COMBATING WEEDS IN MEADOWS WITH REFERENCE TO CIRSIUM VULGARE SPECIES

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Abstract: The meadow is the land surface covered with grassy vegetation, made up mostly of perennial plants, belonging to different botanical families, whose production is used in animal nutrition, by grazing or mowing. *Cirsium vulgare*, spear thistle, bull thistle or common thistle , is a species of the genus Asteraceae Cirsium, widespread throughout Europe, West Asia and North-West Africa. Since we have a target species *Cirsium vulgare*, in the choice of herbicides we had to take into account the active substances of the herbicides and the weeds that combat. At the same time, the dose and the optimal period of application must be respected, and the administration of herbicides must be correct and uniform, thus using a wide range of simple or combined herbicides. The main type of soil found in Câmpia Ierului is leached chernozem (argic). This type of soil prevails in the entire Transylvanian Plain. From the results obtained after experimentation, we notice that through agrotechnical methods of correcting the properties of the soil, a reduced number of plants per m^2 was obtained, and among the chemical methods used, herbicides based on acid 2.4 D, dicamba and clopilarid were the most effective in combating invasive weeds such as *Cirsium vulgare.*

Keywords: meadow, vegetation, soil, fighting, herbicide;

INTRODUCTION

Cirsium vulgare, the spear thistle, bull thistle or common thistle, is a species of the Asteraceae genus *Cirsium*, widespread throughout Europe, western Asia and northwestern Africa. It is also found in North America, Africa and Australia and is an invasive weed in some areas.

Some results have shown that the species has a marked global tendency to expand into warmer climates with less seasonality, although in some regions its invasiveness appears to be less than in others (Roman et al., 2023). The plant can reach a height of 1.5 m (but sometimes it can even exceed 2 m to 3 m). *Cirsium vulgare* seeds are produced in summer or fall and germinate in fall or spring. An experiment confirmed that wetting and drying can delay the germination of some *Cirsium vulgare* seeds (Doucet et al., 2011).

While most seeds die in the first year, deeply buried seeds can survive for 3 or more years (DiTomaso et al., 2013). Massive seed germination occurs when sufficient moisture is present, provided the seeds are also exposed to light. If these seeds are brought to the surface, they will not germinate (Michaux, 1984). Seeds have a low temperature for germination four weeks after they are spilled on the ground (Staden et al., 1995). In all years, over 45% of rosettes that were at least one year old delayed reproduction (Klinkhamer et al., 1987). Flower litter of *Cirsium vulgare* plants has been shown to inhibit the growth of seedlings of the same species at concentrations as low as 0.4% (g liter/g soil). Growth inhibition cannot be fully compensated by nutrient addition, indicating that autotoxicity may occur (Jong et al., 1985). The gall fly, *Urophora stylata*, was released in New Zealand in 1998 as a biological weed control agent of thistle, *Cirsium vulgare* (Scotch thistle). In the summer of 2018, a survey was conducted to assess the field host range of the biological control agent in New Zealand. A random selection of 18 pasture populations in sheep and/or beef production where *C. vulgare* was present was surveyed to quantify the intensity of attack (gall size relative to seed head size) on *C. vulgare* and the presence of attack on other thistles. Weeds within the same population at each location, seed heads were collected from *C. vulgare* and all other thistle species (*Cardueae*) present, which included *Cirsium arvense* (California thistle), *Cirsium palustre* (C. bog), *Carduus nutans* (head thistle) and a species of Arctium (burdock). In addition to the attack on *C. vulgare*, the gall fly was recorded on *C. arvense* (at six locations) and *C. palustre* (at one location). The probability of presence of attack on *C. arvense* was positively correlated with the intensity of attack on *C. vulgare*, suggesting that attack on *C. arvense* is a "spillover effect" that occurs where *C. vulgare* seeds are in limited supply (Cripps, 2020).

