Efficacy of herbicides for weed control in chamomile

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Experiments were conducted to assess the control of weeds with two PRE-EM (pendimethalin and ethofumesate) and one POST-EM (fluroxypyr-meptyl) herbicides used in chamomile. Pendimethalin (990 g a.i. ha^{-1}) and ethofumesate (1000 g a.i. ha^{-1}) were applied after crop sowing but before crop and weed emergence, while fluroxypyr-meptyl (258.48 g a.i. ha^{-1}) was applied when the weeds achieved 2-4 developed leaves and the chamomile was at an early stage of development. Herbicide efficacy was recorded 20 and 40 days after treatment (DAT) for PRE-EM and 15 and 30 DAT for POST-EM herbicides. Better control of most species was observed with POST-EM than with PRE-EM herbicides. Pendimethalin showed good efficacy (>90%) on *Abutilon theophrasti*, *Anagallis arvensis*, *Chenopodium album*, *Chenopodium hybridum*, *Chenopodium polyspermum*, *Rumex crispus*, and *Veronica persica*, while the efficacy of ethofumesate was less than 90% on all weed species. Fluroxypyr-meptyl showed 100% efficacy on *A. theophrasti*, *B. convolvulus*, *P. aviculare*, *R. crispus*, *S. nigrum* and *V. hederifolia* in 2017 and on *A. blitoides* in 2018. These results can help growers select PRE-EM and POST-EM herbicides for weed control in chamomile and enable sustainable management.

Keywords: ethofumesate; fluroxypyr-meptyl; pendimethalin; sustainable weed management

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1. INTRODUCTION

Chamomile (*Matricaria chamomilla* L. syn. *Matricaria recutita* L., *Chamomilla recutita* L. Rauschert) is the annual Asteraceae family medicinal and aromatic plant. This species is native to the temperate regions of Asia and Europe. In Serbia, it is cultivated on approximately 350-400 ha, while world production covers around 20,000 ha (Brdar-Jokanović et al., 2019). A positive characteristic of this species is that it thrives well on salty soils, where it absorbs salt and removes it from the soil (Brdar-Jokanović et al., 2019). Appropriate sowing time in Serbia is the autumn (end of August or during September), but it can also be sown in spring (Stepanović and Radanović, 2011). The harvest is usually realized in intervals during the period May – June (Brdar-Jokanović et al., 2019), because since all flowers not flowering at the same time (Stepanović and Radanović, 2011). Chamomile is one of the most ancient medicinal herbs, which is most widely used for a variety of healing applications (Astin et al., 2000), but also possesses cosmetic and food value (Wan et al., 2019). Traditionally, this species is used as an anti-inflammatory, antioxidant, mild astringent, and healing medicine to treat bruises, burns, canker sores gout, eczema, hemorrhoids, mastitis, neuralgia, rheumatic pain, sciatica, skin irritations, ulcers, wounds and other ailments (Awang, 2006). The flowers (*Chamonile flos*) and essential oils made this medicinal crop well-recognized worldwide by the pharmaceutical, cosmetics and food industries. The pharmacological effect is based on the presence of numerous biologically active components (over 120 components have been identified in chamomile essential oil) (Brdar-Jokanović et al., 2019). The flowers contain between 0.2 and 1.9% blue essential oil (Giannoulis et al., 2020) and the highest percentage is achieved in the phase of full bloom.

Yield losses due to weed competition are one of the most important problems in the cultivation of medicinal and aromatic plant crops. Namely, weeds cause yield losses of up to 45% in these crops (Upadhyay et al., 2012). Also, many studies have confirmed the impact of uncontrolled weeds in medicinal crops on the yield of essential oil and its composition (Dragumilo et al., 2025; Lazarević, Aćimović, et al., 2024; Lazarević, Vrbničanin, et al., 2024). Apart from reducing the flower yield and the quantity and quality of essential oils, weeds make

Table 1. Monthly weather conditions at the experimental field in 2017 and 2018.

