OPTIMIZING LAVENDER PROPAGATION METHODS, TO INCREASE THE ACCESSIBILITY OF THE CROP ON SMALL – SCALE HOLDINGS

Sorina NIȚU (NĂSTASE)[1,2], Monica TOD[1], Virgil NIȚU[2], Emilia CONSTANTINESCU[3]

[1]Research And Development Grasslands Institute, 5 Cucului St., Brașov, 500128, România
[2] University Of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Calea Manastur, 400372, Cluj-Napoca, Romania
[3]University of Craiova, Faculty of Agronomy, Libertatii Street nr.19, Craiova, 200421, Dolj, Romania

author email: nastasesorina03@gmail.com
monica.tod@pajisti-grassland.ro
nituvirgil69@yahoo.com

Corresponding author email: emiliaconst2000@yahoo.com

Abstract

Lavender (Lavandula angustifolia L.) is one of the species cultivated in many countries of the world, being used as a medicinal, industrial and ornamental plant. It is distinguished as one of the most valuable plant species with a high content of essential oils. It is known that Lavender has a low seed germination rate, requiring vegetative propagation techniques, appropriate for obtaining high-quality planting material, which ensures both uniformity and high productivity. This work aimed to identify the most efficient method of lavender propagation by cuttings, to be economically profitable, and thus to support farmers who want to establish a Lavender crop but have limited financial resources. To determine the effect of cutting length on the rooting process, a factorial experiment was carried out, consisting of five variations of cutting length and a control variant of seed propagation. Each experimental variant had five repetitions, the tested lengths were: 3 cm, 5 cm, 8 cm, 10 cm and 15 cm, rooting and emergence evaluations were made 30 days after planting. The results obtained showed that the best rooting variant of lavender cuttings is 5 cm with a percentage of 87% rooted cuttings 45 days after planting.

Key words**: **Lavender, germination, cuttings, rooting, optimizing.

INTRODUCTION

Lavender is native to southern Europe, with its center of distribution in the western part of the Mediterranean basin, from the east to the Dalmatian coast and in Greece (Păun, 1995), it has been known as a medicinal and aromatic plant since 600 BC. The use of lavender for medicinal, phytotherapeutic and pharmacological purposes is due to its essential oil and its components separated from the inflorescences (Gonceariuc, 2008).

The name of the genus comes from the Latin "*lavare*" = to wash, the plant being used for this purpose by the Romans (Muntean et all., 2007).

The genus *Lavandula* belonging to the family *Lamiaceae* comprises 39 lavender species, from which the most cultivated species are *L. angustifolia* (also known as true or English lavender*), L. latifolia* (spike lavender) and *L. x intermedia* (lavandin or Dutch lavender) (Wells et all., 2018; Crisan et all., 2023).

Until the beginning of the last century, lavender was used from the spontaneous flora of France, Italy, Spain and North Africa, the expansion in culture was made in the 20th century, after the First World

