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EFFECTS OF ORGANIC AND MINERAL FERTILIZERS ON GROWTH AND FLOWERING OF YOUNG LAVENDER (*LAVANDULA ANGUSTIFOLIA* MILL.) PLANTS

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Abstract

Although lavender grows in its native environment in rocky and poor soils, various studies have shown that it responds positively to fertilizers, increasing not only the yield but also the quantity and quality of the essential oil. In order to determine the most effective type of fertilizer - organic or mineral, young plants of the Sevtopolis lavender cultivar were tested in a field experiment conducted in the village of Răduleşti, Ialomiţa County, in south-east of Romania. Fertilizers were applied before vegetation, using either yard waste compost or a mineral fertilizer containing 11-11-21 macronutrients and micronutrients. The results showed that in the first year of growth, the mineral fertilized plants had grown less. Floral initiation and flowering period were not influenced by the type of fertilizers. The length of flowering stem and the size of inflorescence were smaller in case of mineral fertilization but the number of inflorescences was significantly lower in lavender plants fertilized with compost.

Key words*: chemical fertilization, Lavandula angustifolia Mill., phenology, sandy soil, yard waste compost.*

INTRODUCTION

Habitat conditions provide essential information about species preferences and establish a starting point for their cultivation in other regions. Although *Lavandula angustifolia* Mill. grows wild in Mediterranean region, characterized by hot and dry summers, followed by cool and wet winters, it showed a great adaptability to other climates (King et al., 2012; Jamoldinovich & Yorkulovich, 2021; Peçanha et al., 2021; Manushkina, 2023). However, before 2010, lavender was not a crop of interest for Romania (Vijulie et al., 2022), especially due to the winter frosts that partially or totally damaged the plants even in the warmest regions of the country. After this year, due to the climate changes and the introduction of new cultivars, it can be cultivated in almost any region of Romania. Lavender is more and more cultivated today, especially in the southern Romania (Vijulie et al., 2022), where dry and hot summers are followed by mild and poor in precipitations winters (Bogdan et al., 2008; Marinica & Marinica, 2019; Marinica et al., 2021; Nagavciuc et al., 2022). This dry climate restricted certain traditional crops, such as wheat or maize. But it is not only the extended periods of droughts and poor irrigation that forced farmers to take action and test other crops, but also the soil characteristics that are affected every year by this climate (Bălteanu & Popovici, 2010). Among various types of soils, in dry climates sandy soils are more susceptible to loss of fertility, erosion and desertification (Dregne, 1986).

Naturally lavender occur on rocky, calcareous and poor soils, but different studies have revealed its plasticity on different soils (Zhelijazkov & Nielsen, 1996; Kotsiris et al., 2012; Najar et al., 2019; Vidican et al., 2023) and positive reaction to fertilizers (Biesiada et al., 2008; Mirrabi et al., 2014; Camen et al., 2016; Chrysargyris et al., 2017; Skoufogianni et al., 2017; Komnenić et al., 2020; Kvaternjak et al., 2020; Minev, 2020; Mavandi et al., 2021; Pryvedeniuk et al., 2023). However, in dry climates, soil recovery from negative changes is more problematic and lower than in wet climates (Squires & Glenn, 2011). Therefore, on such soils, even for drought resistant crops adapted to low fertility soils such as lavender, organic fertilization is essential for their resilience. Soils rich in organic matter tend to preserve better the water and consequently make more efficient use of rainfall or irrigation by crops (Bot & Benites, 2005).

As other plants from Mediterranean region, lavender grows on soil with low content of organic matter. Despite of this fact, organic fertilization proved to increase not only the flower yield (Seidler-Łożykowska et al., 2014; Skoufogianni et al., 2017; Komnenić et al., 2020), but also have influence on essential oil content (Mavandi et al., 2021; Dobreva et al., 2023).
In the current study, a field experiment was set up in south-eastern Romania on a sandy soil, in order to reveal the effects of organic fertilization versus mineral fertilization expressed by growth, flower initiation, flowering period and yield of young lavender plants.

