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The influence of weeds on soybean yield

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THE INFLUENCE OF WEEDS ON SOYBEAN YIELD

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Abstract: *The research was carried out at the Turda Agricultural Research and Development Station (ARDS), located in the hilly area of Transylvania and followed the influence of weed infestation on the Felix soybean variety yield, grown in two tillage systems (CS-conventional-plow, NT- unconventional-direct seeded). Sowing was done at 65 kg/m², the distance between rows being 18 cm. From the results obtained, in six experimental years (2017-2022), it was concluded that, in the climatic and soil conditions of Turda, soybean is less suitable for cultivation in the NT system, noting an increase in the infestation of the soil with weeds, especially with perennial species, but also a significant reduction in yield compared to the conventional system (CS).*

Keyword: *weeds, tillage system, climate, soybean, yield.*

Classification JEL: Q 01, Q 15, Q 16

INTRODUCTION

Soybeans are one of the most important oleoproteaginous plants worldwide, this plant uses the full amount of biomass, especially seeds rich in protein substances, unnitrogenous extractives, fats, vitamins and mineral salts (L.S. Muntean et al., 1995; Chețan et al., 2016). „World soybean yield is heavily concentrated in the US, Brazil and Argentina, which hold 80% of the world surface cultivated with this „miracle plant“ (<https://www.agro-business.ro>). For obtaining higher crops in terms of quantity but also quality, along with all other technological links and biological material used, weed control in a culture is particularly important (Chețan, 2015; Chețan et al., 2013). Efficient weed control is essential for the success of the crop because soybeans have low competitive power against weeds due to slow development in the early stages (Berca, 2004). Ciorlăuș (1983, 1998), Ulinici (1983) considered integrated weed control to be an elevated technology for the purpose of obtaining large yield, of good biological quality by capitalizing on the main components of the agroecosystem in order to avoid or decrease the ecological degradation and the profitability increase (Chețan et al., 2015). Weeds compete with soy for resources such as water, light and nutrients, according to some authors, weeds in the crop can cause yield losses of up to 80% (Braz et al., 2021) or even 90% (Imoloame, 2014) if no control is performed in culture.

The research undertaken at the Agricultural Development Research Station (ADRS) Turda, in the period 2017-2022, aimed at knowing the influence of soil work systems on grain and soybean yield.

MATERIAL AND METHOD

The experiment at SCDA Turda includes two ways of working the soil, a conventional system (CS- with autumn plowing, preparing the soil in the spring with rotary harrow, sowing + fertilized), in parallel with the non-conventional system (NT- „no tillage“, with a direct sowing + fertilized) in a three-year rotation, soy-winter wheat-maize. The biological material is represented by the Felix soybean variety, the sowing was made with the Gaspardo Directa 400 seed drill in aggregate with the John Deere 6630 tractor, at the sowing depth 65 kg/m² and 18 cm distance between rows.

The experience was located on a vertical Faeozem soil, with a slightly alkaline pH, a medium humus content and good supply of nitrogen, phosphorus and potassium.

Table 1. Experimental factors

| No.crt | The factor | Graduations |
|--------|----------------------------|---|
| 1. | A, tillage system: | a ₁ , conventional-plow (CS) |
| | | a ₂ , unconventional-ditect sowing (NT) |
| 2. | B, fertilization level | b ₁ , 200 kg/ha NPK 20-20-0 complex fertilizer applied concomitantly with sowing |
| | | b ₂ , 200 kg/ha NPK 20-20-0 complex fertilizer applied concomitantly with sowing + 100 ammonium nitrate (NH ₄ NO ₃) in soy phenophase of 2-4 tripholated leaves |
| 3. | C, year (clime conditions) | c ₁ -2017, c ₂ -2018, c ₃ -2019, c ₄ -2020, c ₅ -2021, c ₆ -2022 |

The application of weed control treatments was performed in two stages: pre-emergence with 0.35 l/ha Sencor (metribuzin 600 g/l) + 1.5 l/ha Tender (960 g/l S-metolachlor) and post-emergence with 1.0 l/ha Pulsar 40 (40 g/l imazamox) + after 4 days with 1.5 l/ha Agil 100 EC (100 g/l propaquizafop).