It is considered a shrubby plant. Spear thistle has many medicinal properties and can be used as a survival food if necessary (Shahrajabian, 2021). A study reveals the potential antioxidant and antimicrobial activities, including some bioactive components, of *Cirsium vulgare* and implies that *Cirsium vulgare* has possible applications in the food and pharmaceutical industry as an antioxidant, antibacterial and antifungal agent (Kurc et al., 2023). Medicinal plants are particularly useful, and insects play an important role in the pollination process. Therefore, it is essential to analyze the insect pollinators associated with medicinally important plants. The *Cirsium* species is a weed with some very important medicinal properties (Badoni et al., 2021). Mehdi Farid says that the phytotherapeutic agents present in extracts derived from thyme and common thistle have shown positive effects in the inflammatory phase and on the repair process. The plant extract showed a positive effect on the macroscopic appearance of skin lesions in cattle only in the first days of treatment (Mehdi et al., 2023). Some results have shown that the medicinal plant *Cirsium vulgare* is an effective accumulator for the phytoremediation of soils contaminated with chromium (Dökmeci et al., 2020). The application of chemicals has a direct impact on the flora and fauna of the surrounding habitats and indirectly affects the species with which they interact. For example, high concentrations of fertilizer applied regularly to maintain high productivity in modern cropping systems have impacts on soil microbiota (Jangid et al., 2008) and on species diversity, community composition, and primary plant productivity (Gough et al., 1990; Borer et al., 2014).

Research also shows that direct soil improvement (i.e. with fertilizers) can cascade through food chains from plants to herbivores (Staley et al., 2013), including pollinators (Cardoza et al., 2012; Russo and Shea, 2020). Increasing land-use intensity, excessive nutrient input, overgrazing, pasture damage, poaching and fallow in fields, and under-management or over-cutting of linear features may have led to weed growth. (Maskel et al., 2020). The biological form of the species is the biennial hemicryptophyte ("H bienn"); they are plants with a biennial reproductive cycle by means of buds placed on the ground. In the first year they have a single rosette of

leaves, while in the second year they bloom completely. The family to which it belongs (*Asteraceae*) probably originating from South America, is the most numerous in the plant world, comprising over 23000 species distributed in 1535 genera.
Currently, the family (*Asteraceae*) is divided into 16 subfamilies (https://koaha.org/wiki/Cirsium_vulgare). The research was carried out in 2021-2022 in Cîmpia Ierului in the village of Hotoan, Satu Mare county.

The term "soil" defines the most superficial layer of the earth's crust, a layer that, suffering the long-term influence of numerous factors, has acquired a complex of properties that make it possible for plants to grow. These properties, commonly gathered in the notion of, fertility, ensures both the need for mineral nutrients and the plants' water consumption (Borlan et al., 1969).

The aim of the work is the study of the soil and the conditions in which the *Cirsium vulgare* species grows excessively; the study of the requirements of the *Cirsium vulgare* species in relation to the vegetation factors; researching the possibilities of combating the *Cirsium vulgare* species by methods: agrotechnical, mechanical and chemical.

MATERIAL AND METHOD

The research was carried out in 2021-2022 in Cîmpia Ierului in Satu Mare county. In order to determine the fertility properties - physical and chemical of the soil, modifiable under the influence of tillage, it was necessary to collect soil samples and field determinations. The study of the basic soil profiles was carried out up to a depth of 120 cm.

Since we have a target species *Cirsium vulgare*, in the choice of herbicides we had to take into account the active substances of the herbicides and the weeds they fight. At the same time, the dose and the optimal period of application must be respected, and the administration of the herbicides must be correct and uniform, using thus a wide range of simple or combined herbicides. To find out the result of the herbicides, 4 variants were made by chemical methods, 2 variants by mechanical methods and 2 variants by agrotechnical methods according to table 1.

Table 1.

Experimental variants

	The surface of a variant	Applied herbicide and active substance	Dose in l, g/ha	Weeds controlled
Variant I	50 m^2	Untreated	-	
Variant II	50 m^2	Harmony 50 sg. (thifensulfuron-metil 500 g/kg), Sulfonilureice	30 g/ha	*Cirsium arvense, Papaver rhoeas, Brassica Napus, Rumex spp., Galium aparine*
Variant III	50 m^2	Dicopur top 464 sl (344g/l acid 2.4 d din sdma+120 g/l dicamba)	1 l/ha	*Amaranthus retroflexus, Cirsium, Brasicca Nigra, Stelaria media*
Variant IV	50 m^2	Cliophar 600 SL (clopilarid 600g/l) picolinic derivatives	0.12 l/ha	*Cirsium arvense, Arthemis spp, Matricaria spp, Amaranthus spp, Xanthium spp*
Variant V	50 m^2	Sheep manure	100 kg	
Variant VI	50 m^2	Mowing		