Month	Precipitation (mm)		Average temperature (°C)	
	2017	2018	2017	2018
March	18.7	70.9	10.7	5.8
April	56.7	37.2	12.1	17.3
May	99.0	54.5	18.2	21.0
June	37.9	148.1	23.8	22.1
July	43.3	42.0	24.8	23.1
August	34.9	69.9	24.8	24.8
September	49.4	16.5	17.8	19.3
October	58.7	3.8	12.6	15.2

Table 2. Herbicides.

Treatment	Herbicide (a.i.)	Trade name	Application rate	Mode of action	HRAC classification
H1	pendimethalin	Zanat	3 L ha^{-1} (990 g a.i. ha^{-1})	Inhibition of Microtubule Assembly	3
H2	ethofumesate	Norton Super	2 L ha^{-1} (1000 g a.i. ha^{-1})	Very Long-Chain Fatty Acid Synthesis Inhibitors	15
H3	fluroxypyr-meptyl	Bonaca EC	0.72 L ha^{-1} (258.48 g a.i. ha^{-1})	Auxin Mimics	4
					5
C	Untreated control				

mechanical harvesting more difficult and may affect the quality of the final products by mixing with the harvested product. Uncontrolled weeds can reduce the yield of chamomile dry flowers by 34.4% (Singh et al., 1989). The critical period for weed removal (to avoid yield losses of more than 10%) in this crop is estimated by Wariyo et al. (2022) to be 40 to 60 days after crop emergence. This means that chamomile crops should be kept free from weeds during this period. Additionally, Singh (1997) has demonstrated that weed removal is necessary during the 5–11 weeks following chamomile sowing to achieve a higher yield of flowers and oil.

Weed control in medicinal plant crops is primarily based on the use of non-chemical measures, which is due to the increased activity of the Serbian state authorities in charge of checking medicinal plant raw materials according to the criteria established by the Rulebook on the Maximum Permitted Amounts (MDK) of plant protection product residues in food and animal feed, Official Gazette of the RS", No. 49/21 (2021). To obtain the right raw material of good quality, weeds are mostly controlled mechanically. Additionally, the use of organic and synthetic mulches in certain crops is a highly effective measure (Dragumilo et al., 2023; Dragumilo, Marković, Prijić, et al., 2024; Lazarević et al., 2020; Lazarević, Vrbničanin, et al., 2024; Matković et al., 2016). However, this method of weed control is not suitable for chamomile, while denser sowing is one of the possible ways to reduce the weediness of chamomile and thus reduce the losses caused by the presence of weeds (Jovanović-Radovanov et al., 2012; Kwiatkowski et al., 2020; Puhl et al., 2021) discussed methods of weed control in chamomile cultivation in Serbia and pointed out the applicability of herbicides in this crop. Given that until recently there were no officially registered herbicides for use on medicinal plants in Serbia, weed control in their plantations was mainly based on the use of non-chemical measures, primarily hoeing. Although this method of weed control is effective, due to the lack of manpower and funds to finance it, the need to find more acceptable ways to control weeds in these plantations was imposed. Since 2020, thanks to the legal possibility of recognizing registrations for plant protection products registered in the European Union, herbicides have become available for use in medicinal plants. Taking into account the aforementioned information, the present study aimed to investigate the efficacy of selected herbicides for weed management in the chamomile crop.

2. MATERIALS AND METHODS

The field experiments for comparative estimation of the efficacy of different herbicides (two PRE-EM and one POST-EM) for weed control in chamomile were carried out during two consecutive years: 2017 and 2018. These experiments were set up in Pančevo, Serbia (44°52'20.0"N, 20°42'04.7"E) at the field Institute for Medicinal Plant Research" Dr. Josif Pančić". The soil was prepared by deep plowing in autumn at a depth of 30 cm, after which the surface layer of the soil was shredded with a hand tiller. The soil is of the chernozem type. The monthly average air temperature and precipitation in 2017 and 2018 were obtained from the Hydrometeorological Service of the Republic of Serbia for the weather station nearest to the experimental field (Table 1). Chamomile was sown in spring according to the standard cultivation technology commonly used in this area. The experimental field in both years was heavily infested with broadleaf (mainly annual) weeds, which caused herbicide selection.

