Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESEARCH ON WEED CONTROL IN AN OAT CROP

Alexandru POPA, Cristinel Relu ZALĂ, Mihai GÎDEA

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59, Marasti Boulevard, District 1, 011464, Romania, E-mails: popalexsrl@yahoo.com; cristinel.zala@agro-bucuresti.ro; gideam@yahoo.comr

Corresponding author: cristinel.zala@agro-bucuresti.ro

Abstract

Oats are more competitive with weeds than most other crops, especially when both the seed rate, due to its high twinning capacity, and the sowing season that will provide the oat crop with the vigor it needs to compete against weeds, through a good growth of roots and foliage, which will be reflected in their shading. With all these advantages, weed control is an essential and timely factor in obtaining a high production and quality of oats. The purpose of the present work was to determine the reserve of weed seeds in the soil, since their number and germinating ability make the soil the main source of weeding of agricultural crops, namely oats; the structure of soil weeding was also determined and the positive effect of applying the herbicide Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) against annual and perennial dicotyledonous weeds at a dose of 40 g/ha post-emergence was observed. The research was carried out on the Ovidiu variety, during the vegetation period of 2021 in Mircea Vodă commune, Brăila county. The degree of weeding in the oat variety Ovidiu decreased, as a result of the application of the Granstar® Super herbicide, from 147.2 weeds/m^2 to 6.1 weeds/m^2. The application of the Granstar® Super herbicide led to a very significant increase in production in the case of the Ovidiu oat variety, of 380 kg/ha.

Key words**:** *weeds, control, herbicide, oat*

INTRODUCTION

Herbicide use is more and more widespread around the world and is of particular importance in the context of dealing with the lack of labor in agriculture [7]. The intelligent use of herbicides as a curative method has often replaced the need to use different types of tillage for weed control [25].

The need to continue research on reducing the degree of weeding is current, because the chemical industry provides farmers with new herbicides and, on the other hand, until now no herbicide has been created that destroys the entire spectrum of weeds existing in a crop.

Particular importance must be given to the preparation of optimal technologies for combating annual and perennial weeds for each crop, depending on the existing approved herbicides, the level of infestation, the spectrum of weeds and, last but not least, the regional climatic conditions [6, 3, 17].

Weeds are present in all field crops, regardless of the areas in which they are grown, and the losses they cause consist in decreasing yields, increasing production costs and degrading product quality [22].

Weeds have a greater negative impact on yields than insects and diseases. Worldwide weeds are responsible for significant crop yield losses in the order of 10% per year [15].

Weeds are problematic in any agricultural crop as that they it causes important economic losses, because weeds compete with crops mainly for nutrients, water and light [31]. In agriculture, the damage caused by weeds is of various sizes, irreparable and diversified. The magnitude of losses is related to weed spectrum, timing of weed emergence in the crop, weed density and stage of crop development relative to the competition period [21].

In Romania, crop yields can be reduced quantitatively by values between 20% and 60% [19].

The effectiveness of the operation to combat weeds in cereal crops depends to a large extent on the knowledge of the biological particularities of the various species, and the main objective is represented by the

elimination of weed competition below the level of the damage threshold throughout the vegetation period, in order to reduce water consumption and nutrients by them, so that the cultivated plants develop normally, in order to obtain high productions/ha, qualitative and at the level of the biological potential of the cultivated hybrids and varieties [20].

The application of herbicides is an important strategy so that the culture emerges victorious from this competition at the expense of the weeds [14]. Weed control techniques must to achieve a balance between cost of control and crop yield loss, in the present case it is oats, and the herbicide contributes to the achievement of economic and agricultural objectives [29]. The application of herbicides must be done in accordance with good agricultural practices, rules drawn up by the EU and approved by the Ministry of Agriculture and Rural Development [12,16, 27]. In 2020, Romania used the lowest amount of pesticides/ha, respectively 0.8 kg a.s. [24].

