HPU2 Journal of Sciences:
Natural Sciences and Technology

journal homepage: https://sj.hpu2.edu.vn

Article type: Research article

Effects of cutting types, cultivating seasons and several commercial rooting stimulants on root formation of cutting patchouli

Lan-Huong Phung Thi [a,*], Phuong-Quy Nguyen[b],
Xuan-Duong Vu[a], Thu-Thao Nguyen Thi[a]

[a] *Department of Faculty of Natural Sciences, Hung Vuong University, Viet Tri, Phu Tho, Viet Nam*
[b] *Institute of applied research and Development, Hung Vuong University, Viet Tri, Phu Tho, Viet Nam*

Abstract

Patchouli (Pogostemon cablin (Blanco) Benth.) is a plant producing an important essential oil plant for the perfume industry. Moreover, it also has a high medicinal value. This study aims to investigate the effects of several factors, including cutting types, cultivating seasons, and commercial rooting stimulants, on the rooting process of patchouli cuttings. The obtained results demonstrated that the highest rooting efficiency was achieved when using juvenile cuttings, in both winter and spring, in comparison with mature and old ones. Different commercial root stimulants show distinct effects on rooting of patchouli (i.e., rooting rate, root number and root length) on different cutting types. The rooting rate was 100% in all experimental treatments using juvenile shoots. King root and Rooting power were the most effective to improving the number of roots per cutting and the root length, compared to two other commercial root stimulants, N3M and Rootone. The number of roots per cutting was the highest on juvenile shoots (27.2 and 28.8 roots/cutting) and mature shoots (27.0 and 25.6 roots/cutting) treated with King root and Rooting power. Meanwhile, the largest root length was observed on juvenile shoots (50.8 mm) treated with Rooting power. This work suggests using juvenile shoots for patchouli propagation using cutting method. The favorable cultivating seasons was spring. King root and Rooting power were two effective commercial root stimulants to propagate this medicinal plant.

Keywords: Patchouli (Pogostemon cablin (Blanco) Benth.), cuttings, seasons, commercial root stimulants, rooting.

1. Introduction

Patchouli (Pogostemon cablin (Blanco) Benth.) is native from South and Southeast Asia [4]. Nowadays, patchouli is cultivated on large scale in tropical regions in Asia and Africa, such as India, Malaysia, China, Singapore, West Africa and Vietnam, for its essential oil [4,6,7,9]. Patchouli oil is one of the most important natural gredients employed in parfume industry. Besides, it is also used in medical treatments to boosting libido, reduce anger and axienty. Patchouli leaves contain numerous compounds which exhibit the abilities of anti-bacteria, pain-killing, anti-inflammation, anti-oxidation, anti-palatete, sensual stimulation, anticoagulant, anti-depression, stopping vomiting and cytotoxicity [1,6,7].

*Corresponding author. E-mail: phungthilanhuong@hvu.edu.vn
https://doi.org/10.56764/hpu2.jos.2022.1.1.88-96

Received date: 23-8-2022 ; Revised date: 26-8-2022 ; Accepted date: 30-8-2022

Therefore, patchouli is also used in traditional medicine to treat several diseases such as itching, coughing, diarrhea and dizziness [3].

However, in the past several years, the investigation, cultivation and utilization of patchouli in Vietnam is still limited. Patchouli now is scatteredly cultivated in small scaleu. To elevate the production of patchouli to provide enough high-quality ingredient for manufacture of patchouli-based products, multiplication plays an important role. With the characteristic features of asynchronous flowering, a short flowering period and low ratio of fruiting, patchouli seedling exhibits low multiplication coefficients. Thus, patchouli is usually multiplicated by division, however, the multiplication coefficient of this method is not high, and it also requires a large number of initial materials. Meanwhile, stem cutting is an effective method for multiplication of various plants.

This study aims to evaluate the influences of cutting type, cultivating season and several commercial rooting stimulants on the multiplication of patchouli using stem cutting.

