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Effect of Different Indole Butyric Acid Concentrations on Air Layering in Olive (*Olea europaea* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj in August 2022 to December 2022. The experiment was conducted to evaluate the best IBA concentrations among different concentrations of IBA for producing best layering and survival percentage in Olive. The experiment was laid out in Randomized Block Design having 8 treatments and replicated 3 times. The treatment T_4 in which IBA 4000 ppm was applied for air layering was found to be best in terms of shoot and root parameters observed, i.e., Number of days to root formation (46.11), Number of

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roots per layer (7.33), Root length (6.73 cm), Root thickness (1.66 mm), Number of new sprouts (2.67-1MAP, 3.89-2MAP & 5.67-3MAP), length of new shoot (2.78cm-1MAP, 3.73cm-2MAP & 5.44cm-3MAP), Number of new leaves (7.22-1MAP, 10.78-2MAP & 16.56-3MAP) and survival percentage (50.89%) in air layered olive plants, whereas minimum values were recorded in T_8 (control). It can be inferred from this study that, the use of IBA 4000 ppm was effective to produce better root and shoot parameters and successful establishment of air layers in olive.

Keywords: Shoot parameters; root parameters; root length; new leaves.

1. INTRODUCTION

Olive (*Olea europaea* L.) is a hardy, dicotyledonous, attractive evergreen subtropical fruit tree with grey foliage and is native of Mediterranean region. It belongs to family Oleaceae, which is also known as Elaeocarpaceae, having 30 genera and 600 species [1]. It is known as the 'tree of liquid gold' because of great importance of its oil and green olives are considered as 'Green gold' in Greece. Olive tree is considered as Symbol of prosperity and peace.

In India olive is a new crop, which was introduced in 1800 A.D. by British Missionaries, and its cultivation is still in its infancy stage in India. Olive is one of the important and oldest fruit trees in the world [2] and is successfully grown in the areas having mean temperatures 15-20°C, with a minimum of 4°C and maximum of 40°C [3]. The cultivated olive tree can reach heights ranging from just a few meters to 20 m. The tree starts bearing in 4 to 8 years, but commercial production is not reached for 15 or 20 years. The root system is generally shallow, spreading to 0.9 - 1.2 m even in deep soils. The above ground portion of the olive tree is recognizable by the dense assembly of limbs, short internodes, and compact nature of the foliage. Leaves are opposite, thick, leathery, growing over two year's period.

Olive production in the country began in 2007 when olive saplings were imported from Israel and planted in the Thar Desert [1,4,5]. The first olive yield in India occurred in 2012, and commercial olive oil production began in September 2013. The first Indian-made olive oil brand called Raj Oil was launched on 9 November 2016. India produced 150 tons of Olives in 2020. Rajasthan and Gujarat are major trading states in India. The economic part is fruit, which is a small drupe, 1-2.5 cm long when ripe. Olive cultivars may be used primarily for oil, eating, or both. Olives cultivated for consumption are generally referred to as "table olives" [6]. About 92 per cent olives are turned in to oil, while about 10 per cent are used as table olives.

Ripe olive contains proteins (2%), oil (14%), vit. A, B, C and (1%) Fibre and 650 Calories per pound of fresh weight. One tablespoon oil contains 120 calories, (1.8%) protein, (21%) fat, (2.6%) Carbohydrates and (1.5%) fibre. Oil is rich source of polysaturated fatty acids and is free from cholesterol [7,8]. Oil is also rich in minerals like Fe, Ca, P and Vitamin E, and it contains oleic acid (70-80%) and linolenic acid (7-12%). Oil has many industrial as well as culinary uses. It is edible and possesses therapeutic value and it is clinically advocated for hypertension, coronary heart disease and muscular pains. Oil consumption helps to reduce LDL and to raise HDL forms for cholesterol in blood. Oil is also used in textile lubricants, perfumed soaps, cosmetics, perfumery industry and burning of lamps [1].

Olive can be propagated through sexual and asexual methods but the sexual method is usually not recommended, because seedlings are not true to type and the juvenile period is too long to bear fruit [9-14]. Asexual propagation include hardwood, semi hardwood cuttings and air-layering. Air layering is a method of producing plants from aerial branches which remain in position while rooting. In plants which are difficult to root, air layering has been proven as an effective method of increasing their rooting percentage [15,16].

