**Research Article**

**Rooting of Olive cuttings (Olea europaea L.) cv. Pendolino and Frontoio in relation to the propagation medium**

Jagdish C. Kaim, Vinod K. Bisht*

*Herbal Research and Development Institute, Mandal, Gopeshwar–246401, Chamoli, Uttarakhand, India*

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**Abstract**

**Objective:** Present study was carried out to examine the effect of different growth medium on rooting ability of two olive cultivars (Pendolino and Frontoio). **Materials and methods:** Percentage of cuttings that rooted, length of primary roots, average number of secondary roots produced, average dry weight of roots, average number of new leaves developed and average number of bud sprouted were recorded. **Results and conclusion:** The parameters studied significantly influenced by the interactive effect of substrates and cultivars. The semi-hard wood cutting planted in black coloured polybags showed better root proliferation in Vermiculite and soil for different cultivars. Very low rooting was observed in perlite for pendolino and Farm Yard Manure for frontoio. Vermiculite and soil was predictive on root proliferation as higher rooting was achieved for pendolino and frontoio. Vermiculite and soil were found as best medium for rooting in tested cultivars.

**Keywords:** Rooting, Olive cultivars, root length, vermiculite, perlite, bud sprouting

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**Introduction**

*Olea europaea* L. commonly known as olive or European olive (family; Oleaceae) is most important fruit tree. The species have its origin in Mediterranean and commonly grown in Africa, India and Australia, and known to have a large number of cultivars including pendolino and frontoio. Olive tree can be propagated through different means viz. semi-hardwood cuttings, suckers, ovuli, budding and grafting; however, propagation through leafy cuttings has become most acceptable method throughout the world (Hartmann et al. 2002). In fact, vegetative propagation techniques have been quite useful for producing and protecting high quality genotype (Gerakakis and Ozkaya 2005; Chaari Rkhis et al. 2011), however, this technique has the low ability of regeneration leading to low percentage of rooting (Rugini and Fedeli 1990).

Soil environmental condition including rooting media is integral part of the propagation system and has direct influence on rooting percent, root length, and quality of the roots produced (Loach 1988; Fernandes Serrano et al. 2002; Isfendiyaroglu et al. 2009). Vermiculite and perlite are among important media being used in micro-propagation either alone or in combination (Fabbri et al. 2004; Sutter 2005). Several works has been carried out to improve the vegetative propagation techniques in olive (Torres 1986; Fabbri et al. 2004; Hosseini et al. 2004; Isfendiyaroglu et al. 2009; Hechmi et al. 2013).

Despite of such a significant work, only a few studies have been carried out so far with the aim of improving the rooting and shooting of olive plant, however the study on soil media that govern their propagation are not yet. Moreover, the economically important cultivars such as pendolino and frontoio of *Olea europaea* showed intermediate or even poor rooting capacities (Fabbri et al. 2004). Accordingly, the present study was aimed to gather further information that might contribute to the development of a propagation technique of olive plants with especial focus on pendolino and frontoio and help to overcome the inadequacies in the conventional propagation technique.

**Materials and Methods**

**Plant material**

The leafy, semi-hardwood apical shoots (8-10 inch long)

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*Address for Corresponding Author:*

Vinod K. Bisht
Herbal Research and Development Institute, Mandal, Gopeshwar – 246401, Chamoli, Uttarakhand, India
Email: vksbisht@gmail.com

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for both the cultivars studied (pendolino and frontoio) were taken from 01 year old shoot (from 30-40 year old healthy olive trees) cultivated in the Horticulture Garden, Horticulture Training and Testing Centre, Srinagar-Garhwal, Uttarakhand, India. Apical shoots were collected with 2-4 leaves. The material was then washed through tap water, dipped in tween-20 solution for 20 min for disinfection and then washed with distilled water to remove the traces.