Experiments were set up according to standard OEPP/EPPO methods for herbicide efficacy testing, according to a randomized complete block design with four replicates. The area of the elementary plot was 25 m^2. The main data for applied herbicides are given in Table 2. All herbicides are applied at the field recommended rate following manufacturer directions (Table 2). PRE-EM herbicides were applied after crop sowing, but before crop and weed emergence. POST-EM herbicide was applied when the weeds achieved a 2-4 leaf stage and the chamomile was at an early stage of development. The herbicides were applied using a knapsack sprayer and TeeJet 1004 flat-fan nozzles to deliver a spray volume of 300 liters of water per hectare. Estimates of percent weed control based on the number of weed species were recorded 20 and 40 days after treatment (DAT) for PRE-EM and 15 and 30 DAT for POST-EM herbicides. Phytotoxicity was estimated visually. The number of weeds was determined by the square method using a 1×1 m frame. A classification of efficiency was carried out according to the criteria: weak efficacy (<75%), satisfactory efficacy (75-90%) and good efficacy (>90%).

3. RESULTS

A total of 29 weed species were identified in the experimental field in 2017, with a density of 11 species ≥ 3 species m^2 (Table 3). All species from this group were broadleaf and most of them were annuals (10 species). In 2018, weed species diversity was more pronounced with 41 identified species, while 11 species were represented with ≥ 3 species m^2 (Table 3). Most species were broadleaf species (10), while the number of grasses was lower (only 1). The dominant weed species (>10 plants m^2) in 2017 were *Ambrosia artemisiifolia*, *Chenopodium album*, and *Polygonum lapathifolium*, while in 2018 it was *Ch. album* and *Veronica persica*.

In field experiments, none of the applied herbicides had phytotoxicity on the chamomile crop, while weed control efficacy depended on herbicide and year (Table 4, Table 5). The efficacy of pendimethalin for most of the weed species present in the experimental field was better than the efficacy of ethofumesate (Table 4, 5). Namely, many weed species (*A. theophrasti*, *A. arvensis*, *Ch. album*, *Ch. hybridum*, *Ch. polyspermum*, *R. crispus* and *V. persica*) were more than 90% controlled by pendimethalin. The satisfactory efficacy (75-90%) of this herbicide was determined for *B. convolvulus*, *P. lapathifolium*, *S. nigrum*, and *V. hederifolia*, while for other present species weak efficacy (< 75%) was estimated. If the two perennial species present (*C. arvensis*, *S. halepense*) are excluded, the weakest effect of this herbicide was determined for the species *A. artemisiifolia* (2017: 34%; 2018: 0%). Ethofumesate did not show high efficacy on any of the weed species present in the experimental field (Table 4, 5), while

Table 3. Weed species in the experimental field during 2017 and 2018 with density ≥3 plant m^2.

Weed species	Family	Category	Life cycle	Number m^{-2}	
				2017	2018
Abutilon theophrasti	*Malvaceae*	Broadleafoadleaf	Annual	3.5	
Amaranthus blitoides	*Amaranthaceae*	Broadleaf Broad-	Annual		5.0
Ambrosia artemisiifolia	*Asteraceae*	Broadleaf	Annual	12.5	6.0
Anagallis arvensis	*Primulaceae*	Broadleaf	Annual		5.0
Bilderdykia convolvulus	*Polygonaceae*	Broadleaf	Annual	6.5	5.0
Chenopodium album	*Chenopodiaceae*	Broadleaf	Annual	18.5	17.0
Chenopodium hybridum	*Chenopodiaceae*	Broadleaf Broad-	Annual		5.5
Chenopodium polysper-	*Chenopodiaceae*	Broadleaf	Annual	3.5	
Convolvulus arvensis	*Convolvulaceae*	Broadleaf	Perennial		5.3
Polygonum aviculare	*Polygonaceae*	Broadleaf	Annual	5.0	
Polygonum lapathifolium	*Polygonaceae*	Broadleaf	Annual	14.0	
Rumex crispus	*Polygonaceae*	Broadleaf	Perennial	5.5	
Solanum nigrum	*Solanaceae*	Broadleaf	Annual	9.5	5.0
Sorghum halepense	*Poaceae*	Grass	Perennial		8.0
Veronica hederifolia	*Scrophulariaceae*	Broadleaf	Annual	4.5	
Veronica persica	*Scrophulariaceae*	Broadleaf	Annual	6.0	39.0
Viola arvensis	*Violaceae*	Broadleaf	Annual		4.0

Table 4. Comparative efficacy of different herbicides for control of dominant weed species in chamomile (2017).