War (Paun, 1988). Lavender is cultivated in some countries such as Bulgaria, England, the USA and North Africa (Ceylan, 1997).
The lavender is cultivated in some countries such as Bulgaria, England, U.S.A. and North Africa (Ceylan, 1997).
The therapeutic properties of the essential oil extracted from the flowers were rediscovered at the beginning of the 20th century, when René-Maurice Gattefosse, a chemist perfumer.The characteristic aroma of lavender, which makes it so sought after in the perfumery and cosmetic industry, is given by the volatile oils extracted from the inflorescences. The oil is also used in Indian Ayurveda medicine to alleviate depression, as well as by Tibetan Buddhist doctors to treat certain mental disorders (Constantinescu et all., 2022)
Several therapeutic effects of lavender, such as sedative, relaxant, carminative spasmolytic, antiviral, and antibacterial properties have been reported (Gamez, et al.,1990; Cavanagh and Wilkinson, 2002).
Lavender is in the research spotlight due to its increasing economic importance, while market demand is expected to continue to grow. Among the hundreds of essential-oil-bearing plants, *Lavandula angustifolia* Mill. remains one of the most valuable. Lavender crops can be expanded without competing for productive land, instead using marginal, contaminated or unproductive land (Crișan et all., 2023).
Lavender is a perennial subshrub, with an average lifespan of 25 to 30 years, depending on the pedoclimatic conditions and the maintenance technology applied.
Lavender is one of the wild plants cultivated mainly in southern France, Central Italy, Spain and Greece. It has a rooting depth of approximately 2 m, depending on the soil (Ardelean, Mohan, 2008.). The plant has a woody stem at the base, strongly branched, which determines a globular and compact habit. The average height of the plant varies between 50 and 100 cm, depending on the variety and the growing conditions.The leaves are sessile, opposite each other, lanceolate, entire margins, 2 – 6 cm long. The inflorescence is a branched terminal spike, 16 – 20 cm long (Ceylan, 1997; Vârban et all., 2009). The flowers are pentamerous, zygomorphic. On the axis of the spike are 4 – 6 flower clusters, blue – violet (Vârban et all., 2009). Each flower cluster has 6 - 14 flower clusters that change depending on certain factors. The color of the fruit varies from dark brown to black. The weight of 1000 seeds are less than 0.9 – 1g (Ceylan, 1997; Muntean et all., 2007).
Lavender can be propagated both generatively, by producing seedlings from seeds, and vegetatively by rooted cuttings or by dividing the bushes. Lavandin is a sterile hybrid and is propagated exclusively by cuttings. When propagated by seeds, heterogeneous plantations are obtained, which greatly complicates the establishment of harvest times, due to the uneven flowering. (Verzea et all., 2001).
From a biochemical point of view, *Lavandula officinalis* is a valuable species due to its high essential oil content (1.5–2.5%% dry matter), in the composition of the flower linalool and linalyl acetate predominate, compounds with antiseptic, anti-inflammatory and soothing properties (Nadasan, 2004). These substances determine the extensive use of lavender in the pharmaceutical, cosmetic, perfumery and phytotherapy industries.
Improving crop cultivation technology by establishing the optimal planting distance in local climatic and edaphic factors is very important for successful production (Nițu et all., 2022; Constantinescu et. all., 2025).
Also, lavender has a great ecological and agronomic importance, contributing to the diversification of agroecosystems,
attracting pollinators and the valorization of marginal or less fertile lands. Due to its adaptability and moderate requirements towards environmental factors, lavender has become a reference species in the development of sustainable agriculture and organic farming systems.

MATERIALS AND METHODS

In recent years, lavender cultivation has experienced a significant expansion in Romania, due to the increased market demand and the adaptability of the plant to various pedoclimatic conditions. However, one of the major challenges in establishing plantations is the initial costs, especially those associated with the planting material.

The experiment was conducted at the Research and Development Institute for Grasslands Brașov, Romania, within the Laboratory of Medicinal and Aromatic Plants. The experiment was carried out in a greenhouse, using planting material of the *Lavandula angustifolia* Mill. species. Two main propagation methods were tested:

- vegetative propagation by cutting.
- generative propagation by seeds.

For vegetative propagation, cuttings of different lengths were prepared, distributed in the following experimental variants:

In the case of variant 1, the cuttings of Lavandula angustifolia were taken from the apical portions of the young shoots, in the active phase of vegetative growth, characterized by intense meristematic activity (Figure 1).

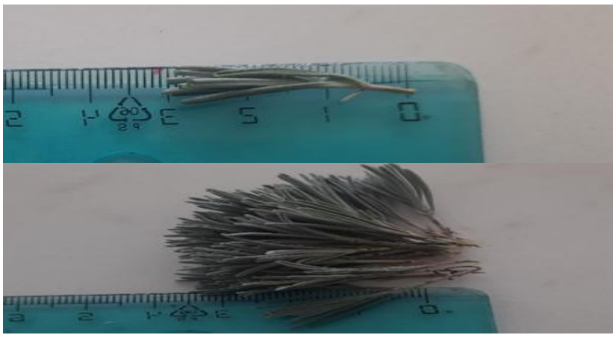
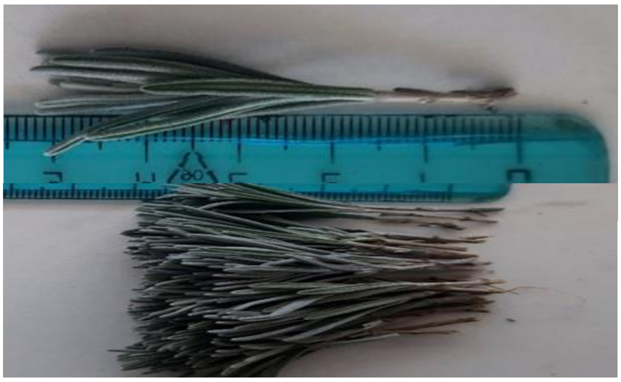


