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RESEARCH REGARDING THE AMOUNT OF FLOWERS AND AERIAL PARTS OF LAVENDER ACCORDING TO PEDOCLIMATIC CONDITIONS

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Abstract

The present study refers to the amount of fresh flowers (inflorescence) and fresh aerial parts of lavender (herba), depending on the year of cultivation and pedoclimatic conditions. The study was carried out in 3 locations: Deta City (Timiş County), Mailat locality (Arad County) and Vinga locality (Arad County), on different soils. The amount of fresh flowers per plant and per hectare ranged from 70 grams/plant to 1322 kg/hectare at Deta and between 82 grams/plant and 1476 kg/hectare at Vinga, in the second year and between 214 grams/plant and 3638 kg/hectare at Deta and between 245 grams/plant and 4375 kg/hectare at Mailat in the third year. Regarding the amount of fresh herba per plant and per hectare, they ranged from 140 grams/plant to 2380 kg/hectare at Deta and between 162 grams/plant and 2916 kg/hectare at Vinga, in the second year and between 411 grams/plant and 6987 kg/hectare at Deta and between 487 grams/plant and 4696 kg/hectare at Mailat, in the third year.

Key words*: aromatic plant, crop yield, Lavandula sp.*

INTRODUCTION

Lavender is an aromatic shrub of Mediterranean origin, used for therapeutic, ornamental or food purposes, as a spice, but consecrated through its use in the cosmetics and perfume industry, thanks to its high content of essential oils and their quality (Kara & Baydar, 2013; Imbrea et al., 2016; Sönmez et al., 2018; Giray, 2018; Mac & Harris, 2002; Butta et al., 2023).
Lavender flowers are the main source of essential oils, which are rich in compounds such as linalool and linalyl acetate (Zuzarte et al., 2013; Guriță et al., 2019). According to a recent study, these compounds are responsible for lavender's aromatic properties and its therapeutic effects, including anxiolytic, sedative, and antimicrobial activities (Rus, et al., 2016). The flowers are harvested at flowering when the concentration of these volatile compounds reaches its peak, optimizing the yield and quality of the oil (Mason 2014; Lucean et al., 2018).
In addition to oil production, lavender flowers play an essential role in pollination and biodiversity. Recent studies have demonstrated that lavender flowers attract a variety of pollinators, including bees and butterflies, improving the health of the local ecosystem (Espinosa & Bieski, 2014; Passalacqua et al., 2017; Beicu et al., 2023*).* Additionally, lavender's floral morphology has been linked to drought tolerance, allowing it to thrive in arid climates, as noted (Kazan & Manners, 2011; Hawke, 2017).
Lavender herb, which includes stems, leaves, and flowers, is valued not only for its essential oil but also for its bioactive compounds. A review by Cavanagh and Wilkinson (2002) in Phytotherapy Research highlights the antioxidant, anti-inflammatory, and antifungal properties of the plant, which contribute to its use in traditional medicine to treat conditions such as insomnia, headaches, and skin infections (Upson, 2002; Upson & Andrews, 2004).
From an agronomic point of view, the yield of lavender biomass is crucial for both the production of essential oils and the dry herb market. Other studies indicates that plant yields are influenced by environmental factors such as soil type, irrigation, and climatic conditions, with optimal yields occurring in the second or third year of cultivation (Andrade et al., 1999; Gonciariuc et al., 2019).

MATERIALS AND METHODS

The study was carried out in three locations, namely Deta (Timiș County), Vinga and Mailat (Arad County). Biological material - the general objective of the research aims at the behavior of a variety of *Lavandula angustifolia* in conventional and organic cultivation in terms of the level of flower and herb production/individual obtained in different years. The year 2023 represents the first year of study and is the 2nd year after planting, and the year 2024 represents the 2nd year of study, namely the 3rd year after planting. In the first year after planting, no flowers were harvested from lavender plants to allow the development of the root system of the plant.

To determine the amount of lavender and herb/individual flowers, 25 individuals from each site were sampled and the stems were cut about 5-10 cm above the base of the plant**.** To obtain only the flowers, cut only the tips of the stem 3-5 cm below the inflorescence. The amount of flowers/individuals and the of herba/individuals were weighed, I mention that in 2024 as the plants were mature, the woody stems were removed before weighing. To determine the number of flowers and herba/plant, the number of cuttings per ha was taken into account and the average quantity resulting from the determinations of the 25 individuals was multiplied by the number of cuttings.

The ideal soil for a lavender plantation must be well drained and with a clayey or sandy structure – thus the plantation in Deta, Timiș county is located on a chernozem-type soil, the one in Mailat locality in Arad County on a reddish-brown forest soil and the one in Vinga locality in Arad County on a brown forest soil.

