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JOURNAL OF AGRICULTURAL PRODUCTION

ISSN: 2757-6620

https://prensip.gen.tr

RESEARCH ARTICLE

Effects of Rooting Mediums and Growth Regulating Agents on Rooting Parameters of Lavender and Lavandin Cuttings (*Lavandula sp.*)

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ARTICLE INFO

Article History
Received: 17.05.2024
Accepted: 28.06.2024
First Published: 30.09.2024

Keywords
Cutting propagation
IBA
Lavandula × *intermedia* Emeric ex Loisel
Lavandula angustifolia
NAA
Rooting medium

ABSTRACT

This study was conducted in Çanakkale province (North-West Anatolia) to determine the optimal auxin dosages (IBA at 2000 ppm and NAA at 1000 ppm) and rooting media (soil, peat, and cocopeat) for the cutting propagation of lavender, which holds significant industrial and commercial value. The research utilized three varieties belonging to the *Lavandula angustifolia* Mill species: Hemus, Sevtopolis and Drujba, as well as the Super A variety from the *Lavandula* × *intermedia* Emeric ex Loisel species. The experiment was organized with three replications, following a split-plot trial design divided into random plots. Results indicated that the Super A variety of *Lavandula* × *intermedia* Emeric ex Loisel, when cultivated in cocopeat medium with IBA at 2000 ppm, achieved the highest rooting rate (88.33%) and rooting status (17.67 units). The Sevtopolis variety of the *Lavandula angustifolia* species exhibited the highest values for root number (15.33), root length (9.88 cm), shoot number (20.93), and shoot length (15.35 cm) when grown in cocopeat medium with IBA at 2000 ppm. Based on these findings, the use of cocopeat medium and IBA at 2000 ppm auxin application is recommended for the effective propagation of lavender by cuttings.

Please cite this paper as follows:

Karakaş, İ., & İzci, B. (2024). Effects of rooting mediums and growth regulating agents on rooting parameters of lavender and lavandin cuttings (*Lavandula sp.*). *Journal of Agricultural Production*, *5*(3), 138-152. https://doi.org/10.56430/japro.1485102

1. Introduction

It is estimated that there are 422,000 blooming plants globally, with 72 thousand of these species employed for medicinal reasons (Arslan et al., 2015; Schippmann et al., 2006). It has been announced that medicinal and aromatic plants had a market share of 60 billion dollars in world trade in 2000 and 100 billion dollars in 2015. Türkiye's share in this market is 2.5 billion TL (İpek, 2017). The world's import value of essential oil derived from these plants is 4.6 billion dollars. Türkiye's imports total 26.7 million dollars, while its exports total 33.3 million dollars. Plant essential oils such as rose, laurel, and thyme play a vital role in Turkish exports, whereas essential oils such as mint, orange, lavender, and citrus fruits dominate imports (Temel et al., 2018).

The fragrant plant lavender is a semi-shrub, perennial, essential oil plant in the Lamiaceae family (Aslancan & Sarıbaş, 2011; Guenther, 1972). Lavender essential oil, fresh flowers and dried products are grown for food and other purposes. Lavender is a very valuable essential oil plant due to the essential oil obtained from its flowers; it is also widely used in

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perfume, cosmetics, aroma, pharmaceutical and detergent industries (Arabacı & Bayram, 2005). Lavender is utilized as an aesthetic plant in landscaping, beekeeping, and eco tourism, as well as an aromatic and essential oil plant. Lavender essential oil is commonly used in cosmetics, perfumes, pharmaceuticals, and soaps (Ceylan, 1996).

The Lamiaceae (Labiatae) family contains roughly 200 genera and 3000 species worldwide. It comprises 45 genera and 546 species growing natively in Türkiye, has a 42.2% endemism rate, and is one of the Lamiaceae family's significant gene centers. There are three distinct lavender species in the globe, each with a high economic and commercial value (Cesur Turgut et al., 2017). Lavander (*L. angustifolia* Mill. = *L. officinalis* L. = *L. vera* DC), Lavandin (*L. intermedium* Emeric ex Loisel. = *L. hybrida* L.), and Spike lavander (*L. spica* = *L. latifolia* Medik.) are three species with substantial economic benefits (Arabacı et al., 2007). These plants are native to the Mediterranean's hilly areas, but they are now commonly grown throughout Southern Europe, Australia, and the United States. Essential oil quality is better in lavender variations, while essential oil output is higher in lavandin kinds (Kara & Baydar, 2013).

Lavender cultivation, which is particularly concentrated in and around Türkiye's Isparta province, has poor practices in other locations, despite its potential (Baydar, 2010; Kara, 2011). However, *L. angustifolia* cultivation, which has high essential oil quality and economic returns, is not common in our country. Instead of *L. angustifolia*, *L. stoechas*, known as French lavender, whose essential oil is obtained from its leaves and flowers and has a strong smelling, grows naturally in our country (Ayanoğlu et al., 2000; Baytop, 1999).

Lavender essential oil is economically very important and has a huge demand worldwide. Lavender essential oil is used in the production of high-priced perfumes, fragrances and essences, pharmaceutical products, and also in the cosmetics and food industries due to its phenolic metabolites (Prusinowska & Śmigielski, 2014). In our nation, which has diverse vegetation, the popularity of lavender, an essential oil plant that can be farmed, is growing by the day, and so is the need for seedlings. To compete in both domestic and international markets, plants that meet the criteria must be grown. Gaining a foothold in domestic and international markets requires providing seedlings with high yield and quality (Çiçek, 2019).

The most pressing issue in lavender is providing high-yielding, high-quality propagation material. The plant reproduces vegetatively (by cuttings) and generatively (by seeds). *Lavandula* species can be propagated by seeds but this should not be the preferred method of propagation. Asexually propagated lavender plants provide more homogeneous products, and quality clones increase the possibility of obtaining higher quality essential oil (Tyub et al., 2007). Moreover, growth is slow in seed propagation, and it is recommended to propagate by cuttings, as problems such as low germination, weed control and cultural operations are difficult, and the plant's development is slow in the early stages and it exhibits a lot of variation in growth rate and oil composition. Plants grown by seeds lack standardization and homogeneity, complicating cultural methods, and the presence of genotypic variations may not give the superior quality essential oil that the species requires globally. Moreover, poor rooting and limited market availability have been problems for superior clones of *Lavandula* species (Calvo & Segura, 1988).

Propagation by cuttings can be defined as the technique of obtaining a new plant with a piece of stem, root or leaf, called cutting, obtained from the mother plant to be produced. Propagation by cuttings is used in many medicinal and aromatic plants and ornamental plants. It is the simplest, cheapest and fastest production technique performed outdoors or indoors in a greenhouse environment. Since propagation by cuttings is taken from the mother plant, whose yield and quality are known, it guarantees high yield and quality in new plantations (Ürgenç, 1992). High quality is the most important criterion in essential oil plants. For these reasons, propagation by cuttings is one of the common methods applied to perennial, semi-shrub and bushy plants. However, there are some problems in *L. angustifolia* and *Lavandula* × *intermedia* Emeric ex Loisel. The most important of these problems is rooting, and to solve this problem, different studies have been conducted. According to the results, it has been reported that the rooting rate varies depending on the type of cutting taken (Bona et al., 2012a).