Figure 1. V_1: 3 cm cuttings

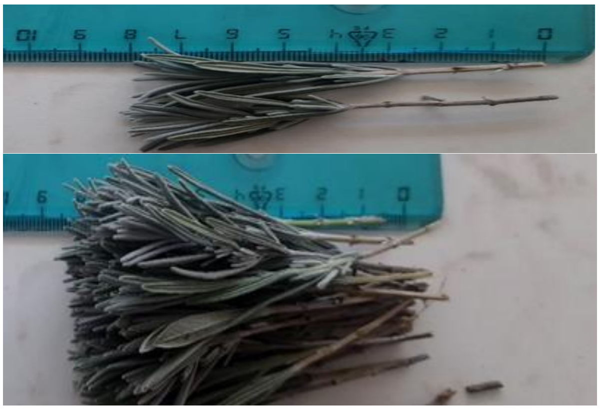
The tissues present a predominantly parenchymal structure, thin-walled cells, without lignin deposits, and no areas of early lignification were evident. The appearance of the taken segments indicates a high degree of juvenile nature of the biological material, specific to the herbaceous phase of the vegetative organs. The cuttings of variant 2 were taken from the mid-apical portions of young shoots, showing the beginning of the lignification process. Their tissues were partially semi-lignified, with basal areas of 1–1.5 cm in which the cell walls showed incipient lignin deposits, while the upper portions retained the herbaceous character. This mixed structural conformation indicates the transition from the herbaceous to the semi-woody stage, specific to the intermediate phase of shoot maturation (Figure 2).

Figure 2. V_2: 5 cm cuttings



Variant 3 followed the dynamics of the rooting process in cuttings with a length of 8 cm. The biological material used presented a degree of semi-lignification, highlighted in the basal area of 2–2.5 cm, partially thickened cell walls, with obvious lignin deposits. The apical portions of the cuttings had an active parenchymal structure, specific to young tissues still in the vegetative growth phase. This conformation reflects the transition to the woody stadium of the shoots (Figure 3).

Figure 3. V_3: 8 cm cuttings



The 10 cm plant material showed a pronounced degree of lignification, manifested in the basal area of approximately 3–3.5 cm, partially lignified cell walls, giving the tissues a firm consistency. The upper regions retained herbaceous characteristics, with active parenchymal tissues. (Figure 4).

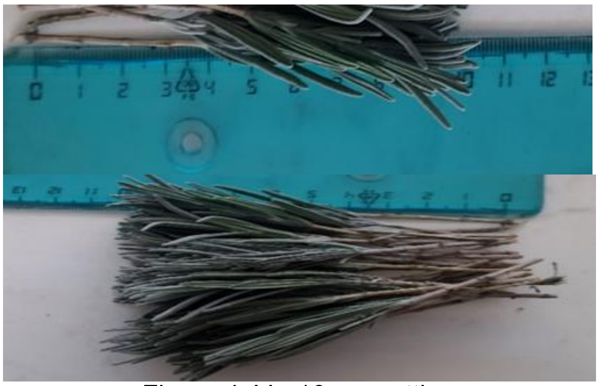


Figure 4. V_4: 10 cm cuttings

The last cuttings analyzed showed an advanced degree of lignification in the basal area (approximately 4–4.5 cm), characterized by partial thickening of the cell walls and lignin deposits. The apical portions showed an active parenchymal structure, with living and permeable cells (Figure 5).

