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WEED CONTROL-AN ESSENTIAL TECHNOLOGICAL STEP IN SPRING BARLEY CULTIVATION TECHNOLOGY

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Abstract: Spring barley is sensitive to weeding especially in the early stages of vegetation (sprouting-flowering-first internode), in the absence of effective crop maintenance measures it loses out in weeds fight and yield is considerably reduced. The research carried out at Agricultural Research and Development Station Turda in the years 2022 and 2023 aimed to know the dependence of technological factors and climatic conditions on the culture and yield of spring barley. The predominant weeds in the crop were dicotyledonous species. Control was carried out with 0.12 l/ha product based on amidosulfuron 100 g/l + iodosulfuron-methyl-Na 25 g/l + mefenpyr diethyl 250 g/l (safener) + 0.6 l/ha product based on 2,4 D acid from DMA salt. The results showed the effectiveness of weed control treatments and the suitability of spring barley for no-tillage system, with yields exceeding 5000 kg/ha in both experimental years.

Key words: *spring barley, weeds, clime, yield*

INTRODUCTION

According to Ullrich (2011) barley is one of the oldest crop plants that played an important role in the development of human civilization, being cultivated all over the world and was for many centuries the staple food of animals and humans (Ceclan et al., 2022). Percival (1921), said that the importance of barley can also be deduced from the interpretation of the name of the Genus *Hordeum* which derives from the word by which Roman gladiators were known as „barley men" and who consumed barley for strength and endurance in the arena battle. The main use of barley grains is animal feeding, to which the yield of malt is added. It is known that barley is the most important source in the beer industry. In general, we could say that the trend of using barley has some variations (Crișan et al., 2023), but globally about 70% from barley yield it is used directly or indirectly in animal feeding (Bhatty, 1993, quoted by Taner et. al., 2004). In obtaining malt and beer, barley has been used since antiquity, having a wide use nowadays. The alpha and beta amylase enzymes that arise from the germination of barley grains are higher in quantity than in wheat and rye (Muntean, 1993). Autumn barley is more sensitive to wintering, so in the hilly and pre-montane areas of our country was extended spring barley culture.

The culture areas of the spring barley (two-row) in Romania include: the very favorable area where the Timiș Plain, Tara Bârsei, the depressions of Sfântu Gheorghe and Târgu Secuiesc, the basins of Olt, Someșului and Mureșului, are included, Suceava Plateau and favorable area represented by Crișurilor valleys, Someșului Plateau, Siret Valley, choline and

pre-Carpathian area of Moldova (Ion, 2010; https://www.scritub.com). Păcurar (2007) states that the areas of favorability for the culture of the spring barley are determined, first of all, by the thermal regime and the rainfall fallen during March-July and secondly, pedological characteristics of the area. The best areas are: Brașov, Sibiu, Covasna, Harghita, Bistrița-Năsăud, Cluj, Suceava, Neamț and Bacău. In order to achieve economic yields, it is necessary to fit the culture in a rotation of three to four years.

Very good pre-emergences for barley are potatoes and sugar beets well maintained and fertilized and good pre-emergences are soy, sunflower and maize. Avoid placing spring barley in monoculture, after barley and autumn wheat. After alfalfa and clover it is preferable that the barley follow in the second year. The fertilizing requirements are generally lower, with the barley making good use of the residual effect of fertilizers that were applied at the previous plant (https://www.agro.basf.ro).

Part of the technical and economic advantages of spring barley cultivation are:

- it is not pretentious to the works of the soil, it can be sown in unprepared ground (straight in the stubble of the pre-emergent plant), with the help of precision seed drillers whose coulters penetrate the soil to the depth of seed incorporation (4-5 cm), the, at the same time as sowing and fertilizers are dosed and unloaded in the seed tube;
- it has a short vegetation period between 90 and 120 days, during which time it manages to mobilize important amounts of mineral substances in the soil, then turns them into organic substances, which are then used to development and yield;
- „due to its shorter vegetation period, the requirements of spring barley versus moisture, in our country in most years are covered by precipitation" (https://iuls.ro/wp-content/uploads/2021/12/2010_mai_Ifrim_Sandel_ro.pdf);
- has a high twinning capacity (it is the cereal with the highest twinning capacity) and a high growth rate, thus controlling more easily the problem weeds in the culture;
- it involves reduced technological resources and is therefore a cost-effective culture, etc (Russu & Munteanu, 2011; Chețan et al., 2021).

