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Studies on the effect of girdling, etiolation and auxins on rooting of olive (*Olea europaea* L) cuttings

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ABSTRACT

An experiment was conducted during summer to find out the effect of girdling, etiolation and auxins viz IBA and NAA on rooting of semi-hardwood cuttings of olive cv Leccino under mist. The experiment comprised of 13 treatments and was combinations of girdling, etiolation and auxins. The results indicated that the best rooting characteristics viz highest per cent rooted cuttings, number of primary and secondary roots and diameter were maximum with IBA at 4000 ppm whereas the maximum root length (primary and secondary) was recorded with girdling + IBA 3000 ppm + NAA 4000 ppm. Regarding the shoot characteristics viz plant height, plant diameter, number of leaves, leaf area and fresh and dry weight of roots were also highest in the treatment IBA @ 4000 ppm. Survival percentage of cuttings was also highest in cuttings treated with IBA @ 4000 ppm. It is concluded that IBA at 4000 ppm was the best treatment for propagation of olive semi-hardwood cuttings in summer.

Keywords: Olive; auxin; IBA; etiolation; girdling; rooting; cutting

INTRODUCTION

Olive (*Olea europaea* L) is the most important subtropical fruit ranking next only to the grape in acreage in the world. In India olive is a new crop which was introduced in 1800 AD by the British Missionaries and its cultivation is still in its infancy stage. Its cultivation is restricted to states of Jammu and Kashmir, Uttrakhand and Himachal Pradesh. There are vast stretches of areas suitable for successful cultivation of olive in Himachal but so far only a limited number of plantations have come up due to the unfamiliarity of this fruit crop among the fruit growers and non-availability of sufficient planting material. Since the seedling rootstocks are not fully compatible with all the olive cultivars hence propagation by rooting of leafy cuttings under mist is recommended for certain varieties and grafting for others (Scaramuzzi 1965).

The most widely used method of propagation in olive is rooting of its

hardwood, semi-hardwood and softwood leafy cuttings. But olive cultivars show wide variation in their rooting potentials (Fouad et al 1986). Various studies have revealed that preconditioning treatments like etiolation, girdling, periderm stripping coupled with growth regulators have to a great extent influenced the rooting ability of olive cuttings. So these treatments prior to growing cuttings under mist have been found to enhance their rooting potential (Petridou and Voyiatzis 1994, Porlingis et al 1999). The propagation of olive cuttings under mist has become a usual practice throughout the world. Some olive cultivars are easily rooted while others are difficult to root. This variation among cultivars may be attributed to the differences in the rooting potentialities. Propagation by cuttings of these cultivars has also presented problems because of low rooting ability. Hence the present study was undertaken to determine the effect of girdling, etiolation and auxins on the rooting of this difficult to root olive cultivar Leccino.

MATERIAL and METHODS

The present investigation was carried out during summer 2010 at Dr YS Parmar university of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. The experiment was laid out in randomized block design with three replications with 20 cuttings in each replication. There were 13 treatments viz T1– IBA 3000 ppm, T2– IBA 4000 ppm, T3– NAA 4000 ppm, T4 – NAA 5000 ppm, T5– girdling + IBA 3000 ppm + NAA 4000 ppm, T6– etiolation + IBA 3000 ppm + NAA 4000 ppm, T7– girdling + IBA 3000 ppm + NAA 5000 ppm, T8– etiolation + IBA 3000 ppm + NAA 5000 ppm, T9– girdling + IBA 4000 ppm + NAA 4000 ppm, T10– etiolation + IBA 4000 ppm + NAA 4000 ppm, T11– girdling + IBA 4000 ppm + NAA 5000 ppm, T12– etiolation + IBA 4000 ppm + NAA 5000 ppm, T13– IBA 3000 ppm + NAA 5000 ppm. Rooting medium was prepared by mixing garden soil, sand and FYM (1:1:1). The basal portion of the three node cuttings was dipped in the growth regulator solution for 8–10 seconds and then planted in the rooting medium in beds with the basal node inside the rooting media. At the end of the experiment five cuttings from each replication were randomly lifted from the bed and observations on the root characters were recorded. The data collected on various parameters were subjected to statistical analysis as described by Gomez and Gomez (1984). The treatment effects were tested at 5 per cent level of significance.