Oats are all the more competitive with weeds when the seed rate is respected, due to its greater capacity for twinning. Sowing at the optimum time provides oat with the necessary vigor to compete against weeds, as there is a dynamic growth of roots and leaf surface (they can create a dense canopy) that shade the soil well [1, 4]. Canopy size varies with cultivar height, so taller oat varieties tend to have a larger canopy. In addition, a larger canopy positively influences photosynthetic energy, reflected in increased production[30].

Increasing seed rate almost always increases crop yields and reduces weed biomass when present [13]. In oats, it was found that a doubling of plant density as a result of increasing seed density/m^2 from 250 to 500 favored an average yield increase of 5% in weeded plots [26].

Currently, weed control in oat crops is more difficult to achieve because there is a limited range of herbicides available compared to other grass cereal crops. In addition, herbicides applied post-emergence to oats are intended to combat dicotyledonous, broad-leaved weeds.

The exact knowledge of the critical situations, the infested surfaces, the dominant species in different soils, allow the farmer to plan in advance the necessary mechanical means, fuel, herbicides, etc., for a high-performance management of weeds, with minimum expenses and with maximum certainty for the success of this decisive action for the level and quality of the harvest, under conditions of minimal environmental pollution [23].

The adoption of herbicides for weed control, which experienced a very strong advance in the 1950s and 1960s, helped to lower production costs and at the same time increase crop yields, as herbicides were cheaper and more effective than hand weeding [7].

In this context, the purpose of the research carried out in the experimental field was to combat the weeds present in the oat crop, by applying the phytosanitary treatment with the Granstar® Super herbicide at the optimal time, respecting the dose recommended by the manufacturer and without having a negative impact on the environment.

MATERIALS AND METHODS

Field experiments were conducted in 2021 to evaluate herbicide efficacy Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) against annual and perennial dicotyledonous weeds and impact on yields of spring oat Ovidiu variety.

Application dose against annual and perennial dicotyledonous weeds in oats of Granstar® Super herbicide: 40 g/ha + 250 ml/ha Trend® adjuvant, which has the role of increasing the effectiveness of the herbicide, as it increases adhesion and facilitates the penetration of the active substance into the tissues, post-emergent, from the appearance of the first 2 leaves-BBCH 12, until the appearance of the standard leaf-BBCH 39 [33, 34,11].

Ovidiu is a spring oat variety created at the Lovrin Agricultural Research and Development Station, approved in 2019.

The Ovidiu spring oat variety is characterized by a high and stable production capacity (approx. 5,000 kg/ha, and its genetic potential is over 7,000 kg/ha), having good to very good resistance to agroclimatic conditions,

especially in drought and heat, it is resistant to falling.

It has a percentage of crude protein of 14% - 16%, the mass of one thousand grains (TGM) of 30-35 g, and the hectoliter mass (HLM) is high: 45 -50 kg. The average number of grains in the panicle is approx. 100 [32].

The research was carried out in the oats experimental fields from Mircea Vodă commune, Brăila county at 45°7′40″ latitude and 27°22′37″ longitude, in natural conditions during the vegetation period of 2021.

The soil is chernozem type.

Weed mapping is a basic method in modern agriculture and consists in the quantitative and qualitative determination of the degree of weediness of the soils of an agricultural farm [2, 9].

After mapping the weeds, the obtained results are entered into the tables and based on this operation executed with responsibility and competence, it will be possible to scientifically substantiate the measures to combat the weeds on the farm [8,10].

Climate is one of the dynamic components of the environment, which greatly influences the appearance of weeds [28].

In the research area, the climate is type Dfb (Köppen formula), D: continental climate with hot summers and cold winters; f: summers wetter than winters; b: the temperature of the warmest month > 22ºC and the temperature of the coldest month below - 4ºC.

The climate is continental, with arid nuances. Average annual temperature of 10.5°C. Average annual precipitation is approx. 500 mm and are distributed unevenly during the year [18].

In the present work, we used the numerical quantitative method (expedited and accurate) to map the weeds in the oat culture, which consisted in counting the weeds for each species on a sample area of 1 m^2/point.

