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Determination of Yield and Quality Characteristics of Lavandula Cultivars in the Kahramanmaras Region

Serkan Aras[1,a], Muhammet Ali Gündeşli[2,b], Kerim Karataş[1,c], Erdem Ertürk[1,d], Güven Borzan[1,e]

[1]*East Mediterranean Transitional Zone Agricultural Research of Institute, Kahramanmaraş, Türkiye*
[2]*Department of Plant and Animal Production, Nurdagı High Vocational School, Gaziantep University, Gaziantep 27310, Türkiye*
[*]*Corresponding author*

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ABSTRACT

In recent years, there has been a growing interest in herbal remedies for therapeutic purposes. Aromatic plants have become a significant source of raw materials for the fragrance, food, and cosmetics industries. Additionally, the emergence of new applications and the trend towards natural nutrition and alternative healing methods, often referred to as "going natural," have increased the interest in medicinal and aromatic plants in our country, as well as in other countries around the world. In this study were investigated to determine yield and quality characteristics of seven different lavender (*Lavandula intermedia Emeric* ex Loisel. = L. *hybrida* L.) (Grasso, Süper-A, Seguret, Dutch, Abrial, Akmeşe, English) cultivars under dry and irrigated cultivation in Kahramanmaraş conditions between 2019 and 2020. The research was carried out in a randomized block design with 4 replications. Fresh stem flower yield was the highest variety Grasso(672.81kg/da). The lowest fresh stem flower yield was found in Seguret variety with 611.33kg/da The highest dry stemless flower yield was determined in Grasso variety with 59,66 kg/da. There were significant differences determined between cultivars the end of 2 years. The highest average fresh stem flower yield (693.067 kg/da) and the highest average dry branched flower yield (252.588 kg/ha) were measured in GRASSO variety.

[a] *serkanaras83@gmail.com* *https://orcid.org/0000-0003-4521-5358*
[b] *maligun4646@gmail.com* *https://orcid.org/0000-0002-7068-8248*
[c] *kerim.karatas@tarimorman.gov.tr* *https://orcid.org/0000-0001-5350-936X*
[d] *erdem.erturk@tarimorman.gov.tr* *https://orcid.org/0000-0002-5339-5558*
[e] *guven.borzan@tarimorman.gov.tr* *https://orcid.org/0000-0003-0385-2658*

Introduction

Lavandula (Lavandula spp.) is one of the most important essential oil plants within the Lamiaceae family (Guenther, 1952). Lavender (Lavandula *angustifolia* Mill.), lavandin (Lavandula intermedia Emeric ex Loisel.), and spike lavender (Lavandula spica) are three varieties of lavender that hold high commercial value worldwide. The majority of lavender (L. angustifolia Mill.) and lavandin (L.x intermedia Emeric ex Loisel.) cultivars are grown globally (Baydar, 2010; Karık et al., 2017). In recent years, medicinal and aromatic plants have found applications in various industries, including paint production, landscaping, ornamental plants, insecticide manufacturing, and even the food industry. Their utilization continues to grow annually, making medicinal and aromatic plants increasingly significant. As interest in these plants rises, both their usage and trade have experienced notable growth in recent times (Hui et al., 2010; Kara and Baydar, 2013: Baydar, 2013). It is challenging to compile precise production and consumption data on medicinal and aromatic plants globally due to the absence of a specific classification system for these plants. Consequently, it remains difficult to consistently assess and explain these figures. While Turkey boasts a conducive climate and ecological conditions for cultivating numerous medicinal and aromatic plants, some, such as laurel, mahaleb, linden flower, sage, rosemary, licorice root, and juniper bark, are primarily collected from natural sources. In contrast, cumin, anise, thyme, fenugreek, fennel, mint, and coriander are cultivated through field agriculture (Kırmızıpekmez et al., 2009; Gül and Çelik, 2016; Karık et al., 2017).

The demand for medicinal and aromatic plants, which were previously primarily sourced from nature, has led to increased efforts to cultivate these plants through field agriculture. Today, many countries, including our own, have undertaken cultivation projects for medicinal and aromatic plants, resulting in the development of various varieties within these plant species (Baydar, 2007; Atalay,

2008; Sönmez et al., 2018; Sekeroglu et al., 2022). In our country, as in other parts of the world, medicinal and aromatic plants, especially those that are not cultivated, are still collected from their natural habitats and utilized in various applications. Consequently, it is challenging to maintain accurate and comprehensive statistics, as there is no consensus on which plants should be classified as medicinal and aromatic.

This study aims to identify the morphological characteristics of seven different commercial cultivars (Seguret, Abrial, Dutch, Akmeşe, Grasso, Süper-A, and British) under Kahramanmaras ecological conditions. The goal is to provide valuable information to producers about the cultivation of the appropriate species and cultivars for their specific needs.