The oldest known hormones that are effective for rooting are the auxin group hormones. With its discovery in 1930, auxin began to be used frequently on rooting (Halloran & Kasım, 2002). Auxin increases carbohydrate transport in shoots, leaves and cuttings and ensures the formation of adventitious roots and also functions in the initiation of rooting (Hartmann et al., 2011). Synthetic hormone auxin forms frequently used in rooting are IBA (Indole Butyric Acid) and NAA (Naphthalene Acetic Acid). The most commonly used one is IBA. IBA is not toxic in large concentrations and is effective in promoting rooting in many plant species (Özbek et al., 1961). IBA also has a stimulating effect on rooting by providing low mobility and chemical stability in plant tissues (Çiçek, 2019; Hartmann et al., 2011). Plants produce auxin in their roots and young leaves, but it is more advantageous to use the application of synthetic auxins to prevent the death of cuttings (Çetin, 2002). In addition, in different studies conducted on the rooting of cuttings, it was found that various hormones, holding times in hormones, and different medium used were effective in rooting and the best rooting was obtained from IBA (Ayanoğlu et al., 2000; Bhat et al., 2008; Bona et al., 2012b). Not only IBA but also NAA is used in the rooting of cuttings, and various studies are carried out on the hormones used, the doses and holding times of these hormones.

However, in lavender, there are almost no studies on the hormone doses used, different media, cuttings types, different hormone applications, and the holding time in the hormone with high practical applicability, and different types. Especially those with high essential oil yield and essential oil quality; research is limited in terms of the applicability of rooting studies on Hemus, Sevtopolis and Drujba varieties belonging to the *L. angustifolia* species and Super A variety belonging to the *Lavandula* × *intermedia* Emeric ex Loisel. species. The aim of this research was to determine the rooting performance of Hemus, Sevtopolis and Drujba varieties of *L. angustifolia* and Super A variety cuttings of *Lavandula* × *intermedia* Emeric ex Loisel. by treating them in Soil, Peat and Cocopeat media and with IBA 2000 ppm, NAA 1000 ppm hormones.

2. Materials and Methods

Cuttings of different lavender species used in the research were obtained from an organic farming enterprise and privately owned nurseries in Çanakkale, Ezine, Yaylacık village in late February 2020. Cuttings to be used in the research (1+0) were bare selected from rooted seedlings. Cuttings of Hemus, Sevtopolis and Drujba cultivars belonging to *L. angustifolia* species and Super A cultivar belonging to *Lavandula* × *intermedia* Emeric ex Loisel. species were used in the research. Plants in the 3rd year of plantation were used as rootstock. The greenhouse trial was carried out in a privately owned greenhouse located at the airport in Çanakkale Province, Merkez District, Barbaros Neighborhood, in 2020. The research was carried out in a greenhouse located at the airport location of Çanakkale Province, Merkez District, Barbaros Neighborhood, and 6-liter rooting pots were used in the experiment. The pots were thoroughly washed and disinfected before being filled with soil, peat and coco peat.

Soil, peat and cocopeat were used as rooting media. Based on an examination of the rooting media's basic structure, the high clay soil can be made more pliable and aerated with the use of the peat medium. Peat is inherently acidic, which decreases pH in highly alkaline soils. Peat also lessens the amount of nutrients that leach or run off. It has the advantage of having excellent soil and air holding properties and making water available when needed, allowing peat, fertilizer and water to pass to plants gradually. Peat soil has a fibrous structure (Anonymous, 2020). Cocopeat is an all-purpose growing medium made from coconut shells. Its air-filled porosity and high water holding capacity make it an ideal growing medium for herb plants. It is 100% organic and environmentally friendly. Its pH value is 5.7-6.5, EC level is <1 mS/cm, ideal for plant growth. It does not contain soil-borne pathogens and weeds. It is easy to use in seedling trays because it has a fluffy structure, does not clump and is not compressed. It supports fast, healthy root growth with constant moisture and oxygenation. It has tremendous oxygenation properties that are important for healthy root growth. Its high water holding capacity can retain moisture up to eight times its volume without sacrificing air supply. It is a tremendous soil conditioner and the presence of organic compounds in cocopeat encourages root growth and may offer some natural resistance to plant diseases. Cocopeat's physical and biochemical properties make it resistant to bacterial and fungal growth (Hartmann & Kester, 1983). The soil used as rooting medium was taken from the agricultural land next to the airport in Çanakkale Province, Merkez District, Barbaros Neighborhood, where the cuttings will be rooted and transferred to the field. Characteristics of the trial area and rooting soil, soil depth (cm) 0-30, pH 7.6, lime (%) 5, EC (mmhos) 193, sand (%) 17, clay (%) 43, silt (%) 44, compound silty-clay, organic matter mmount (%) was recorded as 2.88.

Cuttings obtained from an organic farm in Çanakkale Ezine Yaylacık village and from private sector nurseries were taken from three-year-old shoots of Hemus, Sevtopolis and Drujba varieties of *Lavandula angustifolia* species and Super A variety of *Lavandula* × *intermedia* Emeric ex Loisel. species. The rooting phase trial of the research was established using the Random Plots Trial Design with 3 factors and 3 replications. According to the Experimental Design of Divided Plots in Random Plots, cuttings of plant materials were used in the main plots. Three different media on the lower plots and two different auxins (2000 ppm IBA doses) on the bottom plots. The NAA dose was 1000 ppm, and the control group without any treatment was established in 3 replications. The shoots taken from the rootstock plants were cut to a length of about 10-12 cm, and all the leaves of the lower ¾ part of each cutting were stripped and prepared for planting. The prepared cuttings were kept in a beaker for a while, with the bottoms remaining in the water. Afterwards, the rooting pots were thoroughly washed and sterilized.

In terms of the methods used, the hormone dose applied to the cuttings and the holding times varied. However, studies on minute and slow immersion methods rather than fast immersion and second-based studies are limited and almost non-existent. Therefore, in this research, the cuttings were prepared for planting by keeping them in the rooting hormone for five minutes to ensure better penetration of the cuttings with the rooting hormone, better coverage of the roots, and the hormone doses used were not too high. In the study, cuttings were prepared for planting by keeping their bottom parts in concentrations of IBA (control-0 and 2000 ppm) and NAA (control-0 and 1000 ppm) for 5 minutes. Then, the cuttings were planted in 6-liter rooting pots filled with soil, peat and coco peat and were watered regularly twice a week. In the research, the cuttings were checked regularly during the rooting period, and no diseases or pests were observed. Rooting performances and rooting-related parameters of the cuttings, removed from the rooting medium after an average of 60-70 days, were measured and analyzed.