Cultivation technology: at the establishment of the plantations, the soil tillage consisted of an autumn ploughing (basic soil tillage) at a depth of 30 cm, then shredding and leveling works were carried out in order to keep the surface clean of weeds. Before the actual establishment of the plantation (planting), a superficial preparation of the land was carried out with the combiner. Before planting, the land was marked and staked according to the planting scheme established with a planting norm that varied between 17000 and 18000 cuttings per ha. For the establishment of the plantations, the use of cuttings was chosen, knowing that this option ensures a better stability of the crop both in terms of growth and development, as well as its productivity. The planting was carried out manually with cuttings of *Lavandula angustifolia* Vera in the autumn of 2021 in pits with a depth of 15 cm, using trimming as a cleaning process (cutting the tips of the shoots and roots) followed by sludge and then planting. For the maintenance of the crop, between 8 and 10 mechanical pruning between the rows and manual pruning between plants were carried out starting with April of each year.

The harvest was carried out at full flowering when at least 75% of the information was opened - technical ripening in the second half of June, since in this phenophase the volatile oil content is at the highest level. It should be noted that the harvest was carried out in the morning, between 7 and 11 a.m., in sunny weather conditions, without wind, dew or fog, in order to preserve and ensure in optimal parameters, the quantity and quality of the volatile oil in the inflorescences.

RESULTS AND DISCUSSIONS

The results of the research on the number of flowers/plant according to the experimental year are presented in Table 1.

The results of the research on the amount of Flowers/Plant in lavender according to the crop year (Table 1), show a significant increase in the amount of flowers per plant between the crop years 2023 and 2024: the year 2023 - 77g flowers/plant, the year 2024 - 230 g flowers/plant, the difference of 153 g flowers/plant, is distinctly significant.

This significant increase ($p < 0.01$) can be attributed to several factors. First of all, lavender, as a perennial, shows a progressive increase in biomass and flowering capacity as the root system develops and the plant adapts to pedoclimatic conditions. Thus, in the second year of study (2024) year - 3 after planting, the plants benefit from a better developed root system, which allows them a more efficient absorption of nutrients and water, which translates into more abundant flowering.

It is also possible that inter-annual climate variations contributed to this significant difference. Favorable weather conditions in

2024, such as a higher average temperature during the growing season and an optimal rainfall regime, could explain this substantial increase in the amount of flowers.

Statistical tests confirm the robustness of the difference: the value of the significant difference at 5% (LD5% = 30.53) is far exceeded by the observed difference (153 g flowers/plant), emphasizing the importance of the crop year as a determining factor.

Table 1. Amount of flowers/plant depending on the cultivation location

Year of Culture	Flowers/ plant (g)	%	Difference	Significance
A1 – 2023	77	100		
A2 - 2024	230	299	153	**
Dl 5%= 30.53, Dl 1%= 70.41, Dl01%= 224.12				

The amount of flowers/plant depending on the cultivation location is shown in Table 2. The comparative analysis of the three crop localities - Deta, Vinga, and Mailat - showed the following results: Deta (b1): 162 g flowers/plant; Vinga (b2): 156 g flowers/plant; Mailat (b3): 142 g flowers/plant.

Table 2. Amount of flowers/plant depending on the cultivation location

Locality	Flowers/ plant (g)	%	Difference	Meaning
b1 - Deta	142	100		
b2 - Vinga	156	110	14	Ns
b3- Mailat	162	114	20	Ns
Dl 5%= 37.39, Dl 1%= 86.24, Dl01%= 274.49				