Materials and Methods

Material

This study was conducted in the research greenhouses of the Eastern Mediterranean Transition Zone Agricultural Research Institute (DAGTEM) between 2019 and 2020. We utilized seven commercial lavender cultivars (Seguret, Abrial, Dutch, White Oak, Grasso, Super-A, and English) with one-year-old roots, all belonging to *Lavandula intermedia* Emeric ex Loisel. = L. hybrida L..

Method

We employed a randomized blocks split-plot design with four replications to investigate the impact of seven irrigated conditions (rain + irrigation) and non-water conditions (rain only) on the lavender cultivars. Each plot measured 6 meters in length and had four rows, with 12 plants in each row, resulting in a total of 48 plants per plot. The experiment was organized into four blocks, totaling 192 plants for each cultivar. The overall trial area spanned 1800 square meters. Drip irrigation was consistently applied during June, July, and August at 15-day intervals.

Morphological Characteristics Examined in the Study

Plant Height (cm): Before harvest, the height from the soil surface to the tip of ten plants within each plot was measured in centimeters, and the average height per plot was calculated.

Fresh Stem Flower Yield (kg/da): Flower stalks representing 50 percent flowering of the plants in each plot were cut and weighed fresh without moisture loss. These measurements were then converted to yield per decare (da), yielding the fresh branched flower yield per decare.

Dry Stem Flower Yield (kg/da): Fresh branched flowers from each plot were combined and air-dried in the shade for approximately seven days. Afterward, the dry herb yields were calculated in kilograms per decare.

Dry Stemless Flower Yield (kg/da): The dry flower yield per decare was determined by separating the stems from the flowers in the dry, air-dried branched flowers (dried in room temperature and shade for seven days) and weighing the flowers using a precision scale.

Statistical Evaluation

We performed variance analyses according to the experimental design in the randomized blocks using the collected data. Subsequently, we grouped the means based on their significance using the Least Significant Difference (LSD) at a 5% level of significance. We employed an appropriate software package for the statistical analysis of the examined features.

Results and Discussion

Plant Height

The results of the variance analysis regarding the plant height (BB) values of the lavender cultivars we used in the research are given in Table 1. Upon examining the factors influencing plant height values, we observed significant differences at the 1% significance level between treatments and annual applications.

Table 1. Average Plant height values of Lavandula spp for 2019-2020 for varieties and applications in the study.

Cultivars	No Irrigated		Cultivars × Application Average	Irrigated		Cultivars × Application Average.	Application Average		
							Year × Cultivars		Cultivar
	2019	2020		2019	2020		2019	2020	
Abrial	52.75	50.75	51.75	62.24	63.93	63.09	57.50	57.34	57.42abc
Akmeşe	47.70	45.60	46.65	66.55	62.94	64.75	57.13	54.27	55.70bc
Dutch	55.94	55.65	55.80	67.95	66.20	67.08	61.95	60.93	61.44a
Grasso	47.60	45.70	46.65	64.73	67.37	66.05	56.17	56.54	56.35bc
Ingiliz	54.27	52.28	53.28	61.85	59.95	60.90	58.06	56.12	57.09bc
Seguret	49.39	47.39	48.39	60.60	61.83	61.22	55.00	54.61	54.80c
Super A	53.60	51.60	52.60	63.57	65.75	64.66	58.59	58.68	58.63ab
YAA	51.61b	49.85b		63.93a	64.00a				
AA	50.73b			63.96a					
Year Average.							57.77	56.92	
LSD year	2.04n.i								
LSD Application	2.89**								
LSD Çeşit	3.82*								
LAY	2.87**								
LSD cultivar x year	7.40n.i								
LCA	8.92n.i								
LCAY	9.64n.i								
CV(%)	9.45								

YAA: Year × Application Average; AA: Application Average; LAY: LSD Application × year; LCA: LSD cultivar × application; LCAY: LSD cultivar × application × year; n.i: no important; *: 0.05 important; **: 0.01 important

Table 2. Average fresh stem flower yield of Lavandula spp for 2019-2020 for varieties and applications in the study.