Spring barley is sensitive to weeding especially in the first phases of vegetation (emergence-first internode), in the absence of effective measures for the maintenance the crop loses in the fight with weeds and the yield is considerably diminished. In the Mediterranean climate, the presence of weeds in culture, especially *Lolium rigidum* can greatly reduce yield by up to 80%, depending on the season and the level of infestation (Zhou, 2010; Izquierdo et al., 2003). Weeds are also host plants for other harmful agents, including cereal aphids (www.sanatateaplantelor.ro) that are on some annual and perennial monocotyledonous weeds. Cultural practices such as increasing the sowing rate favor the competition of cultures.

The research carried out at Agricultural Research and Development Station (ARDS) Turda in 2022 and 2023 aimed at study the influence of tillage system and climatic condition on the weeds and yield at spring barley.

MATERIAL AND METHODS

The biological material used in this study (Romanița variety) is part of the most appreciated local varieties with good tolerance at drought and high yield potential (Munteanu, 2005; Crișan et al., 2021; Chețan & Chețan, 2021).

In the two experimental years, the spring barley was sown in no-tillage system, in the second decade of March, at density of 500 germinate grains/m^2 and 18 cm distance between the rows, using the Directa-400 seed drill.

For weed control, a single chemical treatment was applied, in the end-twinned phase of the spring barley, using 0.12 l/ha produced on the basis of amidosulfuron 100 g/l +

iodosulfuron-methyl-Na 25 g/l + mefyr diethyl 250 g/l (safener) + 0,6 l/ha product based on 2,4 D from DMA salt. The weeding degree was made visually and numerically with the metric frame with sides of 0.5 m before the treatment on the vegetation and before the spring barley harvest. The determinations were performed in three points (on the plot diagonal) after which calculated the average number and species of weeds/variant.

Against diseases (*Erysiphe graminis, Ustilago nuda, Pyrenophora graminea*) and pests (*Lema melanopa, Macrosiphum avenae*), two treatments were carried out on vegetation: the first treatment with 0.6 l/ha fungicide based on protioconazole 53 g/l + spiroxamine 224 g/l + tebuconazole 148 g/l) + 0.2 l/ha insecticide based on 200 g/l/l acetamiprid and the second treatment with 0,7 l/ha fungicide based on trifloxystrobin 100 g/l + tebuconazole 200 g/ + 0,2 l/ha insecticide based on tau-fluvalinate 240 g/l/l.

Due to the shorter vegetation period, for the Romanița variety of about 74-75 days, (www.itcseeds.ro) and taking into account the fertility of the soil in the experimental area (average humus content), at the same time as sowing a single fertilization was applied with 250 kg/ha NPK 20-20-0. After harvesting the spring barley and weighing, samples were taken to determine the moisture content of the grains with the GRANOMAT PERTEN. Based on the momentary moisture of the grains, the yield was calculated, after which it was recalculated to the STAS humidity (14%) using correction factors (at 86% dry matter) and then related to the surface of 1.0 hectare. The results obtained were statistically processed according to the variance analysis method and establishing the lowest significant differences, LSD (5%, 1% and 0.1%) (ANOVA, 2015).

RESULTS AND DISCUSSION

The multiannual average over the last 65 years in the Turda area is characterized by a temperature of 9.3° C and precipitation of 532.4 (Șimon, 2022). Climate conditions at ARDS Turda from the 2022, 2023 experimentation years (March-July period) is shown in Table 1 and 2 mm (source Turda Meteorological Station).

It should be noted that in 2022 the March and April period was cold compared with the multiannual temperature for these months. May, June and July was warm, in June there were five days with heat (T max ≥ 32ºC) and one day with heat temperature (T max ≥ 35ºC) and in July were 16 days with heat and six days very hot. In 2023, March was warmer than the monthly average for 65 years, April slightly cooler followed by three months with higher temperatures than the multiannual. If an average of the temperature is made for the five months studied, it can be seen that both experimental years had higher values (14.6ºC in 2022, 14.3ºC in 2023) compared to the 65-year average for the same period (14.0ºC), the difference being between 0.6-0.3ºC. The heating phenomenon in Turda area is visible, the data in Table 1 reflect this fact.

