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# Effect of type of terminal cuttings and growing conditions on rooting behaviour and survival percentage of patchouli

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**Abstract**
The objective of this study was to standardize type of terminal stem cuttings for propagation of patchouli in different environmental conditions. The experiment was carried out in factorial completely randomized design with three replications. The factor 1 comprising of two treatments *i.e* terminal cuttings with retention of leaf and without retention of leaf and factor 2 *i.e* 7 different growing environmental conditions. The result revealed that number of roots per cutting (12.33), cumulative root length (25.93 cm), average root length (1.98 cm) and survival percentage (70.95) were significantly higher when leaves were retained on stem cuttings at 45 DAP. The cuttings raised under polytunnel in shade house condition recorded maximum number of roots per cutting (17.43) and cumulative root length (31.75 cm). The maximum survival percentage (90.00) was recorded under polytunnel maintained in poly house condition.

**Keywords:** Patchouli, cuttings, growing condition

## Introduction
Patchouli (*Pogostemon patchouli* Pellet), a member of lamiaceae family, is the source of commercial patchouli oil. It is one of the important essential oils used in modern perfumery and cosmetic industries. There is hardly any preparation of oriental nature where patchouli oil is not used. Oil of patchouli is obtained by steam distillation of shade dried herbage. The oil has a strong fixative property and is known to improve tenacity. The oil has mainly a woody note. It is generally blended with other essential oils and is used in beverages, candy making and meat products. Blended with sandalwood oil, it gives one of the finest attars, widely used for scenting soaps, perfumes, body lotions, aftershave lotions, detergents, cosmetics and incense sticks.

Type of stem cuttings and propagation structures play an important role in the success of vegetative propagation. Hence, in plant propagation, different environments, *viz.,* natural shade, shade net, polyhouse and polyhouse with mist have been widely used. Temperature and humidity have great influence on the success of rooting, sprouting and growth of propagules. During cutting propagation, one of the important variables which is supposed to influence the rooting capacity of cuttings is leaf retention, because leaves hold auxin, a small signaling molecule which is translocated to the cutting base, allowing production of carbohydrates by photosynthesis (Hartmann *et al.*, 2002) [6] and acting as a trigger to the developmental process of rhizogenesis (Robert and Friml, 2009) [9]. The research work on the propagation of this crop under different growing conditions is relatively meagre. Hence, the present experiment was taken up to study the effect of type of terminal stem cuttings and different growing conditions on rooting attributes of patchouli stem cuttings.

## Material and Methods
### Experimental details
Design of an experiment: Factorial completely randomized design

**Factor 1:** Two treatments
1) Terminal cuttings with leaf
2) Terminal cuttings without leaf

**Factor 2:** Environmental conditions
Number of treatments: 7
Number of replication: 3
Year: 2018-19

**The experiment was laid out in college campus, CoH, Sirsi under following environmental conditions.**

1. **Polytunnel:** Dome shaped polytunnel of 200 micron thickness covered with UV resistant polythene sheet.
2. **Polytunnel in poly house:** Dome shaped polytunnel of 200 micron thickness covered with UV resistant polythene maintained in polyhouse condition.
3. **Polytunnel in shade house:** Dome shaped polytunnel of 200 micron thickness covered with UV resistant polythene maintained in shade house condition.
4. **Poly house:** Polythene sheets of 200 micron thickness.
5. **Shade house:** Shade net of green colour with 50 per cent light transmission.
6. **Open:** The open area in level land receiving direct sunlight throughout the day was selected.
7. **Natural shade:** Cuttings were maintained under the partial shade of forest trees.

Shoot tip (Terminal) cuttings of 10-15 cm length were prepared during the month of September, 2018 and planted in poly bags filled with nursery media. Nursery media consisting of Soil: Sand: FYM (1:1:2). The poly bags planted with cuttings were kept in different environmental / growing conditions as per the treatments.

Observations were recorded after one month and 45 DAP after planting. Number of roots in the rooted cutting was recorded after uprooting the plant and washed thoroughly in water to remove the dirt and wiped carefully, then total number of roots were calculated by counting of roots in the uprooted cuttings. Summation of root length of all the roots in a rooted cutting was worked out and expressed as cumulative root length in centimetre. Average root length was calculated by dividing the cumulative root length with number of roots and expressed in centimeter. Survival percentage was recorded at 45 days after planting and expressed in percentage as under.

$$\text{Survival percentage} = \frac{\text{Number of cutting surviving}}{\text{Total number of cuttings kept for rooting}} \times 100$$

**Result and Discussion**

Number of roots per cutting, cumulative root length, average root length and survival percentage differed significantly between terminal stem cuttings with leaf and without leaf at 45 DAP.