TEST DUNCAN - factor B, DL5% = 37.39

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Date originale                    Date sorate
 Mean    1 =    142.0  A    Mean    3 =    162.0  A
 Mean    2 =    156.0  A    Mean    2 =    156.0  A
 Mean    3 =    162.0  A    Mean    1 =    142.0  A
```

Mean 1 – b1 – Deta
Mean 2 – b2 – Vinga
Mean 3 – b3 – Mailat

Although there are numerical variations between localities, they are not statistically significant, as indicated by the Duncan test, where all averages are classified in the same statistical group (A). The differences recorded are below the limit of the significant difference at 5% (LD5% = 37.39), which suggests a homogeneity of edaphic and climatic conditions between the three locations.

This homogeneity is explained by the similarity of the pedological characteristics (soil texture, pH, organic matter content) and climatic characteristics (average temperature, precipitation) of the three localities. At the same time, the applied culture technology was uniform in all three locations, which contributed to reducing the variability between locations.

The contribution of factors A [crop year] and B [crop locality] on the amount of flowers/plant in lavender is shown in Figure 1. The graph of the contribution of the factors reveals the contribution of each factor analyzed to the total variability of the quantity of flowers/plant: Crop year (Factor A): 96.44%; Locality (Factor B): 1.13%; Experimental error: 0.42%.

These results show that the year of cultivation is the main determining factor in the variation of the amount of flowers/plant. Its contribution of 96.44% indicates an overwhelming influence, which is typical for perennial crops in which plant age and annual climatic conditions play a key role.

The locality, with a contribution of only 1.13%, does not exert a significant influence on flower production, which can be interpreted as evidence of lavender's adaptability to a wide range of pedoclimatic conditions or as a consequence of similar soil and climate conditions in the analyzed locations.

The low experimental error value (0.42%) reflects a rigorous experimental design and proper management of variables, ensuring high reliability of the results obtained.

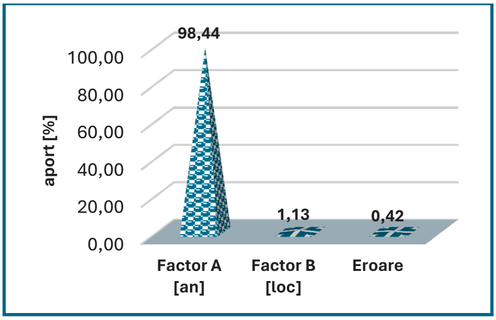

Figure 1. Contribution of factors A [crop year] and B [crop locality] on the amount of flowers/plant in lavender

The results of the research on the amount of herb/plant according to the experimental year are presented in Table 3. The year 2023 represents the first year of study and is the 2nd year after planting, and the year 2024 represents the 2nd year of study, namely the

3rd year after planting. The data indicate a significant increase in the amount of herb harvested per plant between crop years 2023 and 2024: 2023 (a1): 152 g/plant; 2024 (a2): 449 g/plant, the difference of 297 g/plant in the second year of study compared to the first year is statistically ensured as distinctly significant, indicating that the results are not due to chance, but real and measurable factors. The almost threefold increase in the amount of herb/plant between 2023 and 2024 reflects both the positive effect of plant maturation and the favorability of pedoclimatic conditions. Lavender, as a perennial species, presents a natural growth dynamic in which the first 1-2 seasons are intended for stabilization and development of the root system. After this period, the plants reach a maximum production potential.

Table 3. Amount of herb/plant by year of cultivation

Year of Culture	Herb/Plant (g)	%	Difference (g)	Significance
A1 - 2023	152	100		
A2 - 2024	449	295	297	**
Dl 5%= 79.96, Dl 1%= 184.44, Dl01%= 587.04				

In addition to the effect of plant age, the significant increase in biomass in 2024 can be attributed to agronomic and climatic factors such as: favorable weather conditions: a warmer and wetter spring that favored vegetative growth; adaptation of plants to the growing environment: as the plants acclimatize, the yield increases.

The results of the research on the amount of herb/plant according to the cultivation location are presented in Table 4.

Table 4. Amount of herb/plant depending on the cultivation location

Locality	Herb/ Plant (g)	%	Difference (g)	Meaning
b1 – Deta	275.5	100		
b2 - Vinga	305.5	111	30	Ns
b3 – Mailat	320.5	116	45	Ns
Dl 5%= 97.33, Dl 1%= 225.89, Dl01%= 718.98				

The comparative analysis of the three locations (Deta, Vinga, and Mailat) showed the following results: Deta (b1): 275.5 g/plant; Vinga (b2): 305.5 g/plant and Mailat (b3): 320.5 g/plant. The differences observed between localities (30 g between Deta and Vinga and 45 g between Deta and Mailat) are not statistically significant (ns).

Although numerically Mailat recorded the highest production of herb/plant, followed by Vinga and Deta, these differences are statistically insignificant. This suggests a homogeneity of edaphic and climatic conditions between the three locations, and a high adaptability of lavender to various growing environments. Specifically, soil conditions (pH, texture, organic matter content) and climate (average temperature, rainfall regime) are similar between locations. The cultivation technology applied uniformly in all locations (fertilization, irrigation, phytosanitary management) has reduced the variability of production. Lavender exhibits high resilience to minor variations in environmental conditions.