2.1. Features Examined During the Rooting Stage

The following measurements and examinations were made after the roots of the cultures, planted in rooting medium and kept in this medium for an average of 2 months, were washed with sterile pure water.

Rooting rate: The number of rooted and unrooted shoots after each application was determined and expressed as a percentage.

Rooting status: In each application, the number of cuttings showing or not showing rooting was determined.

Number of roots: The number of roots in cuttings showing or not showing rooting in each application was determined.

Stem length: The lengths of the roots in cuttings showing or not showing rooting in each application were measured in cm.

Shoot length: After culture, the shoot lengths of the plants were measured in cm.

Number of shoots: The number of shoots developed in each application has been determined.

2.2. Statistical Analysis and Evaluations

Variance analysis was performed according to the split-plot trial design in which random parcels were divided. According to this analysis, the average values of the application that were statistically significant were grouped according to DUNCAN. Statistical evaluations were made using the TOTEMSTAT package program (Dumanoğlu et al., 2019).

3. Results and Discussion

3.1. Rooting Rate

The effect of different rooting media, cultivars and IBA 2000 ppm and NAA 1000 ppm doses on the rooting rate of lavender cuttings was statistically significant ($p \leq 0.01$) and it was observed that it differed according to the cultivars (Table 2). The highest rooting rate among the varieties was obtained in Super A variety with 88.33%, while the lowest rooting rate was obtained a rate of 48.67% was obtained in Sevtopolis and Drujba cultivars. When the general effects of different rooting media are examined, it is seen that the highest rooting rate is obtained from the cocopeat medium with 88.33%, and the lowest rooting rate is obtained from the soil medium with 48.67%. In addition, when the main effects of hormone applications were examined, it was observed that the highest rooting rate was obtained in the IBA 2000 ppm application with 88.33%, and the lowest rooting rate was obtained in the 0 (control) application with 48.67%. When we look at the rooting rate averages of hormone applications in general, we can say that the IBA 2000 ppm dose is more effective (Table 1).

Table 1. Effect of IBA 2000 ppm and NAA 1000 ppm dose on the rooting rate (%) of lavender in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	50.33	72.33	71.67	64.77
	Peat	53.67	76.00	71.33	67.00
	Cocopeat	57.00	86.00	81.67	74.88
	Average	53.66	78.111	74.889	68.88 BC
Sevtopolis	Soil	48.67	67.67	67.33	61.22
	Peat	49.67	72.00	72.33	64.66
	Cocopeat	53.33	82.67	78.33	71.44
	Average	50.55	74.111	72.667	65.77 C
Drujba	Soil	48.67	73.33	71.67	64.55
	Peat	49.67	77.67	75.00	67.44
	Cocopeat	58.67	86.33	83.33	76.11
	Average	52.33	79.111	76.667	69.37 B
Super A	Soil	52.67	78.00	74.67	68.44
	Peat	53.67	82.00	77.67	71.11
	Cocopeat	62.00	88.33	86.00	78.77
	Average	56.11	82.77	79.44	72.77 A
	Variety Average	53.16 C	78.52 A	75.91 B	69.20
	Rooting Medium Average	64.75 B	67.55 B	75.30 A	

* There is no statistical difference between averages indicated with the same letter.

When the variety×medium interaction was examined in the study, the effect on the rooting rate of lavender cuttings was statistically insignificant (Table 2). In the average of the cultivar×medium interaction, the rooting rate ranged from 50.55 to 56.11% and the highest rooting rate was 62.00% in the Super A variety and cocopeat medium, the lowest rooting rate with 48.67% was obtained in the Sevtopolis and Drujba cultivars and soil medium. According to the general averages, we can say that the Super A variety and cocopeat medium stand out compared to the others (Table 1). When the variety×hormone interaction was examined in the study, the

effect on the rooting rate of lavender cuttings was statistically insignificant.

In variety×hormone interaction averages rooting rate varies between 72.66 and 82.77%. The highest rooting rate of 88.33% was observed in the Super A variety with the IBA 2000 ppm dose, the lowest rooting rate of 48.67% was observed in the Sevtopolis and Drujba cultivars with the 0 (control) combination. Generally, we can say that the Super A variety and the IBA 2000 ppm dose stand out. In the study, when the medium×hormone interaction was examined, the effect on the rooting rate of lavender cuttings was statistically insignificant (Table 2). The average rooting rate in the medium×hormone interaction ranged from 50.55 to82.77%. The highest rooting rate of 88.33% was observed in the cocopeat medium with the IBA 2000 ppm interaction, and the lowest rooting rate of 48.67% was observed in the soil medium with the0 (control) combination. Generally, we can say that cocopeat medium and IBA 2000 ppm dose application stand out (Table 1).

When the variety×medium×hormone interaction was examined in the study, the effect on the rooting rate of lavender cuttings was statistically insignificant (Table 2). In the average of the variety×medium×hormone interaction the rooting rate ranged from 61.22 to 78.77%, the highest rooting rate of 88.33% was observed in the Super A variety, cocopeat medium and IBA 2000 ppm combination, while the lowest rooting rate of 48.67% was observed in the Sevtopolis and Drujba cultivar, from the soil medium and 0 (control) combination (Table 1). Generally, it is seen that the Super A variety, cocopeat medium and IBA 2000 ppm application stand out. When IBA, NAA and different medium applications are examined, it is seen that the IBA 2000 ppm dose stands out and the applied hormone and doses increase rooting compared to 0 (control) and cocopeat medium stands out in different medium used. In studies examining the effects of different rooting media on the rooting rate, Türkmen (2019) reported that the highest rooting rate of 57% of the yellow-girl tea plant was obtained from sand medium applied with 1000 ppm IBA. Bayraktar et al. (2018) investigated the effects of different greengouse media and hormones on the rooting yew (*Taxus baccata* L.) and found that the best results were obtained in greenhouse 2 with the IBA 5000 ppm treatment in perlite rooting medium. Kumar and Ahmed (2013) investigated the effects of different rooting media and different IBA doses on the rooting of cuttings in pelargonium (*Pelargonium graveolens* L.) and reported that the highest rooting rate of 94.05% was obtained in cocopeat medium.

Table 2. Mean square values obtained as a result of variance analysis of the examined parameters.