Variant VII	50 m^2	Minced		
Variant VIII	50 m^2	Liquid amendment	5 l/ha	

Through the 8 experimental variants, the determination of the degree of weeding was followed, which was carried out with the metric frame according to the quantitative-numerical method. Determinations regarding the agrophysical indicators: Granulometric analysis (%) - the pipette method with the interpretation of the results after ICPA-Kacinski; Determinations regarding hydrophysical indicators of soil fertility: Soil moisture (U, %g). The gravimetric method was used by drying in an oven until the weight was constant and determining the amount of water lost; Determination of agrochemical and agrobiological indicators of soil fertility: Humus (%) - Walkley-Blak method in Gogoaşă modification; Humus reserve (t/ha): R.H. = ∑ HUMxHxD.a.; in which: HUM - % of humus, H - horizon thickness in cm, D.a., - apparent density in g/cm³: total N (%) - Kjeldahl method. Nitrogen index, - IN = HUM x VAh / 100; Mobile P (ppm) - in solution with ammonium lactate acetate at pH=3.75 by the colorimetric method; Mobile K (ppm) - in ammonium lactate acetate solution at pH=3.75 by the flame photometric method.
The chemical analyzes were done in the OSPA Cluj laboratory.

Table 2.

Physico-chemical examination (profile soil)

Sample identification		Name of analysis /UM												
No. Prob harvesting	Location	pH	N %	P Ppm	K ppm	Humus %	CaCO 3	Cond. el.S	Granulometric analysis				
									coarse sand	fine sand	dust 1	dust 2	clay
1	Hotoan Jd.Satu Mare	7.18	0169	3	224	3.94	3.1	0.14	0.49	31.74	6.28	7.33	53.76
2		7.96	0.115	1	150	2.07	3.2	0.25	0.33	37.92	6.24	7.12	48.39
3		7.92	0.058	3	194	0.45	1.8	0.31	0.46	39.29	7.32	7.73	45.20
4		7.96	0.061	6	194	1.04	2.8	0.23	0.30	28.16	8.17	8.17	55.20

Interpretation of the physical-chemical examination: pH: 7.18 – neutral; 7.96 ,7.92 - slightly alkaline; N: 0.169 - moderate supply 0.115 - weak supply; 0.058 0.061 - weak f. supply; Phosphorus: 3 1 6- poor f. supply; Potassium: 224 - good f. supply; 150 - moderate supply; 194 - good supply; CaCO3: 3.1; 3.2; 1.8; 2.8 - low carbonate content; Humus: 3.94 - medium content 2.07 - weak content; 0.45 - extremely weak content; 1.04 - weak f. content; Grain analysis: sample no. lab. 2, 3 and 5 - loamy clay texture, sample no. 1lab.4 - clay loam texture; Cond. el.: 0.14 - low content of soluble salts 0.25, 0.31, 0.23 - low content of soluble salts.

Soil profile composition: Am-Bt-C or Cca.
Horizon Am – is represented by a clay-loamy texture, with a neutral pH and a moderate supply of nitrogen (N), very poor supply of phosphorus (P), very good supply of potassium (K), with a low content of carbonates (CaCo3), medium content of humus and a very low content of salts.

Horizon A/B - is represented by a clay-loamy texture, with weak alkaline pH, with a weak supply of nitrogen (N), very weak supply of phosphorus (P), very good supply of potassium (K), with a low content of carbonates, low content of humus and a low content of soluble salts.

Horizon Bt - is represented by a clay-loamy texture, with a slightly alkaline pH, very poor supply of nitrogen (N) and phosphorus (P), good supply of potassium (K), with a low content of carbonates, extremely poor in humus and low in soluble salts.

Horizon C - is represented by a loamy-clay texture, with a slightly alkaline pH, very poor supply of nitrogen (N) and phosphorus (P), good supply of potassium (K), with a small content of carbonates, very poor content in Humus and low content of soluble salts.