The value of the significant difference at 5% for the locality factor (LD5% = 97.33 g) is considerably higher than the differences recorded between locations (30-45 g). This fact indicates a minor influence of the crop locality on the amount of herb/plant, emphasizing instead the determining role of the crop year and the conditions associated with it.

The results also suggest that the choice of locality has little impact on herba production, meaning that lavender can be successfully grown in a variety of locations, as long as the minimum soil and climate requirements are met.

Given the major influence of the crop year, farmers should focus their efforts on optimizing agrotechnical practices (fertilization, irrigation, disease and pest management) and monitoring climatic conditions to anticipate and adjust technological strategies.

The results of the research demonstrate that the crop year has a significant impact on the production of lavender herb, with a spectacular increase in biomass in the second year of cultivation. The locality of cultivation has a low, statistically insignificant influence, emphasizing the ability of lavender to adapt to a variety of edaphic and climatic conditions.

These findings can guide farm management decisions and help optimize yields in lavender crops, with a focus on adapting crop technologies to climatic conditions and maximizing the potential of plants in the long term.

DUNCAN TEST - factor B, LD5% = 97.93

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Original dates
 Mean 1 = 275.5 A Mean 3 = 320.5 A
 Mean 2 = 305.5 A Mean 2 = 305.5 A
 Mean 3 = 320.5 A Mean 1 = 275.5 A
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Mean 1 – b1 – Deta
Mean 2 – b2 – Vinga
Mean 3 – b3 – Mailat

As a result of the 3 comparisons [C_3^2], only one class A was obtained.

The DUNCAN test is used to compare the means of several groups and to identify significant differences between them. In this case, the analysis compares the amount of herb/plant depending on the locality of cultivation: b1 – Deta: 275.5 g/plant; b2 – Vinga: 305.5 g/plant and b3 – Mailat: 320.5 g/plant. All averages are accompanied by the same statistical letter (A), which indicates that the differences between the locations are not significant at the 5% significance level.

Although numerically there is a slight increase in the amount of herb/plant from Deta to Mailat, this difference is not large enough to be considered statistically significant. The lack of statistical significance indicates that the observed variations can be attributed to natural variation or other uncontrolled factors, rather than to actual differences between locations.

In Deta (275.5 g/plant) it has a slightly lower production compared to Vinga (305.5 g/plant) and Mailat (320.5 g/plant), but the differences are minor and do not reflect a clear agronomic advantage for a certain location. This homogeneity of the results can be interpreted as a high resilience of lavender to minor edaphic and climatic variations between these locations. This result can encourage farmers to adopt sustainable practices without significantly compromising production.

As variations between locations are insignificant, in order to increase productivity, the focus should be on optimising environmental and agrotechnical factors: controlled irrigation and efficient management of water resources; fertilization adapted to the specific needs of lavender and weed control and pest control

The results of the DUNCAN test indicate that the locality of cultivation does not have a significant impact on the amount of herba in lavender, which confirms the ability of this plant to adapt to varied conditions. This suggests that agronomic management strategies and annual (climatic) conditions are the key factors for optimising production.

Based on these results, farmers can consider lavender a flexible and resilient crop with the potential to grow in various environments without major differences in productivity.

The contribution of factors A [crop year], B [crop locality] on the amount of herb/plant is shown in Figure 2.

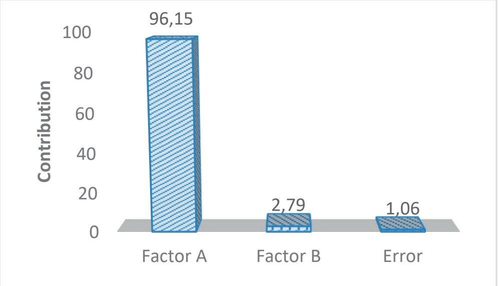

Figure 2. Contribution of factors A [crop year], B [crop locality] on the amount of herb/plant

Figure 2 shows the percentage contribution of the analyzed factors - the year of cultivation (Factor A) and the locality of cultivation (Factor B) - on the variation of the amount of herb/plant. In addition, the experimental error is also evaluated, which reflects the variability not explained by these factors.

The year of cultivation is the determining factor in the production of herba in lavender, explaining 97.68% of the total variation. This result emphasizes the overwhelming influence of climatic conditions and plant age on vegetative development.

The significant increase in production in 2024, compared to 2023, is the result of several factors, such as plant maturation and climatic conditions.

Lavender, being a perennial plant, registers a progressive increase in biomass in the first years of cultivation. In the second year of vegetation, the root system is better developed, which facilitates the absorption of nutrients and water, leading to a substantial increase in the amount of herb.