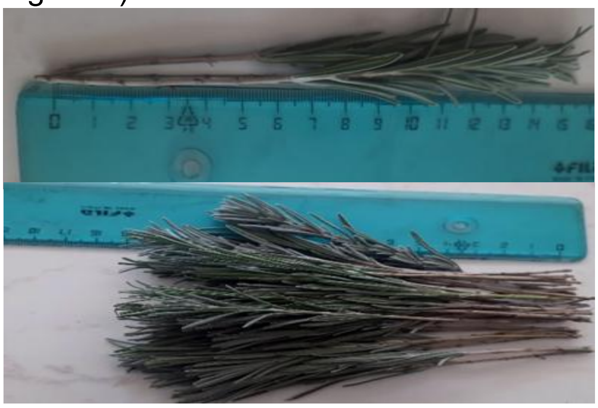


Figure 5. V_5: 15 cm cuttings

Variant 6 was represented by Lavandula angustifolia seeds, sown on the same day as the other experimental variants. This constituted the control variant, being used to comparatively evaluate the efficiency of vegetative propagation methods by cuttings compared to the generative one. The purpose of including this variant was to highlight the differences between the rooting and emergence rates, respectively, depending on the type of propagation material used (Figure 6).

Figure 6. V_6: direct sowing (control).

Each experimental variant consisted of 30 cuttings harvested on the same date. The rooting substrate used was red peat substrate for sowing / cuttings 250 – liter bale. One week after planting, all cuttings were pinched approximately 1 – 3 cm, depending on their length to stimulate the rooting process.

All variants were monitored under identical environmental conditions (humidity, temperature, light), and the observed parameters included: the percentage of attachment, the speed of root development and the general condition of the plants during and after rooting, until planting (Figure 7).

Figure 7. Seedlings vs. direct sowing

RESULTS AND DISCUSSIONS

The study on the influence of the length of Lavandula angustifolia cuttings on the rooting process compared to seed propagation noted considerable differences in the action of the cuttings length in the five cases analyzed, compared to seed propagation. In the V1 variant, consisting of cuttings with a length of 3 cm, very good results were noted, the cuttings showing well-developed roots ranging between 3 - 7 cm in length. Two or three rows of secondary branches are also present. The formed roots show a very good state of health; there are no active spots or molds. The vegetative part shows a growth of approximately 2 - 5 cm (Figure 8). The number of rooted cuttings being 26 out of 30, representing a percentage of 87%.

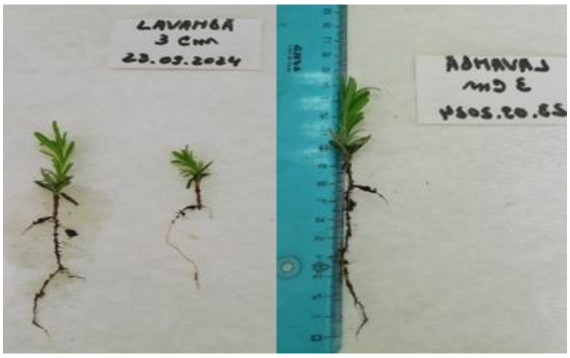


Figure 8. V_1: 3 cm rooted cuttings

Direct observations on variant no. 2 demonstrate the formation of a developed root system (Figure 9), composed of fine adventitious roots, with an estimated length between 2 and 6 cm. The roots had uniform branching, a light color, specific to young and healthy roots. The aerial part remained green, without signs of necrosis or dehydration, which denotes normal metabolic activity and efficient adaptation to the environment. The number of rooted cuttings was 29 out of 30, representing a percentage of 97%.

Figure 9. V_2: 5 cm rooted cuttings

When examining variant no. 3, the base of the stem shows callus and roots at the beginning of formation. The basal tissue has a slightly lignified appearance, the aerial part of the cutting remained only partially viable, with slightly wilted leaves, which confirms a physiological imbalance due to the impossibility of water absorption. No secondary regenerations or signs of active growth are observed. The results indicate a difficult rooting process in 8 cm cuttings. This result can be attributed to several physiological and anatomical factors. Thus, the greater length of the cuttings correlates with a reduction in root regeneration capacities, unlike 5 cm cuttings, which show complete root development (Figure 10).