At 45 DAP, number of roots per cutting (12.33), cumulative root length (25.93 cm) and average root length (1.98 cm) were significantly higher when leaves were retained on stem cuttings ($M_1$) compared to the lowest number of roots per cutting (5.64), cumulative root length (7.97 cm) and average root length (1.42 cm) in $M_2$ (Cuttings without retention of leaf). This may be due to flow of photosynthates from the leaves to the base of the stem may have contributed to the increased percentage of rooting and enhanced number and length of roots. It is also documented that the leaves on the stem exert a positive influence by inducing rooting, as some rooting cofactors produced in the leaves flow back to the base of the stem.

Larger leaf areas may allow better photosynthetic performance of cuttings and serve as source of auxin and co-factors to initiate and improve rooting, because differential auxin accumulation is perceived and interpreted, at the level of cells of the wounded tissues by nuclear auxin signaling pathway, which regulates gene expression and reprogramming of cell fates. Similar results have also been reported by Selvarajan and Rao (1981) [10], Bhattacharjee and Thimmappa (1991) [3] and Bettoni *et al*. (2010) [2] in patchouli. It is also reported in other crops by Govekar (1984) [5] in blackppper, Thomas and Schiefelbein (2004) [12] in grape and Bona and Biasi (2010) [4] in *Lavandula dentate.*

Higher survival percentage was recorded in cuttings with retention of leaf (70.95) at 45 DAP compared to without retention of leaf (48.10). This is due to high concentration of endogenous root promoting substance in the apical cuttings which arise from the terminal buds and more cells are capable of becoming meristematic. These results are in conformity with findings of Anon. (1956) [1] in blackpepper and Shivashankara *et al.* (2000) [11] in betel leaf.

**Rooting behaviour and survival percentage of terminal stem cuttings as influenced by growing conditions**

Number of roots per cutting (17.43) and cumulative root length (31.75 cm) were significantly higher in the cuttings raised under polytunnel in shade house condition ($V_3$) compared to the lower number of roots per cutting (3.17) and cumulative root length (2.90 cm) in natural shade ($V_7$) at 45 DAP. This may be due to physiological and the biochemical activation of stem cuttings during rooting markedly depend on the maintenance of congenial propagation environment. Maintenance of optimum humidity and temperature inside the poly tunnel in shade house condition improved the microclimate condition resulted in early sprouting of stem cuttings. These observations are in line with the findings of Milind (2008) [8] and Ingle and Venugopal (2009) [7] in stevia.

The maximum survival percentage (90.00 %) was recorded under polytunnel in poly house condition ($V_2$) and which is on par with polytunnel in shade house condition (81.67 %). This may be due to favourable environmental conditions that helps in cuttings to acclimatize to the new environment. The optimum humidity coupled with temperature was the ideal conditions for the survival of rooted cuttings.

Among the interaction effect between type of terminal cuttings and growing condition higher number of roots (24.47) and cumulative root length (47.90 cm) were noticed in $M_1V_3$ compared to the lower number of roots (2.07) and cumulative root length (2.27 cm) in $M_2V_7$ .Foliage (terminal leaf) in cuttings with leaf are acting as a source of rooting cofactors, leafy cuttings provides continuous supply of photosynthates besides their reserves. Poly tunnel in shade house condition provides the congenial environment for rooting of terminal stem cuttings.

**Table 1:** Effect of type of cuttings and growing condition on number of roots, cumulative root length and average root length in patchouli cuttings at one month after planting