Fig. 1. Soil profile

RESULTS AND DISCUSSIONS

The main type of soil found in the Câmpia Ierului is the leached chernozeum (argic). This type of soil prevails throughout the Transylvanian Plain. The chernozeums were formed under the conditions of the predominance of the variability of the herbaceous plants of the former meadows and steppes. The main qualities of chernozems are conditioned by the humus content (humiferous, moderately and weakly humiferous), the thickness of the profile (≈100 m) with humus content >1%,(according to table 3) the lack of soluble salts in the profile, the low content of carbonates, the granular, glomerular structure , hydrostable etc. Currently, chernozems are practically fully exploited, subject to various degradation processes. The arable layer is destructured, subjected to compaction and dehumification. Bioaccumulation: less intense humification, less accumulation of humus than cambic chernoziomas. More intense elution and migration of colloids against the background of accentuated desirification. Clay illuviation determined by the illuviation of the clay fraction and deposition in the horizon. underlying with formation of clay films on the surface and inside the structural aggregates.

Table 3.

Physico-chemical examination (variants)

No.	Collection sample no	PH	Humus, %	Phosphorus, ppm	Potassium, ppm	Azote, %
1	Variant I	6.27	2.69	5.24	100	0.0198
2	Variant II	6.68	3.32	4.98	150	0.0198
3	Variant III	6.38	2.99	4.73	75	0.0099
4	Variant IV	6.25	2.78	4.23	75	0.0099
5	Variant V	7.82	1.90	43.89	2750	0.0099
6	Variant VI	6.36	3.09	4.53	75	0.0199
7	Variant VII	6.05	3.79	4.03	75	0.0198
8	Variant VIII	7.05	4.45	10.44	175	0.0198

Cirsium vulgare prefers soils with a neutral or slightly alkaline pH, with a poor supply of N (nitrogen) and P (phosphorus), a good supply of K (potassium), with a low content of $CaCO_3$ (carbonates), and a low content of salts soluble.

Table 4.

Experimental variants (before/after application)

	Year 2021 Plants/m^2 *Cirsium vulgare*		Year 2022 Plants/ m^2 *Cirsium vulgare*	
	Before	After	Before	After
	Aplication		Aplication	
Variant I	8	8	10	10
Variant II	14	14	13	12
Variant III	7	1	3	0
Variant IV	9	0	4	0
Variant V	1	1	0	0
Variant VI	3	3	4	3
Variant VII	4	4	4	4
Variant VIII	3	3	2	2

CONCLUSIONS

From the total surface of the Earth, of 51,010,000 thousand ha, dry land represents 29%. From the surface of the earth, arable represents 9.8%; permanent meadows 22.7% and forests 28.2%; which means that 60.7% is covered with vegetation and 39.3% is represented by other lands. According to the statistical yearbook from 1999, in Romania the area of permanent meadows is 4.872 million ha, their share in the total area is 20.4 % compared to the land surface of 21.2%, and compared to the agricultural surface 32.9%. The permanent meadows in our country are mainly spread in the hill and mountain regions, where they hold 74% of the surface of the pastoral fund. Depending on the type of grassland, in the absence of current maintenance and improvement works, the production of permanent grassland ranges between 0.5 and 3 t/ha S.U.

From the results obtained after the experimentation we notice that through agrotechnical methods of correcting the soil properties, a reduced number of plants per m^2 was obtained, and among the chemical methods used, the herbicides based on acid

2.4 D, dicamba and clopilarid were the most effective in combating invasive weeds such as C*irsium vulgare.*

Through the mechanical methods used, a good result was obtained, but for a short period of time, the weeds regenerating almost completely after a certain period.

