeding), can be climatic and/or technological.

The experience, carried out in the wheat soil, highlights a pronounced weeding of the culture, including 4 segetal species, all dicotyledonous, of which 3 are annual and one perennial - *Convolvulus arvensis* (field bindweed) (table 1.) (ANCHEȘ and MANEA, 2023).

Table 1

Status of weeds in the wheat crop, before herbicide application

Nr. crt.	The segetal species	The presence of segetal species (plants/m <sup>2</sup> )	The share of weed species (%)	The degree of soil coverage (%)	The botanical class
1.	<i>Polygonum aviculare</i> (POLAV)	80	85.1	20	D.a.
2.	<i>Veronica hederifolia</i> (VERHE)	6	6.4	3	D.a.
3.	<i>Convolvulus arvensis</i> (CONAR)	5.7	6.1	4	D.p.
4.	<i>Galium aparine</i> (GALAP)	2.3	2.4	2	D.a.
	TOTAL	94	100.0	29	-

The total number of weeds/m<sup>2</sup> is observed, this being 94, of which *Polygonum aviculare* (knotgrass) - 80 plants/m<sup>2</sup> (85.1 % of the total weeds), the surface of the soil covered by this segetal species being 20%, *Veronica hederifolia* (Ivy-leaved Speedwell) – 6 plants/m<sup>2</sup> (6.4% of the total weeds), the surface of the soil covered by weeds being 3%, *Convolvulus arvensis* (field bindweed) – 5.7 plants/m<sup>2</sup> (6.1% of the total weeds), the surface of the soil covered by weeds being 4%, *Galium aparine* (catchweed) – 2.3 plants/m<sup>2</sup> (2.4% of total weeds), the degree of soil cover being 2%. It is obvious that *Polygonum aviculare* (knotgrass), present in such a large number, compared to the other 3 identified species, is the dominant species (figure 4.) (ANCHEȘ and MANEA, 2023).

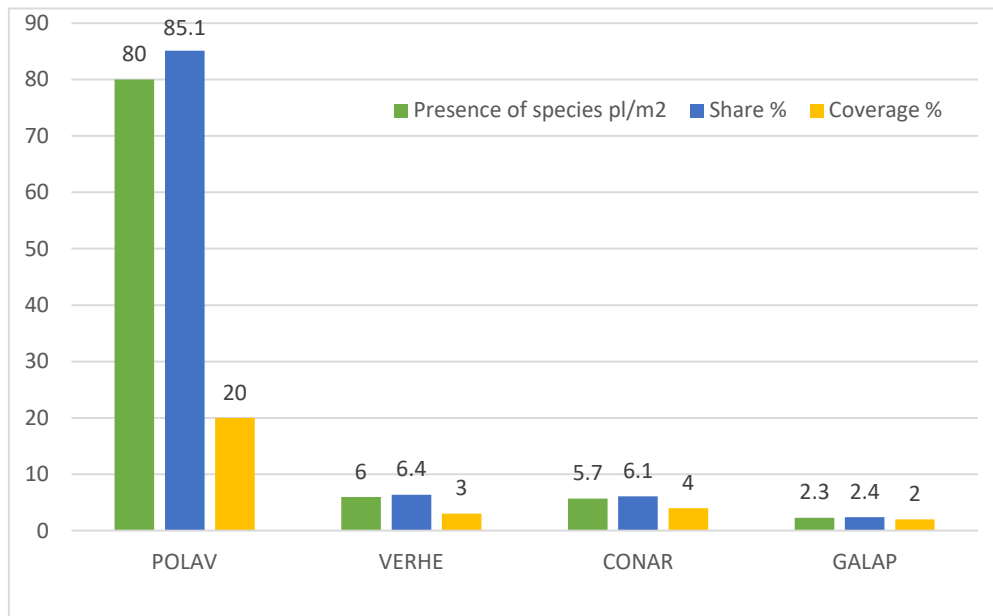


Figure 4. Status of weeds in the wheat crop, before herbicide application

After 15 days of application, an assessment was made, which determined: the number of plants of *Polygonum aviculare*/m<sup>2</sup> and the surface of the soil covered with the evaluated weed, at the same time being given a grade of the effectiveness of the herbicide.