The degree of weeding of the crop was made visually and numerically with the metric frame with sides of 0.5 m before the herbicidation on the vegetation and before the soybean harvest. The determinations were performed in three points (on the plot diagonal) after which calculated the average number and species of weeds/variant. At pest alert, a treatment of 0.8 l/ha acaricide based on 570 g/l was performed to control *Tetranychus urticae* and a treatment with 0.2 l/thiacloprid insecticide 240 g/l for *Vanessa cardui*.

After harvesting the soybeans and weighing each experimental variant, samples were taken to determine the moisture content of the grains (with the Granomat PERTEN) laboratory humidometer. Based on the momentary moisture of the grains, the yield was calculated, after which it was recalculated to the STAS humidity (13%) using correction factors (at 87% dry matter) and then related to the surface of 1.0 hectare. Experimental data were processed by analyzing the variant (PoliFact, 2015) and setting the limit differences (LDS, 5%, 1%, 0.1%).

RESULTS AND DISCUSSIONS

The evolution of the thermal and rainfall regime at ADRS Turda (Turda Meteorological Station) is shown in Figure 1 and 2. The research area is characterized by an average multiannual temperature of 9.3 ° C and average multiannual rainfall of 532.4 mm.

If we analyze the six experimental years (2017-2022) we can see that each year was warmer than the multiannual average of 65 years (9.3°C).

The highest air temperature values were recorded in 2019 (11.4°C) and 2018 (11.2°C), with deviations of + 1.9°C and + 2.1°C. Significant deviations were recorded in the other four years: + 1.2°C in 2017 (10.5°C), 0,6°C in 2021 (9,9°C) and +1,6°C in 2022 (10,9°C).

It should be noted that in June 2022 there were five days with heat (T_{max} ≥ 32°C) and one day with heat temperature (T_{max} ≥ 35°C) and in July were 16 days with heat and six days with heat temperatures (Şimon, 2022).

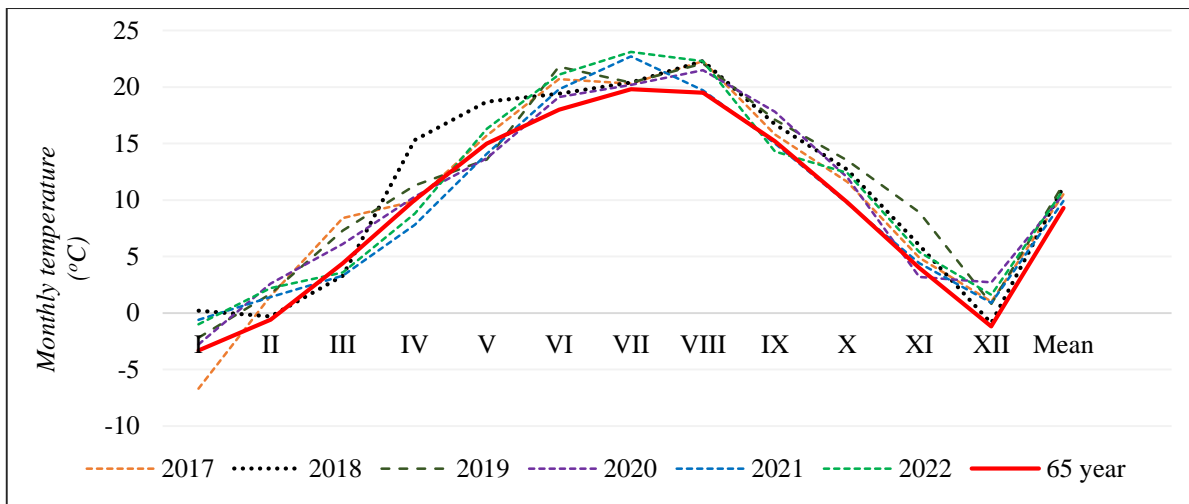


Figure 1. Thermal regime in Turda, 2017-2022

Regarding the evolution of the rainfall regime, if we refer to the multiannual average for 65 years (532.4 mm), from the six years studied, only the year 2020 was rainy (606 mm). In two years (2018, 2019) rainfall was slightly above multiannual values, the differences being 8.3 mm and 10.8 mm respectively, 2021 by 530 mm and 2017 by 532.3 mm were almost equal to the multiannual average (deviation only 2.4 and 10.9 mm respectively) but the lowest rainfall values were recorded in 2022 (514.4 mm) with a deviation of 28.8 mm.