MATERIALS AND METHODS

The study was conducted an experimental field situated in Rădulești village, south-eastern Romania (44°46'N, 26°21'E, 81 m a.s.l.) during 2021-2023. In this area, the climate is dry continental, with dry and hot summers, followed by mild winters with little precipitations.
Two years old rooted cuttings of *Lavandula angustifolia* 'Sevtopolis' were planted in November 2021, at 1 m inter-row distance and 0.50 m within row.
The soil of the experimental field was sandy, with a pH of 7.6 and both low in essential nutrients and humus (Table 1).

Table 1. Soil characteristics before treatments (0-30 cm)

Parameter	Data
Soil texture	Sandy loam
Sand (%)	64.4
Clay (%)	16.9
Silt (%)	18.7
pH (1:2.5)	7.6
EC (dS/m)	0.14
Organic carbon (%)	0.31
Humus (%)	1.98
N (%)	0.02
P (ppm)	7.0
K (ppm)	123

Lavender plants were differentially fertilized, organic and mineral, before vegetation in April. Organic fertilization with yard waste compost was achieved using 60 t ha^{-1}. The compost was obtained within the University of Agronomical Science and Veterinary Medicine Bucharest, using leaves, grass clippings, weeds, woody pruning and waste from vegetable and flower plants collected from the campus park, fields and greenhouses. Mineral fertilization was applied using 400 kg/ha YaraMila Cropcare, which contains 11-11-21 NPK and micronutrients. In the study, an unfertilized control plot was used for comparison.
Plants were irrigated weekly during vegetation period. Weeds were controlled manually when necessary. No pest treatments were applied during study. No plant protection was applied in winter. After the first growing season, plants remain to be observed without any fertilization. Lavender plants were trimmed to 15 cm in the first season, before fertilization and to 25 cm in the second season of growth, in April.
Harvesting of inflorescences was initiated gradually as they reached the full flowering stage, in order to establish the natural duration of flowering.
The effect of organic and mineral fertilization on plants growth, flowering and dormancy were analysed using one-way ANOVA test. The statistical differences between means were estimated with the Least Significant Difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSIONS

Lavender plants were responsive at fertilization type (Table 2). In the first year of growth, mineral fertilized plants grew significantly less ($P>0.05$) than those organic fertilized.

Table 2. Growth parameters of *Lavandula angustifolia* 'Sevtopolis' under organic and mineral fertilization

Fertilization type	Plant height (cm)		Plant diameter (cm)	
	Year 2022	Year 2023	Year 2022	Year 2023
Organic	32.0 a	29.5 a	26.5 a	34.9 a
Mineral	28.0 b	29.3 a	23.8 b	35.4 a
Unfertilized	33.2 a	27.6 a	27.6 a	37.4 a
LSD	*1.89*	*1.71*	*2.40*	*3.58*

LSD - Least Significant Difference
All data within columns with the same letter are not statistically different at $P \leq 0.05$.

Mineral fertilizers tend to release nutrients quickly compared to organic fertilizers. Some researchers showed that growth of lavender plants depends on the level of nitrogen and phosphorus in the soil. Yasemin et al. (2017) found that the highest level of nitrogen (800 mg L^{-1} N) applied to young *Lavandula dentata* plants in pots had a significant negative effect on both their height and root length. Chrysargyris et al. (2016) showed that lower concentration of

phosphorus had a significant negative effect on the growth of lavender plants (*Lavandula angustifolia*) under hydroponic conditions.

In our study, organic fertilized plants (yard waste compost) were not significantly different in both height or diameter from unfertilized plants. In yard waste composts, the nitrogen content varies with the components that are mixed. Michel et al. (1993) showed that nitrogen losses by volatilization during composting when grass ratio increases in the mix. In an experiment conducted by Hue et al. (1994), yard waste compost was found to increase phosphorus availability to plants.