2. Materials and methods or Experiments

2.1. Materials

Patchouli (*Pogostemon cablin* (Blanco) Benth.) was collected from patchouli cultivating region in Nghia Trai (Hamlet), Tan Quang (Village), Van Lam (District), Hung Yen and kept in the botanical garden of Nature Science Faculty, Hung Vuong University. Stem cuttings at different ages were collected for experiments with the length of around 10 cm and 3 nodes. Pure IAA was purchased from Merk (Germany). Commercial rooting stimulants include N3M (Nong Phu Lam Biochemistry Single share-holder limited company, Vietnam), King root (AVAN Agriculture Single share-holder limited company, Vietnam), Rooting power (Bontone, USA), Rootone (Complejo Industrial Bioiberica, Spain)

2.2. Methods

Experiment 1: Effects of cutting types and cultivating season on rooting process

Cuttings at different ages (juvenile, mature and old cuttings) were 0.5 cm dipped in glass beakers containing IAA (50 ppm) in 5 min and washed with distilled water before being posited into growing media to evaluate the effects of cutting ages on rooting ability. Experiments were carried out in the winter (12/2019) and the spring (3/2020). Each experiment was repeated 3 times, using 15 cuttings. All the experiment were placed randomly [5].

Experiment 2: Effects of several commercial rooting stimulants on rooting process

Experiments were carried out with the use of N3M (20g/l), King root (2g/l), Rooting power (3g/l) and Rootone (4ml/l): cuttings were 0.5 cm dipped in glass beaker containing rooting stimulant solution in 15 min, washed with distilled water. Growing medium was clean humid sand. Each experiment was repeated 3 times, using 15 cuttings. All the experiment were placed randomly [5].

Rooting level, root number and root length were determined after 4 weeks [5]. Rooting level was the number of rooted cuttings over the whole number of cuttings employed for each experiment. Root

number was determined through counting. Root length were measure using Mitutoyo digimatic micrometer (Japan).

Data analysis: Statistical analysis was carried out using Tukey's HSD test (p = 0.005) employing SPSS software.

3. Results and discussion

a) Effects of cutting types and cultivating season on patchouli rooting level

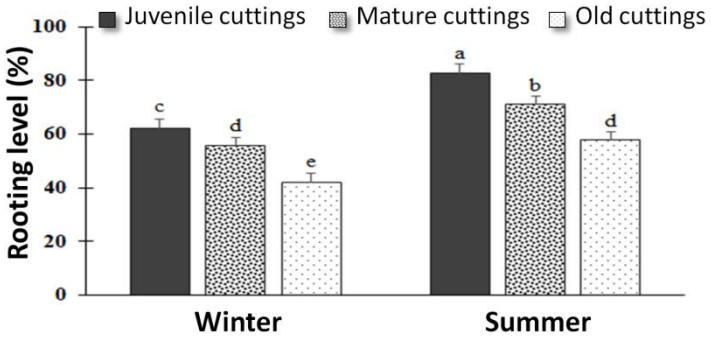

Figure 1. Effects of cutting types and cultivating seasons on rooting level (%) of patchouli cuttings after 4 weeks. Note: Different letters in the same column indicate significant statistical differences (two-factor ANOVA, Tukey's HSD test, p = 0.05)

The obtained results (Figure 1) shows that juvenile cuttings exhibit the highest rooting level in both winter (66.22 %) and spring (82.50 %), followed up by mature cuttings (55.56 % in winter and 71.11% in spring) and finally old cuttings (42.44 % and 57.78 %). Besides, rooting levels are higher in spring than those in winter. In winter, rooting levels of juvenile, mature and old cuttings are 61.67 %, 56.33 % and 41.67 %, respectively. Meanwhile, in spring, their rooting levels are 81.57 %, 72.67 % and 59,67 %, respectively.

b) Effects of cutting types and cultivating season on patchouli root number and root length

