Influence of cutting type and size on rooting of *Lavandula dentata* L.

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ABSTRACT: Even though the *Lavandula* species may be propagated by seeds, it should not be the preferred propagation method because it causes a great lack of uniformity. On the other hand, asexually propagated lavender crops would provide more homogeneous crops, and clones from high quality plant material would increase the odds for obtaining a higher quality essential oil. However, problems such as poor rooting and restrict market availability for superior clones have been a problem in vegetative propagation of the *Lavandula* species. The objective of this work was to define which type and size of cutting is more adequate for cutting propagation of *L. dentata*, a very productive *Lavandula* species. Cuttings with 5, 8, 10 or 13 cm and from the apical or basal parts of stems cut from *L. dentata* stock plants were placed in Plantmax HT® filled polystyrene foam trays and kept under intermittent mist system for two months. Averages of root number, length of the longest root, fresh and dry root weight, and percentage of rooting were evaluated. Apical cuttings combined 97.9% rooting with an average of 13.2 roots per cutting and basal cuttings 93.7% rooting with 2.98 roots per cutting. Apical cuttings with at least 10 cm in length were considered the most adequate for cutting propagation of *L. dentata*.

Key words: vegetative propagation, lavender, medicinal plant

RESUMO: Influência do tipo e tamanho de estaca no enraizamento de *Lavandula dentata* L. Apesar de serem propagadas por sementes, as espécies de *Lavandula* deveriam ser preferencialmente propagadas por estaquia devido a grande falta de uniformidade causada pela primeira, enquanto que a propagação assexual da alfazema permite maior homogeneidade da lavoura e o uso de clones de alta qualidade aumentaria as chances de se obter óleo essencial de alta qualidade. No entanto, o baixo poder de enraizamento e o mercado restrito de clones superiores têm sido problemas para a propagação vegetativa de espécies de alfazema. O objetivo deste trabalho foi definir qual tipo e tamanho de estaca seriam mais adequados para a propagação de *L. dentata*, espécie muito produtiva de *Lavandula*, por estaquia. Estacas com 5, 8, 10 ou 13 cm das partes apical e basal de ramos de plantas matrizes de *L. dentata* foram colocados em bandejas de isopor com o substrato Plantmax HT® e mantidas em casa de vegetação sob nebulização por dois meses. As médias de número de raízes, comprimento da raiz mais longa, massa fresca e seca de raízes e porcentagem de enraizamento foram avaliadas. Estacas apicais apresentaram enraizamento de 97,9% e 13,2 raízes por estaca em média e as estacas basais 93,7% de enraizamento e 2,98 raízes por estaca. Estacas apicais com pelo menos 10 cm de comprimento foram consideradas as mais adequadas para a propagação da *L. dentata* por estaquia.

Palavras-chave: propagação vegetativa, alfazema, planta medicinal

INTRODUCTION

Lavender, *Lavandula* genus, is a perennial shrub of the Labiaceae family (Cavanagh & Wilkinson, 2002). The species from the genera are original from Europe but are currently grown in temperate climate regions around the world. The lavender essential oil is very important economically and there is a huge world demand for it (Hughes, 1998). The lavender essential oil is used for the production of high price perfumes, fragrances and essences, in pharmaceutical products, and also in the cosmetic

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and food industries due to its phenolic metabolites (Singh et al., 1997; Al-Amier et al., 1999; Shellie et al., 2002; Moss et al., 2003; Chemat et al., 2006; Dob et al., 2006). Nevertheless, commercial oil composition presents great content variation, in part due to genetic differences among plant populations since lavender crops have been mostly propagated by seeds and problems such as low secondary metabolites synthesis and great variability among species are ruling (Nogueira & Romano, 2002). Even tough *Lavandula* species may be propagated by seeds it should not be the preferred propagation method because it causes great lack of uniformity while asexually propagated lavender crops would provide more homogeneous crops, and clones from high quality would increase the odds of obtaining higher quality essential oil (Tyub et al., 2007). However, poor rooting and restrict market availability for superior clones of *Lavandula* species have been problems (Calvo & Segura, 1989).

L. angustifolia angustifolia P. Mill. (English lavender), formerly known as *L. vera* or *L. officinallis*, is practically free from camphor, differently from other species in the genus, however, it is less productive (Cavanagh & Wilkinson, 2002; Floreno, 1997). *L. dentate* is rich in 1,8-cineol and fenchol, presents higher camphor content, however it is much more productive than *L. angustifolia* (Echeverrigaray et al., 2005).

Cutting type (original position on stem of plant stock) may influence the rooting capacity of the cutting. Apical cuttings are less lignified than basal cuttings, have many meristematic cells, which are actively growing, and presents less or none phenolic compounds (Hartmann et al., 2002). However, apical cuttings tend to lose humidity more easily than basal cuttings and extra care, a mist system for example, is required in order keep those cuttings hydrated (Lima et al., 2006). Not only type but size of cuttings matters because of the amount of carbohydrates and nutrients held in the plant tissue, however, larger cuttings means larger evaporation areas as well, and may suffer more dehydration because of it (Hartmann et al., 2002).

The objective of this work was to define which type and size of cutting is more adequate for cutting propagation of *L. dentata*, a very productive *Lavandula* species.

MATERIAL AND METHOD

Influence of cutting size on rooting

Cuttings with 5, 8, 10 or 13 cm in length were made from stems detached on August of 2007, from *L. dentata* stock plants located at the Canguiri Experimental Station of the Federal University of Parana, in Pinhais, PR, Brazil, and placed in Plantmax HT® filled polystyrene foam trays which were kept under intermittent mist system. A voucher specimen was deposited in the herbarium of the UFPR´s Department of Botany (voucher specimen no. UPCB 61.305). A total of 96 cuttings (eight cuttings per treatment and three replications) were used. A completely randomized experimental design was applied. After two months, averages of root number, length of the longest root, fresh and dry root weight, and percentage of rooting were evaluated.