In the second season (year 2023), when lavender plants grew with residual fertilizers, they were almost the same in height and diameter.

The fertilization type did not significantly affect the occurrence and duration of phenological stages in the first phases of plants development (Table 3).

Table 3. Phenological response of lavender plants at organic and mineral fertilization

Fertilization type	Phenological stages (days)			
	Start of growth to bud initiation	Bud initiation to flowering	Last harvest to second flowering	Last harvest to dormancy
Organic	30.4 a	11.8 a	75.7 a	55.7 a
Mineral	29.8 a	12.1 a	90.4 b	46.7 b
Unfertilized	30.2 a	11.8 a	74.7 a	56.2 a
LSD	*0.92*	*1.03*	*1.58*	*4.66*

LSD - Least Significant Difference

All data within columns with the same letter are not statistically different at $P \leq 0.05$.

All lavender plants started their vegetation in the third decade of April, when the maximum air temperature was around 22-25°C. Floral bud initiation was noted on average after 30 days for all fertilization types. No significant differences were observed among variants in the number of days from bud initiation to flowering, on average 11.8 days for organic fertilized plants and 12.1 days for mineral fertilized ones.

Regardless fertilization type, all lavender plants had a second wave of flowering in the fall. However, mineral fertilization significantly delayed the second flowering of the plants. Compared to organic fertilization or unfertilized plants, mineral fertilized lavender opened their flowers on average of 90.4 days after the last harvest of the first blooming wave (almost two weeks later). Delay of flowering in lavender can be caused by high nitrogen content of the soil (Matysiak and Nogowska, 2016), which stimulate the vegetative growth.

Significant differences were also remarked for dormancy in mineral fertilized plants. After the last harvest of the second flowering, these entered into dormancy 10 days before both the unfertilized and organic fertilized plants.

Organic fertilized plants followed almost the same trend as unfertilized plants, with no significant differences in the phenological stages.

First flowering wave started in June for all plants independently of the fertilization type. Also, all plants recorded a second wave of flowering in the fall. Lavender 'Sevtopolis' has been reported as a late flowering cultivar compared to other Bulgarian cultivars (Stanev & Angelova, 2023) and the oil's quality from the second flowering is perfectly suitable for perfumery use (Zhekova & Nedkov, 2011). In our study, this cultivar reached maximum flowering in mid-June (Figure 1) independent of fertilization type. Its earliness can be explained by the higher temperatures recorded in the last decade during summer months, in south-east of Romania.

In the second flowering wave, organic fertilized plants and those unfertilized began to flower in mid-September. Mineral fertilized lavender started to flower two weeks later, in the first decade of October. However, the flowering period was not significantly influenced by the type of fertilization neither in the first, nor in the second flowering wave (Table 4).

The fertilization type had a significant impact on floral stems produced by the plants. The best flowering was recorded on unfertilized plants, from which 78.8 stems/plant were harvested during summer. At this time, organic fertilized plants produced a significantly lower number of 37.5 floral stems/plant. Various studies have shown that organic fertilizers generally increase the number of floral stems on the plant (Seidler-Łożykowska et al., 2014; Komnenić et al., 2020). However, some other research has revealed that lavender plants can react differently to composts and their dose (El-Ghadban et al., 2008; Mavandi et al., 2021; Shoeip et al., 2022). In our study, yard waste compost reduced flower production in the first flowering wave, but not in the second or subsequent year of studies.