RESULTS and DISCUSSION

The data in Table 1 show that the highest rooting (58.33%) was recorded in the cuttings treated with IBA 4000 ppm which was significantly superior to all other treatments. This treatment was followed by cuttings treated with IBA 3000 ppm and

Table 1. Effect of preconditioning treatments and auxins on per cent rooting, root number, root length and diameter of primary roots in semi-hardwood cuttings of olive

Treatment (ppm)	Rooting (%)	Average number of primary roots	Average root length (cm)	Average root diameter (mm)
T1: IBA 3000	51.66 (45.96)	6.82	5.33	0.47
T2: IBA 4000	58.33 (49.83)	7.85	4.56	0.58
T3: NAA 4000	15.00 (22.60)	3.66	3.75	0.27
T4: NAA 5000	18.33 (25.00)	3.38	3.36	0.25
T5: Girdling + IBA 3000 + NAA 4000	48.33 (44.04)	5.63	6.13	0.37
T6: Etiolation + IBA 3000 + NAA 4000	38.33 (38.19)	4.46	4.72	0.43
T7: Girdling + IBA 3000 + NAA 5000	45.00 (42.12)	6.00	4.35	0.38
T8: Etiolation + IBA 3000 + NAA 5000	35.00 (36.24)	4.54	4.65	0.36
T9: Girdling + IBA 4000 + NAA 4000	28.32 (32.14)	4.97	4.70	0.41
T10: Etiolation + IBA 4000 + NAA 4000	25.00 (29.93)	4.34	4.40	0.35
T11: Girdling + IBA 4000 + NAA 5000	26.66 (30.95)	4.00	4.26	0.34
T12: Etiolation + IBA 4000 + NAA 5000	23.33 (28.67)	3.28	3.33	0.31
T13: IBA 3000 + NAA 5000	35.00 (36.24)	4.20	4.66	0.43
Mean	34.48	4.85	4.47	0.38
$CD_{0.05}$	5.95	1.09	1.18	0.09

Figures in the parentheses are arc sine transformed values.

girdling + IBA3000 ppm + NAA 4000 ppm which exhibited 51.66 and 48.33 per cent rooting respectively. Seyhan and Gezerel (2005) while working on olive cuttings of Gemlik and Domat varieties reported cuttings treated with 4000 ppm IBA to be the best treatment to propagate olive. Murat and Elmas (2008) obtained best rooting in semi-hardwood leafy cuttings of olive cv Domat treated with higher concentration of IBA. The present investigations also reveal that preconditioning treatments (girdling, etiolation) had no significant effect on the rooting percentage of cuttings. This might be related to the fact that combination of auxins at high concentrations might have produced antagonistic effect on each other or may have shown toxicity effect on the cuttings.

The maximum number of primary roots (7.85) was recorded in cuttings treated with IBA 4000 ppm which was statistically at par with IBA 3000 ppm (6.82). Aziz et al (2010) also reported highest number of roots with IBA at 4000 ppm in cv Coratina. Rafael (2005) and Adelson (2009) in separate studies recorded maximum number of roots with IBA at 3000 ppm in various cultivars of olive. It was recorded that girdling along with auxins improved root length. Maximum root length (6.13 cm) was observed in cuttings treated with girdling + IBA 3000 ppm + NAA 4000 ppm which was statistically at par with IBA 3000 ppm (5.33 cm). Pratima (2009) while studying the effect of preconditioning treatments and auxin on rooting of cuttings of kiwi cv Allison found blanching and girdling along with auxin to produce longest roots. Pandit et al (2011) and Sharma et al (2005) in separate studies reported IBA at 3000 ppm to produce highest root length in clonal rootstocks of apple viz MM 106, MM 111, M 2, M 9 and MM 106. Maximum root diameter (0.58 mm) was recorded in cuttings treated with IBA 4000 ppm. Riaz et al (2007) reported an increase in the number of roots and diameter in callused cuttings of kiwi cv Hayward and Abbott with IBA at 4000 ppm.