Physiological basis of layering involves accumulating organic substances like carbohydrates, hormones, and growth factors in a stem where rooting is desired by interrupting their downward translocation from the shoot tips and leaves [17-19]. The rooting ability of layering can be improved by preconditioning treatments such as etiolation, girdling, periderm stripping, and application of growth regulators like auxins. The accumulated substances stimulate the formation of adventitious roots in the layered stem, which then grow into the soil, enabling the stem to be cut from the parent plant [20-22].

Air layering is an easy method of propagation of horticultural crops and it is widely used for commercial multiplication. The growth,

establishment and survival of branches from air layering plants depend on the quality of rooting media. There are many commercial rooting media used for layering, but many are expensive and locally unavailable. Cocopeat is a multipurpose growing medium made out of coconut husk. The fibrous coconut husk is pre washed, machine dried, sieved and made free from sand and other contaminations such as animal and plant residue. Increasing demand and mounting costs for peat, sphagnum moss etc. as a growing media in horticulture have led to the search for high quality and low-cost substrates as an alternative. Cocopeat is considered as a good growing media component containing good source of nutrients with acceptable pH, [23] it can also be mixed easily with other substrates.

The latest advance in the knowledge of growth regulators in plant propagation has further improved the scope of their use in vegetative propagation of various fruit crops. Application of root promoting substances during layering helps to get profuse roots within a short time. The use of plant growth regulators to increase the efficiency of propagation in cuttings and layering are now common. Growth substances accelerate the rooting, produce large root system and increase the percentage of survival. Growth regulators like IAA, NAA and IBA have been used to stimulate plant growth and specially root formation in layering. In air layering experiments among auxins, IBA has been found to be most effective in producing maximum number of roots with better vigour. IBA is widely used as a root-initiation promoter in horticultural crops. IBA is a suitable rooting hormone for this type of experiment because it shows a large amount of flexibility when dealing with the range of concentration that can be used.

2. MATERIALS AND METHODS

The experiment was conducted from August 2022 to February 2023, at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25^0 39‟ 42” N latitude, $81^0$67‟56” E longitude and 98 m altitude above the mean sea level.

The present investigation was carried out on semi-hardwood stems of Olive. Plant growth regulator, Indole -3-Butyric Acid was used as a root induction chemical at seven different concentrations and combinations replicated thrice in randomized block design. Cocopeat was used as the root growing media in layering and soil, sand and vermicompost in equal proportion were used as growing media in polybags at the time of transplantation of rooted air layered plants. Treatments were listed of T_1 (IBA 1000 ppm), T_2 (IBA 2000 ppm), T_3 (IBA 3000 ppm), T_4 (IBA 4000 ppm), T_5 (IBA 5000 ppm), T_6 (IBA 6000 ppm), T_7 (IBA 7000 ppm) and T_8(Control).

To conduct air layering on Olive trees, healthy branches of one-year, old uniform vigour, and pencil thickness were selected. Only disease-free branches were chosen, and a careful girdling of the bark, about 2-2.5 cm, was done just below the bud. Two circular cuts were made around 45-60 cm below the top end of the selected shoot, being careful not to harm the underlying wood. Pre-prepared IBA at different concentrations were applied evenly on all sides of the upper cut of the ringed portion using a brush The cut portion was then covered with coco peat as rooting media and transparent polythene wrappers were used to wrap the air layered portion Observations were made after 1, 2 and 3 month(s) from the day of operation, recording various root parameters such as the number of days for root formation (initial rooting), number of roots, root length and root thickness. After detaching the air layers by making a cut just below the lowest end of the ringed surface with sharp secateurs, they were transplanted into the fruit nursery of the Department of Horticulture at SHUATS. Shoot parameters and survival percentage were recorded after 1, 2 and 3 months after planting into polybags.

3. RESULTS AND DISCUSSION

3.1 Root Parameter

In olive air layers the minimum number of days taken for initial root formation 46.11 days was observed in T_4 (IBA 4000 ppm) which was on par with treatment T_5 (IBA 5000 ppm) which took 62.11 days for root formation. It was followed by treatment T_1 (IBA 1000 ppm) 68.88 days which took for root initiation. Maximum number of roots (7.33) were recorded in Treatment T_4 (IBA 4000 ppm) which was significantly superior to all other treatments. It was followed by treatment T_5 (IBA 5000 ppm (6.44), which was on par with treatment T_6 (IBA 6000ppm) which had 6.00 roots. Treatment T_4 (IBA 4000 ppm) recorded the

Table 1. Root parameters as effected by different IBA concentrations on air layering in olive