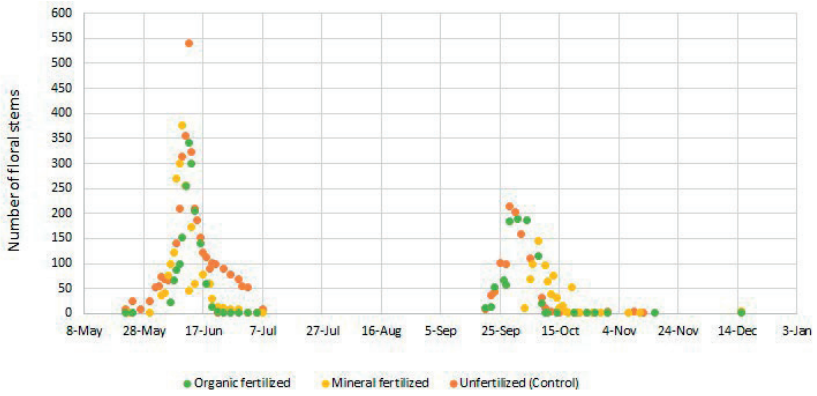

Figure 1. Flowering dynamics of *Lavandula angustifolia* 'Sevtopolis' under organic and mineral fertilization

Table 4. Flowering parameters of *Lavandula angustifolia* 'Sevtopolis' under organic and mineral fertilization

Fertilization type	Flowering duration (days)		Number of floral stems/plant		Stems length (cm)		Inflorescence length (cm)	
	1st wave	2nd wave	1st wave	2nd wave	1st wave	2nd wave	1st wave	2nd wave
Organic	36.0 a	46.4 a	37.5 a	10.5 b	19.2 a	13.0 b	8.2 b	8.0 b
Mineral	34.2 a	41.9 a	44.1 b	8.5 a	19.0 a	11.3 a	7.4 a	5.0 a
Unfertilized	34.7 a	38.4 a	78.8 c	12.0 c	21.7 b	11.5 a	9.0 c	5.5 a
LSD	*4.62*	*23.7*	*6.16*	*1.42*	*1.65*	*1.03*	*0.78*	*1.02*

LSD - Least Significant Difference
All data within columns with the same letter are not statistically different at $P \leq 0.05$.

All lavender plants, fertilized and unfertilized, produced fewer floral stems during autumn compared to summer. In autumn, only 12 floral stems/plant were harvested from unfertilized plants, but significantly more than mineral fertilized ones (8.5 floral stems/plant).

Various studies have reported a significant effect of macronutrients on the number of floral stems of *Lavandula* species. Potassium applied in the form of KCl has been shown to have a positive influence on the number of inflorescences in *Lavandula dentata* (Peçanha et al., 2023). Pryvedeniuk et al. (2023) reported in *Lavandula angustifolia* an increase of inflorescences yield by combining mineral fertilization with foliar application of nitrogen by 8.1%, phosphorus by 4.4%, potassium by 7.4% and NPK by 9.6%.

Floral stems had the same length in both types of fertilization, organic and mineral, but only for the first flowering wave. However, these were shorter than the floral stems of unfertilized plants. In the second flowering wave, organic fertilized plants had significantly longer floral stems of 13.0 cm compared to mineral fertilized or unfertilized plants, of 11.3 cm and 11.5 cm, respectively.

Organic fertilization stimulated the development of long inflorescences both in summer and in autumn, of 8.2 cm and 8.0 cm, respectively. Anyway, the greatest length of inflorescences was obtained in unfertilized plants, of 9.0 cm during the summer period. In the second flowering wave, these plants formed shorter inflorescences, of 5.5 cm. Mineral fertilization negatively influenced the inflorescence length in both flowering periods. These were significantly shorter than those formed by organic fertilized plants. Although with a shorter length, the inflorescences of mineral fertilized plants were denser and heavier. Therefore, fresh flower yield in 2022 was higher in mineral fertilized plants compared to organic fertilized ones, considering both flowering periods (Table 5). The second flowering during autumn was better for the organic fertilized plants, which recorded a yield of 86.1 kg.ha^{-1}. Anyway, it should be noted that the unfertilized plants achieved an almost double production of fresh flowers compared to both organic or mineral fertilized plants.