Differences in temperature, rainfall and brightness between growing years can significantly influence the growth and development of lavender. This result indicates that optimizing annual management practices is essential to maximize production. The locality of cultivation contributes to a very small extent to the variation in the amount of herb/plant, explaining only 1.55% of the variability. This low influence can be explained by lavender's ability to adapt to various pedoclimatic conditions. Lavender is recognized for its tolerance to varied soils and drought resistance, which gives it high flexibility in terms of growing location. It follows that the locality of cultivation is not a critical factor in determining the production of herb, which gives farmers great flexibility in choosing land. This suggests that lavender can be successfully grown in various regions without the risk of significant drops in yield.

The experimental error of 0.76% is extremely low, which reflects a solid experimental design and high data consistency. A small error indicates that the measurements are accurate and reproducible, and the influence of uncontrolled factors is minimal. This low level of error suggests that cropping practices were uniformly applied and that uncontrolled agronomic factors (such as pest infestation or unforeseen soil variations) had an insignificant impact on production.

Table 5 shows the results regarding the quantity of flowers/ha depending on the crop year. In the first year of study 2023 (a1) - year 2 from planting, 1353 kg of flowers/ha were obtained, considered the reference year (Mt), and in 2024 (a2) - year 3 from planting, 4111 kg of flowers/ha, representing an increase of 304% compared to 2023.

Table 5. Quantity of flowers/ha according to the year of cultivation

Year of Culture	Flowers/ha (kg)	%	Difference	Significance
A1 - 2023	1353	100		
A2 - 2024	4111	304	2758	**
Dl 5%= 689.64, Dl 1%= 1590.69, Dl01%= 5062.95				

DUNCAN TEST - factor B, LD5% = 844.6

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Original dates
 Mean 1 = 2414.  A Mean 2 = 2898.  A
 Mean 2 = 2898.  A Mean 3 = 2884.  A
 Mean 3 = 2884.  A Mean 1 = 2414.  A
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Mean 1 – b1 – Deta
Mean 2 – b2 – Vinga
Mean 3 – b3 – Mailat

The absolute difference is 2758 kg of flowers/ha, the difference between the two years is marked with **, which indicates a distinctly statistically significant difference at a significance level of 5% (DL 5% = 689.64).

This significant increase is due to the maturity of the plants and the climatic conditions. Also, applying more efficient care techniques or adapting fertilization and irrigation can help increase yield.

All media are classified in the same significance group: "A", which indicates that there are no statistically significant differences between locations. Interpreting the differences between locations:

- Vinga vs. Deta: Difference = 2898 - 2414 = 484 kg flowers/ha. This difference is smaller than the LD5% (844.6), so it is not statistically significant.
- Mailat vs. Deta: Difference = 2884 - 2414 = 470 kg flowers/ha. The difference is also smaller than the LD5%, so not statistically significant.
-Vinga vs. Mailat: The difference = 2898 - 2884 = 14 kg flowers/ha, This difference is negligible and well below the significance threshold.

All three locations (Deta, Vinga and Mailat) show statistically similar yields. Even though Vinga and Mailat had slightly higher productions than Deta, the differences are not enough to be considered statistically relevant. The choice of location between the three tested will not have a significant impact on the production of lavender flowers. Thus, farmers can decide to place crops based on other factors, such as land accessibility, costs or infrastructure, without compromising yield. The soils and climatic conditions in the three locations can be similar enough that they do not generate significant differences in production. The application of standardized agricultural techniques can contribute to yield uniformity

Figure 3 shows the relative contribution of two main factors - Crop year (Factor A) and Crop locality (Factor B) - on the number of flowers/ha, as well as the contribution of the experimental error.

The year of cultivation contributes 96.77% to the variation in the amount of flowers/ha. This is an extremely high value, indicating that the year in which the crop is grown is the main determining factor for lavender production. The major difference between the years of cultivation may reflect the maturation of the plants and the establishment of a deeper and more efficient root system.

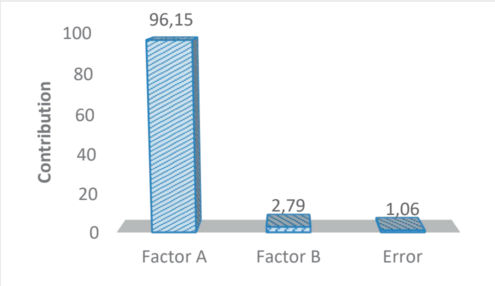

Figure 3. Contribution of factors A [crop year], B [crop locality] on the quantity of flowers/ha

Farmers need to pay close attention to crop management every year, adapting their strategies according to climatic conditions and the age of the crop. Anticipating significant growth in the years following planting is essential for crop planning.