Treatment	Treatment Combination	Days to root formation	No. of Roots	Root length (cm)	Root Thickness (mm)
T1	IBA@ 1000 ppm	68.88	4.33	4.82	1.23
T2	IBA@ 2000 ppm	87.88	4.88	5.19	1.26
T3	IBA@ 3000 ppm	83.33	5.11	4.56	1.53
T4	IBA@ 4000 ppm	46.11	7.33	6.73	1.66
T5	IBA@ 5000 ppm	62.11	6.44	6.20	1.60
T6	IBA@ 6000 ppm	85.78	6.00	5.15	1.52
T7	IBA@ 7000 ppm	82.89	4.66	4.68	1.53
T8	Control	97.00	3.44	3.19	1.13
S.E. (m) (±)		7.28	0.22	0.18	0.10
CD (5%)		22.09	0.68	0.56	0.31

Table 2. Shoot parameters and survival percentage as effected by different IBA concentrations on air layering in olive

Treatment	NUMBER OF NEW SROUTS			LENGTH OF NEW SHOOTS			NUMBER OF NEW LEAVES			SURVIVAL PERCENTAGE		
	1MAP	2MAP	3MAP	1MAP	2MAP	3MAP	1MAP	2MAP	3MAP	1MAP	2MAP	3MAP
T1	1.78	2.33	3.33	1.49	2.09	4.40	5.44	5.44	11.67	41.56	38.44	34.67
T2	1.67	3.33	4.22	1.53	2.23	4.77	6.33	6.78	12.11	41.33	39.33	36.89
T3	1.78	3.22	4.22	1.50	3.27	4.62	6.11	7.11	14.44	45.11	44.11	38.67
T4	2.67	3.89	5.67	2.78	3.73	5.44	7.22	10.78	16.56	57.56	54.44	50.89
T5	2.00	3.44	4.33	1.76	3.41	4.99	6.56	8.44	16.00	53.67	47.11	43.00
T6	1.89	3.11	4.11	1.51	3.34	4.91	6.22	8.11	14.78	44.89	43.22	39.67
T7	1.89	2.44	4.00	1.50	3.32	4.77	5.67	7.56	14.56	43.78	42.00	38.44
T8	1.44	2.00	2.78	1.40	2.06	3.73	5.00	5.89	10.56	35.00	33.78	33.33
S.E. (m) (±)	0.21	0.12	0.16	0.11	0.05	0.05	0.30	0.36	0.30	0.58	0.67	0.41
CD (5%)	0.64	0.37	0.50	0.33	0.14	0.16	0.91	1.08	0.90	0.82	0.95	0.58

longest root length (6.73 cm) which was statistically on par with Treatment T_5 (IBA 5000 ppm) which measured root length of 6.20 cm. It was followed by treatment T_2 (IBA 2000ppm) with (5.19 cm) root length, it was on par with treatment T_6 (5.15 cm), T_1 (4.82 cm) and T_7 (4.68 cm). Maximum root thickness (1.66 mm) was recorded in Treatment T_4 (IBA 4000 ppm.) which was on par with treatment T_5 (1.60 mm), T_3 (1.53 mm) and treatment T_6 (1.52mm).

3.2 Shoot Parameters

Maximum number of new sprouts in transplanted olive air layers at 1, 2 and 3 month(s) after transplanting (2.67), (3.89) and (5.67) was observed in T_4 (IBA@4000 ppm). Maximum shoot length in transplanted olive air layers at 1, 2 and 3 month(s) after transplanting was 2.78 cm, 3.73 cm and 5.44 cm respectively it was recorded in T_4 (IBA@4000 ppm). Maximum number of new leaves in transplanted olive air layers at 1, 2 and 3 month(s) after transplanting 7.22, 10.78 and 16.56 was recorded in treatment, T_4 in which IBA 4000 ppm was applied.

3.3 Survival Percentage

Maximum survival rate in transplanted olive air layers was 57.56%, 54.44% and 50.89% at one month after transplanting, two months after transplanting and three months after transplanting was recorded in treatment T_4 (IBA@4000 ppm).

4. CONCLUSION

The study revealed that different concentrations of IBA had significant effect on shoot, root parameters and survival percentage in olive air layering. From the study, it is concluded that treatment T_4 (IBA 4000 ppm) was found to be best in terms of shoot and root Parameters observed. The least number of days to root formation (46.11days), number of roots per layer (7.33), root length (6.73 cm), root thickness (1.66 mm), number of new sprouts (5.67), length of new shoot (5.44 cm), and number of new leaves (16.56), survival percentage (50.89%) was recorded in treatment T_4, where, 4000 ppm IBA was used in air layering. So, IBA 4000 ppm can be suggested for air layering based on this study as successful vegetative propagation method in olive.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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