**Culture conditions**

Each cuttings were placed in black coloured polybags with 8 x 6 inches dimension, containing 09 different media either on their own or as mixture at Srinagar Garhwal (560 m asl) under the mist chamber condition in the last week of February 2016 and were taken out of the polybag after 2 months in April 2016. The different media used and their characteristics are given in Table 1. The polybags was watered every day. During the experimental period, the average minimum and maximum temperature under mist chamber was 22.16 ± 2.65 °C and 33.38 ± 3.11 °C respectively. All experiments were conducted in three replicates using randomized complete block design using three replicates of 25 cuttings per treatment.

**Table 1. Multiplication soil medium composition**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Soil Medium Composition</th>
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<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Sand (Coarse)</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Vermiculite (Horticultural grade no. 1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>Perlite (Horticultural grade no. 1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Sand + Vermiculite (1:1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Sand + Perlite (1:1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>Vermiculite + Perlite (1:1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>Sand + Vermiculite + Perlite (1:1:1)</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>Farm Yard Manure (FYM)</td>
</tr>
<tr>
<td>T&lt;sub&gt;9&lt;/sub&gt;</td>
<td>Soil</td>
</tr>
</tbody>
</table>

**Statistical analysis**

Obtained data was used for calculating percent of cuttings had rooted, the length of primary root, length and number of secondary roots, the dry weight of roots, length of shoots and number of new leaves. The results are expressed as mean ± standard error (SE).

**Results**

The effect of the different medium on rooting and shooting characteristics of the cuttings were significant. The highest percentage of rooting in cuttings for pendolino was observed for treatment T<sub>9</sub> (66.67±12.47) followed by T<sub>5</sub> (60.00±16.33), T<sub>6</sub> (56.67±18.67), likewise for frontoio, it was 80.00%±0.00 for T<sub>7</sub>, 73.33±16.99 for T<sub>9</sub>, 63.33±12.47 for T<sub>5</sub>. Lowest percent of root proliferation observed for pendolino and frontoio was 23.33±4.71 (T<sub>1</sub>) and 40.00±8.16 (T<sub>1</sub>) respectively (Table 2). The length of roots for pendolino was ranged between 1.10±0.08 to 15.73±7.26, while it was between 1.67±0.62 to 16.00±4.96 for frontoio. Cutting of pendolino grown in treatment T<sub>9</sub> had the highest root length. The highest root length for frontoio was observed in treatment T<sub>9</sub>.

Cuttings grown in the treatment T<sub>1</sub> had the highest number of secondary roots (15.67±3.09) for pendolino, likewise, for frontoio, the highest number of secondary roots develops for T<sub>9</sub> was 33.33±9.18. Treatment T<sub>1</sub> had the lowest number of secondary roots with the value of 1.33±0.47 for the cultivar pendolino and treatment T<sub>9</sub> with the value of 2.00±0.00 for frontoio cultivar. For pendolino cultivar, the width of the primary root was found highest for treatment T<sub>9</sub> and T<sub>5</sub> with the value of 3.00±0.82 and 2.33±0.62 respectively, and it was 2.67±0.62 (T<sub>5</sub>) and 2.23±0.61 (T<sub>1</sub>) for frontoio cultivar.

Shoot proliferation for olive cultivar pendolino in terms of number of additional leaves developed was found highest for T<sub>5</sub> with the value of 12.00±0.00 followed by T<sub>7</sub> and T<sub>9</sub> with the value of 9.00±0.81 for both the treatments. For cultivar frontoio, the number of new leaves developed was found highest for T<sub>9</sub> with the value of 6.00±0.81 followed by T<sub>5</sub> and T<sub>7</sub> with the value of 5.33±0.94 for both the treatments. The highest number of new bud sprouted in pendolino was observed 2.00±0.00 for the treatments T<sub>9</sub>, T<sub>5</sub> and T<sub>7</sub>, and for cultivar frontoio, it was 2.33±0.47 for the treatment T<sub>9</sub>. The least number of new buds sprouted was 1.00±0.00 (T<sub>1</sub>) and 0.00±0.00 (T<sub>5</sub>) for the cultivar pendolino and for frontoio respectively.