Influence of cutting type on rooting

Cuttings with 10 cm in length were removed from apical and basal part of stems detached from *L. dentata* stock plants located at the Canguiri Experimental Station of the Federal University of Parana, in Pinhais, PR, Brazil, and placed in Plantmax HT® filled polystyrene foam trays which were kept under intermittent mist system. A total of 74 cuttings (eight cuttings per treatment and four replications) were used. A completely randomized experimental design was applied. After two months, averages of root number, length of the longest root, fresh and dry root weight, and percentage of rooting were evaluated.

Data were submitted to ANOVA and Tukey test ($p<0.05$).

RESULT AND DISCUSSION

Influence of cutting size on rooting

Size did not influence rooting percentage, which was 100%. Average root number was statistically lower on 5 cm long cuttings compared to the larger ones, specially the 10 and 13 cm long cuttings, which produced significant heavier roots (Table 1). This was probably due to the amount of reserves accumulated in different cutting sizes (Hartmann et al., 2002). Similarly to what was observed herein, Costa et al. (2007) preferred longer *Ocimum selloi* Benth cuttings (20 cm) than shorter ones (10 cm) for vigorous vegetative propagation of the species. Biasi & Costa (2003), working with *Lippia alba*, also preferred longer 20 cm cuttings instead of 5, 10 or 15 cm, even without mist. Longer cuttings were also considered better than shorter cuttings on propagation of *Baccharis stenocephala* because they produced more roots (Bona et al., 2004).

In spite of not differing statistically from the 8 cm long cutting, the average root number on 10 and 13 cm long cuttings was larger (Table 1), and showed tendency of stabilizing, indicating that 10 cm long cuttings have the most ideal length to produce adventitious roots, as it requires less plant propagation material and, not as a regular rule (Biasi & Costa, 2003), larger cuttings may suffer more dehydration (Hartmann et al., 2002).

Roots were longer in the 5 cm long cuttings,

TABLE 1. Influence of cutting length on rooting of *L. dentata*.

Length of cuttings (cm)	Rooting (%)	Root number	Root lenght (cm)	Fresh weight (g)	Dry weight (g)
5	100	10.38 b	10.21 a	1.78 b	0.05 b
8	100	13.92 ab	7.69 b	1.48 b	0.11 b
10	100	16.58 a	9.11 ab	2.62 ab	0.17 ab
13	100	16.58 a	8.84 ab	4.94 a	0.30 a
C.V. (%)	-	16.48	9.28	44.17	40.32

Average values on same column followed by similar letters do not differ statistically according to Tukey's test at 5%.

TABLE 2. Influence of cutting type on rooting of *L. dentata*.

Type of cuttings (position on stem)	Rooting (%)	Root number	Root lenght (cm)	Fresh weight (g)	Dry weight (g)
Apical	97.9 a	13.12 a	9.00 a	1.50 a	0.12 a
Basal	93.7 a	2.98 b	3.20 b	0.39 b	0.02 b
C.V. (%)	6.30	38.75	21.48	56.95	81.31

Average values on same column followed by similar letters do not differ statistically according to Tukey's test at 5%.

however, it did not differ from 10 and 13 cm long cuttings (Table 1). Anyhow, pruning is usually necessary and very long roots are not ideal for transplantation as breakage or circling roots may form and cause girdling, jeopardizing the perfect functioning of sieve-tube elements, which transports water and solutes upward and downward in the plant (Sadava et al., 2008).

Nevertheless, root number and weight are considered important variables which influence the new plant's survival (Carvalho et al., 2007). Hence, accordingly to results presented in Table 1, if length of stems on stock plants allows it, longer cuttings (10 or 13 cm long) should be used for propagation of *L. dentata*.

Influence of cutting type on rooting

Rooting percentage of apical cuttings was 97.9% and of basal cuttings 93.7%. The cutting type, i.e., position on stock plant stem, was effective on rooting of *L. dentata* cuttings. In general, apical cuttings were significantly superior to basal cuttings for all variables tested (Table 2). Such outcome was probably due to internal plant hormones such as auxins and other cofactors which are concentrated on plants' apex, where meristematic cells abound (Hartmann et al., 2002). Greater average numbers of longer, heavier roots were obtained. For cutting propagation of *L. dentata*, apical cuttings were considered better than basal cuttings, however, different *Lavandula* species may respond differently and tests should be performed before choosing the best cutting type for other *Lavandula* species. Bona et al. (2005) observed different rooting and development responses on different types of *Baccharis*, a medicinal plant, cuttings. Apical cuttings were better to propagate *B. articulata* and *B. stenocephala,* but to *B. trimera,* cutting type did not matter. However, to Carvalho et al. (2007), basal cuttings of *B. trimera* presented best rooting quality, both in rooting percentage and mass of roots produced. For rooting of another medicinal plant, *Ocimum gratissimum* L., cuttings removed from basal and middle parts of stems were considered better than the apical cuttings (Sousa et al., 2005); for the vegetative propagation of *Hydrangea macrophylla* (Thunb.) Ser., an ornamental shrub, basal cuttings were preferentially used (Luz et al., 2007). In 2006, Maia observed the interference of cutting type on cutting propagation of *Hyptis suaveolens* (L.), an aromatic perennial shrub. Later it was observed that basal and middle stem cuttings presented better performance, but apical cuttings presented better growth during the acclimation process; even thought the species could be propagated independently of the cutting type (Maia et al., 2008).

CONCLUSION

1) *L. dentata* cuttings rooted easily.

2) Better rooting response was obtained using apical cuttings with 10 or 13 cm.

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