The differences between variant 1 (Untreated) and the rest of the variants with the herbicide Resital Duo (SE) can be observed in doses 0.2 l/ha (Variant 2), 0.4 l/ha (Variant 3), 0.6 l/ha (Variant 4). It should be noted that the treatments had similar values in the 4 repetitions, with minor differences.

It can also be seen that the first version (Variant 1) is the plot that has the largest number of weeds, the average being 80 plants/m<sup>2</sup> and soil cover of 31.5%. The lowest amount of herbicide (Variant 2 – 0.2 l/ha) records a smaller number of weeds compared to the first version (average of 72.5 plants/m<sup>2</sup>), but at the same time higher, compared to other treatments; the surface covered by weeds decreases to 11.3 %. Variant 3 (0.4 l/ha) has fewer weeds than variant 2, but more compared to variant 4. Weed-covered surface (7.8%) and applied herbicide efficacy ( 57.5% ). Variant 4, (0.6 l/ha) has a number of weeds of 42.5 plants /m<sup>2</sup>, which halves the number of weeds compared to the first variant. The herbicide had an efficiency of 77.5%, being in acceptable parameters, taking into account the number of days passed since the application of the product (ANCHEȘ and MANEA, 2023).

In order to better view the obtained data, a graph was elaborated with the three monitored parameters: the number of weeds, the surface of the soil covered by weeds and at the same time the efficiency of the applied product (figure 5).

Table 2

Average of recorded data/experienced treatment, 15 days after application

Variant	The presence of <i>Polygonum aviculare</i> (plants/m <sup>2</sup> )	The degree of soil cover (%)	Herbicide efficiency (%)
1	80	31.3	0
2	72.5	11.2	25
3	47.5	7.8	57.5
4	42.5	5.5	77.5

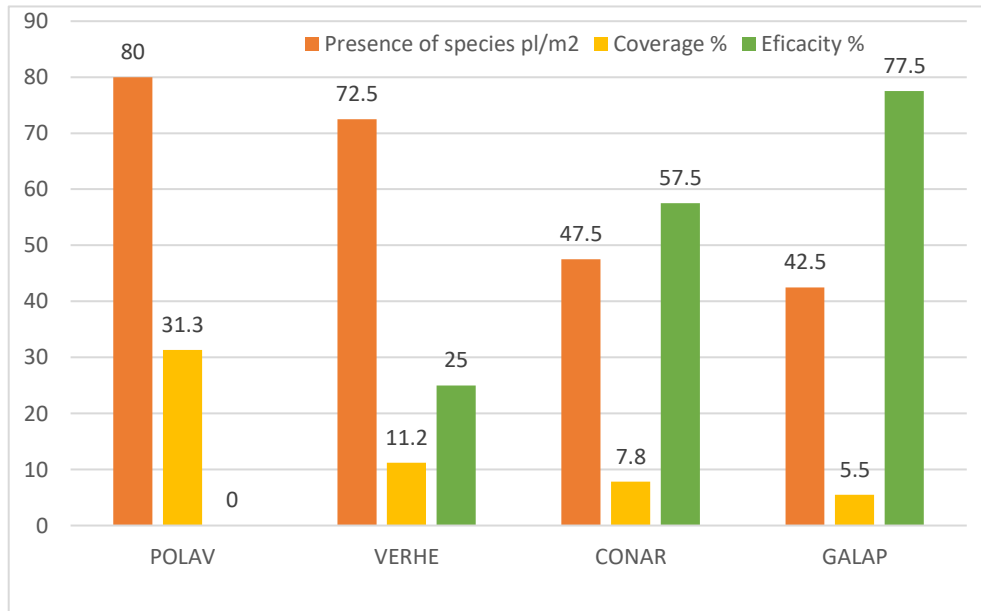


Figure 5. Status of weeds in the wheat crop, 15 days after herbicide application

After the 30 days since the application of the product Resital Duo (SE), the third evaluation was made, on which occasion the plants of *Polygonum aviculare* / m<sup>2</sup> were counted, the surface of the soil covered with the target weed was assessed and, at the same time, the herbicide was given an efficacy note (table 3).