Table 1. Thermal regime during March-July from 2022, 2023 at ARDS Turda

Year	Decade/month	Average air temperature (ºC)					
		March	April	May	June	July	Average March-July
2022	I decade	0.4	7.4	14.7	20.4	23.0	
	II decade	0.6	7.6	16.9	20.1	21.2	
	III decade	9.4	11.4	17.1	22.9	24.9	
	Monthly average	3.6	8.8	16.3	21.1	23.1	14.6
2023	I decade	5.7	4.9	13.3	19.0	21.3	
	II decade	5.4	10.8	14.2	17.8	23.7	
	III decade	7.8	10.7	18.3	20.2	20.5	
	Monthly average	6.3	8.8	15.4	19.0	21.8	14.3
Monthly multiannual average for 65 years		**4.4**	**10.0**	**15.0**	**18.0**	**19.8**	**14.4**

Regarding the evolution of the rainfall regime (Table 2), if we refer to the multiannual average for 65 years, from the five months studied (60.38 mm), only the year 2023 had close values (60.96 mm). In year 2022 rainfall was under the multiannual values, the difference was 20.24 mm. Specific to the area of experimentation is the uneven distribution of rainfall, after long periods of drought occur abundant rainfall of short duration sometimes accompanied by strong wind and hail. In the two years, 2022, 2023 these phenomena (wind, hail) were reduced in intensity without adversely affecting the culture, the spring barley variety chosen in the experiment has a pretty good resistance to falling. The registered climatic changes (increasing temperatures, decrease in rainfall or non-uniformity of rainfall), as well as the unpredictable ones in the future require the judicious choice of the biological material to be cultivated and the application of some technologies adequate to the new climatic conditions (Chețan et al., 2021).

Table 2. Rainfall regime during March-July from 2022, 2023 at ARDS Turda

Year	Decade/month	Monthly sum (mm)					
		March	**April**	**May**	**June**	**July**	**Average March-July**
2022	I decade	1.5	10.6	14.5	14.1	23.1	
	II decade	6.8	1.5	24.2	27.1	0.2	
	III decade	0	30.4	44.2	0.6	1.9	
	Monthly sum	8.3	42.5	82.9	41.8	25.2	40.14
2023	I decade	3.3	21.2	15.0	11.5	12.4	
	II decade	2.3	7.0	17.0	72.9	9.6	
	III decade	5.2	2.3	1.2	60.1	63.8	
	Monthly sum	10.8	30.5	33.2	144.5	85.8	60.96
Monthly multi-annual amount for 65 years		**24.3**	**45.6**	**69.4**	**84.6**	**78.0**	**60.38**

Table 3 shows the presence of 15 weed species (100%) determined prior to chemical treatment, in the two years. Dominant are dicotyledonous weeds with 11 species (73.3%) followed by monocotyledonous weeds (26.7%) with four species.The predominant annual monocotyledonous weeds were: *Bromus tectorum* (5 weeds/m^2) and Setaria glauca (2 weeds/m^2) and the annual dicotyledonous: *Adonis aestivalis* (2 weeds/m^2), *Viola arvensis* (2 weeds/m^2) and perennial such as *Convolvulus arvense* (2 weeds/m^2). It seems that the system of soil work without ploughing (no till) contributes to the increase of the weeds, from 13 weeds/m^2 present in 2022 reaches 17 weeds/m^2 in 2023. The specialized literature, including Chetan et al., (2022), mention that by expanding the unconventional systems and under the conditions of a strong infestation with monocotyledonous weeds, combating in the cereals cultures is more difficult to achieve, *Bromus tectorum* being one of the most dangerous weeds.

Table 3. The weeds species present in culture before treatments, Turda 2022, 2023

No.	Weed species	Agrotechnically grouping	Years/ no.weeds/m^2	
			2022	**2023**
1.	*Avena fatua* (common wild oat)	Monocotyledonous	0	1
2.	*Bromus tectorum* (downy brome)		2	4
3.	*Setaria glauca* (yellow bristle-grass)		2	1
4.	*Echinochloa crus-galli* (cockspur grass)		1	1
Total monocotyledonous weeds			**5**	**7**
1.	*Adonis aestivalis (*the summer pheasant's-eye*)*	Dicotyledonous	0	2
2.	*Galeopsis tetrahit* (common hemp-nettle)		1	0
3.	*Gallium aparine* (cleavers)		0	1
4.	*Myosotis arvensis* (field forget-me-not)		1	0
5.	*Sinapis arvensis* (wild mustard)		0	1
6.	*Stelaria media* (chickweed)		1	0
7.	*Veronica hederifolia* (ivy-leaved speedwell)		1	0
8.	*Viola arvensis* (field pansy)		1	2

9.	*Convolvulus arvensis* (field bindweed)		1	2
10.	*Rubus caesius* (European dewberry)		1	1
11.	*Lathyrus tuberosus* (tuberous pea)		1	1
Total dicotyledonous weeds			**8**	**10**
TOTAL (30 weeds)			**13**	**17**