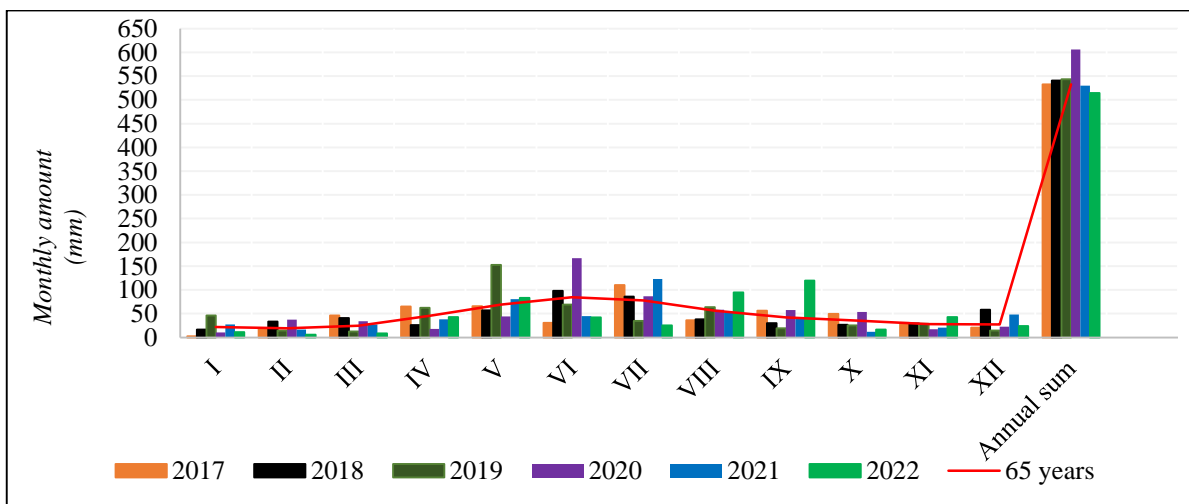


Figure 2. Rainfall regime in Turda, 2017-2022

The weeds spectrum identified before post-emergency treatment (Table 2) consists of 24 species as follows: three species of annual monocotyledonous (AM), one perennial monocotyledonous species (PM), five perennial dicotyledonous species (PD) and 15 annual dicotyledonous species (AD). The AD species are in first place in terms of participating in the soaking of soybean crop on the lands of the ADRS Turda unit. There was an increase in weeds in both soil work systems, especially in the NT system (from 29 to 41 weeds). This increase may be due to the fact that in recent years spring has been less favorable to this culture (from sowing-racing-the first stages of soybean development), temperatures between day and night fluctuated a lot and rainfall had an uneven distribution, but these climate changes favored the emergence and rapid development of weeds. Over all in the period 2017-2022 in the plowing system (CS) there were an average number of 22 weeds/m² and 33 weeds/m² in the NT version. In 2022 the presence of species was also found,

Bromus tectorum, *Tragopogon dubius*, *Taraxacum officinale*, *Portulaca oleracea*, *Anagallis arvensis* and *Anthemis cotula*.

Table 2. Weed species present in soybean culture before post-emergency treatments, Turda 2017, 2022