Weed species	Assessment	Efficacy of herbicide (%)		
		H1	H2	H3
Abuthilon theophrasti	1st	57.1	57.1	100.0
	2nd	96.4	78.6	100.0
Ambrosia artemisiifolia	1st	0.0	16.0	68.0
	2nd	34.0	42.0	77.6
Bilderdykia convolvulus	1st	46.2	30.8	100.0
	2nd	88.5	30.8	100.0
Chenopodium album	1st	70.3	29.7	67.5
	2nd	99.3	51.4	67.5
Chenopodium polyspermum	1st	100.0	71.4	71.4
	2nd	100.0	85.7	85.7
Polygonum aviculare	1st	0.0	70.0	100.0
	2nd	70.0	85.0	100.0
Polygonum lapathifolium	1st	67.9	71.4	71.4
	2nd	83.0	78.6	71.4
Rumex crispus	1st	45.5	18.2	100.0
	2nd	100.0	36.4	100.0
Solanum nigrum	1st	31.6	36.8	100.0
	2nd	76.3	73.7	100.0
Veronica hederifolia	1st	11.1	0.0	100.0
	2nd	75.0	27.8	100.0
Veronica persica	1st	83.3	41.7	83.3
	2nd	100.0	45.8	95.8

Table 5. Comparative efficacy of different herbicides for control of dominant weed species in chamomile (2018).

Weed species	Assessment	Efficacy of herbicide (%)		
		H1	H2	H3
Amaranthus blitoides	1st	57.5	0.0	100.0
	2nd	70.0	45.0	100.0
Ambrosia artemisiifolia	1st	0.0	0.0	83.3
	2nd	0.0	0.0	83.3
Anagallis arvensis	1st	90.0	30.0	60.0
	2nd	100.0	60.0	60.0
Bilderdykia convolvulus	1st	85.0	20.0	90.0
	2nd	85.0	20.0	95.0
Chenopodium album	1st	88.2	20.6	64.7
	2nd	91.2	32.4	70.6
Chenopodium hybridum	1st	95.5	50.0	90.9
	2nd	97.7	56.8	90.9
Convolvulus arvensis	1st	0.0	2.4	4.8
	2nd	0.0	2.4	4.8
Solanum nigrum	1st	0.0	0.0	90.0
	2nd	40.0	15.0	95.0
Sorghum halepense	1st	0.0	0.0	0.0
	2nd	0.0	0.0	0.0
Veronica persica	1st	94.9	57.1	64.1
	2nd	100.0	82.7	87.2
Viola arvensis	1st	50.0	31.3	87.5
	2nd	56.3	71.9	93.8

its efficacy was satisfactory (75-90%) for several species (*A. theophrasti*, *Ch. polyspermum*, *P. aviculare*, *P. lapathifolium*, and *V. persica*).

POST-EM herbicide showed excellent efficacy on many species (Table 4, 5). Therefore, fluroxypyr-meptyl showed an efficacy of 100% on A. theophrasti, B. convolvulus, P. aviculare, R. crispus, S. nigrum and V. hederifolia in 2017 and on A. blitoides in 2018. High efficacy (>90%) of fluroxypyr-meptyl was observed on V. persica and B. convolvulus, respectively, in 2017. In 2018, fluroxypyr-meptyl also showed high efficacy on B. convolvulus, Ch. hybridum, S. nigrum, and Viola arvensis. The satisfactory efficacy (75-90%) of fluroxypyr-meptyl was estimated for A. artemisiifolia and Ch. polyspermum in 2017, as well as for A. artemisiifolia and V. persica in 2018. The efficacy of those POST-EM herbicides on other weed species present in the experimental field was weak (<75%).