REFERENCES

1. Aydın Kurç, M., Orak, H. H., Gülen, D., Caliskan, H., Argon, M., Sabudak, T. 2023. Antimicrobial and Antioxidant Efficacy of the Lipophilic Extract of Cirsium vulgare. Molecules, 28(20), 7177.
2. Badoni, A., Kumar, A. M., 2021. Quantitative assessment of anthophilous insects associated with medicinally important weeds plants of genus *Cirsium*. Indian journal of ecology, 48, 3, 731-738.
3. Borer, E., Seabloom, E., Gruner, D. et al., 2014. Herbivores and nutrients control grassland plant diversity via light limitation. Nature 508, 517–520. https://doi.org/10.1038/nature13144.
4. Borlan, Z., Boeriu, I., Nicolae, C., 1969. Ameliorarea solurilor acide, Edit. Agro-silvică, Bucureşti.
5. Cardoza, Y. J., Harris, G. K., Grozinger, C. M., 2012. Effects of soil quality enhancement on pollinator-plant interactions. Psyche: a journal of entomology, 2012, 1-8.
6. Cripps, M., Navukula, J., Kaltenbach, B., van Koten, C., Casonato, S., Gourlay, H., 2020. Spill-over attack by the gall fly, Urophora stylata, on congeners of its target weed, *Cirsium vulgare*. https://researcharchive.lincoln.ac.nz/items/4b460558-3d5d-47db-9beb-72fb18906b24
7. de Jong, T. J., Klinkhamer, P. G., 1985. The negative effects of litter of parent plants of Cirsium vulgare on their offspring: autotoxicity or immobilization?. Oecologia, 65, 153-160.
8. Ditomaso, J. M., Kyser, G. B., 2013 Weed Control in Natural Areas in the Western United States ,Weed Research and Information Center, University of California 544
9. Dökmeci, A. H, Adiloğlu, S., 2020. The Phytoremediation of Chromium from Soil Using *Cirsium Vulgare* and the Health Effects. Biosci Biotech Res Asia,17(3). Doi: http://dx.doi.org/10.13005/bbra/2857.
10. Doucet, C., Cavers, P., 2011. A Persistent Seed Bank of the Bull Thistle *Cirsium vulgare*, Canadian Journal of Botany 74(9):1386-1391.
11. Farid, M., Rahimian, Y., Alavi, M. 2023. Evaluation the effect of common thistle (*Cirsium vulgare*) and thyme (*Thymus vulgaris*) derived extracts on cutaneous lesions healing in Holstein heifers. Journal of Medicinal Herbs, 13(4), 49-54.
12. Gough, M. W., Marrs, R. H., 1990. A comparison of soil fertility between semi-natural and agricultural plant communities: Implications for the creations of species-rich grassland on abondoned agricultural land. Biological Conservation, 51(2), 83-96.
13. Jangid, K., Williams, M. A., Franzluebbers, A. J., Sanderlin, J. S., Reeves, J. H., Jenkins, M. B., et al., 2008. Relative impacts of land-use, management intensity

and fertilization upon soil microbial community structure in agricultural systems. Soil Biology and Biochemistry, 40(11), 2843-2853.
14. Klinkhamer, P. G., de Jong, T. J., Meelis, E., 1987. Delay of flowering in the'biennial'*Cirsium vulgare*: size effects and devernalization. Oikos, 303-308.
15. Maskell, L. C., Henrys, P., Pescott, O. L., Smart, S. M., 2020. Long-term trends in the distribution, abundance and impact of native "injurious" weeds. Applied Vegetation Science, *23*(4), 635-647.
16. Michaux, B., 1984. Biological control of Scotch thistle *Cirsium vulgare.* Biology, Environmental Science. Corpus ID: 88563165.
17. Román, J. C., Palaquibay, L. L., López, D. C., Santamaría, E. R., 2023. Modelos de nicho ecológico aplicados a invasiones biológicas: el caso de *Cirsium vulgare* Savi Ten. a través de los contienentes. Sur Academia: Revista Académica-Investigativa de la Facultad Jurídica, Social y Administrativa, 10(20), 27-42.
18. Russo, L., Buckley, Y. M., Hamilton, H., Kavanagh, M., Stout, J. C., 2020. Low concentrations of fertilizer and herbicide alter plant growth and interactions with flower-visiting insects. Agriculture, Ecosystems & Environment, 304, 107141.
19. Shahrajabian, M. H., 2021. Spear Thistle (*Cirsium vulgare* L.) and Ramsons (Allium ursinum L.), Impressive Health Benefits and High-Nutrient Medicinal Plants. Pharmacognosy Communications, 11(3), 168-171.
20. Stanley, D. A. 2013. Pollinators and Pollination in Changing Agricultural Landscapes: Investigating the Impacts of Bioenergy Crops (Doctoral dissertation, Trinity College Dublin).
21. Van Staden, J., Kelly, K. M., Ross, J. A., 1995. Changes in the germination requirements of Cirsium vulgare with storage, South African Journal of Botany 61(1): 1-4.
22. ***https://biblioteca.regielive.ro/proiecte/agronomie/cultura-pajistilor-si-a-plantelor-furajere-232274.html).
23. ***https://koaha.org/wiki/Cirsium_vulgare#.
24. ***https://researcharchive.lincoln.ac.nz/items/4b460558-3d5d-47db-9beb-72fb18906b24