Before harvesting the crop, was identified nine weed species (mono + dicotyledonous) including: three species monocotyledonous present in both experimental years (*Avena fatua, Bromus tectorum, Setaria glauca*) and one species only in 2023 (*Echinochloa crus-galli*); the five species dicotyledonous: *Chenopodium album, Convolvulus arvensis, Rubus caesius, Lathyrus tuberosus and Xanthium strumarium*. The annual species *Xanthium strumarium* was found in the experimental field late in spring after chemical weed control treatment was applied. The chemical treatment/products used were very effective in fighting weeds sprouted at that time. The different germination period at weeds contribute at re-infestation of the land/culture. Was identified in the two years 19 weeds, but these had a low waist/poor development and no longer competed with spring barley (Table 4). „Scientists have found that the fruits of the *Xanthium strumarium* plant, known as rough cocklebur, have antioxidant and anti-inflammatory properties, and can make them useful, among others, as anti-aging products to protect the skin" (https://360medical.ro). This weed prefers sunny areas, with high temperatures, heavy and fertile lands. The high temperatures recorded in recent years was favoring their development and maturity. Until 30 years ago, it was not found on the cultivated fields (just ruderal) from the experimentation area, but, the passage of animals (sheep especially) over land propagated this species on the cultivated fields.

Table 4. The weeds species present in culture before spring barley harvested, Turda 2022, 2023

No.	The species (known as)	Agrotechnically grouping	Years/ no.weeds/m^2	
			2022	2023
1	*Avena fatua* (common wild oat)	Monocotyledonous	1	2
2	*Bromus tectorum* (downy brome)		1	1
3	*Setaria glauca* (yellow bristle-grass)		1	1
4	*Echinochloa crus-galli* (cockspur grass)		0	1
Total monocotyledonous weeds			**3**	**5**
1	*Chenopodium album* (wild spinach)	Dicotyledonous	1	1
2	*Convolvulus arvensis* (field bindweed)		1	1
3	*Rubus caesius* (European dewberry)		1	1
4	*Lathyrus tuberosus* (tuberous pea)		1	2
5	*Xanthium strumarium* (rough cocklebur)		1	1
Total dicotyledonous weeds			**5**	**6**
TOTAL (19 weeds)			**8**	**11**

Figure 1 indicates the suitability of spring barley at no-tillage system. The yields they exceeded 5000 kg/ha in both experimental years. If we refer to the mean of years (control) with a yield of 5226 kg/ha we can notice a slight decreases in 2022 (5127 kg/ha) and slight increase in 2023 (5340 kg/ha) with differences between 99-114 kg/ha, without statistical assurance. In the two experimental years, in the Turda area, the climatic conditions were very good for the spring barley crop, the data obtained confirm this fact.

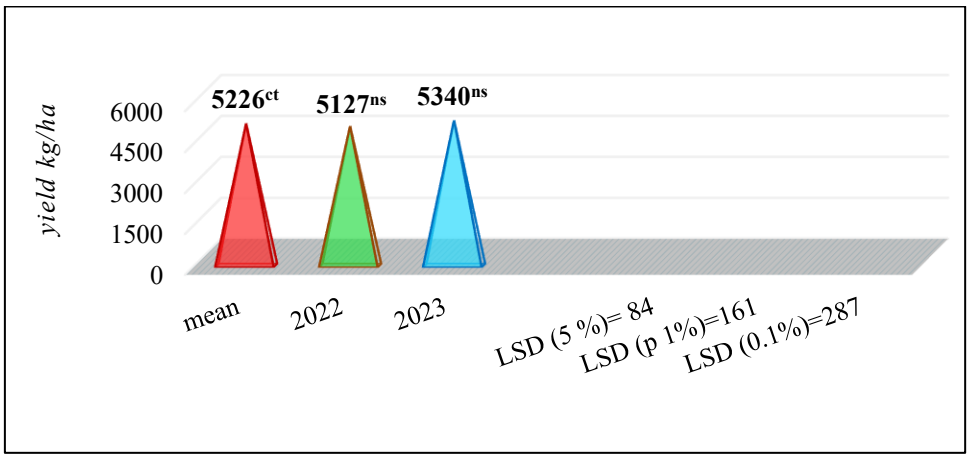

Figure 1. The influence of climatic conditions on spring barley yield

CONCLUSIONS

Due to the fact that the weed species have spread quite a lot in the crop, we believe that a different approach is needed in terms of the tillage system, the herbicides used (active substance) and the timing of their application. In the Transylvanian Plain where climate and soil conditions are similar, at spring barley the no-tillage system could be adopted with the mention that farmers must pay particular attention to weed control measures.

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