The locality of cultivation contributes only 2.57% to the variation of flower production/ha. This is an insignificant contribution compared to the year of culture.

Minor differences between locations suggest that lavender is a resilient crop that adapts well to a variety of environmental conditions. The edaphic (soil type and structure) and microclimatic (temperature, local humidity) conditions in the studied locations seem to be similar enough not to significantly influence production. Uniform agricultural practices in the three locations (Deta, Vinga and Mailat) Are Another factor that has helped reduce variation between locations. This gives farmers flexibility in choosing the available land.

Experimental errors account for only 0.65% of the total variation. This extremely low value indicates a high degree of precision of the experiment and suggests that the results are reliable. The rigorous control of the experimental variables and the well-implemented data collection methodology helped to minimize errors. Homogeneity of samples and consistent application of experimental treatments reduced also uncontrolled variations.

Table 7 shows the amount of herb (total biomass) harvested per hectare by crop year. The data highlights a significant difference between production in 2023 and 2024.

Table 7. Amount of herb/ha by crop year

Year of Culture	Herb/ha (Kg)	%	Difference	Meaning
A1 - 2023	2682	100		
A2 - 2024	7922	295	5240	**
Dl 5% = 1672.11, Dl 1% = 3856.76, Dl01% = 5868.21				

The production of herb/ha in 2024 (7922 kg/ha) is 5240 kg/ha higher than in 2023 (2682 kg/ha). This represents an increase of 295%, almost triple compared to the first year. The difference of 5240 kg/ha exceeds the materiality limit at 1% (3856.76 kg/ha), but is below the limit of 0.1% (5868.21 kg/ha).

The statistical assurance of the difference between years as distinctly significant indicates that this difference is very statistically significant ($p < 0.01$). This means that there is less than a 1% chance that this difference is the result of random variation, confirming that the crop year has a decisive impact on herb production. Therefore, the crop year has a significant impact on the amount of herb/ha, the production in 2024 being almost triple compared to 2023. Distinctly significant difference, confirming that this result is not random. Plant maturation and favorable climatic conditions are the main likely causes of this growth.

Table 8 shows the amount of herb/ha (total harvested biomass) according to the locality of cultivation. The data compares production from three locations: Deta, Vinga and Mailat, assessing whether the differences are statistically significant.

Table 8. Amount of herb/ha depending on the cultivation location

Locality	Herb/ha (kg)	%	Difference	Significance
b1 - Deta	4684	100		
b2 - Vinga	5499	117	815	Ns
b3 – Mailat	5723	122	1039	Ns
Dl 5% = 2047.9, Dl 1% = 4723.55, Dl01% = 7208.12				

The Vinga experimental field (5499 kg/ha) has a production 815 kg/ha higher than Deta (4684 kg/ha), which represents an increase of 17%. In Mailat (5723 kg/ha) with a production of 1039 kg/ha higher than Deta, equivalent to an increase of 22%. The differences of 815 kg/ha

(Vinga vs. Deta) and 1039 kg/ha (Mailat vs. Deta) are below the materiality limit at 5% (2047.9 kg/ha). This means that there is a high probability that these variations are due to random factors or natural variations and not to actual differences in growing conditions. Although Vinga and Mailat had slightly higher yields than Deta, these differences are within the limits of natural variations and cannot be attributed to specific environmental or management factors.

The Duncan test to analyze the influence of crop locality (Factor B) on the amount of herb/ha (total biomass) demonstrates that all three locations (Deta, Vinga and Mailat) are classified in the same significance group "A". This indicates that the differences between locations are not statistically significant at a significance level of 5% (LD5%). And through this test it is demonstrated that the locality of cultivation does not significantly influence the production of herb/ha.

Although there are slight differences between Deta, Vinga, and Mailat, they are statistically insignificant, suggesting that lavender biomass production is relatively constant across different locations.

DUNCAN TEST - factor B, LD5% = 2048

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Original dates
 Mean 1 = 4684.   A Mean 3 = 5723.   A
 Mean 2 = 5499.   A Mean 2 = 5499.   A
 Mean 3 = 5723.   A Mean 1 = 4684.   A
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Mean 1 – b1 – Deta
Mean 2 – b2 – Vinga
Mean 3 – b3 – Mailat

Figure 4 shows the percentage contribution of the two main factors – Year of cultivation (Factor A) and Locality of cultivation (Factor B) – on the amount of herb/ha (total biomass of lavender). The contribution of experimental error is also included.

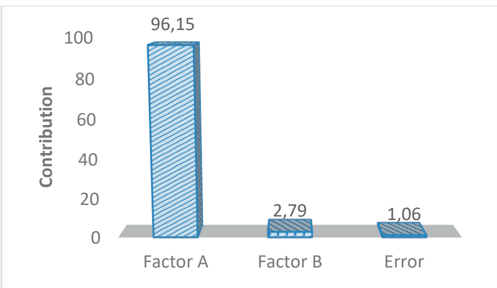

Figure 4. Contribution of factors A [crop year], B [crop locality] on the amount of herb/ha

The year of cultivation contributes 96.15% to the variation in the amount of herb/ha, which indicates an overwhelming impact of this factor on production.