It can be observed that the plots in variant 1 have the most weeds, the average being 80 plants/m<sup>2</sup> and the surface covered by weeds of 50%. The lowest dose (Variant 2 – 0.2 l/ha) recorded a lower number of weeds compared to variant 1 (60 plants/m<sup>2</sup>), but higher compared to the rest of the variants, with a coverage percentage of 9.2%. Variant 3, records a much lower degree of weeding compared to variant 2, but higher compared to variant 4. The surface covered with weeds (1.5%) and the efficiency of the applied product (92.5%). Variant 4 (0.6 l/ha), records a number of weeds of 0.5 plants/m<sup>2</sup> (which sprouted late after applying the product). The herbicide had an efficiency of 99.5 % (figure 6.).

Data on the phytotoxicity and vigor of wheat plants were performed and recorded 15 and 30 days after spraying with the product Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester (EHE) + 6.25 g / l Florasulam). These observations reveal that the wheat plants did not have phytotoxicity, the applied product did not create any phytotoxicity to our crop at any of the 3 doses tested, and the vigor of the wheat remained at the level of 100 % (ANCHEŞ and MANEA, 2023).

Table 3

Average data recorded for each treatment of the experience, 30 days after application

Variant	The presence of <i>Polygonum aviculare</i> (plants/m <sup>2</sup> )	The degree of soil cover (%)	Herbicide efficiency (%)
1	80	50	0
2	60	9.2	42.5
3	4.3	1.5	92.5
4	0.5	0.5	99.5