4. DISCUSSION

The composition of weed species plays a key role in the selection of herbicides for their control. The weed community in the experimental field was more abundant in 2018 (41 species) than in 2017 (29 species), with the domination of annual broadleaf species. Detected dominant species (Table 3) in this study were mainly different from the dominant species detected in the peppermint crop in 2016 and 2017 in the experimental field of the Institute of Medicinal Plant Research "Dr Josif Pančić" (Dragumilo et al., 2023). Also, the listed species differ from the dominant species present in other medicinal plant crops (feverfew, lemon balm and peppermint) at the same location (Dragumilo, Marković, Mikić, et al., 2024).

Some studies confirmed the possibility of weed control in chamomile by herbicide application and estimated that the measure of weed control is the most economical and safe. Horn (1969) published the first finding on chemical weed control in chamomile in Germany. He concluded that the combination of chlorpropham and propazine was most promising thanks to good weed control and caused no phytotoxicity. Then, application of oxyfluorfen (0.4 kg h^{-1}) and pendimethalin (1.5 kg ha^{-1}) in chamomile resulted in higher dry flower heads yield and essential oil yield (Kewalanand and Pandey, 2001). Also, many herbicides (atrazine, chlorpropham, linuron, mecoprop, prometryn, propyzamide and trifluralin) were estimated as effective for weed control in chamomile (Singh et al., 2011). In our study, the efficacy of POST-EM herbicides was better than the efficacy of PRE-EM herbicides. Although weed composition was similar between years (Table 3), the effects of applied herbicides on some species were different. Also, the efficacy of ethofumesate for several species (*A. artemisiifolia*, *B. convolvulus*, *Ch. album* and *S. nigrum*) was better in 2017 than in 2018, except for *V. persica* which was better controlled by ethofumesate observed in 2018 than in 2017 (Table 4, 5). Better efficacy of PRE-EM herbicide in 2017 indicates more precipitation after herbicide application than in 2018. Differences between years for POST-EM herbicides were not as prominent as for PRE-EM herbicides. Efficacy of POST-EM herbicides was better than the efficacy of PRE-EM herbicides, which is probably the consequence of insufficient amounts of precipitation immediately after the application of PRE-EM herbicides. As it is well known that the efficacy of PRE-EM herbicides depends on several factors (weed density and composition, soil characteristics, weather conditions, etc), including the amount of precipitation (Jursík et al., 2020; Landau et al., 2021). If the two present perennial species (*C. arvensis* and *S. halepense*) are excluded, the weakest effect of PRE-EM herbicide was determined for *A. artemisiifolia* (2017: 34%; 2018: 0%). These results follow the findings of Mitrić et al. (2021), who studied the efficacy of metribuzin as PRE-EM herbicide in *A. artemisiifolia* control and determined high efficacy (>90%).

The none of the applied herbicides caused chamomile injury, indicating their selectivity for chamomile. This is contrary to findings of Schmatz et al. (2007) who noticed susceptibility of chamomile plants to pendimethalin if they used at the stage preemergence.

5. CONCLUSION

Selected PRE-EM (pendimethalin and ethofumesate) and POST-EM (fluroxypyr-meptyl) herbicides effectively control many broadleaf weed species in chamomile without phytotoxic effects on the crop. It can be concluded that weed control may vary according to the selected herbicide and environmental conditions. In general, the efficacy of POST-EM herbicides was better than the efficacy of PRE-EM herbicides, as a consequence of insufficient precipitation immediately after the application of PRE-EM herbicides.

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CONFLICT OF INTEREST

The authors declare that they have no financial and commercial conflicts of interest.

REFERENCES

Astin, J. A., Pelletier, K. R., Marie, A., and Haskell, W. L. (2000): Complementary and alternative medicine use among elderly persons: one-year analysis of Blue Shield Medicare supplement, *The Journal of Gerontology. Series A, Biological Sciences and Medical Sciences*, **55**(1), M4-9. https://doi.org/10.1093/gerona/55.1.m4

Awang, D. V. C. (2006): *Tyler's Herbs of Choice: The therapeutic use of Phytomedicinals*, Taylor & Francis Group, CRC Press, New York.