The experience regarding the influence of the Granstar® Super herbicide in combating weeds in oats was of a monofactorial type, with 2 variants: V1-unherbicated control; V2-herbicide with Granstar® Super.

RESULTS AND DISCUSSIONS

Determination of weed species and the degree of weediness in oats

The determinations were carried out 3 days before the application of the Granstar® Super herbicide, in 5 points/plot (Table 1), and the determinations regarding the effectiveness of the herbicide application were carried out 3weeks before the harvest (Photo 1), in 2 points/plot according to the recommendations of the specialists [5].

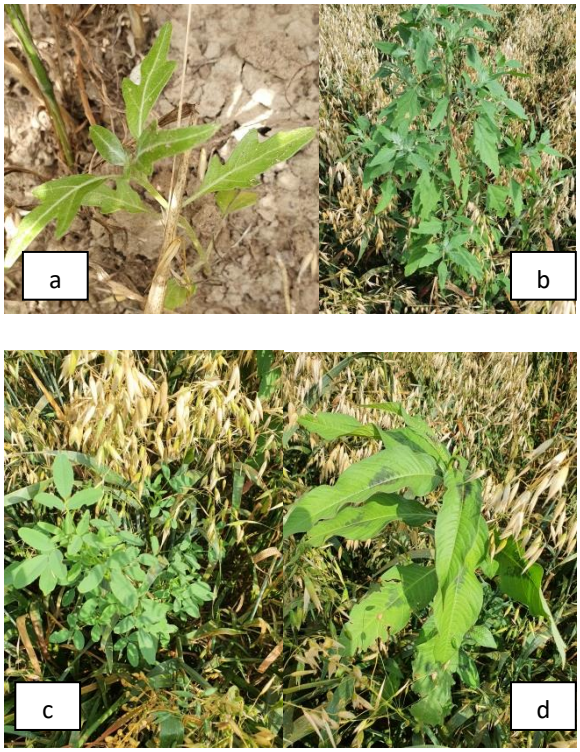

Photo 1. a) *Sonchus arvensis*, b) *Chenopodium album*, c) *Medicago sativa*, d) *Polygonum persicaria*
Source: Original photo taken by Popa A.

As can be seen, in oat culture, in 2021, 7 species of annual dicotyledonous weeds were identified: *Brassica nigra*, *Chenopodium album*, *Galium aparine*, *Polygonum persicaria*, *Polygonum aviculare*, *Polygonum convolvulus* and *Xanthium italicum*, two weed species perennial dicots: *Cirsium arvense* and *Sonchus arvensis*, an annual monocot: *Setaria* sp. and *Medicago sativa*, which is classified in the present case as a perennial dicotyledonous weed.

The average number of weeds, before the herbicide,was 147.2 plants/m^2.

Observing the data from the participation column, it is concluded that the species *Setaria* sp. (28.53%) and *Polygonum*

aviculare (25.95%) are dominant, and the species *Galium aparine* (14.0%), *Brassica nigra* (10.33%) and *Chenopodium album* (8.83%) are codominant species.

Species whose constancy (k%) exceeded 60% show that they are present in most of the soil and depending on them the type of herbicide is chosen.

Only *Xanthium italicum* had a sporadic presence in the plot, which is explained by the low constancy of 20%.

The specification of the botanical class is of practical importance since it must be taken into account when choosing the herbicide that perennial dicotyledonous weeds are more difficult to destroy than annual dicotyledonous weeds. All the information resulting from the determinations and calculations performed (phenophase, sum and average of species, participation, constancy and botanical class) give a complete picture of the situation in the researched plot for the establishment of control measures.