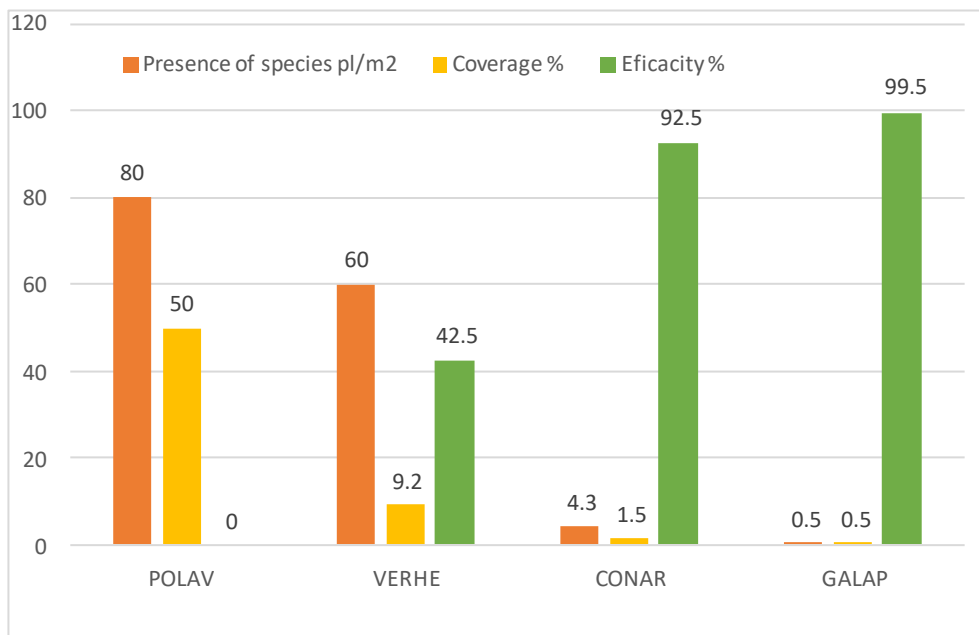


Figure 6. Status of weeds in the wheat crop, 30 days after herbicide application

## CONCLUSIONS

The initial mapping highlights a pronounced weeding of the wheat crop (94 plants/m<sup>2</sup>), including 4 dicotyledonous segetal species, of which 3 are annuals (*Polygonum aviculare* - knotgrass, *Veronica hederifolia* - Ivy-leaved Speedwell, *Galium aparine* - catchweed), and a perennial one (*Convolvulus arvensis* - field bindweed). *Polygonum aviculare* L. (knotgrass) was by far the dominant segetal species, with 80 plants/m<sup>2</sup> (85.1 % of the total weeds), covering, from the beginning, over 20 % of the soil surface. After 15 days of the application of Resital Duo (SE) (452.42 g/l 2.4-D 2-Ethylhexyl Ester EHE) + 6.25 g/l Florasulam), the most effective treatments in the experience were in variant 3 (0.4 l/ha) and variant 4 (0.6 l/ha), with an efficacy of 57.5 %, respectively 77.5 %. After 30 days of the application of Resital Duo (SE), the most effective treatments in our experience were in variant 3 (0.4 l/ha) and variant 4 (0.6 l/ha), which accumulated an efficacy of 92.5%, respectively



99.5%. The dose effect was visible in all treatments, which indicates the importance of following the recommended dose by the manufacturers; the applied product did not create any kind of phytotoxicity to our crop, at none of the 3 doses tested, and the vigor of the wheat was maintained at the level of 100%;

In order to keep the wheat crop clean of weeds, it is necessary to use selective herbicides for this crop, with known efficiency on the weeds present in each soil, respecting the recommended doses and period of application.