**Discussion**

Vegetative propagation technique is vital to reduce both the cost of production per plant and the propagation time and to protect the high quality genotype. In present study the percentage of cuttings had rooted was varied from 23.33 to 66.67 for cultivar pendolino and was varied from 40.00 to 80.00 for frontioio cultivar depending on the medium tested. Several studies reported that the rooting in olive cuttings increased when the basal part of the cuttings placed in darkness especially at the beginning of the rooting process (Chaari-Rkhis et al. 2002). Therefore, in this study, the cuttings were planted in black coloured polybags.

Root proliferation in explants is a crucial step of the vegetative propagation especially of woody species like olive. Of the 09 different media tested in this study, the soil (T<sub>1</sub>) and sand and vermiculite (T<sub>5</sub>) showed high rooting for cultivar pendolino, while it was vermiculite (T<sub>6</sub>) and soil (T<sub>9</sub>) for cultivar frontoio. Vermiculite is the most used propagation medium and has reported to positively affect the rooting of Iranian cultivar of olive (Hosseini et al. 2004).
Sand, perlite and vermiculite (T$_1$) treatment showed highest growth in the primary root for pendolino cultivar, while for frontoio, it was observed in treatment T$_3$ (sand and vermiculite; 1:1). Better results for good rooting in vermiculite may attribute to the good water retention and aeration capacity of the vermiculite. Both the cultivar showed poor rooting in medium perlite (T$_2$). The aeration capacity and water holding capacity of an ideal media is requisite to promote the root formation and growth (De Boodt and Verdonck 1972). Root initiation and development for cuttings of tree species was negatively affected by medium linked to rapid loss of water (Torres 1986; Isfendiyaroglu et al. 2009). However, in present study, we observed average growth of root production in the sand for both the cultivars, which may be attributed to frequent watering of the cuttings. Age of mother plant, length of cuttings, rooting media is among important factors affecting rooting ability in olive cuttings (Turkoglu and Durmus 2005). Hechmi et al. (2013) reported that mixture of pure perlite and sand (2:1) ratio was appeared to be the best component for rooting in olive cuttings.
There are several attempts to delineate suitable technique for propagation for the efficient in vitro rooting of olive tree, it seems that different olive tree cultivars require different basic medium formulations (Zuccherelli and Zuccherelli 2002; Peixe et al. 2007; Chaari-Rkhis et al. 2011). The composition of the micro-propagation technique is an important factor for the achievement of high multiplication rates (Revilla et al. 1999). In present study, rooting rates above 60 percent was achieved for pendolino in sand and vermiculite (treatment T1:1) and soil (T4) and for frontoio in vermiculite (treatment T5) and soil (T9). Thus, indicating the use of vermiculite and soil as the best medium. With regards to the growth of primary root in terms of length and width and number of secondary roots, cytokinin required for inducing proliferation of roots (Micheli et al. 2009). Hartmann et al. (2002) reported that rooting success depends mainly upon the medium and the cultivar.

In present study, we used the cuttings with 2-4 leaves in view of the reports that presence of leaves on the cuttings showed a higher rooting ability than those without leaves (Fontanazza and Rugini 1997). Moreover, presence of leaves on cuttings also influences the growth of lateral shoots. In present study, the number of lateral shoots and lateral leaves develops were very low, and may attributed to low activity of axillary buds. In consequence, when leaves are present on cuttings, the rooting process which requires high quantity of metabolism, was met through the photosynthesis carried out by the leaves present in the cuttings. It is reported that growth of lateral bud to form new leaves and shoots were inhibited when there was no leaves present on the cuttings (Troncoso et al. 1975).

Conclusion

In summary, the investigation showed that vermiculite and soil was predictive on root proliferation as higher rooting was achieved in vermiculite and soil and for both the cultivar studied. Thus, indicating the use of vermiculite and soil as the best medium. The findings thus encouraging and can, therefore, open new ways for the development of in-vitro micro-propagation technique of the olive tree cuttings. However, further research should be carried out to improve the micro-propagation technique of olive tree.

References