	Source of Variation	Rooting Rate	Rooting Status	Number of Roots	Root Length	Shoot Number	Shoot Length
AVERAGE OF SQUARES	Recurrence	3.398	0.298	1.869	0.573	0.034	0.019
	Variety	221.741**	13.699**	14.154**	7.938**	13.680**	17.511**
	Error 1	13.769	0.969	0.327	0.002	0.185	0.046
	Medium	1076.120**	51.826**	10.145**	4.566**	16.180**	9.485**
	Variety x Medium	1.972	0.892	0.598	0.049**	0.336	0.031*
	Error 2	27.301	1.418	0.795	0.001	0.594	0.010
	Hormone	7005.398**	309.716**	644.500**	303.705**	1309.345**	581.694**
	Variety x Hormone	7.843	0.574	3.940**	0.695**	3.351**	1.089**
	Medium x Hormone	22.037	0.400	1.419	0.433**	1.141*	0.579**
	Variety x Medium x Hormone	7.185	0.646	1.222	0.026**	0.327	0.014
	Error 3	18.412	1.369	0.866	0.001	0.436	0.019
	1. CV(Variety) = 0.74%		CV(Medium) = 1.35%	CV(Hormone) = 0.41% Rooting Rate			
	2. CV(Variety) = 7.15%		CV(Medium) = 8.66%	CV(Hormone) = 8.51% Rooting Status			
	3. CV(Variety) = 5.97%		CV(Medium) = 9.31%	CV(Hormone) = 9.72% Number of Roots			
	4. CV(Variety) = 0.72%		CV(Medium) = 0.43%	CV(Hormone) = 0.47% Root Length			
	5. CV(Variety) = 3.02%		CV(Medium) = 5.41%	CV(Hormone) = 4.64% Shoot Number			
	6. CV(Variety) = 2.46%		CV(Medium) = 1.14%	CV(Hormone) = 1.60% Shoot Length			

*, **: Respectively, significant at p≤0.05 and p≤0.01 levels.

Alp et al. (2010) reported the highest rooting rate at 53.3% in green, semi-wood and wood cuttings of garden roses taken at different periods in 0 (control), 1000, 1500 and 2000 ppm IBA applications and a minimum of 2000 ppm IBA in wood cuttings of *R. chinensis* var. Arslanoğlu and Albayrak (2011) documented that the highest rooting rate in rosemary and lavender to stem suttings in IBA applications at 1000, 2000, 4000 and 6000 ppm doses. Our findings also show that the highest rooting rate obtained in lavender at 2000 IBA doses is similar to the studies in the above literature. In another study, lavender (*Lavandula angustifolia* Mill) semi-wood, green bottom and green tip cuttings were treated with control-0, 2000, 4000, 6000, 8000, and 10000 ppm IBA doses, and the highest rooting rate was observed in the green bottom cutting type with 8000 and 10000 ppm IBA (Çiçek, 2019). Kara (2011) stated that the highest rooting rate of 95.13% was obtained in the *L.*

angustifolia var. Silver variety from the application of different IBA doses (0, 1000, 2000, 3000, and 4000 ppm) to different lavender and lavandin cuttings and planted with 4000 ppm IBA in March. This difference may be due to different plants, the use of different rooting media, differences in cutting types or holding times.

Shahhoseini et al. (2015) reported that the highest rooting rate for rosemary (*Rosmarinus officinalis* L.) semi-wood cuttings with IBA and NAA (0, 2000, 3000, 4000, 5000 ppm) doses in 1-minute immersion application was 84% with NAA 1000 ppm. The results showed that the highest rooting rate of NAA 1000 oom 84% does not agree with our findings. When all the findings are examined; it is seen that plant species, rooting products and doses, rooting medium and techniques used differ, affect the results and may change.

3.2. Rooting Status

According to the results of variance analysis performed on the effects of IBA 2000 ppm and NAA 1000 ppm doses on the rooting status of lavender cuttings under in vivo conditions in different media; variety, medium and dose of IBA 2000 ppm and NAA 1000 ppm were found to be statistically significant at the level of $p \leq 0.01$, while the interaction effects of variety × medium, variety × hormone, medium × hormone and variety × medium × hormone dose were found to be statistically insignificant (Table 2). The highest rooting rate was obtained in the Super A variety with 17.67 units, while the lowest rooting rate was obtained in the Sevtopolis and Drujba varieties with 9.73 units. When the general effects of different rooting media are examined, it is seen that the highest rooting status was obtained from cocopeat media with 17.67 units, and the lowest rooting status was obtained from soil media with 9.73 units. In addition, when the main effects of hormone applications were examined, it was that the highest rooting status was obtained from IBA 2000 ppm application with 17.67 units, and the lowest rooting rate was obtained in IBA 0 (Control) application with 9.73 units (Table 3). In general, when the rooting status averages of the varieties are examined, the highest values were obtained in the Super A variety compared to the others. When the averages effects of hormone applications on rooting status are examined in general, it can be said that there is a difference between the effects of IBA 2000 ppm and NAA 1000 ppm doses, and considering that different environments generally affect the rooting status, the effects of soil, peat and cocopeat on rooting status vary and there are differences between them.

The effect of lavender cuttings on rooting status was found to be statistically insignificant in terms of variety×medium interaction (Table 2). Rooting status ranged between 10.11 and 10.73 in the average of variety×medium interaction, and the highest rooting status was obtained from the Super A variety and cocopeat combination with 12.40. The lowest rooting status was obtained from the combination of Sevtopolis variety and Drujba varieties in soil medium with 9.73 (Table 3). The effect of the variety×hormone interaction on the rooting status of lavender cuttings was found to be statistically insignificant (Table 2). In the average of variety×hormone interaction, rooting status varied between 10.63 and15.70, the highest rooting status was obtained from the Super A variety and IBA 2000 ppm combination with 17.67. The combination of Sevtopolis and 0 (Control) gave the lowest rooting status with 9.73, while the combination of Drujba and 0 (Control) gave the same result.

Table 3. Effect of IBA 2000 ppm and NAA 1000 ppm dose on the rooting status (number) of lavender in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	10.07	14.47	14.33	12.95
	Peat	10.73	15.20	14.27	13.40
	Cocopeat	11.40	17.20	16.33	14.97
	Average	10.73	15.62	14.97	13.77 A
Sevtopolis	Soil	9.73	13.53	13.47	12.24
	Peat	9.93	14.40	14.47	12.93
	Cocopeat	10.67	16.53	15.67	14.28
	Average	10.11	14.82	14.53	13.15 B
Drujba	Soil	9.73	14.67	14.33	12.91
	Peat	9.93	15.53	15.00	13.48
	Cocopeat	11.73	17.27	16.67	15.22
	Average	10.46	15.82	15.33	13.87 A
Super A	Soil	10.53	15.60	14.93	13.68
	Peat	10.73	16.40	15.53	14.22
	Cocopeat	12.40	17.67	17.20	15.75
	Average	11.22	16.55	15.88	14.55 A
	Variety Average	10.63 B	15.70 A	15.18 A	13.84
	Rooting Medium Average	10.45 C	13.51 B	15.06 A	

* There is no statistical difference between averages indicated with the same letter.