Brdar-Jokanović, M., Maksimović, L., and Adamović, D. (2019): Chamomile in Republic of Serbia, *Alternative Crops and Cultivation Practices*, **1**, 27–31.

Dragumilo, A., Đurović Pejčev, R., Božić, D., Sarić-Krsmanović, M., Vrbničanin, S., Rajković, M., and Marković, T. (2025): Impact of synthetic films and organic mulches on yield and quality of *Mentha piperita* L. essential oil, *Industrial Crops and Products*, **224**, 120356. https://doi.org/10.1016/j.indcrop.2024.120356

Dragumilo, A., Marković, T., Mikić, S., Prijić, Ž., Radanović, D., Rajković, M., and Božić, D. (2024): Korovska flora useva lekovitog bilja, *Zbornik radova, XII kongres o korovima i savetovanje o herbicidima i regulatorima rasta*, Veliko Gradište, 60.

Dragumilo, A., Marković, T., Prijić, Ž., Đurović Pejčev, R., Radanović, D., and Božić, D. (2024): Mulch strategies for weed management in peppermint (Mentha x piperita) cultivation, *Acta Herbologica*, **33**(1), 63–71. https://doi.org/10.5937/33ah-52272

Dragumilo, A., Marković, T., Vrbničanin, S., Prijić, Ž., Mrđan, S., Radanović, D., and Božić, D. (2023): Weed suppression by mulches in Mentha x piperita L., *Journal of Applied Research on Medicinal and Aromatic Plants*, **35**(1), 100499. https://doi.org/10.1016/j.jarmap.2023.100499

Giannoulis, K. D., Kamvoukou, C., Gougoulias, N., and Wogiatzi, E. (2020): *Matricaria chamomilla* L. (German chamomile) flower yield and essential oil affected by irrigation and nitrogen fertilization, *Emirates Journal of Food and Agriculture*, **32**(5), 328–335. https://doi.org/10.9755/ejfa.2020.v32.i5.2099

Horn, R. (1969): First results on chemical weed control in chamomilla (*Matricaria chamomilla* L.), *Die Pharmazie*, **24**, 170–173.

Jovanović-Radovanov, K., Radojević, R., and Petrović, D. (2012): Weed control methods in *chamomile production* in Serbia, *Proceedings of the seventh conference on medicinal and aromatic plants of southeast european countries (7th CMAPSEEC)*, Subotica, Republic of Serbia, 435–441.

Jursík, M., Kočárek, M., Kolářová, M., and Tichý, L. (2020): Effect of different soil and weather conditions on efficacy, selectivity and dissipation of herbicides in sunflower, *Plant, Soil and Environment*, **66**(9), 468–476. https://doi.org/10.17221/223/2020-PSE

Kewalanand, and Pandey, C. S. (2001): Chemical Weed Control in Chamomile (*Matricaria chamomilla L.*), *Indian Journal of Weed Science*, **33**, 156–159.

Kwiatkowski, C. A., Haliniarz, M., and Harasim, E. (2020): Weed infestation and health of organically grown chamomile (*Chamomilla recutita* L. Rausch.) depending on selected foliar sprays and row spacing, *Agriculture*, **10**(5), 168. https://doi.org/10.3390/agriculture10050168

Landau, A. C., Hager, G. A., Tranel, J. P., Davis, S. A., Martin, F. N., and Williams, M. M. (2021): Future efficacy of pre-emergence herbicides in corn (*Zea mays*) is threatened by more variable weather, *Pest Management Science*, **77**(6), 2683–2689. https://doi.org/10.1002/ps.6309

Lazarević, J., Aćimović, M., Đurović-Pejčev, R., Lončar, B., Vukić, V., Pezo, L., Roljević-Nikolić, S., Vrbničanin, S., and Božić, D. (2024): Linking weed control techniques to anti-inflammatory potential: Comparative analysis of *Angelica archangelic* L. root essential oil profiles, *Industrial Crops and Products*, **216**, 118656. https://doi.org/10.1016/j.indcrop.2024.118656