| No. crt | Species (no/m ²) | Group d.p.d.v. agrotechnical | 2017 | | 2022 | |
|--------------|--------------------------------|------------------------------|-----------|-----------|-----------|-----------|
| | | | CS | NT | CS | NT |
| 1 | <i>Bromus tectorum</i> | AM | 0 | 0 | 1 | 2 |
| 2 | <i>Setaria glauca</i> | AM | 1 | 0 | 2 | 0 |
| 3 | <i>Echinochloa crus-galli</i> | AM | 2 | 1 | 1 | 2 |
| 4 | <i>Agropyron repens</i> | PM | 0 | 2 | 1 | 1 |
| 5 | <i>Xanthium strumarium</i> | AD | 3 | 4 | 1 | 1 |
| 6 | <i>Chenopodium album</i> | AD | 1 | 1 | 1 | 3 |
| 7 | <i>Polygonum convolvulus</i> | AD | 0 | 1 | 1 | 1 |
| 8 | <i>Tragopogon dubius</i> | AD | 0 | 0 | 1 | 2 |
| 9 | <i>Sonchus asper</i> | AD | 0 | 2 | 0 | 1 |
| 10 | <i>Hibiscus trionum</i> | AD | 1 | 0 | 2 | 3 |
| 11 | <i>Anthemis cotula</i> | AD | 0 | 0 | 1 | 1 |
| 12 | <i>Viola arvensis</i> | AD | 1 | 2 | 3 | 2 |
| 13 | <i>Amaranthus hybridus</i> | AD | 1 | 1 | 1 | 2 |
| 14 | <i>Datura stramonium</i> | AD | 0 | 1 | 1 | 1 |
| 15 | <i>Galeopsis tetrahit</i> | AD | 1 | 0 | 2 | 1 |
| 16 | <i>Polygonum lapathifolium</i> | AD | 1 | 2 | 0 | 1 |
| 17 | <i>Convolvulus arvensis</i> | PD | 1 | 3 | 2 | 4 |
| 18 | <i>Rubus caesius</i> | PD | 1 | 2 | 2 | 3 |
| 19 | <i>Cirsium arvense</i> | PD | 0 | 1 | 1 | 3 |
| 20 | <i>Lathyrus tuberosus</i> | PD | 0 | 2 | 1 | 3 |
| 21 | <i>Taraxacum officinale</i> | PD | 0 | 0 | 0 | 2 |
| 22 | <i>Bifora radians</i> | AD | 1 | 0 | 1 | 0 |
| 23 | <i>Portulaca oleracea</i> | AD | 0 | 0 | 2 | 0 |
| 24 | <i>Anagallis arvensis</i> | AD | 0 | 0 | 1 | 2 |
| Total | | | 15 | 25 | 29 | 41 |

Before the soybean harvest, the weed crop was re-infestation, the data presented in Table 3 show as predominant species the annual dicotyledonous (AD) in both soil work variants. It should be noted that in the CS version in which the deep mobilization of the soil (28 cm deep) was achieved in autumn and in spring the processing of the germination bed with rotary harrow, the number of weeds was reduced compared to the NT version. The herbicides applied in post-emergence was effective in combating weeds that were not eliminated after pre-emergence treatment but drought and high temperatures in the summer months (July, August) 2022 adversely affected soybean cultivation, stagnating its development and forcing its ripening, which is beneficial for the growth and development of weeds by providing them with more light and nutrition. In climate-friendly years, soybean cultivation developed very well and weeds sprouted after chemical treatment on vegetation, are suppressed by soybeans and have a lower development, showing a low competitive capacity compared to soybean crop (Simon et al., 2023).

Weeds have a good adaptability to withstand negative growth and development factors (<https://www.cotidianulagricol.ro>) fact found after our research. Daramola et al. (2019) states that „ the re-infestation of a culture is influenced by the degree of coverage of the crop and the

environmental conditions, the rainfall regime of this period affecting the distribution of weed species and their competitiveness within the weed community".

Table 3. The crop re-infestation with weeds with weeds before harvest, Turda 2017, 2022

| Classification d.p.d.v. agrotechnics | | Species (no/m ²) | 2017 | | 2022 | |
|--------------------------------------|----|--------------------------------|----------|-----------|-----------|-----------|
| | | | CS | NT | CS | NT |
| 1 | AM | <i>Bromus tectorum</i> | 0 | 0 | 0 | 3 |
| 2 | | <i>Setaria glauca</i> | 0 | 1 | 1 | 1 |
| 3 | | <i>Echinochloa crus-galli</i> | 1 | 0 | 1 | 0 |
| 4 | PM | <i>Agropyron repens</i> | 1 | 2 | 1 | 4 |
| 5 | AD | <i>Xanthium strumarium</i> | 1 | 2 | 1 | 2 |
| 6 | | <i>Polygonum convolvulus</i> | 0 | 1 | 0 | 0 |
| 7 | | <i>Tragopogon dubius</i> | 0 | 1 | 1 | 1 |
| 8 | | <i>Hibiscus trionum</i> | 1 | 0 | 2 | 1 |
| 9 | | <i>Galeopsis ladanum</i> | 0 | 0 | 1 | 0 |
| 10 | | <i>Portulaca oleracea</i> | 0 | 0 | 1 | 0 |
| 11 | | <i>Polygonum lapathifolium</i> | 0 | 0 | 0 | 1 |
| 12 | PD | <i>Convolvulus arvensis</i> | 0 | 1 | 2 | 5 |
| 13 | | <i>Rubus caesius</i> | 1 | 1 | 1 | 2 |
| 14 | | <i>Cirsium arvense</i> | 0 | 2 | 0 | 2 |
| 15 | | <i>Taraxacum officinale</i> | 0 | 0 | 0 | 1 |
| Total | | | 5 | 11 | 12 | 23 |

The spectrum and density of weeds are influenced by the nutrient space and the favorability of climate conditions for emergence and development. Weed infestation until the development stage of the first clogged leaves of soybean cultivation does not have a negative influence on yield if a proper control is achieved, but it can significantly reduce yield if the reduction in weeding is not achieved properly (Şimon et al., 2023).