The locality of cultivation contributes only 2.79% to the variation in the amount of herb/ha. This value is extremely low, suggesting minimal impact of location on production. The differences between locations are statistically insignificant, which indicates that lavender has a high ability to adapt to different soil conditions and microclimates.

Experimental errors account for only 1.06% of the total variation, indicating a high degree of accuracy and reliability of the data collected. The rigorous control of the experimental variables and the well-implemented methodology contributed to minimizing errors. Also, the homogeneity of the samples and the consistent application of experimental treatments reduced uncontrolled variations.

The relationship between the amount of flowers/individual and the amount of herba/individual (total biomass, including stems, leaves and flowers) for the lavender crop at Deta in 2023, is shown in Figure 5.

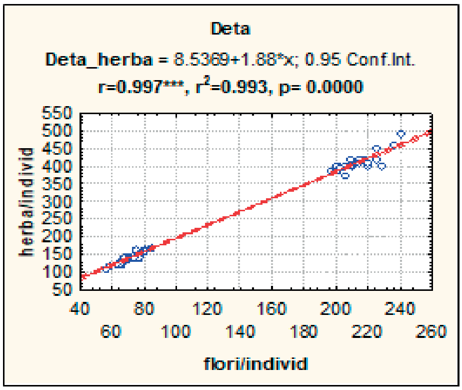

Figure 5. The correlation between flowers/individual and herb/individual at Deta

This relationship is expressed by a linear regression equation and is supported by a series of statistical parameters that indicate the strength and significance of the relationship. For each additional flower unit/individual (g), the amount of herba increases by an average of 1.88 units (g). The negative value of the intercept suggests that, theoretically, at 0 flowers/individual, the amount of herb would be negative. It does not have a direct biological interpretation and may indicate that the model is valid only in the analyzed range. The correlation coefficient (r=0.997) indicates a very strong positive correlation between the amount of flowers/individual and the amount of herb/individual. The r-value can range from -1 to +1. A coefficient close to +1 suggests a near-perfect linear relationship between the two variables. The coefficient of determination (r^2= 0.8798) means that 87.98% of the variation in the amount of herb/individual can be explained by the variation in the amount of flowers/individual. In other words, the regression model explains almost 88% of the total variation, which suggests an excellent fit of the data on the linear model. The p-value ($p < 0.0001$) indicates that the results are extremely statistically significant. This confirms that the observed relationship between the amount of flowers and the amount of herb is not due to chance. There is a very strong and positive linear relationship between the amount of flowers/individual and the amount of herb/individual at Deta in 2023. It can be concluded that for each additional flower, the amount of herba increases significantly, suggesting that the number of flowers is a good predictor of total biomass. The model explains almost 88% of the variation in herb production, which indicates a close relationship between the two variables and a very good fit of the model. The results are extremely statistically significant (p = 0.0000), which confirms the validity of the identified relationship. Practical implications of this determination - the optimization of harvesting is given by the fact that farmers can use the number (or quantity) of flowers/individual as a quick and efficient indicator for estimating the amount of herb before harvesting. This relationship can be used to select varieties or plants that produce more flowers, thus having a greater potential for herb production

The results of the correlation between flowers/individual and herb/individual in Vinga are shown in Figure 6.

The graph looks at the relationship between the amount of flowers/individual and the amount of herba/individual (total biomass, including stems, leaves, and flowers) for the lavender crop at Vinga. The relationship is expressed through a linear regression equation, accompanied by statistical indicators that highlight the strength and significance of this relationship. For each additional flower unit/individual (g), the amount of herba increases by an average of 1.9413 units (g), The negative intercept value suggests that theoretically, at 0 flowers/individual, the amount of herba would be negative, this is the theoretical amount of herba when the number of flowers is zero.

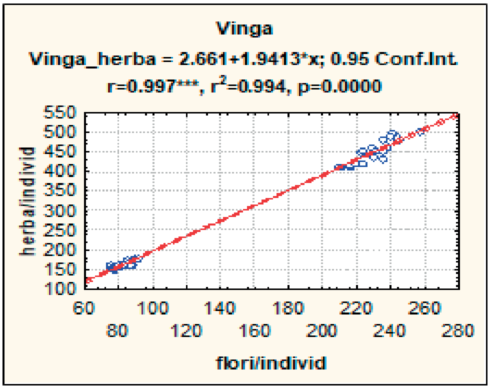

Figure 6. The correlation between flowers/individual and herb/individual in Vinga

The correlation coefficient (r= 0.997) indicates an almost perfect positive correlation between the amount of flowers/individual and the amount of herb/individual. The value is extremely close to 1, which suggests a direct and very close linear relationship between the two variables.

The coefficient of determination (r^2= 0.994) means that 99.4% of the variation in the amount of herb/individual is explained by the variation in the amount of flowers/individual. This represents a near-perfect fit of the data on the linear model, suggesting a highly accurate predictable relationship.