Table 1. The weed species determined in the oat culture, (16.IV.2021) – preceding maize crop (original)

Species	Phenophase Height (cm)	Determination points					Sum of species (s)	Species average (a)	Participation (p%)	Constancy (k%)	Botanical class
		1	2	3	4	5					
Brassica nigra	A6	10	22	18	11	15	76	15.2	10.33	100	Da
Chenopodium album	A3	2	14	11	22	16	65	13.0	8.83	100	Da
Cirsium arvense	A6	5	12	10	10	5	42	8.4	5.7	100	Dp
Galium aparine	A12	35	28	20	20	-	103	20,6	14.0	80	Da
Medicago sativa	A20	1	1	-	2	-	4	0.8	0.54	60	Dp
Polygonum persicaria	A8	3	6	2	-	4	15	3.0	2.04	80	Da
Polygonum aviculare	A8	42	35	36	48	30	191	38.2	25.95	100	Da
Polygonum convolvulus	A6	10	5	-	-	7	22	4.4	2.99	60	Da
Setaria sp.	A1	42	21	32	65	50	210	42.0	28.53	100	Ma
Sonchus arvensis	A4	1	3	2	-	-	6	1.2	0.82	60	Dp
Xanthium italicum	A4	-	-	-	2	-	2	0.4	0.27	20	Da
		151	147	131	180	127	736	147.2	100.0		

Legend: A-plant without reproductive organs.
Source: Original results.

The influence of Granstar® Super herbicide in the control of weeds in oats

The time of application of the Granstar® Super was in the phenophase of 4 internodes of oats.

Agrophytotechnical measures from land preparation to harvesting were the same in all variants.

To highlight the role of herbicide application, two insecticide treatments were applied in the variants in combination with two fungicides, so that pests and diseases do not influence the productions.

In 2021, we recorded a very significant increase in production, of 3.8 q/ha in the herbicide variant with Granstar® Super 50 SG (Table 2).

Table 2. Ovidiu oat variety production, following herbicide application in 2021 (original)

Variant	Productions		Difference q/ha	Significance
	q/ha	%		
Control	45.1	100	-	-
Granstar® Super	48.9	108.43	3.8	***
DL 5%(*)= 1.4 q/ha; DL 1%(**)= 2.6 q/ha; DL 0.1%(***)= 3.1 q/ha.				

Source: Original results.

The average number of weeds, after herbicide, was 6.1 plants/m^2.

In 2021, good results were obtained in terms of weed control, due to the fact that the

elimination was successful and thus the main objective, the reduction of the degree of infestation, was achieved.

CONCLUSIONS

The application of the herbicide Granstar® Super (25% thifensulfuron-methyl + 25% tribenuron-methyl) did not cause phytotoxic symptoms for the cultivated oat variety - Ovidiu.

Although oats can be competitive against weeds, the application of herbicides favored the increase of production.

It is very important to consult the herbicide label for the most up-to-date product information.

It is of particular importance to respect the recommended dose of herbicide application, as well as the time of application, which contributes to avoiding pollution of the environment and production, with positive effects on the health of the final consumer, animals or people.

To ensure effective weed control, their maximum height must also be taken into account, without harming the oat plants either (avoid the occurrence of phytotoxicity).

The control and management of the weeding condition occupies an important role in the technological links of any culture.

Despite the fact that there is a systematic and sustained fight against weeds, they continue to decrease the quality of production and damage their quality.

Herbicide phytosanitary treatment is an important part of oat production.

Effective crop monitoring will help farmers make the right decisions about when to apply herbicides.

Accurate knowledge of infested areas and dominant species allows farmers to plan in advance the required mechanical equipment, fuel and herbicides for successful weed control with minimal environmental pollution.

Before weeding, the average degree of weeding was 147.2 weeds/m^2, and after the application of the Granstar® Super herbicide-40 g/ha, the average degree of weeding was only 6.1 weeds/m^2, at the time of determination, 3 weeks before harvest.

Following the application of phytosanitary treatment with the Granstar® Super herbicide, a superior efficacy of 95.86% was recorded.

The existence of some weeds among the oat plants, before harvesting, is attributed to their later emergence.