Soybean cultivation is very profitable, as long as it is properly cared for and here we refer first of all to the correctness of the execution of the treatments for combating the harmful agents: weeds, diseases and pests (Cheţan et al., 2016; <https://www.agro.basf.ro>). The yield reduction in the NT version is primarily due to the larger number of weeds present in this variant, especially perennial weeds. It is known that plowing is one of the agrotechnical methods of control of weeds. Crop rotation and soil work system remain one of the most effective measures in weed control (Rusu et al., 2013).

Regarding the yield obtained, from the data presented in Table 4, the major influence of the environment (climate conditions) is observed. The highest yield was obtained in 2017 (2434 kg/ha) and the yield with the lowest value was achieved in 2022 (1100 kg/ha), the difference being 1109 kg/ha compared to the average of the years considered as a control (2209). Of the six years, only 2017 had a very significant positive influence on culture and implicitly in yield. In 2018 and 2019 there were no significant increases in yields, the differences from the control being insignificant and between 3-21 kg/ha. The last three years (2020, 2021 and 2022) had a negative influence in the harvest with differences of 67-1109 kg/ha.

Soy cultivation in the conventional version (CS) brings a yield increase of 421 kg/ha compared to the NT version in which only 2016 kg/ha was achieved (very significantly negative influence). As expected, higher yields values were obtained in the additional fertilization version (2317 kg/ha) compared to the single fertilization variant where the average yield achieved was 1752 kg/ha, the difference being statistically ensured as a very positive significance (565 kg/ha).

Table 4. The influence of the experimental factors on soybean yield, Turda 2017-2022

| The factor | Yield kg/ha | Differences kg/ha |
|--|-------------|----------------------|
| C, year- climate conditions | | |
| Years average | 2209 | 0 ^{mt} |
| 2017 | 2434 | 226 ^{***} |
| 2018 | 2187 | -21 ^{ns} |
| 2019 | 2205 | -3 ^{ns} |
| 2020 | 2072 | -135 ⁰⁰ |
| 2021 | 2141 | -67 ⁰ |
| 2022 | 1100 | -1109 ⁰⁰⁰ |
| LSD (p 5%) = 118, LSD (p 1%) = 492, LSD (p 0.1%) = 798. | | |
| A-tillage system | | |
| Conventional (CS) | 2437 | 0 ^{ct} |
| No till (NT) | 2016 | -421 ⁰⁰⁰ |
| LSD (p 5%) = 104, LSD (p 1%) = 144, LSD (p 0.1%) = 199. | | |
| B- fertilization | | |
| 200 kg/ha NPK 20-20-0 complex fertilizer applied concomitantly with sowing | 2317 | 0 ^{ct} |
| 200 kg/ha NPK 20-20-0 complex fertilizer applied concomitantly with sowing + 100 ammonium nitrate (NH ₄ NO ₃) in soy phenophase of 2-4 tripholated leaves | 1752 | 565 ^{***} |
| LSD (p 5%) = 123, LSD (p 1%) = 345, LSD (p 0.1%) = 659. | | |

CONCLUSIONS

The tillage system and climatic conditions differently influenced the degree of soybean culture, in a dry year such as 2022 the weeding degree was higher. This year, the *Portulaca oleracea* species (also was identified in the CS system), species that in previous years was not found in soybean crops in the area of experimentation.

In the NT system, before post-emergency treatments, an increase in weeding from 25 weeds was recorded/m² in 2017 to 41 weeds in 2022 compared to the number of weeds present in the CS system where the increase in the number of weeds was lower, from 15 weeds/m² in 2017 at 25 weeds/m² in 2022. The difference between the numbers of weeds present in the two variants of soil work was 12 weeds/m².

The NT soil work system has significantly influenced the yield obtained at soybean, which is reduced by about 450 kg/ha compared to the CS version.

Soybean yield is influenced by the climatic conditions of the agricultural year, so that compared to 2022, a dry year with a yield of 1100 kg/ha, in 2017 which was a rainy year, yield is very significantly positive, with 2434 kg/ha.