Figure 10. V_3: 8 cm rooted cuttings

The high degree of lignification in the basal zone of 10 cm cuttings constitutes a major inhibitory factor of rhizogenesis (Figure 11). Thus, lignified tissues limited callus formation by reducing cambial activity; decreasing the diffusion of endogenous auxin-type hormones; increasing the mechanical resistance of the cell walls, preventing root formation.

Figure 11. V_4: 10 cm rooted cuttings

The cuttings analyzed in variant 5 showed an advanced degree of lignification in the basal area, over a portion of approximately 4–4.5 cm. This lignified structure reduced the capacity for cell division and differentiation, preventing the formation of callus and adventitious roots. Consequently, no visible roots were observed at the base of the cutting.

The apical portions retained an active parenchymal structure, with living, thin and permeable cells, but the lack of functional connection with a rhizogenic basal area determined a general physiological stagnation. The aerial part remained partially viable in the first weeks, followed by signs of wilting and progressive dehydration (Figure 12).

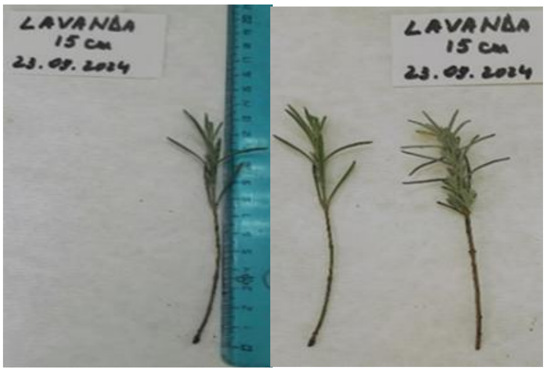


Figure 12. V_5: 15 cm rooted cuttings

Following the seed propagation process in the Lavandula sp. species, the formation of a well-developed primary root system was observed, characterized by a main taproot and several fine secondary branches, specific to the juvenile stage of the plant. The aerial part is represented by a thin, erect green stem, with the first fully formed true leaves, of intense green color, which denotes an incipient photosynthetic activity and a good state of health. The only problem observed was the low number of germinated seeds. Thus, out of 30 seeds, 9 plants sprouted, representing a germination percentage of 30% (Figure 13).

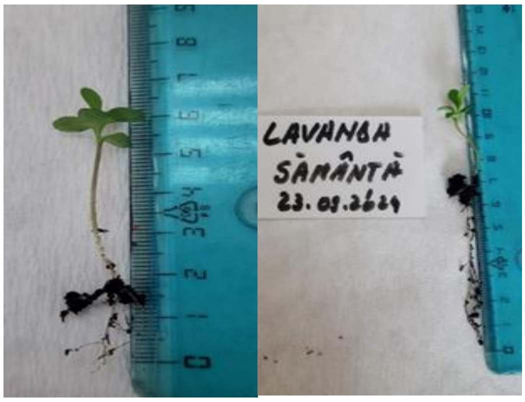


Figure 13. V_6 direct sown (control)

CONCLUSIONS

The influence of the length of Lavandula angustifolia cuttings on the rooting process compared to seed propagation noted considerable differences in the action of the cuttings length in the five cases analyzed, compared to seed propagation. Propagation by cuttings is very effective in the case of short semi-herbaceous cuttings of 3 - 5 cm, when the degree of lignification is reduced and the capacity for callus formation is high. In longer cuttings, basal lignification causes rhizogenetic blockage and delays the emission of adventitious roots.

Propagation by seeds allows the obtaining of young plants with a strong taproot system and a healthy physiological state, has a low germination rate (≈30%) and generates genetic variation.

The vegetative propagation method (by cuttings) ensures uniformity but requires rigorous control of the physiological stage of the propagation material.

The generative method (through seeds) is biologically more stable and natural, but less quantitatively efficient.