Biotic factors (weed species) play a limiting role in the oat culture, materialized by the quantitative decrease of 380 kg/ha of production, in the present experience.

REFERENCES

[1]Adamiak, E., Adamiak, J., 2004, Effect of varied crop sequence and chemical control of the stand on weed infestation of oat. Acta Sci. Pol. Agricult. 3 (1): 119-128.

[2]Anghel, Gh., Chririlă, C., Ciocîrlan, V., Ulinici, A., 1972, Weeds from agricultural crops and their control (Buruienile din culturile agricole şi combaterea lor). Ceres Publishing House, Bucharest, pp. 80-95.

[3]Budoi, Gh., Şarpe, N., 1984, Contributions regarding the control of weeds in wheat culture (Contribuţii privind combaterea buruienilor din cultura de grâu). Scientific Papers (Lucrări Ştiinţifice) IANB Bucureşti, Series A XXVII:67-71.

[4]Budzyński, W., 1999, Ten years of studies on oat cultivation in Poland: a review. Żywność, Supl. 1 (18):11-25.

[5]Chirilă, C., 1989, Mapping weeds from agricultural crops (Cartarea buruienilor din culturile agricole). Ministry of Agriculture, Brăila Regional Center for Plant Protection (Ministerul Agriculturii, Centrul zonal de protecția plantelor Brăila. Redacția de propagandă agricolă). Agricultural propaganda office, București.

[6]FMC, An Agricultural Sciences Company, Granstar-r-super-50-SG, https://fmcagro.ro/produse/granstar-r-super-50-sg, Accessed on January 5, 2023.

[7]FMC, An Agricultural Sciences Company, Trend-90, https://fmcagro.ro/produse/trend-90, Accessed on January 5, 2023.

[8]Fryer, J.D., 1978, Weed Control Handbook. Vol II. Recommendations. Eighth edition. Blackwell Scientific Publications. Oxford, London, Edinburgh, Melbourgne, pp. 1-532.

[9]Gianessi, L.P., 2013, The Increasing Importance of Herbicides in Worldwide Crop Production. Pest Management Science 69(10):1099-1105.

[10]Gutenmaher, I., Cîrnu, S., Chirilă, C., 1975, Utilizarea hărţilor de îmburuienare la organizarea combaterii buruienilor în judeţul Ilfov (The use of weeding maps in the organization of weed control in Ilfov county). Cereals and technical plants (Cereale şi plante tehnice), 10:37-41.

[11]Hilbig, W., Mahn, E.G., 1971, Die kartierung von Ackerunkrauter als Grundlage fűr den gezielten Einsatz von Herbicide. Sys Reporter 3.