Table 1. Effects of cutting types and cultivating season on patchouli root number and root length after 4 weeks

Cultivating season	Cutting type	Number of roots/cutting (M ± SD)	Root length (mm) (M ± SD)
Winter	Juvenile cuttings	$18,8^{b}$ ± 1,17	$30,4^{b}$ ± 1,02
	Mature cuttings	$19,6^{b}$ ± 0,75	$27,6^{c}$ ± 1,02
	Old cuttings	$15,8^{c}$ ± 1,33	$15,0^{e}$ ± 1,67
Summer	Juvenile cuttings	$30,6^{a}$ ± 1,17	$49,2^{a}$ ± 1,17
	Mature cuttings	$29,2^{a}$ ± 1,17	$31,2^{b}$ ± 1,17
	Old cuttings	$19,8^{b}$ ± 0,98	$21,8^{d}$ ± 0,98

Note: M = Mean, SD = standard deviation, different letters in the same column indicate significant statistical differences (two-factor ANOVA, Tukey's HSD test, p = 0.05)

Cultivating seasons and different cutting types influence root number per cutting and root length

(Table 1). Two-factor (cultivating season × cutting type) statistical analysis with significant differences (p = 0.05) shows the effects of cultivation seasons, cutting types and their interaction on root number per cutting and root length of patchouli. On each type of cuttings (juvenile, mature and old cuttings), the root number per cutting is higher in spring than in winter. To be more detailed, the number of roots of juvenile and mature cuttings is similar in winter (18.8 and 19.6 roots/cutting, respectively) and in spring (30.6 and 29.2 roots/cutting, respectively). These root numbers are all higher than those of old cuttings (15.8 roots/cutting in winter and 19.8 roots/cutting in spring).

Two-factor (cultivating season × cutting type) statistical analysis with significant differences (p = 0.05) shows their effects on patchouli root length. With each type of cuttings (juvenile, mature and old cuttings), the root length is higher in spring than in winter. To be more detailed, in both winter and spring, juvenile cuttings have longer root than mature ones while old ones show the shortest (Table 1). Cultivated in winter, roots from juvenile, mature and old cutting were measured to be 30.4, 27.6 and 15.0 mm, respectively. In spring, they are 49.2, 31.2 and 21.8 mm, respectively. These results are in agreement with that of Bui Van Thanh and Ninh Khac Ban (2013), who multiplicated *Kadsura heteroclita* using cuttings. Root number per cutting reached 25.71 in spring while in winter, it was only 9.70. Also, root length reached 4.14 cm in spring while it was only 2.54 cm in winter [8].

It might be because juvenile shoots contain growing tissues, which are not as highly differentiated as mature and old ones. Thus, they can be undifferentiated, so they are more convenient to be differentiated towards root formation. Cuttings cultivated in winter must face up with harsher weather conditions, in comparison to those in spring. For example, the temperature was lower, preventing the life processes of plants. In contrast, in spring, environmental factors such as temperature, humidity and light are more convenient for the occurrence of those life processes. Therefore, the ability of rooting of cuttings in spring is higher than that in winter [2].

2.2.2. Effects of commercial rooting stimulants on patchouli rooting process

a) Effects of commercial rooting stimulants and cutting types on patchouli rooting level

Effects of commercial rooting stimulants and cutting types on patchouli rooting level after 4 weeks are represented in Figure 2.