Table 2 depict that cuttings treated with IBA 4000 ppm gave highest fresh weight of roots (0.59 g) which was at par with treatment girdling + IBA 3000 ppm + NAA 4000 ppm (0.55 g). Highest dry weight of roots (0.21 g) was recorded in cuttings treated with IBA 4000 ppm which was statistically at par with treatments girdling + IBA 3000 ppm + NAA 4000 ppm (0.20 g) and IBA 3000 ppm (0.18 g). This can be explained on the basis that IBA at 4000 ppm produced better results in terms of root number as well as diameter and fairly better results in terms of root length which produced highest fresh as well as dry weight of roots. Riaz et al (2007) recorded highest number of roots, root length, root diameter and root weight in callused cuttings of kiwi cv Hayward and Abbott. Das et al (2006) reported highest number of primary and secondary roots in semi-hardwood cuttings of olive cv Leccino and obtained highest fresh weight and dry weight of roots in cuttings treated with IBA 4500 ppm + NAA 1000 ppm.

Preconditioning treatments (girdling and etiolation) along with auxins had no significant effect on plant height in rooted semi-hardwood cuttings of olive. However maximum plant height (15.13 cm) was recorded in cuttings treated with IBA 4000 ppm and minimum plant height (9.56 cm) was recorded in cuttings treated with NAA 5000 ppm (Table 3). Maximum plant diameter (2.59 mm) was recorded in cuttings treated with IBA 4000 ppm. This treatment was statistically at par with treatment IBA 3000 ppm (2.54 mm). Preconditioning treatments (girdling and etiolation) along with auxins showed no

Table 2. Effect of preconditioning treatments and auxins on the number and length of secondary roots and fresh and dry weight of roots in semi-hardwood cuttings of olive

Treatment (ppm)	Average number of secondary roots (cm)	Average root length (g)	Fresh weight of roots (g)	Dry weight of roots (g)
T1: IBA 3000	8.91	2.16	0.51	0.18
T2: IBA 4000	10.49	2.50	0.59	0.21
T3: NAA 4000	5.06	1.33	0.36	0.14
T4: NAA 5000	5.87	1.83	0.32	0.15
T5: Girdling + IBA 3000 + NAA 4000	6.67	2.85	0.55	0.20
T6: Etiolation + IBA 3000 + NAA 4000	7.68	1.63	0.49	0.14
T7: Girdling + IBA 3000 + NAA 5000	8.64	2.30	0.51	0.15
T8: Etiolation + IBA 3000 + NAA 5000	6.35	2.05	0.45	0.13
T9: Girdling + IBA 4000 + NAA 4000	5.68	1.99	0.40	0.12
T10: Etiolation + IBA 4000 + NAA 4000	6.02	1.75	0.43	0.14
T11: Girdling + IBA 4000 + NAA 5000	5.30	1.93	0.42	0.11
T12: Etiolation + IBA 4000 + NAA 5000	4.55	1.66	0.31	0.16
T13: IBA 3000 + NAA 5000	6.29	2.06	0.46	0.14
Mean	6.73	2.00	0.44	0.15
$CD_{0.05}$	1.35	0.49	0.04	0.04

significant difference in shoot:root ratio. However maximum shoot:root ratio (3.47) was recorded in cuttings treated with IBA 4000 ppm and minimum (1.99) in cuttings treated with etiolation + IBA 3000 ppm + NAA 5000 ppm.

The data given in Table 4 show the effect of treatments on number of leaves, leaf area field survival of olive. Maximum number of leaves (16.80) was observed in cuttings treated with IBA 4000 ppm which was statistically at par with treatments IBA 3000 ppm (14.73) and girdling + IBA 3000 ppm + NAA 4000 ppm (13.30). Maximum leaf area (38.29 cm^2) was recorded in cuttings treated with IBA 4000 ppm. This treatment was found statistically superior to all other remaining treatments. Survival of rooted cuttings was significantly influenced

by different treatments. The maximum field survival (77.26%) was recorded in cuttings treated with IBA 4000 ppm.

These findings are in agreement with the findings of Seyhan and Gezerel (2005) who reported highest germination field survival and other root and shoot characters in terms of length, number, diameter and leaf number and area in the olive cuttings of Gemlik and Domat varieties when treated with IBA 4000 ppm. Similar findings were also obtained by Murat and Elmas (2008) who reported best results on rooting, field survival and various characters of semi-hardwood cuttings of olive cv Domat after their treatment with higher concentration of IBA. Lal et al (2007) observed similar results in terms of rooting percentage, number of roots, root length, survival percentage and root and shoot characters with higher concentration of IBA in stooled shoots of guava.