Applications	Cultivars (kg/da)							Application
	Ingılız	Seguret	Akmeşe	Grasso	Süper-A	Abrial	Dutch	Average
No Irrigated (Dry)	633.39	625.44	629.14	662.79	629.13	623.17	627.40	632.92
Irrigated	663.77	597.18	664.64	682.823	599.11	652.82	657.90	645.46
Average	648.58	611.31	646.88	672.81	614.36	637.99	642.65	639.23
F Application	8.93*							
F cultivars.	0.53 n.i							
F application x cultivars	0.0064 n.i							
CV %	12.82							

n.i: no important; *: 0.05 important; **: 0.01 important

Additionally, the average values of two-year-old cultivars showed significance at the 5% level and are grouped in Table 1. However, we did not find any significant relationships between year, variety-year, variety-application, or variety-application-year. Among the treatments, plant height under wet conditions was 63.96 in Group A, while under dry conditions, it recorded 50.73 in Group B. Notably, in 2020, under wet conditions, plant height reached 64 cm in Group A, but in dry conditions, it decreased to 49.85 cm in Group B. An examination of climate data revealed that the total precipitation amount in 2019 was 840 mm, but it decreased to 744 mm in 2020. In dry conditions, plant height was 51.61 cm in 2019, dropping to 49.85 cm in 2020, with an average of 56.92 cm. This result underscores a linear relationship between precipitation levels and plant height. Among the varieties, the Dutch variety exhibited the tallest plants, with an average height of 61.44 cm, while the Seguret variety had the lowest average plant height at 54.80 cm. Previous studies have reported varying plant height values for lavender (Table 1).

For instance, Ceylan et al. (1996) found lavender plant height to be 41.3 cm, while Arabacı and Bayram (2005) reported a range of 43.7 to 69.5 cm for lavender types. Kara and Baydar (2011) observed that lavandin-type cultivars had a higher average plant height (86.2 cm) compared to the lavender group (63.2 cm) in the Isparta region. Balyemez and Özel (2014), in ecological conditions similar to Harran Plain, reported plant height values between 29.30 and 31.15 for seven different lavender cultivars, including L. angustifolia Mill. (Grosso Tina, English, Little Lady) and L. x intermedia Emerice x Loisel. (Grosso, Super A, Dutch, Abriel). While plant height is influenced by various environmental factors, it is widely recognized that genetic potential plays a pivotal role in determining this trait. In a study by Aslancan (2016) featuring five different varieties (Seguret, Abrial, Grasso, Dutch, Super A) and one ecotype (White oak) of Lavandula intermedia, the Super A cultivar exhibited the highest plant height (86.1 cm) and spike stem length (58.67 cm). Our findings regarding lavender plant heights at the harvest period align with plant height values reported in prior studies (Ceylan, 1988; Hassiotis,et al.,2014; Karık et al.,2017; Ozyazıcıoglu ve Kevseroglu, 2019; Sonmez et al., 2019).

Fresh Stem Flower Yield

The analysis results of the fresh branched flower yield (FBFY) values of the lavender variety we used in the research are given in Table 2. The observed no significant differences in fresh branched flower yield among the cultivars at the 5% significance level under both irrigated and non-irrigated conditions. The highest fresh branched flower yield was achieved by the Grasso variety, totaling 672.81 kg/da, while the Seguret variety exhibited the lowest yield at 611.33 kg/da. The differences in fresh branched flower yield between cultivars were deemed statistically insignificant. In a study conducted by Arabacı and Bayram (2005) in Aydın, fresh flower yield in lavender ranged from 201.90 to 1499 kg/da. Karık et al. (2017) reported the highest fresh branched flower yields of 937.64 kg/da and 913.25 kg/da in the lavandin type Provence variety among eight different commercial lavender cultivars over two yield years. Among the lavandin group varieties, Seguret had the lowest yield value over two years, with an average yield of 251.00 kg/da. Lavander-type cultivars consistently exhibited the lowest fresh branched flower yield in both years (Table 2). Kara (2011), in a study conducted in Isparta ecological conditions, observed fresh branched flower yields ranging from 290.5 to 820.4 kg/da. In our study, fresh branched flower yield ranged between 183.0 and 937.64 kg/da, and these results align with the findings of previous studies. Our study results partially overlap with those from other studies conducted on lavender species and varieties in diverse ecological settings. Researchers have noted that fresh-branched flower yield in lavender can vary based on cultivar characteristics, harvest timing, environmental factors, cultivation conditions, planting frequency, and maintenance practices (Arabacı and Bayram, 2005; Salinas et al., 2007; Atalay, 2008; Karık et al., 2017).

Dry Stem Flower Yield (%)

The results of the variance analysis for the dry branched flower yield (KDÇV) values of the lavender variety used in our research are presented in Table 2. In a study conducted by Kara (2011) in Isparta, it was reported that the dry branched flower yield of lavender varied between 145.10 kg/da and 460.40 kg/da. In our study, there was no significant difference in dry branched flower yield among the varieties under both irrigated and non-irrigated conditions. The highest dry branched flower yield was recorded in the Grasso variety under irrigated conditions, reaching 252.59 kg/da, followed by the English variety at 248.80 kg/da. Subsequently, the Dutch (248.12 kg/da), Akmeşe (246.05 kg/da), Abrial (239.58 kg/da), and SüperA (239.57 kg/da) varieties followed in yield, while the Seguret variety had the lowest dry branched flower yield at 233.23 kg/da. The yield differences among the varieties were found to be statistically insignificant.. Karık et al. (2017), in a two-year study with eight different commercial varieties, reported that the lavandin type

Provence variety achieved the highest dry branched flower yield in both yield years, with 539.11 kg/da and 451.25 kg/da. Researchers noted that among the lavandin group varieties, Seguret had the lowest yield value over two years, with an average yield of 114.00 kg/da.