In terms of medium×hormone interaction, the effect on the rooting status of lavender cuttings was statistically insignificant (Table 2). In the medium×hormone interaction averages, the rooting status varied between 10.11 and 16.55, and the highest rooting status was obtained from the interaction of cocopeat medium and IBA 2000 ppm with 17.67. The lowest rooting status was obtained from soil and 0 (control) interaction with 9.73 units (Table 3). When the variety×medium×hormone interaction was examined, the effect on rooting status of lavender cuttings was statistically insignificant (Table 2). The rooting status ranged from 12.24 to 15.75 when cultivar, medium, and hormone interactions were considered. The Super A variety, cocopeat medium, and IBA 2000 ppm dosage with 17.67 units provided the maximum rooting status. The lowest rooting status was obtained from the combination of Sevtopolis and Drujba varieties with soil medium and 0 (control) with 9.73 units (Table 3). When the general averages are examined, it is seen that cocopeat medium and IBA 2000 ppm applications have positive effects on the results. In general, it was observed that the application of cocopeat and IBA 2000 ppm doses were effective in the Super A variety.

3.3. Number of Roots

According to the results of the variance analysis on the root number effect of lavender cuttings in vivo conditions, in different media and at the dose of IBA 2000 ppm and NAA 1000 ppm; cultivars, medium, IBA 2000 ppm and NAA 1000 ppm dose and variety×hormone interaction was found to be statistically significant at 0.01 level ($p \leq 0.01$). The interaction effects of variety×medium, medium×hormone and variety×medium×hormone dose were insignificant. The effect of different rooting media and IBA 2000 ppm and NAA 1000 ppm dose and the effect of variety×hormone interaction on root number of lavender cuttings was statistically significant ($p \leq 0.01$) and it was observed that it changed according to cultivars (Table 2). While the highest root number was obtained from the Sevtopolis variety with 15.33, the lowest root number was obtained from the Super A variety with 4.47. In terms of the general effects of different rooting media, the highest root number was obtained in the cocopeat medium with 15.33, while the lowest root number was obtained from the soil medium with 4.47. In addition, the highest root number was obtained from IBA 2000 ppm application with 15.33, while the lowest root number was obtained from 0 (control) application with 4.47 in terms of the main effects of hormone applications (Table 4). When the impacts of hormone application on the effect of root number are analyzed, it was observed that IBA 2000 ppm dose and NAA 1000 ppm dose applications have positive impacts compared to 0 (control) group, and the number of roots increased.

Table 4. Effect of IBA 2000 ppm and NAA 1000 ppm dose on the number of roots (number) of lavender cuttings in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	4.60	12.00	9.27	8.62
	Peat	5.00	11.67	10.27	8.97
	Cocopeat	4.87	13.07	10.67	9.53
	Average	4.82	12.24	10.06	9.04 C
Sevtopolis	Soil	4.60	13.73	11.40	9.91
	Peat	4.93	14.47	12.27	10.55
	Cocopeat	5.27	15.33	12.67	11.08
	Average	4.93	14.51	12.11	10.519 A
Drujba	Soil	5.13	12.47	10.07	9.22
	Peat	5.07	13.13	11.20	9.80
	Cocopeat	5.13	14.13	11.53	10.26
	Average	5.11	13.24	10.93	9.76 B
Super A	Soil	4.47	12.20	9.60	8.75
	Peat	5.07	12.87	10.27	9.40
	Cocopeat	5.00	13.40	10.87	9.75
	Average	4.84	12.82	10.24	9.30 C
	Variety Average	4.92 C	13.20 A	10.83 C	9.65
	Rooting Medium Average	9.12 B	9.43 B	10.16 A	

* There is no statistical difference between averages indicated with the same letter.

The effect of lavender cuttings on root number was statistically insignificant in terms of the variety×medium interaction (Table 2). In the average of the cultivar×medium interaction, the number of roots varied between 4.82 and 5.11, and the highest number of roots was 15.33, obtained from the combination of Sevtopolis cultivar and cocopeat medium. The

lowest root number was obtained from the combination of the Super A variety and soil medium with 4.47 (Table 4). When the variety×hormone interaction was examined, the effect on the rooting status of lavender cuttings was found to be statistically significant ($p \leq 0.01$) (Table 2). In the average of variety×hormone interaction, the highest number of roots was obtained from the combination of Sevtopolis cultivar and IBA 2000 ppm dose with 15.33 roots, followed by the combination of Drujba cultivar and IBA 2000 ppm dose. On the other hand, the lowest number of roots was obtained from the Super A variety and 0 (control) with 4.47, followed by the interaction of Hemus with the Sevtopolis variety and 0 (control) with 4.60 (Table 4).

When the medium×hormone interaction was examined, the effect of lavender cuttings on the root number was found to be statistically insignificant (Table 2). In the medium×hormone interaction, the average number of roots ranged between 4.82 and 14.51, and the highest root number, 15.33, was obtained from the combination of cocopeat medium and IBA 2000 ppm dose. The interaction between the soil medium and 0 (control) was found to produce the lowest root number, with 4.47 roots (Table 4). When the variety×medium×hormone interaction was examined, the effect of lavender cuttings on root number was found to be statistically insignificant (Table 2). Considering the average values of the effect of variety×medium×hormone interaction on root number, the number of roots varied between 8.62 and 11.08, and the highest root number was obtained as 15.33from the interaction of Sevtopolis variety, cocopeat medium and IBA 2000 ppm dose. The lowest root number was obtained from the combination of Super A variety, soil medium and 0 (control) with 4.47 (Table 4).

The effect of different medium and hormone applications on the number of roots in the cultivars and Hemus cultivar was below average compared to other cultivars, and the highest averages belonged to the Sevtopolis variety. When the effect of different mediums on the number of roots was examined, it was observed that the soil medium remained below the average values, and the highest average values were obtained from the cocopeat medium followed by the peat medium. When the impact of various hormone applications on the root number is examined, it was seen that the 0 (control) application was significantly below the average compared to the others, and the highest average values were obtained from the NAA 1000 ppm application and the IBA 2000 ppm application. However, the preferred application should be the combination of Sevtopolis variety, cocopeat medium and IBA 2000 ppm.

Polat and Yıldırım (2017) reported that the highest root number was obtained in the application of IBA 2000 ppm dose with 1.61. Yusnita et al. (2018) documented that the highest root number was 17.8-25.5 in 2000 and 4000 ppm applications. The findings obtained at the 2000 IBA are consistent with our findings with the highest root number. Ayanoğlu and Özkan (2000) reported the highest root number (22.35 units) was obtained from 100 ppm and was observed in the rapid dipping method. This may be due to plant variety, use of different rooting media, different cutting types, or holding times. When all the findings are examined, it is seen that the plant species, rooting products and doses, rooting media and the techniques used differ, have an effect on the results and can vary.