Table 5. Fresh flower yield under organic and mineral fertilization

Fertilization type	Yield in 2022 (kg.ha^{-1})		Yield in 2023 (kg.ha^{-1})	
	1st wave	2nd wave	1st wave	2nd wave
Organic	311.25	86.1	2990.4	644.43
Mineral	313.11	44.2	3510.9	662.11
Unfertilized	693.44	67.2	2870.0	640.08

In 2023, the highest yield was obtained in mineral fertilized plants, of 3510.9 kg.ha^{-1} in the summer and 662.11 kg.ha^{-1} in the fall. Organic fertilized plants also exceeded the yield of unfertilized plants, both at the first harvest and the second harvest.

Organic and mineral fertilization did not improve the yield in the first year when these were applied, but in the second year. These results indicate a delayed reaction of plants to fertilization in the tested conditions and can probably be explained by the priority in using resources for roots development over the aerial part, as a result of the growing conditions on sandy soil and hot summer.

CONCLUSIONS

Yard waste compost proved to be a fertilizer that can be used in lavender crops, but not superior to mineral fertilizer in terms of yield. The positive effects of this organic fertilizer were observed only one year after application, when the yield exceeded that of unfertilized plants. Further research is needed to establish the amount and frequency of using this green compost in order to obtain comparative or superior benefits to mineral fertilizers.

REFERENCES

Bălteanu, D., & Popovici, E. A. (2010). Land use changes and land degradation in post-socialist Romania. *Romanian journal of geography*, *54*(2), 95-107.

Biesiada, A., Sokol-Letowska, A., & Kucharska, A. (2008). The effect of nitrogen fertilization on yielding and antioxidant activity of lavender (*Lavandula angustifolia* Mill.). *Acta scientiarum Polonorum. Hortorum cultus*, *7*(2).

Bogdan, O., Marinică, I., Rusan, N., & Rusu, S. (2008). Warm winter risk in Romania. In *Conference on water observation and information system for decision support, BALWOIS* , 84.

Bot, A., & Benites, J. (2005). *The importance of soil organic matter: Key to drought-resistant soil and sustained food production* (No. 80). Food & Agriculture Org.

Camen, D., Hadaruga, N., Luca, R., Dobrei, A., Nistor, E., Posta, D., & Sala, F. (2016). Research concerning the influence of fertilization on some physiological processes and biochemical composition of lavender (*Lavandula angustifolia* L.). *Agriculture and Agricultural Science Procedia*, *10*, 198-205.

Chrysargyris, A., Panayiotou, C., & Tzortzakis, N. (2016). Nitrogen and phosphorus levels affected plant growth, essential oil composition and antioxidant status of lavender plant (*Lavandula angustifolia* Mill.). *Industrial Crops and Products*, *83*, 577-586.

Chrysargyris, A., Drouza, C., & Tzortzakis, N. (2017). Optimization of potassium fertilization/nutrition for growth, physiological development, essential oil composition and antioxidant activity of *Lavandula angustifolia* Mill. *Journal of soil science and plant nutrition*, *17*(2), 291-306.

Dobreva, A., Petkova, N., Todorova, M., Gerdzhikova, M., Zherkova, Z., & Grozeva, N. (2023). Organic vs. Conventional Farming of Lavender: Effect on Yield, Phytochemicals and Essential Oil Composition. *Agronomy*, *14*(1), 32.

Dregne, H. E. (1986). Desertification of arid lands. In *Physics of desertification* (pp. 4-34). Dordrecht: Springer Netherlands.

El-Ghadban, E. M., El-Tobgy, K., & Soliman, S. (2008). Response of lavender plant (*Lavandula multifida* L.) to compost and active dry yeast. *Journal of Productivity and Development*, *13*(1), 79-99.

Hue, N. V., Ikawa, H., & Silva, J. A. (1994). Increasing plant-available phosphorus in an Ultisol with a yard-waste compost. *Communications in Soil Science and Plant Analysis*, *25*(19-20), 3291-3303.