Table 3. Effect of preconditioning treatments and auxins on plant height, plant diameter and shoot:root ratio in semi-hardwood cuttings of olive

Treatment (ppm)	Plant height (cm)	Average plant dia (mm)	Average shoot:root ratio
T1: IBA 3000	14.86	2.54	2.79
T2: IBA 4000	15.13	2.59	3.47
T3: NAA 4000	11.03	1.95	3.04
T4: NAA 5000	9.56	1.90	2.98
T5: Girdling + IBA 3000 + NAA 4000	14.13	2.34	2.37
T6: Etiolation + IBA 3000 + NAA 4000	12.86	2.41	2,52
T7: Girdling + IBA 3000 + NAA 5000	13.63	2.18	2.66
T8: Etiolation + IBA 3000 + NAA 5000	11.06	1.91	1.99
T9: Girdling + IBA 4000 + NAA 4000	11.76	1.94	2.58
T10: Etiolation + IBA 4000 + NAA 4000	11.13	1.83	2.54
T11: Girdling + IBA 4000 + NAA 5000	11.33	1.86	2.74
T12: Etiolation + IBA 4000 + NAA 5000	10.76	1.80	3.36
T13: IBA 3000 + NAA 5000	13.03	1.94	2.83
Mean	12.32	2.09	2.75
$CD_{0.05}$	NS	0.07	NS

Table 4. Effect of preconditioning treatments and auxins on the number of leaves, leaf area and field survival in semi-hardwood cuttings of olive

Treatment (ppm)	Number of leaves	Total leaf area (cm^2)	Field survival (%)
T1: IBA 3000	14.73	33.13	73.14 (58.80)
T2: IBA 4000	16.80	38.29	77.26 (61.58)
T3: NAA 4000	8.90	17.70	41.33 (40.01)
T4: NAA 5000	8.06	15.80	48.00 (43.85)
T5: Girdling + IBA 3000 + NAA 4000	13.30	29.40	70.88 (57.35)
T6: Etiolation + IBA 3000 + NAA 4000	11.66	24.90	67.18 (55.07)
T7: Girdling + IBA 3000 + NAA 5000	12.50	25.82	60.90 (51.31)
T8: Etiolation + IBA 3000 + NAA 5000	10.20	24.49	64.06 (53.18)
T9: Girdling + IBA 4000 + NAA 4000	10.63	26.62	55.31 (48.05)
T10: Etiolation + IBA 4000 + NAA 4000	11.76	23.51	60.10 (50.83)
T11: Girdling + IBA 4000 + NAA 5000	9.63	18.16	53.08 (46.77)
T12: Etiolation + IBA 4000 + NAA 5000	9.80	20.93	48.72 (44.27)
T13: IBA 3000 + NAA 5000	12.43	27.82	52.24 (46.29)
Mean	11.56	25.12	59.40
$CD_{0.05}$	3.73	4.75	3.03

Figures in the parentheses are arc sine transformed values.

SUMMARY

The results obtained in the present studies thus reveal that propagation of olive cv Leccino through semi-hardwood cuttings during summer with the treatment of IBA 4000 ppm in July statistically improves the various root characters, highest per cent rooting (58.33%), number of primary roots (7.85), root diameter (0.58 mm) and number of secondary roots (10.49). Maximum primary (6.13 cm) and secondary root length (2.85 cm) was recorded with the treatment girdling + IBA 3000 ppm + NAA 4000 ppm in July. Among shoot characters maximum plant height (15.13 cm), plant diameter (2.59 mm), number of leaves (16.80) and leaf area (38.29 cm^2) were recorded with the treatment IBA 4000 ppm. Highest fresh and dry weight of roots (0.59 and 0.21 g respectively) was recorded with the treatment of IBA 4000 ppm too.

The survival percentage was also recorded to be highest (77.26 %) with the treatment of IBA 4000 ppm in the semi-hardwood cuttings of olive collected and

planted in July. Thus to propagate olive through semi-hardwood cuttings taken during active growth stage ie in summer the dose of IBA at 4000 ppm is recommended.

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