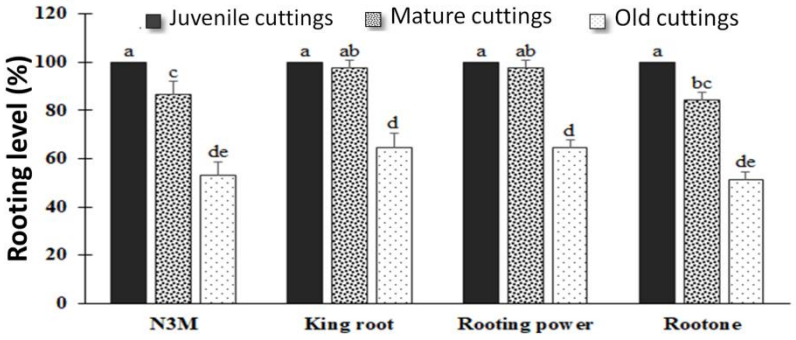

Figure 2. Effects of commercial rooting stimulants and cutting types on patchouli rooting level after 4 weeks. Note: Different letters in the same column indicate significant statistical differences (two-factor ANOVA, Tukey's HSD test, p = 0.05)

It is shown that every commercial rooting stimulant has effects on rooting process of all cutting types, among which juvenile cuttings achieve the rooting level of 100%, followed up by mature ones

and old cutting shows the lowest level. Rooting levels of mature cuttings treated with N3M, King root, Rooting power and Rootone were 86.67 %, 97.78 %, 97.78 % and 84.44 %, respectively. Concerning old cuttings, they were 53.33 %, 64.44 %, 64.44 % and 51.11%, respectively.

b) Effects of commercial rooting stimulants and cutting types on root number and root length of patchouli

Concerning juvenile cuttings, numbers of roots stimulated by N3M, Ring root, Rooting power and Rootone were 17.2, 27.2, 28.8 and 19.6 roots/cutting, respectively. Therefore, King root and Rooting power were more effective to stimulate root formation than N3M and Rootone. Concerning mature cuttings, numbers of roots stimulated by N3M, Ring root, Rooting power and Rootone were 17.4, 27.0, 25.6 and 16.8 roots/cutting, respectively. Thus, similar to juvenile cuttings, King root and Rooting power are better for rooting stimulation than N3M and Rootone. For old cuttings, numbers of roots stimulated by N3M, Ring root, Rooting power and Rootone were 11.4, 18.4, 17.0 and 15.2 roots/cutting, respectively. Hence, N3M showed the poorest ability of rooting stimulation from old cuttings. Effects of commercial rooting stimulants on old cuttings were different from juvenile and mature ones. Evaluating the effects of each kind of commercial rooting stimulant on root formation from different cutting types, numbers of roots on juvenile and mature cuttings are higher than that on old ones, expect for Rootone.

Table 2. Effects of commercial rooting stimulants and cutting types on root number and root length of patchouli

Rooting stimulants	Stem cuttings	Number of roots/cutting (M ± SD)			Root length (mm) (M ± SD)		
N3M	Juvenile cuttings	$17,2^{bc}$	±	1,17	$39,8^{c}$	±	0,75
	Mature cuttings	$17,4^{bc}$	±	1,36	$38,4^{cd}$	±	1,85
	Old cuttings	$11,4^{d}$	±	1,85	$27,4^{g}$	±	2,42
King root	Juvenile cuttings	$27,2^{a}$	±	1,47	$50,8^{a}$	±	1,17
	Mature cuttings	$27,0^{a}$	±	3,45	$44,4^{b}$	±	1,36
	Old cuttings	$18,4^{bc}$	±	1,36	$31,4^{efg}$	±	1,20
Rooting power	Juvenile cuttings	$28,8^{a}$	±	1,17	$47,4^{ab}$	±	1,02
	Mature cuttings	$25,6^{a}$	±	1,02	$38,6^{cd}$	±	1,85
	Old cuttings	$17,0^{bc}$	±	1,41	$32,0^{ef}$	±	1,41
Rootone	Juvenile cuttings	$19,6^{b}$	±	1,02	$38,6^{cd}$	±	1,85
	Mature cuttings	$16,8^{bc}$	±	1,17	$34,8^{de}$	±	2,14
	Old cuttings	$15,2^{c}$	±	1,72	$28,6^{fg}$	±	2,06

Note: M = Mean, SD = standard deviation, different letters in the same column indicate significant statistical differences (two-factor ANOVA, Tukey's HSD test, p = 0.05)

Besides, Effects of commercial rooting stimulants on root length of patchouli are also presented in Table 2. It was shown that with juvenile cuttings, length of root stimulated by N3M, Ring root, Rooting

power and Rootone was 39.8, 50.8, 47.4 and 38.6 mm, respectively. Thus, King root exhibited the best effects on root growth on juvenile roots, followed up by Rooting power and N3M and Rootone showed the poorest.