| Growing condition | Number of roots | | | Cumulative root length (cm) | | | Average root length (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | Mean | $M_1$ | $M_2$ | Mean | $M_1$ | $M_2$ | Mean |
| Polytunnel in open ($V_1$) | 9.63 | 5.20 | 7.42 | 19.67 | 7.55 | 13.61 | 2.04 | 1.48 | 1.76 |
| Polytunnel in poly house ($V_2$) | 7.60 | 4.27 | 5.93 | 12.39 | 4.71 | 8.55 | 1.64 | 1.16 | 1.40 |
| Polytunnel in shade house ($V_3$) | 16.17 | 7.34 | 11.75 | 31.33 | 12.17 | 21.75 | 1.94 | 1.66 | 1.80 |
| Poly house($V_4$) | 3.33 | 2.67 | 3.00 | 4.09 | 3.87 | 3.98 | 1.25 | 1.54 | 1.39 |
| Shade net($V_5$) | 6.27 | 2.93 | 4.60 | 5.29 | 4.13 | 4.71 | 0.85 | 1.41 | 1.13 |
| Open($V_6$) | 2.27 | 2.21 | 2.24 | 1.61 | 1.53 | 1.57 | 0.80 | 0.70 | 0.75 |
| Natural shade($V_7$) | 1.40 | 1.20 | 1.30 | 1.26 | 1.19 | 1.23 | 0.90 | 1.01 | 0.96 |
| Mean | 6.67 | 3.69 | | 10.80 | 5.02 | | 1.34 | 1.28 | |
| **For comparing means** | | | | | | | | | |
| | **S. Em ±** | **CD at 1 %** | **CV (%)** | **S. Em ±** | **CD at 1 %** | **CV (%)** | **S. Em ±** | **CD at 1 %** | **CV (%)** |
| Type of cuttings (M) | 0.31 | 0.46 | 10.52 | 0.40 | 0.58 | 8.67 | 0.15 | NS | 20.31 |
| Growing condition (V) | 0.12 | 0.87 | | 0.15 | 1.09 | | 0.06 | 0.43 | |
| Interaction | 0.22 | 1.23 | | 0.28 | 1.55 | | 0.11 | 0.60 | |

$M_1$: Terminal cuttings with leaf
$M_2$: Terminal cuttings without leaf
NS: Non significant

**Table 2:** Effect of type of cuttings and growing condition on number of roots, cumulative root length, average root length and survival percentage in patchouli cuttings at 45 days after planting (DAP)

| Growing condition | Number of roots | | | Cumulative root length (cm) | | | Average root length (cm) | | | Survival percentage (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | Mean | $M_1$ | $M_2$ | Mean | $M_1$ | $M_2$ | Mean | $M_1$ | $M_2$ | Mean |
| Polytunnel in open ($V_1$) | 16.57 | 9.16 | 12.86 | 37.60 | 11.68 | 24.64 | 2.27 | 1.30 | 1.79 | 83.33 | 60.00 | 71.67 |
| Polytunnel in poly house ($V_2$) | 13.23 | 6.77 | 10.00 | 33.20 | 8.05 | 20.63 | 2.52 | 1.18 | 1.85 | 93.33 | 86.67 | 90.00 |
| Polytunnel in shade house ($V_3$) | 24.47 | 10.39 | 17.43 | 47.90 | 15.60 | 31.75 | 1.96 | 1.50 | 1.73 | 90.00 | 73.33 | 81.67 |
| Poly house($V_4$) | 8.08 | 3.58 | 5.83 | 21.24 | 6.78 | 14.01 | 2.63 | 1.89 | 2.26 | 73.33 | 43.33 | 58.33 |
| Shade net($V_5$) | 12.90 | 4.39 | 8.65 | 28.20 | 7.35 | 17.77 | 2.19 | 1.68 | 1.94 | 66.67 | 36.67 | 51.67 |
| Open($V_6$) | 6.80 | 3.11 | 4.96 | 9.83 | 4.04 | 6.94 | 1.45 | 1.30 | 1.37 | 50.00 | 26.67 | 38.33 |
| Natural shade($V_7$) | 4.27 | 2.07 | 3.17 | 3.53 | 2.27 | 2.90 | 0.84 | 1.11 | 0.97 | 40.00 | 10.00 | 25.00 |
| Mean | 12.33 | 5.64 | | 25.93 | 7.97 | | 1.98 | 1.42 | | 70.95 | 48.10 | |
| **For comparing means** | | | | | | | | | | | | |
| | **S. Em ±** | **CD at 1 %** | **CV (%)** | **S. Em ±** | **CD at 1 %** | **CV (%)** | **S. Em ±** | **CD at 1 %** | **CV (%)** | **S. Em ±** | **CD at 1 %** | **CV (%)** |
| Type of cuttings (M) | 0.40 | 0.58 | 7.62 | 0.75 | 1.11 | 7.69 | 0.11 | 0.16 | 11.28 | 4.88 | 7.21 | 14.20 |
| Growing condition (V) | 0.15 | 1.09 | | 0.28 | 2.08 | | 0.04 | 0.31 | | 1.84 | 13.48 | |
| Interaction | 0.28 | 1.54 | | 0.53 | 2.94 | | 0.08 | 0.43 | | 3.45 | NS | |

$M_1$: Terminal cuttings with leaf
$M_2$: Terminal cuttings without leaf
NS: Non significant

## Conclusion

In patchouli terminal stem cuttings with nursery management practices under polytunnel maintained in shade-net house condition resulted in quality planting material with higher root attributes.

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