3.4. Root Length

The effect of different rooting media, IBA 2000 ppm and NAA 1000 ppm doses and the interaction of variety×hormone, medium×hormone and variety×medium×hormone on root length of lavender cuttings were found to be statistically significant ($p \leq 0.01$) and differed according to cultivars (Table 2). While the highest root length was obtained in the Sevtopolis variety with 9.88 cm, the lowest root length was obtained in the Hemus variety with 2.34 cm. When the general effects of different rooting media were examined, the highest root length was obtained in the cocopeat medium with 9.88 cm, while the lowest root length was obtained in the soil medium with 2.34 cm. In addition, when the main effects of hormone applications were examined, the longest root length was obtained from IBA 2000 ppm application with 9.88 cm, while the lowest root length was obtained from 0 (control) application with 2.34 cm. In general, it is seen that the effect of different media and hormone applications on root length in cultivars gives very positive and important results (Table 5).

According to the results of variance analysis regarding the effects of IBA 2000 ppm and NAA 1000 ppm doses on root length of lavender cuttings in different media in vivo conditions; it was observed that interactions of cultivars, medium, IBA 2000 ppm and NAA 1000 ppm doses, variety×medium, medium×hormone and variety×medium×hormone were statistically significant at $p \leq 0.01$ level. When the variety×medium interaction was examined, the effect of lavender cuttings on root length was found to be statistically significant ($p \leq 0.01$) (Table 2). The average root length of the variety×medium interaction ranged between 2.48 and 3.09 cm and the highest root length of 9.88 cm was obtained from the interaction of the Sevtopolis variety and cocopeat medium. The lowest root length of 2.34 cm was obtained from the interaction of the Hemus cultivar with the soil medium. In general, it was observed that the combination of cocopeat and peat medium used compared to the soil, especially in Sevtopolis and Drujba varieties, gave very positive and significant results on root length compared to the soil medium (Table 5).

Table 5. Effect of IBA 2000 ppm and NAA 1000 ppm dose on root length (cm) of lavender cuttings in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	2.34	7.43	5.34	5.04
	Peat	2.46	7.31	5.78	5.18
	Cocopeat	2.66	8.27	6.30	5.74
	Average	2.48	7.66	5.80	5.32 D
Sevtopolis	Soil	2.86	9.30	6.45	6.20
	Peat	3.10	9.61	7.23	6.64
	Cocopeat	3.32	9.88	7.68	6.96
	Average	3.09	9.59	7.12	6.60 A
Drujba	Soil	2.54	8.13	5.73	5.46
	Peat	2.73	8.35	6.29	5.79
	Cocopeat	2.85	8.74	6.74	6.10
	Average	2.70	8.40	6.25	5.78 B
Super A	Soil	2.46	7.86	5.55	5.29
	Peat	2.62	8.22	6.20	5.68
	Cocopeat	2.82	8.64	6.64	6.03 C
	Average	2.63	8.23	6.13	5.66
	Variety Average	2.72 C	8.47 A	6.32 B	5.84
	Rooting Medium Average	5.50 C	5.82 B	6.21 A	

* There is no statistical difference between averages indicated with the same letter.

When the variety×hormone interaction was examined, the effect of lavender cuttings on root length was found to be statistically significant ($p \leq 0.01$) (Table 2). The average root length of the variety×hormone interaction ranged from 2.72 to 8.47 cm and the highest root length was 9.88 cm, obtained from the interaction of the Sevtopolis with IBA 2000 ppm. It was observed that the lowest root length was 2.34 cm and was obtained from the interaction of Hemus cultivar with 0 (control). In general, the highest average values were obtained in the Sevtopolis cultivar in IBA 2000 ppm application (Table 5).

The effect of lavender cuttings on root length was found to be statistically significant in terms of the medium×hormone interaction ($p \leq 0.01$) (Table 2). The medium×hormone interaction averages showed that the root length varied between 2.48 and 9.59 cm and the highest root length of 9.88 cm was observed from the combination of cocopeat medium and IBA 2000 ppm. The lowest root length was obtained in soil medium and 0 (control) interaction with 2.34 cm. Regarding the effect of the medium and hormone applications generally used in the experiment, the interaction of cocopeat medium and IBA 2000 ppm stands out and is seen to have more positive effects (Table 5).

When the variety×medium×hormone interaction was examined, the effect of lavender cuttings on root length was found to be statistically significant ($p \leq 0.01$) (Table 2). Root length ranged from 5.04 to 6.96 cm. The interaction of the Sevtopolis cultivar with the cocopeat medium and IBA 2000 ppm dose resulted the longest root length, measuring 9.88 cm. The lowest root length, 2.34 cm, was obtained from the interaction of Hemus cultivar with soil medium and 0 (control) (Table 5). The IBA 2000 ppm dose produced more effective results in the Sevtopolis cultivar, followed by the Drujba cultivar, while the cocopeat medium was more effective in promoting root length compared to the other media.

When IBA, NAA, and different medium applications are examined, it is observed that the IBA 2000 ppm dose stands out, and the applied hormones and doses significantly increase rooting compared to 0 (control). Additionally, cocopeat medium also stands out among the different media used. Polat and Yıldırım (2017) investigated the effects of 1:1 perlite–cocopeat mixture medium and different IBA doses on the cuttings of several jujube genotypes. they found that the highest root length, 21.91 mm, was obtained in February with the IBA 2000 ppm dose. Similarly, Demirbaş (2019) examined the effects of cuttings of oil rose (*Rosa damascena* Mill.), a plant known for its difficult rooting, across different periods and different hormone doses. The highest root length was achieved with 2000 ppm. Our findings are similar with these studies.

Kara et al. (2011) investigated the effects of different cutting periods and IBA doses on the rooting of cuttings from rosemary (*Rosmarinus officinalis*), hyssop (*Hyssopus officinalis*), and sage (*Salvia officinalis*). The highest root lengths were recorded as 7.1 cm for rosemary, 6.1 cm for hyssop, and 5.1 cm for sage, using a 4000 ppm IBA dose in cuttings taken in March. These differences may be attributed to

the plant species, the use of different rooting media, variations in cutting types, different hormones, doses, or holding times.

3.5. Shoot Number

It was observed that the effects of different rooting media, the IBA 2000 ppm and NAA 1000 ppm doses, and the interactions of variety×medium, variety×hormone, medium×hormone, variety×medium×hormone on shoot number of lavender cuttings varied depending on the variety. While the highest number of shoots was observed in the Sevtopolis variety (20.93), the lowest shoot number was recorded for the Super A variety (6.93). When examining the general effects of different rooting media, cocopeat produced the highest shoot number, matching the 20.93 shoots of the Sevtopolis variety, while soil medium produced the lowest number (6.93 shoots). In terms of hormone application, the IBA 2000 ppm dose resulted in the highest shoot count of 20.93, while the control (0 ppm) yielded the lowest (6.93 shoots). These findings suggest that different rooting media and hormone applications significantly influence the shoot number of lavender varieties, generally leading to positive results (Table 6).