REFERENCES

Adal, A.M.; Demissie, Z.A.; Mahmoud, S.S. (2015). Identification, validation and cross-species transferability of novel *Lavandula* EST-SSRs. *Planta* 241, 987–1004. [Google Scholar] [CrossRef]

Aprotosoaie, A.C.; Gille, E.; Trifan, A.; Luca, V.S.; Miron, A. (2017). Essential oils of Lavandula genus: A systematic review of their chemistry. *Phytochem. Rev*. 16, 761–799. [Google Scholar] [CrossRef]

Ardelean, A., Mohan, G. (2008). *Flora medicinală a României,* Ed. All, București, ISNB 978-973-571-838-1, p.285.

Cavanagh, H. M. and Wilkinson, J. M. (2002). Biological activities of lavender essential oil. *Phytother. Res*., 16: 301–308.

Ceylan, A. (1997). Medicinal Plants II (Essential oil plants). E.U.J. *Fac. Agri. Pub. I.* No: 481, pp: 306. Bornova/IzmirTurkey.

Constantinescu, E., Nitu-Nastase, S., Bonea, D., Olaru, L. A., Blaj, V. A., Saracin, I., & Nitu, V. (2025). Planting density: Key factor for crop management of Cassia angustifolia Vahl. *Chilean journal of agricultural research,* 85 (2), 245-255.

Constantinescu, E., Niţu, S., Boruz, V., & Ştefan, I. O. (2022). *Lavender (Lavandula angustifolia Mill.*) -medicinal alternative species in the structure of crops in agricultural farms, in the context of climate change. *" Annals of the University of Craiova-Agriculture Montanology Cadastre Series"*, *52*(1), 87-94.

Crișan, I., Ona, A., Vârban, D., Muntean, L., Vârban, R., Stoie, A., Mihăiescu, T., and Morea, A. (2023). Current trends for lavender (*Lavandula angustifolia* Mill.) crops and products with emphasis on esențial oil quality. *Plants,* 12(2), 357. DOI:10.3390/plants12020357.

Gamez, M. J., Jimenez, J. C. and Zarzuelo, N. A. (1990). Study of the essential oil of *Lavandula dentata* L. *Pharmazie*., 45: 69-76.

Gonceariuc, M. (2008).*Lavandula angustifolia* Mill. În: Plante medicinale şi aromatice cultivate. *Centrul Edit. UASM*: 99-120

Muntean, L. S., Tămaș M., Muntean S., Duda M., Vârban D., Florian S. (2007). *Tratat de plante medicinale cultivate si spontane*. Ed. RISOPRINT. Cluj-Napoca.

Nădășan, V. (2004). *Incursiune în fitoterapie*" Ed. a 2-a. – Bucuresti: Casa de Editură Viață și Sănătate; ISBN 973-79933-45-1. p. 92.

Nițu, S., Hermeziu, M., & Chelmea, C. (2022). Study of some growth and reproductive elements in the *Cassia angustifolia* species.

Pâun, E. (1988) *Tratat de plante medicinale si aromatice cultivate*. Vol. II. Ed. Academiei RSR, p.7;

Păun, E. (1995). *Sănătatea Carpaţilor. Farmacia din cămară*. Buc. Ed. Stil Commerce.

Upson, T. (2002). The taxonomy of the genus *Lavandula* L. In *Lavender*. The Genus Lavandula; Lis-Balchin, M., Ed.; Taylor & Francis: London, UK; New York, NY, USA, pp. 16–48. ISBN 9780429218590. [Google Scholar]

Varban, Rodica, Stoie A, Stana, Doina. (2009). *Botanica sistematica: indrumator lucrari practice.* Cluj – Napoca, Editura AcademicPres, ISBN 978-973-744-146-1, p.171

Verzea, M. (2001). *Tehnologii de cultură la plantele medicinale şi aromatice*. Bucureşti: Orizonturi, 120-126.

Wells, R., Truong, F., Adal, A.M., Sarker, L.S., and Mahmoud, S.S. (2018). *Lavandula essential oils*: A current review of applications in medicinal, food, and cosmetic industries of lavender. *Natural Product Communications*, 13(10), 1403–1417. DOI:10.1177/1934578X1801301038.