Jamoldinovich, K. J., & Yorkulovich, T. B. (2021). Methods of Fertility and Increasing of the Seeds of Medicinal Lavanda (*Lavandula officinalis* L.) in the Climate and Soil of Fargona Volley. *Annals of the Romanian Society for Cell Biology*, 3832-3837.

King, C. M., Robinson, J. S., & Cameron, R. W. (2012). Flooding tolerance in four 'Garrigue' landscape plants: Implications for their future use in the urban landscapes of north-west Europe? *Landscape and Urban Planning*, *107*(2), 100-110.

Komnenić, A., Jovović, Z., Velimirović, A. (2020): Impact of different organic fertilizers on lavender productivity (*Lavandula officinalis* Chaix). *Agriculture and Forestry, 66 (2)*, 51-56.

Kotsiris, G., Nektarios, P. A., & Paraskevopoulou, A. T. (2012). *Lavandula angustifolia* growth and physiology is affected by substrate type and depth when grown under Mediterranean semi-intensive green roof conditions. *HortScience*, *47*(2), 311-317.

Kvaternjak, I., Erhatić, R., Stojnović, M., Louis, A., & Jouve, A. (2020). Macroelement content of true lavender (*Lavandula angustifolia* Mill.) and lavender (*Lavandula× intermedia* Emeric ex Loisel.) in organic fertilization. *55th Croatian & 15th International Symposium on Agriculture,* 54-58.

Manushkina, T. M. (2023). Agroecological significance of cultivation of essential oil crops in the conditions of climate change in the zone of the Southern Steppe of

Ukraine. *Food security of Ukraine in the conditions of the war and post-war recovery: global and national dimensions. International Scientific and Practical Conference Mykolaiv*, c.90-92.

Marinică, A. F., Marinică, I., & Chimisliu, C. (2019). Climatic Variability in Southwestern Romania in the Context of Climate Changes during the Winter of 2018–2019. *Stud. Commun. Nat. Sci. Olten. Mus. Craiova*, *35*, 169-172.

Marinica, F. A., Marinica, I., & Chimisliu, C., (2021). The warm winter of 2020-2021 in south-west Romania in the context of climate change. *Oltenia, Studii si Comunicari Seria Stiintele Naturii*, *37*(1).

Matysiak, B., & Nogowska, A. (2016). Impact of fertilization strategies on the growth of lavender and nitrates leaching to environment. *Horticultural Science*, *43*(2), 76-83.

Mavandi, P., Abbaszadeh, B., Emami Bistgani, Z., Barker, A. V., & Hashemi, M. (2021). Biomass, nutrient concentration and the essential oil composition of lavender (*Lavandula angustifolia* Mill.) grown with organic fertilizers. *Journal of Plant nutrition*, *44*(20), 3061-3071.

Michel Jr, F. C., Reddy, C. A., & Forney, L. J. (1993). Yard waste composting: studies using different mixes of leaves and grass in a laboratory scale system. *Compost Science & Utilization*, *1*(3), 85-96.

Minev, N. (2020). Effect of foliar fertilization on the yield and quality of lavender (*Lavandula angustifolia* Mill.). *Journal of Mountain Agriculture on the Balkans*, *23*(2), 248-261.

Mirrabi, H., Abbaszadeh, B., & Akbarzadeh, M. (2014). The effect of chemical and biological fertilizers on flower yield, leaf yield and essential oil of lavender (*Lavandula angustifolia*). *Journal of Medicinal Plants and By-products*, *1*, 85-87.

Nagavciuc, V., Scholz, P., & Ionita, M. (2022). Hotspots for warm and dry summers in Romania. *Natural Hazards and Earth System Sciences*, *22*(4), 1347-1369.

Najar, B., Demasi, S., Caser, M., Gaino, W., Cioni, P. L., Pistelli, L., & Scariot, V. (2019). Cultivation Substrate composition influences morphology, volatilome and essential oil of *Lavandula angustifolia* Mill. *Agronomy*, *9*(8), 411.