Concerning mature cuttings, the length of rooted stimulated by N3M, Ring root, Rooting power and Rootone was 38.4, 44.4, 38.6 and 34.8 mm, respectively. Therefore, King root still showed the best influences on the growth of roots on mature cuttings, compared to the other three. With old cuttings, the length of rooted stimulated by N3M, Ring root, Rooting power and Rootone was 27.4, 31.4, 32.0 and 28.6 mm, respectively. Hence, King root and Rooting power exhibited better effects on root growth than N3M and Rootone.

3. Conclusions

In this study, effects of cutting types, cultivating seasons and commercial rooting stimulants on rooting process of patchouli were investigated. The results showed that the best rooting efficiency was achieved on juvenile cuttings in both winter and spring. Different commercial rooting stimulants have distinct influences on rooting process (rooting level, root number and root length) on different cutting types. King root and Rooting power are two suitable commercial rooting stimulants for patchouli multiplication.

Acknowlegments

This research was supported by the Fundamental Science Studying Program of Hung Vuong University through a research project (08/2019/HĐKH) and Phu Tho Department of Science and Technology through a research project (02/ĐT-KHCN.PT/2020)

References

[1] Hu G., Peng C., Xie X., Zhang S., Cao X, *Availability, pharmaceutics, security, pharmacokinetics, and pharmacological activities of patchouli alcohol*, Evidence-Based Complementary and Alternative Medicine, 2017, 9. doi:https://doi.org/10.1155/2017/4850612

[2] Nguyen Nhu Khanh, Cao Phi Bang, *Sinh lý học thực vật*, Ha Noi, 2013, Vietnam Education Publishing House Limited Company

[3] Do Tat Loi, *Những cây thuốc và vị thuốc Việt Nam* (12 ed.), Ha Noi, 2004, Medical Publshing House.

[4] Maheshwari, M. L., Vasantha Kumar, T., Sharma, N., Chandel, K. P. S. Patchouli-an Indian perspective. Indian perfumer, 1993, 37, 9-11.

[5] Nguyen Van Ma, La Viet Hong, Ong Xuan Phong, *Phương pháp nghiên cứu Sinh lý học thực vật*, Hà Nội, 2013, VNU Publishing House.

[6] Swamy, M. K., Sinniah, U. R, *A Comprehensive Review on the Phytochemical Constituents and Pharmacological Activities of Pogostemon cablin Benth.: An Aromatic Medicinal Plant of Industrial Importance*, Molecules, 2015, 20(5), 8521-8547. doi:10.3390/molecules20058521

[7] Swamy, M. K., Sinniah, U. R, *Patchouli (Pogostemon cablin Benth.): botany, agrotechnology and biotechnological aspects*, Industrial Crops and Products, 2016, 87, 161-176.

[8] Bui Van Thanh, Ninh Khac Ban, *Nghiên cứu một số yếu tố ảnh hưởng đến kết quả giâm hom Nắm cơm (Kadsura coccinea (Lem.) A. C. Smith)*, Paper presented at the Hội nghị khoa học toàn quốc về Sinh thái và Tài nguyên sinh vật lần thứ 5, Ha Noi, 2013.

[9] *Tran Huy Thai*, N*ghiên cứu đặc điểm sinh học và tích lũy tinh dầu của Hoắc hương (Pogostemon cablin (Blanco) Benth.) ở Việt Nam*, PhD Thesis, Institute of Ecology and Biological resources, 1996.