[12]Ionescu-Şişeşti, Gh., 1955, Weeds and their combat (Buruienile şi combaterea lor). Agrosilvică de Stat, Publishing House, Bucharest, pp.8-10.
[13]Lancashire, P.D., Bleiholder, H., Langeluddecke, P., Stauss, R., van den Boom, T., Weber, E., Witzen-Berger, A., 1991, A uniform decimal code for growth stages of crops and weeds. Ann. Appl. Biol. 119 (3): 561-601.
[14]Lipianu, S., Zală, C.R., Istrate, R., Ciontu, C., 2023, Research on winter wheat, corn and sunflower crops protection in Ilfov county respecting national legislation. Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 23 (2), 371-377.
[15]Ministry of Agriculture and Rural Development, MARD, A guide of good practices for the safe use of the products for plant protection (Cod de bune practici pentru utilizarea in siguranta a produselor de protectia plantelor), https://www.madr.ro/docs/fitosanitar/utilizare-durabila-pesticide/cod-de-bune-practici-utilizarea-produselor-de-protectie-a-platelor.pdf, Accessed on Jan. 20, 2024.
[16]Mohler, C.L., 2001, Enhancing the competitive ability of crops. In M. Liebman, C. L. Mohler, and C. P. Staver, eds. Ecological management of agricultural weeds. Cambridge University Press, Cambridge, UK. pp.269-374.
[17]Oerke, E.C., 2006, Crop losses to pests. Journal of Agricultural Science. 144:31-43.
[18]Order of Emergency no.34 from June 27, 2012, for establishing the institutional framework of action for sustainable utilization of pesticides on Romania's territory. (Ordonanță de urgență nr. 34 din 27 iunie 2012 pentru stabilirea cadrului instituțional de acțiune în scopul utilizării durabile a pesticidelor pe teritoriul României).
[19]Organic Research Centre, ORC, 2012, Oat variety characteristics for suppressing weeds. ORC Bulletin, No.111, Winter 2012, pp.6-7. https://www.organicresearchcentre.com/manage/authincludes/article_uploads/Oats%20in%20Bulletin%20111.pdf, Accessed on December 10, 2023.
[20]Pascu, Gh., 2012, Research regarding weed control in wheat. Scientific Papers. Series A. Agronomy, Vol. LV: 216-219.
[21]Peel, M.C., Finlayson, B.L., McMahon, T. A., 2007, Updated world map of the Köppen-Geiger climate classification. Hydrol. Earth Syst. Sci., 11:1633-1644.
[22]Penescu, A., Ciontu, C., 2001, Agrotechnics (Agrotehnică). Ceres Publishing House, Bucharest, p.7.
[23]Popescu, A., 2007, Experimental results regarding the chemical control of weeds in crops field. (Rezultate experimentale privind combaterea chimică a buruienilor din culturile de câmp). Annals of INCDA Fundulea, LXXV:343-356.
[24]Popescu, A., Tindeche, C., Mărcuță, A., Mărcuță, L., Honțuș, A., 2021, Pesticides - A Problem in Romania's agriculture? Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 21(4):477-486.
[25]Sayadmansour, I., Ebrahimi, M.S., 2020, Analysis of the paddy farmers' knowledge about integrated weed management (IWM). Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 20, (1), 549-555.
[26]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, 61:1-7.
[27]Stoicea, P., Dinu, T.A., Tudor, V.C., Gîdea, M., Iorga, A.M., Chiurciu, I.A., Soare, E. 2022, The impact of implementing the farm to fork strategy regarding the use of fertilizers and pesticides in the EU. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 22(2), 659-670.
[28]Șerban, M., Măturaru, Gh., Lazăr, C., 2022, Research regarding the selectivity and the efficacy of herbicide treatments applied for weed control in barley crop under pedoclimatic conditions from NARDI Fundulea. An. INCDA Fundulea, Vol. XC:149-158.
[29]Șerbu, D., Chirilă, C., 1982, Achievements and perspectives in the mapping of weeds from agricultural crops (Realizări și perspective în cartarea buruienilor din culturile agricole). Cereals and technical plants (Cereale şi plante tehnice), 8: 38-41.
[30]State Institute for Registering and testing cultivars, Testing varieties in order to register them in the official catalogue of crop varieties in Romania, https://istis.ro/, Accessed on December 5, 2023.
[31]Vlasova, O.I., Perederieva, V.M., Shabaldas, O.G., 2023, Agrophytocenotic relationships of cultivated and weed plants at the level of competition and allelopathy. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 23(1), 869-879.
[32]Wildeman, J.C., 2004, The effect of oat (*Avena sativa* L.) genotype and seeding rate on wild oat (*Avena fatua* L.) competition. M.Sc. Thesis of the department of plant science, University of Saskatchewan, Saskatoon, SK. 103 pp.
[33]Zală, C.R., Manole, M.-S., Istrate, R., Ciocoiu, E., Țurcan, D., 2023, Preliminary research on soil microflora and macrofauna in the experimental field Moara Domnească, Scientific Papers. Series A. Agronomy, Vol. LXVI, No. 1:190-196.
[34]Zimdahl, R.L., 2018, Chapter 10 - Methods of Weed Management, Editor(s): Robert L. Zimdahl, Fundamentals of Weed Science (Fifth Edition), Academic Press, pp. 271-335.