Lavander type varieties had the lowest dry branched flower yield in both years, with an average of 101.37 kg/da from the Munstead variety and 85.62 kg/da from the Hidcote variety.

Dry Stemless Flower Yield ((kg/da)

The results of the variance analysis for the dry branched flower yield values of the lavender variety used in our research are presented in Table 4. In the study, there was no significant difference in dry flower yield among the varieties under both irrigated and non-irrigated conditions at a 5% significance level. The highest dry flower yield was recorded in the Grasso variety at 59.66 kg/da, followed by the English variety at 58.51 kg/da. Subsequently, the Dutch (56.83 kg/da), Akmeşe (56.25 kg/da), SüperA (55.81 kg/da), and Abrial (55.00 kg/da) varieties followed in yield, while the lowest dry flower yield was observed in the Seguret variety at 54.35 kg/da. The yield differences among the varieties were found to be statistically insignificant. Researchers Arabacı and Ceylan (1990), Salinas et al. (2007), Atalay (2008)] have also noted that the dry stemless flower yield of lavender varies according to factors such as variety characteristics, harvest timing, environmental conditions, cultivation practices, planting frequency in rows and rows. In a study by Çimen (2016), the effect of mulch application on flower yield and essential oil components of Lavender (*Lavandula officinallis* L.) was investigated.

Lavender was grown both traditionally in open fields and on plastic black nylon covers. The results showed that the fresh stem flower yield per decare ranged from 33.95 to 168.22 kg, dry stem flower yield per decare ranged from 10.62 to 60.87 kg, and dry stemless flower yield per decare ranged from 4.15 to 49.17 kg. These findings highlight the variability in dry flower yield in lavender, which can be influenced by a range of factors including variety attributes, harvest timing, environmental conditions, cultivation methods, and planting density.

Conclusion

Medicinal and aromatic plants have not only found their place in the food industry but have also been increasingly utilized in the paint industry, landscaping and ornamental plant cultivation, as well as insecticide production. Their usage continues to grow year by year, reflecting their expanding significance. These plants, which have maintained their importance from the past to the present, have now become essential commodities in many countries worldwide, including our own, especially with the rise of natural nutrition and natural treatment methods, often referred to as "going natural.". In this study, conducted to assess the morphological characteristics of various lavender (Lavandula spp.) cultivars in the ecological conditions of Kahramanmaraş, several significant differences were observed among these characteristics. Notably, based on the two-year average, the GRASSO variety displayed the most impressive results in terms of fresh branched flower yield (672.81 kg/da), dry branched flower yield (240.40 kg/da), and dry flower yield (59.04 kg/da). Consequently, the GRASSO variety consistently outperformed other cultivars across many parameters. These findings underscore the influence of environmental factors, especially in regions like Kahramanmaraş with temperate climates, where irrigated conditions play a significant role in enhancing certain morphological parameters.

Table 3. Average dry stemless flower yield (%) of Lavandula spp for 2019-2020 for varieties and applications in the study

Applications	Cultivars (%)							Application
	Ingiliz	Seguret	Akmeşe	Grasso	Süper-A	Abrial	Dutch	Average
No Irrigated (Dry)	223.67	210.61	220.41	228.21	213.43	214.19	219.62	218.59
Irrigated	248.80	235.24	246.05	252.59	239.57	239.58	248.12	244.28
Average	236.24	222.93	233.23	240.40	226.50	226.89	233.87	231.44
F Application	3773							
F cultivars.	0.59							
F application x cultivars	0.007							
CV %	9.81							

n.i: no important; *: 0.05 important; **: 0.01 important

Table 4. Average dry stemless flower yield (kg/da) of Lavandula spp. for 2019-2020 for varieties and applications

Applications	Cultivars (kg/da)							Application
	Ingiliz	Seguret	Akmeşe	Grasso	Süper-A	Abrial	Dutch	Average
Dry	57.41	53.44	55.26	58.41	53.47	53.84	55.80	55.38
Irrigated	58.51	54.36	56.25	59.66	54.95	55.00	56.83	56.51
Average	57.96	53.90	55.76	59.04	54.21	54.42	56.32	55.94
F Application	289.68 n.i							
F cultivars	0.64 n.i							
F application x cultivars	0.001							
CV %	12,37							

n.i: no important; *: 0.05 important; **: 0.01 important

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