Statistically, the effects of different rooting media, the IBA 2000 ppm and NAA 1000 ppm doses, and the interaction between variety and hormone significantly affected the shoot number ($p \leq 0.01$). The medium and hormone interaction was also statistically significant ($p \leq 0.05$), though the interaction between variety, medium, and hormone was insignificant. Analyzing the variety and medium interaction showed an insignificant effect on the shoot number, with averages ranging from 7.40 to 7.68. (Table 2). The highest number of shoots (7.93) was achieved with the Drujba variety in cocopeat medium, while the lowest (6.93) was seen in Super A variety with soil medium (Table 6).

Table 6. Effect of IBA 2000 ppm and NAA 1000 ppm dose on the number of shoots (number) of lavender cuttings in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	7.00	17.67	13.67	12.77
	Peat	7.60	17.80	15.47	13.62
	Cocopeat	7.60	19.20	16.00	14.26
	Average	7.40	18.22	15.04	13.55 C
Sevtopolis	Soil	7.00	20.20	16.93	14.71
	Peat	7.60	20.67	17.60	15.28
	Cocopeat	7.80	20.93	18.00	15.57
	Average	7.46	20.60	17.51	15.19 A
Drujba	Soil	7.40	17.73	14.87	13.33
	Peat	7.73	19.47	16.60	14.60
	Cocopeat	7.93	20.13	16.93	15.00
	Average	7.68	19.11	16.13	14.31 B
Super A	Soil	6.93	18.00	14.60	13.17
	Peat	7.87	18.73	15.40	14.00
	Cocopeat	7.67	19.53	16.07	14.42
	Average	7.48	18.75	15.35	13.86 BC
	Variety Average	7.51 C	19.17 A	16.01 B	14.23
	Rooting Medium Average	13.50 C	14.37 B	14.81 A	

* There is no statistical difference between averages indicated with the same letter.

When the variety×hormone interaction was examined, the effect of lavender cuttings on the number of shoots was statistically significant ($p \leq 0.01$) (Table 2). The number of shoots in the variety × hormone interaction ranged from 7.51 to 19.17, with the highest shoot number of 20.93 obtained from the combination of the Sevtopolis variety and the IBA 2000 ppm dose, while the lowest number of shoots, 6.93, was recorded for the Super A variety with no hormone application (Control). In general, the application of IBA 2000 ppm significantly increased the number of shoots compared to the control (Table 6).

When the medium×hormone interaction was examined, the effect of lavender cuttings on the number of shoots was statistically significant at the $p \leq 0.05$ level (Table 2). In the medium×hormone interaction, the number of shoots varied between 7.40 and 20.60, with the highest number of 20.93 shoots obtained from the combination of cocopeat medium and IBA 2000 ppm dose. The lowest shoot number, 6.93, was recorded in the soil medium with no hormone application (Control). The application of cocopeat medium and IBA 2000 ppm hormone dose stood out, as the soil medium and control combination yielded values well below the average (Table 6).

When the variety×medium×hormone interaction was examined, the effect of lavender cuttings on the number of shoots was statistically insignificant (Table 2). The number of shoots in this interaction ranged between 13.17 and 15.57, with the highest number of 20.93 obtained from the combination of the Sevtopolis cultivar with cocopeat medium and IBA 2000 ppm dose (Table 6). The lowest number of shoots, 6.93, was recorded for the Super A variety in the soil medium without hormone application (control). Overall, the use of the medium and hormones positively influenced the number of shoots, with the highest values observed in the combination of IBA 2000 ppm and cocopeat medium. Based on these results, the combination of the Sevtopolis variety with IBA 2000 ppm and cocopeat medium, as well as the Hemus variety with cocopeat medium and IBA 2000 ppm, can be recommended.

3.6. Shoot Length

The effects of different rooting media, IBA 2000 ppm, and NAA 1000 ppm doses, as well as the interaction of variety×medium, variety×hormone, medium×hormone, variety×medium×hormone on the shoot length of lavender cuttings varied across different varieties. The highest shoot length, 15.35 cm, was obtained from the Sevtopolis variety, while the lowest shoot length, 4.19 cm, was recorded for the Hemus variety. Regarding the general effects of rooting media, the cocopeat medium produced the highest shoot length at 15.35 cm, and the soil medium produced the lowest at 4.19 cm. Additionally, in terms of hormone application, the IBA 2000 ppm dose resulted in the highest shoot length (15.35 cm), whereas the control treatment (0 ppm) resulted in the lowest shoot length (4.19 cm) (Table 7). Overall, the use of different rooting media and hormone applications generally increased shoot length and had positive effects on the cultivars.

Table 7. Effect of IBA 2000 ppm and NAA 1000 ppm dose on shoot length (cm) of lavender cuttings in different medium.

		Control	**IBA**	**NAA**	**Average**
Hemus	Soil	4.19	11.31	7.05	7.51
	Peat	4.42	11.77	7.67	7.95
	Cocopeat	4.75	12.38	8.25	8.45
	Average	4.45	11.82	7.65	7.97 D
Sevtopolis	Soil	5.09	13.94	8.59	9.20
	Peat	5.60	14.37	9.43	9.80
	Cocopeat	5.90	15.35	10.13	10.46
	Average	5.52	14.55	9.38	9.82 A
Drujba	Soil	4.57	12.25	7.57	8.13
	Peat	4.78	12.70	8.33	8.60
	Cocopeat	5.07	13.37	8.90	9.11
	Average	4.80	12.77	8.26	8.61 B
Super A	Soil	4.47	11.93	7.31	7.90
	Peat	4.66	12.37	8.01	8.34
	Cocopeat	4.98	12.95	8.71	8.88
	Average	4.70	12.41	8.01	8.37 C
	Variety Average	4.87 C	12.89 A	8.33 B	8.69
	Rooting Medium Average	8.20 C	8.66 B	9.22 A	

* There is no statistical difference between averages indicated with the same letter.

The effect of different rooting media, varieties, and IBA 2000 ppm and NAA 1000 ppm doses on shoot length of lavender cuttings were statistically significant for both cultivar×hormone and medium×hormone interactions ($p \leq 0.01$), while the variety×medium interaction was significant at the $p \leq 0.05$ level. The variety×medium×hormone interaction, however, was statistically insignificant. The variety×hormone interaction significantly affected shoot length ($p \leq 0.01$) (Table 2). The average shoot length in this interaction ranged from 4.87 to 12.89 cm, with the highest value, 15.35 cm, obtained from the interaction between the Sevtopolis cultivar and IBA 2000 ppm. The lowest shoot length, 4.19 cm, was recorded for the Hemus cultivar with the control treatment (Table 7). In general, all varieties showed increased shoot length when treated with IBA 2000 ppm or NAA 1000 ppm, compared to the control.

The medium×hormone interaction significantly affected the shoot length of lavender cuttings ($p \leq 0.01$) (Table 2). The average shoot length for this interaction ranged from 4.45 to 14.55 cm. The highest shoot length of 15.35 cm was obtained from the combination of cocopeat medium and IBA 2000 ppm, while no hormone application. The use of cocopeat medium, combined with the IBA 2000 ppm dose, proved particularly effective in increasing shoot length (Table 7).