The p-value < 0.0001 indicates that the results are extremely statistically significant. This confirms that the relationship between the amount of flowers and the amount of herba is not the result of random variation. We notice that most of the points are very close to the regression line, suggesting minimal data dispersion and a highly accurate relationship. And for this location we can conclude that there is an extremely strong and positive linear relationship between the amount of flowers/ individual and the amount of herb/individual in Vinga. For each additional flower, the amount of herba increases significantly, suggesting that the number of flowers is an excellent predictor of total biomass. The model accounts for 99.4% of the variation in herb production, indicating near-perfect data matching and high predictability. The results are extremely statistically significant (p = 0.0000), confirming the validity of the relationship.

Analyzing the results with Deta (Figure 5), it is observed that in Vinga, the correlation is closer (r = 0.997) than in Deta (r = 0.938).

The coefficient of determination r^2 at Vinga (0.994) suggests a higher predictability of the relationship with Deta (r^2=0.8798). These differences could indicate more uniform growing conditions in Vinga or less genetic variation between individuals.

The results of the correlation between flowers/individual and herb/individual in Vinga, are presented in Figure 7.

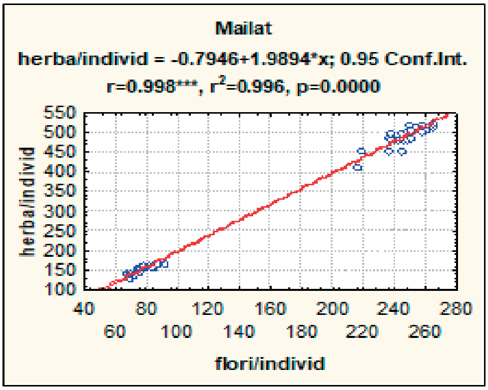

Figure 7. The correlation between flowers/individual and herb/individual in Vinga

The results of the regression equation show that for each additional flower unit/individual (g), the amount of herb increases by an average of 1.9894 units (g). The correlation coefficient (rr=0.998) indicates an almost perfect positive correlation between the number of flowers/individual and the amount of herb/individual. The value is extremely close to 1, which suggests a direct and very close linear relationship between the two variables. The coefficient of determination (r^2=0.996) shows that 99.6% of the variation in the amount of herb/individual is explained by the variation in the amount of flowers/individual. This represents a near-perfect fit of the data on the linear model, suggesting a highly accurate predictable relationship.

The p-value < 0.0001 indicates that the results are extremely statistically significant. This confirms that the relationship between the number of flowers and the amount of herba is not the result of random variation.

Most of the points are very close to the regression line, suggesting minimal data dispersion and a highly accurate relationship.

The results obtained in the Mailat field confirm that there is an extremely strong and positive linear relationship between the amount of flowers/individual and the amount of herb/individual at Mailat.

Comparing the results from Mailat with those from Deta and Vinga, we notice that:

The strength of the correlation at Mailat (r = 0.998) and Vinga (r = 0.997) shows an almost perfect correlation, while Deta (r = 0.938) has a strong but noticeably weaker correlation.

The explanatory power (r^2) in Mailat (r^2 = 0.996) explains 99.6% of the variation in herb production, followed by Vinga (r^2 = 0.994) and Deta (r^2 = 0.8798), and in Deta, there is a greater variability that is not explained by the number of flowers, possibly due to environmental factors or genetic variations.

Differences in the slope of the regression at Deta, the slope is slightly higher (2.0227), which indicates a greater increase in biomass per flower, but with a greater dispersion of data, and at Mailat and Vinga, the slope is similar (~1.94-1.99), suggesting a more constant efficiency in converting flowers into total biomass. The comparative results show that:

Mailat has the most accurate linear relationship, followed by Vinga. This indicates a high uniformity of plants and environmental conditions. Deta exhibits greater variability, which could be caused by genetic differences between plants or more variable environmental factors. In all locations, the amount of flowers/individual is an excellent predictor of the amount of herb/individual, but Mailat and Vinga provide more accurate estimates.

CONCLUSIONS

The results of the research clearly indicate that the year of cultivation is the main factor influencing flower production in lavender, highlighting the importance of plant adaptation and inter-annual climatic variations. The locality of cultivation does not have a significant impact, which suggests that lavender can be successfully grown in various locations, provided that the appropriate agrotechnical technologies are observed.

The results of the research demonstrate that the crop year also has a significant impact on the production of lavender herb, with a spectacular increase in biomass in the second year of cultivation. The locality of cultivation has a low, statistically insignificant influence, emphasizing the ability of lavender to adapt to a variety of edaphic and climatic conditions. The choice of the cultivation location can be based on logistical and economic considerations, without the risk of a negative impact on production.

The results of the regression function suggest that Mailat could be an optimal location for genetic selection programs due to the high uniformity of the relationship between flowers and herbs.

These conclusions are essential for the optimization of cultivation practices and for the choice of management strategies, emphasizing the need to monitor and adapt to annual climatic conditions in order to maximize production.

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