Peçanha, D. A., Freitas, M. S. M., Vieira, M. E., Cunha, J. M., & de Jesus, A. C. (2021). Phosphorus fertilization affects growth, essential oil yield and quality of true lavender in Brazil. *Industrial Crops and Products*, *170*, 113803.

Peçanha, D. A., Freitas, M. S. M., Cunha, J. M., Vieira, M. E., & de Jesus, A. C. (2023). Mineral composition, biomass and essential oil yield of french lavender grown under two sources of increasing potassium fertilization. *Journal of Plant Nutrition*, *46*(3), 344-355.

Pryvedeniuk, N., Hlushchenko, L., Kutsyk, T., Shatkovskyi, A., Shatkovska, K., & Shevchenko, T. (2023). Influence of mineral fertilizers and planting density on the growth, development and yield of narrow-leaved lavender (*Lavandula angustifolia* Mill). *Poljoprivreda i Sumarstvo*, *69*(2), 165-180.

Seidler-Lozykowska, K., Mordalski, R., Kucharski, W., Kedzia, B., & Bocianowski, J. (2014). Yielding and quality of lavender flowers (*Lavandula angustifolia* Mill.) from organic cultivation. *Acta Scientiarum Polonorum. Hortorum Cultus*, *13*(6).

Shoeip, A. M., Hameed, A. E., Samia, M., Gad, D. A., & Aboud, F. S. (2022). Improving growth, yield and essential oil of lavander (*Lavandula officinalis*) L. by using compost and biofertilizer application in clay soil. *Egyptian Journal of Agricultural Research*, *100*(3), 357-370.

Skoufogianni, E., Giannoulis, K. D., Bartzialis, D., Tzouvara, D., & Danalatos, N. G. (2017). The effect of fertilization on *Lavandula angustifolia* L. yield in North Greece. In *VIII International Scientific Agriculture Symposium,"Agrosym 2017", Jahorina, Bosnia and Herzegovina, October 2017. Book of Proceedings* (pp. 1037-1043). Faculty of Agriculture, University of East Sarajevo.

Squires, V. R., & Glenn, E. P. (2011). Salination, desertification and soil erosion. *The role of food, agriculture, forestry and fisheries in human nutrition*, *3*, 102-123.

Stanev, S., & Angelova, D. (2023). Peculiarities in the flowering of the Bulgarian varieties of lavender (*Lavandula angustifolia* Mill.). *Bulgarian Journal of Crop Science, 60(1)*, 78-83.

Vidican, R.; Mihăiescu, T.; Pleșa, A.; Mălinaș, A.; Pop, B. The phytoremediation potential of *Lavandula angustifolia* Mill. grown in soils historically polluted with heavy metals: A case study from Baia Mare, Romania. Journal of Applied Life Sciences and Environment 2022, 55 (4),495-504.

Vijulie, I., Lequeux-Dincă, A. I., Preda, M., Mareci, A., & Matei, E. (2022). Could Lavender Farming Go from a Niche Crop to a Suitable Solution for Romanian Small Farms? *Land*, *11*(5), 662.

Yassemin, S., Ozkaya, A., Koksal, N., Gok, B. (2017). The effect of nitrogen on growth and physiological features of lavender. In *Proceedings of the International Congress on Medicinal and Aromatic Plants - "Natural and Healthy Life"*, Konya, Turkey, 746–754.

Zhekova, G., & Nedkov, N. (2011). Profile of lavender oil from second harvest. *Agricultural Science and Technology*, 3(2), 121 – 122.

Zheljazkov, V. D., & Nielsen, N. E. (1996). Studies on the effect of heavy metals (Cd, Pb, Cu, Mn, Zn and Fe) upon the growth, productivity and quality of lavender (*Lavandula angustifolia* Mill.) production. *Journal of essential oil research*, *8*(3), 259-274.