The variety×medium×hormone interaction did not have a statistically significant effect on the length of lavender cuttings (Table 2). The average shoot length for this interaction ranged from 7.51 to 10.46 cm. The highest shoot length, 15.35 cm, was recorded for the interaction between the Sevtopolis variety, cocopeat medium, and IBA 2000 ppm (Table 7). The lowest shoot length, 4.19 cm, occurred with the Hemus variety, soil medium and, no hormone application. When considering the results and averages overall, the variety×hormone and medium×hormone interactions had statistically significant effects on the shoot length of lavender cuttings ($p \leq 0.01$). The IBA 2000 ppm dose showed a pronounced effect on increasing shoot length across varieties (Table 2). Furthermore, the use of cocopeat medium in combination with IBA 2000 ppm promoted rooting. Based on their effects on shoot length, the recommended applications are cocopeat medium and IBA 2000 ppm, with the most effective combination being Sevtopolis variety with cocopeat medium and IBA 2000 ppm.

Upon examining the effects of IBA, NAA, and different medium applications, the IBA 2000 ppm dose emerged as particularly effective, significantly increasing shoot length compared to the control (0 ppm). The cocopeat medium also stood out among the various media tested. In line with these findings, Uzunoğlu and Mavi (2016) observed that in ornamental pomegranate (*Punica granatum* L.) cuttings treated with IBA (0, 500, 1000, 2000, 3000 ppm) the best results for shoot length were obtained with 3000 ppm IBA. However, Çiçek (2019) reported contrasting findings in lavender (*Lavandula angustifolia* Mill) cuttings, where 4000 ppm IBA applied to bottom cuttings produced the longest shoots. These variations indicate that plant species, rooting products and doses, rooting medium, and techniques can all influence the results, and differences in these factors may lead to changes in outcomes.

Various studies have shown differences in the rooting status, rooting rates, number of roots, root lengths, number of shoots, and shoot lengths of the cuttings. These variations may be attributed to physiological and chemical factors, as well as the differing regenerative abilities and genetic structures of the species and their environmental conditions. Factors such as the age of the mother plant, the timing and type of cutting, and the plant's nutrient status, hormonal levels, and anatomical structure can also influence these outcomes (Ahmed et al., 2002; Gil-Albert & Boix, 1978; Hartmann et al., 1997; Kara, 2011; Schaberg et al., 2000).

4. Conclusion and Recommendations

In recent years, the cultivation of medicinal and aromatic plants has been steadily increasing. Alongside yield, the quality of these plants is of great importance, as the primary value of medicinal and aromatic plants lies in the active substances they contain. As a result, scientific research on advanced breeding techniques aimed at improving quality has accelerated, leading to significant advancements. In Türkiye, lavender cultivation has expanded to various regions, particularly Isparta. This study, briefly summarizes the findings on the effects of different rooting media and doses of IBA 2000 ppm and NAA 1000 ppm on the rooting of cuttings from various lavender varieties. The study found that the highest rooting rate of lavender cuttings, using different rooting media and doses of IBA 2000 ppm and NAA 1000 ppm, was observed in the Super A variety at 88.33%, while the lowest rooting rate was seen in the Sevtopolis and Drujba varieties at 48.67%. When examining the overall effects of different rooting media, the highest rooting rate was achieved with cocopeat medium at 88.33%, while the lowest rooting rate was recorded in soil medium at 48.67%. When analyzing the effects of IBA and NAA, and different media applications, the IBA 2000 ppm dose emerged as particularly effective, significantly increasing rooting compared to control (0 ppm). The cocopeat medium also stood out among the tested media.

Among the tested varieties, the highest rooting status was recorded in the Super A variety with 17.67 units, while the lowest rooting status was noted in the Sevtopolis and Drujba varieties, both at 9.73 units. When examining the overall effects of different rooting media, the highest rooting status was achieved with the cocopeat medium at17.67 units, while the lowest rooting status was observed in the soil medium at 9.73 units. The IBA 2000 ppm dose was particularly effective, significantly enhancing rooting compared to control (0 ppm), Additionally, the cocopeat medium proved to be the most effective among the various media tested. Among the tested varieties, the highest number of roots was recorded in the Sevtopolis variety at 15.33, while the lowest number of roots was noted in the Super A variety at 4.47. When analyzing the overall effects of different rooting media, the highest number of roots was also observed in cocopeat medium at 15.33, while the lowest number of roots was found in the soil medium at 4.47. The IBA 2000 ppm dose proved to be particularly effective, significantly enhancing the number of roots compared to control (0 ppm), with the cocopeat medium demonstrating superior results among the various media used.

Among the varieties, the highest root length was recorded in the Sevtopolis variety at 9.88 cm, while the lowest root length was noted in the Hemus variety at 2.34 cm. When examining the overall effects of different rooting media, the highest root length was achieved in the cocopeat medium, also measuring 9.88 cm, whereas the lowest root length was observed in the soil medium at 2.34 cm. Furthermore, when evaluating the effects of different hormone applications, the longest root length was obtained from the IBA 2000 ppm application, measuring 9.88 cm, while the lowest root length was noted in the control group (0 ppm) at 2.34 cm. Overall, the impact of various media and hormone applications on root length among the different varieties yielded very positive and

significant results. Similarly, among the varieties, the highest number of shoots was observed in the Sevtopolis variety at 20.93, while the lowest number of shoots was recorded in the Super A variety at 6.93. When analyzing the general effects of different rooting media, the highest number of shoots was obtained from the cocopeat medium, also at 20.93, while the lowest number of shoots was found in the soil medium at 6.93. Furthermore, when assessing the effects of different hormone applications, the highest number of shoots, 20.93, was achieved with the IBA 2000 ppm dose, while the lowest number of shoots was noted in the control group (0 ppm).

Among the varieties, the highest shoot length was obtained in the Sevtopolis variety with 15.35 cm, while the lowest shoot length was obtained in the Hemus variety with 4.19 cm. When the general effects of different rooting medium were examined, the highest shoot length was obtained from the cocopeat medium with 15.35 cm, while the lowest shoot length was obtained from the soil medium with 4.19 cm. When the general effects of different hormone applications are examined, the highest shoot length of 15.35 cm was obtained from the IBA 2000 ppm dose application, while the lowest shoot length of 4.19 cm was obtained from the 0 (Control) application. When all the results are examined, in the propagation of lavender by cuttings, cocopeat medium and IBA 2000 ppm dose application, where the highest rooting parameters are obtained, can be recommended for cuttings taken from different varieties, especially Sevtopolis and Super A varieties. the cuttings of the plantations to be created with these varieties, using cocopeat medium, and 2000 ppm IBA applied to the cuttings will increase rooting and make a big difference.

Acknowledgment

This paper is a part of the MSc thesis of the first author.

Conflict of Interest

The authors declare that they have no conflict of interest.

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