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BIBLIOGRAPHY

1. Berca, M. (2004). Integrated weed management. Ceres Publishing House, Bucharest.
2. Braz, G. B. P.; Cruvinel, A. G.; Caneppele, A. B.; Takano, H. K.; Silva, A. G.; Oliveira, J. R. S. (2021). Sour grass interference on soybean grown in Brazilian Cerrado. *Rev. Caatinga* 34, 350-358.
3. Chețan, C. (2015). Research regarding the control of weeds in the soybean cultivation in the conventional and conservative agricultural system. PhD thesis, USAMV Cluj-Napoca.
4. Chețan, C.; Rusu, T.; Chețan, F.; Șimon, A. (2015). Research on treatments to control weeds to influence yield and qualitative soy indicators grown in the minimum cultivation system. *USAMV Bulletin* 73 (2) 2016, p: 170-175.
5. Chețan, F.; Deac, V.; Șimon, A.; Chețan, C. (2013). The influence of tillage system on production and quality of soybean yield at Agricultural Research- Development Station Turda. The 7th International Symposium "Soil Minimum Tillage Systems, Cluj-Napoca, vol. 6, no. 14. *Pro-Environment* 6 (2013) p: 362-367.
6. Chețan, F.; Chețan, C.; Mureșanu, F. (2016). Establishing the influences of the technology for cultivating soybeans, production and economic efficiency in the Turda area" Volume International Symposium on Agrarian Economics and Rural Development - Realities and Perspectives for Romania, Bucharest, 7th edition, p: 124-129. ISSN 2285- - 6404, ISSN-L 2247-7187.
7. Ciorlăuș, A.T. (1983). Theoretical agro-phytotechnical problems applied, no.5.
8. Ciorlăuș, A.T., (1998). A confession of faith in support of the chemical control of weeds, 11th National Symposium on Herbology, Sinaia.
9. Daramola, O. S.; Adeyemi, O. R.; Adigun, J. A.; Adejuyigbe, C. O. (2019). Row spacing and weed management methods influences growth and yield of soybean. *Agric. Trop. Subt.* 52(2):59-71.
10. Imolame, E. A. (2014). The effects of different weed control methods on weed infestation, growth and yield of soybeans (*Glycine max* (L) Merrill) in the southern guinea savanna of Nigeria. *Agro Search.* 14(2):129-43.
11. L.S. Muntean, L.S.; Axinte, M.; Borcean, I.; Roman Gh., (1995). Phytotechnics, EDP, Bucharest.
12. Rusu, T.; Bogdan, I.; Moraru, P.I.; Pop, A. I.; Oroian, I.; Marin, D. I.; Ranta, O.; Stănila, S.; Geres, M.; Duda, M.; Mogoșan, C. (2013). The influence of minimum cultivation systems on the control of *Convolvulus arvensis* L. over wheat, maize and soybeans. *Journal of Food, Agriculture & Environment*, Vol. 11, Edition 2: 563-566.
13. Șimon, A. (2022). Climate characterization of June and July of the last decade for the Turda area. *Transylvanian Agriculture, Bulletin*, no. 37, p.9-14. ISSN 1454-7287. Ed. SC ELA Design SRL Turda. Șimon, A.; Rezi, R.; Urdă, C.; Ceclan, A.; Chețan, F.; Bărdaș, M. (2023). Degree of understanding a variety culture according to the sowing date. *Transylvanian Agriculture, Bulletin*, no. 39, September 2023. ISSN 1454-7287. Ed. SC ELA Design SRL Turda.
14. Ulinici, A., (1983). Integrated weed control in the buying crop, General aspects. Theoretical and applied agro-phyto-technics problems, no. 4, vol. V.
15. Turda Meteorological Station (longitude: 23°47' ; latitude 46°35' ; altitude 427 m)
16. Poly Fact, (2015). ANOVA and Duncan's Test PC, Program for variant analyses made for completely randomized Poly factorial experiences. USAMV Cluj-Napoca.
17. <https://www.agro-business.ro/piata-mondiala-a-soiei/2015/04/22/>.
18. <https://www.cotidianulagricol.ro/adaptabilitatea-buruienilor-o-problema-pentru-agricultura>
19. <https://www.agro.basf.ro/ro/stiri/basf-in-camp/combatare-boli-buruieni-soia.html>