## BIBLIOGRAPHY

- ANCHEȘ D.I., MANEA D.N., 2023. – Controlul speciei segetale *Polygonum aviculare* L. din cultura de grâu. Lucrare de Disertație P.E.F., U.S.V. Timișoara.
- ARENDS L, PEGG IR, 1990. Thifensulfuron methyl with metsulfuron methyl - a new sulfonylurea herbicide for broad-leaved weed control in winter cereals in New South Wales and Queensland. Proceedings of the 9th Australian Weeds Conference, 60-64
- Brown JC, Eke KHR, Tayler PN, 1991. Pendimethalin/prometryn - a new coformulation for weed control in peas and beans. Aspects of Applied Biology, 27:393-396.
- CIOCÂRLAN V., 2009 - Flora ilustrată a României. *Pteridophyta* et *Spermatophyta* (ed. II, III). Edit. Ceres, București, 1138 pp., 1141 pp.
- ESPIR AF, 1987. Weed control in spring barley in Scotland with thiameturon-methyl plus metsulfuron-methyl. In: Proceedings, Crop Protection in Northern Britain 1987. Dundee, UK: Association for Crop Protection in Northern Britain, 31-36.
- GIBBS RUSSELL G. E., WELMAN W. G. M., RETIEF E., IMMELMAN K. L., GERMISHUIZEN G., PIENAAR B. J., VAN WYK M. & NICHOLAS A., 1987 - List of species of southern African plants. Memoirs of the Botanical Survey of South Africa 2(1-2): 1-152 (pt. 1), 1-270 (pt. 2).
- GRUNDY AC, FROUD-WILLIAMS RJ, BOATMAN ND, 1997. The control of weeds in cereals using an integrated approach. Aspects of Applied Biology, No. 50:367-374; 18 ref.
- HOLM, L., DOLL, J., HOLM, E., PANCHO, J. V., & HERBERGER, J. P. (1997). World weeds: Natural histories and distribution. New York: John Wiley & Sons.
- HU M, LI SQ, CHEN ZP, YAN DP, 1989. Observations on *Entomoscelis orientalis* Motschulsky and its control effects on *Polygonum aviculare*. Insect Knowledge, 26(5):280-282
- KIM HYOUNG JA, WOO EUN-RHAN, PARK HOKOON, 1994 - A Novel Lignan and Flavonoids from *Polygonum aviculare*. Journal of Natural Products. 57 (5): 581-586. doi:10.1021/np50107a003.
- LINDAU G., 1894 - Beiträge Zur Argentinischen Flora. Botanische Jahrbücher Für Systematik, Pflanzengeschichte Und Pflanzengeographie 19 (4, Beibl. 48): 8-23 descriptions and geographic information in Latin, commentary in German.
- MANEA DAN NICOLAE, RAMONA ȘTEF, IOAN PEȚ, ANIȘOARA AURELIA IENCIU, IOANA GROZEA, ALIN CĂRĂBEȚ, 2016 - Control of *Avena fatua* species (Wild Oat) - a Weed in Expansion in Banat Area, Bulletin UASVM series Agriculture 73(1): 44-48
- MAROCCHI G, 1994. A useful insect for weed control. Vita in Campagna, 12(6):50
- MEERTS, P., VEKEMANS, X. (1991). Phenotypic plasticity as related to trampling within a natural population of *Polygonum aviculare* subsp. aequale. *Acta Oecologica*, 12, 203-212.
- RAFII S, 1993. Interaction between various methods of weed control and increased fertilizer with different wheat cultivars in the Islamic Republic of Iran. Giessen, Germany; Fachbereich Veterinarmedizin der Justus-Liebig-Universität.
- SALAMA HEDIAT M.H.; MARRAIKI N., 2010 - Antimicrobial activity and phytochemical analyses of *Polygonum aviculare* L. (*Polygonaceae*), naturally growing in Egypt. Saudi Journal of Biological Sciences. 17 (1)57- 63.
- ȘTEF R., I. GROZEA, C. PUIA, A. CARABET, M. VLAD, D. MANEA, 2014 - The effect of seed treatment on the main pathogens present in wheat agroecosystems, Comm. Appl. Biol. Sci, Ghent University, 79/3, PAG 473-479
- STRIJKERS J, 1992. Les Plantes Adventices des Champs et leur Destruction. Brussels, Belgium: MinistFre de l'Agriculture.

- ȘTEF RAMONA, A. CĂRĂBET, IOANA GROZEA, D. MANEA, ANA-MARIA VÎRTEIU, ANIȘOARA IENCIU, R. CHIFAN, 2020 - The sensitivity of the *Galium aparine* L. species to sulfonylurea herbicides, Research Journal of Agricultural Science, 52 (2), 2020
- TOTTMAN DR, WILSON BJ, 1990. Weed control in small grain cereals. In: Hance RJ, Holly K, eds. Weed Control Handbook: Principles. Oxford, UK: Blackwell, 301-328.
- VILLALOBOS ALLAN, FRANKLIN HERRERA, 2002 - Control químico de *Polygonum aviculare* y otras Malezas en el cultivo de la Zanahoria (*Daucus carota*), Rev. Agr. Trop. 32: 07-16 (1999-2002)
- XU FUQUAN; GUAN HUASHI; LI GUOQIANG; LIU HONGBING, 2009 - LC Method for Analysis of Three Flavonols in Rat Plasma and Urine after Oral Administration of *Polygonum aviculare* Extract. *Chromatographia*. 69 (11–12):1251–1258. doi:10.1365/s10337-009-1088-x. S2CID 93888073.
- [https://en.wikipedia.org/wiki/Polygonum\\_aviculare#Habitat](https://en.wikipedia.org/wiki/Polygonum_aviculare#Habitat)
- [http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=200006713](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200006713)
- <https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:695422-1#source-KBD>
- <https://pp1.eppo.int/standards/PP1-152-4>
- <https://hektas.com.tr/en/urun/resital-duo-2/>