Lazarević, J., Dragumilo, A., Marković, T., Savić, A., and Božić, D. (2020): Weed control in angelica (*Angelica archangelica* L.), *Acta Herbologica*, **29**(2), 129–139. https://doi.org/10.5937/ActaHerb2002129L

Lazarević, J., Vrbničanin, S., Dragumilo, A., Marković, T., Đurović Pejčev, R., Roljević Nikolić, S., and Božić, D. (2024): Analysis of the Effects of Organic and Synthetic Mulching Films on the Weed, Root Yield, Essential Oil Yield, and Chemical Composition of *Angelica archangelica* L., *Horticulturae*, **10**(11), 1199. https://doi.org/10.3390/horticulturae10111199

Matković, A., Marković, T., Filipović, V., Radanović, D., Vrbničanin, S., and Božić, D. (2016): Preliminary investigation on efficiency of mulches and other mechanical weeding methods applied in *Mentha piperita* L. cultivation, *Lekovite Sirovine*, **36**, 61–74. https://doi.org/10.5937/leksir1636061M

Mitrić, S., Golić, D., Janjić, V., Božić, D., Kovačević, Z., Jovanović, V., and Kelečević, B. (2021): Efficacy of soil herbicides in controlling common ragweed depending on the amount and the number of days after herbicide application, *Acta Herbologica*, **30**(2), 91–103. https://doi.org/10.5937/actaherb2102091M

Official Gazette of the Republic of Serbia (2001), No. 49/21 (2021): Pravilnik o dokumentaciji koja se podnosi uz zahtev za izmenu, odnosno dopunu rešenja o registraciji sredstva za zaštitu bilja.

Puhl, A. J., Heldwein, A. B., Rosa da Silva, J., Moreira Salvadé, D., da Rocha, L., Leonardi, M., and Vila Meus, K. (2021): Yield of chamomile capitula and essential oil in competition with weeds in different spacings and sowing dates, *Comunicata Scientiae*, **12**, e3608. https://doi.org/10.14295/cs.v12.3608

Schmatz, R., Schakel, C., and Dick, C. (2007): Herbicide tests in camomile (*Matricaria recutita* L.) in Thuringia, *Gesunde Pflanzen*, **59**(4), 151–159. https://doi.org/10.1007/s10343-007-0170-2

Singh, A. (1997): Cultivation of *Matricaria chamomilla*, 241–253 *in* H. S. Handa and M. K. Kaul, eds., *Supplement to cultivation and utilization of aromatic plants*, Regional Research Laboratory (CSIR), Jammu-Tawi.

Singh, A., Singh, M., Singh, K., and Singh, D. V. (1989): Comparative efficacy of thiobencarb, nitrofen and oxyflurofen in German chamomile (*Matricaria chamomilla L.*), *Indian Perfumer*, **33**, 228–231.

Singh, Khanam, Misra, and Srivastava (2011): Chamomile (*Matricaria chamomilla* L.): An overview, *Pharmacognosy Reviews*, **5**(9), 82–95. https://doi.org/10.4103/0973-7847.79103

Stepanović, B., and Radanović, D. (2011): *Tehnologija gajenja lekovitog i aromatičnog bilja u Srbiji*, Institut za proučavanje lekovitog bilja "Dr Josif Pančić," Belgrade.

Upadhyay, R., Baksh, H., Patra, D., Tewari, S., Sharma, S., and Katiyar, R. (2012): Integrated weed management of medicinal plants in India, *International Journal of Medicinal and Aromatic Plants*, **1**(2), 51–56.

Wan, W. T., Song, Y. J., Xu, L. J., Xiao, P. G., and Miao, J. H. (2019): Research Review and Application Prospect Analysis of Matricaria, *Modern Chinese Medicine*, **21**, 260–265.

Wariyo, A., Abayechaw, D., and Guteta Bayisa, N. (2022): Determination of Critical Weed Competition Period in Chamomile (*Matricaria chamomilla* L.) Production at Wondo Genet, Southern Ethiopia, *Global Academic Journal of Agriculture and Biosciences*, **4**(2), 13–21. https://doi.org/10.36348/gajab.2022.v04i02.001