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Effect of Different Concentrations of IBA (Indulebutyric Acid) Hormone and Cutting Season on the Rooting of the Cuttings of Olive (*Olea Europaea Var* Manzanilla)

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ABSTRACT

Objective: In order to study the effect of different concentrations of IBA hormone on rooting of olive cuttings in spring and winter of 2012-2013 in a greenhouse in Jiroft, Iran. **Methods:** a split-plot experiment was conducted on the basis of a Randomized Complete Block Design in which hardwood cuttings of one-year-old olive plants cv. Manzanilla with the diameter of 0.7-1 cm were used. The main plot was devoted to cutting seasons at two levels of spring (late-May) and winter (late-January) and the sub-plot was devoted to IBA (indulebutyric acid) hormone treatment at five levels of 0, 1000, 2000, 3000 and 4000 ppm. **Results:** It was found that 3000 ppm IBA increased the number of roots, the percentage of rooted cuttings, branch length, and root:shoot fresh weight. In traits such as root length and root dry weight, the highest effect was observed under the treatment with 4000 ppm IBA. But, control treatment had the lowest effect on the traits of rooting in olive cuttings. Cuttings planted in spring showed the highest effect on their evaluated traits (by 10-15%) with a significant difference with those planted in winter. The interaction between hormone and planting time was significant only for root fresh weight.

1.INTRODUCTION

Olive (Olea europaea) belongs to the family of Oleaceae. It is one of the most useful crops with unique perils. Undoubtedly, olive is one of the most ancient crops in Mediterranean regions, particularly in the Middle East (Isfendiyaroğlu and Ozeker, 2009). It is widely common to use growth regulators (hormones) for inducing root formation in mist microsystems. Their application to the bottom of the cuttings almost always results in faster and more rooting. There is no doubt that IBA is considered as the best artificial hormone which is used. However, the application of other hormones, too, has given good results such as indole acetic acid (IAA) and naphthaleneacetic acid (NAA) (Isfendiyaroğlu and Ozeker, 2009; Muller et al., 2005).

In a study on three olive cultivars, Epstein and Ludwig-Müller (1993) concluded that the studied cultivars had significant differences in rooting. The cuttings whose bottom had been soaked in IBA showed the best results in summer and spring and those that received IBA through their leaves showed better results in other seasons. In addition, in another study on two olive cultivars they found the best time for rooting of the cuttings to be early to late autumn and late winter to early spring. Khaled (2003) studied the effect of five concentrations of IBA and two cutting collection times on rooting percentage and mean number of roots of two local cultivars of olive. It was clear that the capability of rooting in olive was more affected by the interaction among cultivar, cutting time and IBA concentration that by each of them. It was found that the best time for

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cutting was December and that IBA at the rate of 6000 ppm resulted in the highest rooting percentage in both cultivars.

The root formation of four olive varieties induced by the application of hormone was examined under mist conditions. Four different IBA solutions (0, 500, 1000 and 2000 ppm) were treated. It was revealed that hormone application increased rooting (Turkoglu and Durmus, 2005). Ucler and Parlak (2004) examined the impact of IBA and cutting date on rooting of semi-hardwood cuttings of kiwifruit and observed that the cutting taken in August had better rooting that those taken in July. In addition, they concluded that cutting date had significant influence on rooting potential. Bartolini et al. (1986) reported that the rate of endogenous hormones was decreased during cool seasons due to the decrease in metabolic activities of the trees and it was increased during hot seasons and so, lower concentrations of hormones suffice for rooting in cold seasons but in hot seasons, higher concentrations of hormones are required. Auxin IAA is the first floral hormone applied for inducing rooting in cuttings. The second hormone was IBA which is a synthesized auxin that increases rooting and is even more effective than IAA (Kovar and Kuchenbuch, 1994). The treatment of the cuttings of most plant species with IBA induced adventitious rooting and it was more effective than IAA in most cases (Epstein and Ludwing-Müller, 1993). Higher ability of IBA in increasing adventitious rooting than IAA is related to higher stability of IBA than the plant tissue and solution (Nordström et al., 1991). Harbage and Stimart (1996) revealed that low accumulation IBA at low pH's of planting bed induced rooting of apple cuttings. Muller et al. (2005) found that the application of IBA at the rates of 0.1 and 1 mM had no inhibiting effect on rooting and increased it, but the rate of 100 mM inhibited rooting completely. Nordström et al. (1991) reported that IBA exists in plant naturally and is more stable than IAA during the examination of rooting which affects both decomposition and metabolism.

In a series of studies on the propagation of olive, Briccoli (1989) reported that two groups of cuttings obtained from intermediate propagation in spring and autumn responded to the application of 2000 ppm IBA, particularly in spring. Ibrahim et al. (1991) treated hardwood cuttings of Ascolano and Frantoio with 500 or 1000 ppm IBA and found that they resulted in better rooting of olive and that cuttings taken in March had better rooting than those taken in late summer and early autumn. Khattak et al. (1981) reported 22.5% rooting of semi-hardwood cuttings of Lisino olive and stated that IBA at the rate of 6000 ppm caused rapid rooting and that the number and length of the roots were increased with the application of 9000 ppm hormone. Rahman et al. (2002) reported that the application of IBA at the concentration of 3000 ppm resulted in 70% rooting. They reported that the maximum number of roots of the cuttings was recorded when they were treated with 3000 ppm IBA, whereas the minimum roots rate was shown in control implying that IBA influences the resilience potential of cellular walls and accelerates cellular division.

2. MATERIALS AND METHODS

Given that olive is one of the hard-to-rooting plants, the present split-plot experiment was conducted in greenhouse in Jiroft, Iran in winter and spring of 2012-2013 on the basis of a Randomized Complete Block Design to investigate the influences of different concentrations of IBA hormone on the rooting of olive cuttings. The hardwood cuttings of olive cv. Manzanilla taken from one-year-old branches were used. The main plot (A) was composed of cutting seasons at two levels of spring and summer and the sub-plot (B) was composed of IBA (Indulebuyric acid) hormone treatment at five levels of 0, 1000, 2000, 3000 and 400 ppm. The study was conducted in late-February and late-April. Each seasons included five treatments and three replications. The planting bed was composed of perlite and sand at the ratio of 1:1. Two centimeter from the bottom of the cuttings was soaked in the treated solution for 10 seconds and then, it was soaked in Talc powder for better retention of the hormone. Afterwards, they were transferred to planting pots. The hatch of the pots had the diameter of 20 cm and the height of the pots was 25 cm. Three cuttings were planted in each pot diagnostically. The cuttings had 2-3 terminal leaves. After randomly putting the cuttings in hot greenhouse, they were irrigated daily and the sampling was started 75 days after the planting of the cuttings. The percentage of rooted cuttings and the number of roots per cutting were measured. Root and branch length was measured by caliper. Root fresh and dry weights were determined by digital 0.01-precision scale. The data were analyzed and the targeted traits were compared by MS-TATC software and the graphs were drawn by MS-Excel software.

3. RESULTS AND DISCUSSION

Analysis of variance revealed that different concentrations of the hormone and planting season resulted in significant differences in the percentage of rooted cuttings, root number, root length, branch length, root fresh weight, and root dry weight at 1% statistical level and they interaction was significant for root fresh weight at 5% level, but it was not significant for other traits. The increase in IBA level can partially affects rooting and the growth of shoots and if the concentration of this hormone is increased in plant, not only it cannot play an active role in rooting, but also it may reduce the number of roots that play a role in the uptake of nutrients.

IBA at the rate of 3000 ppm had the highest effect on the percentage of rooted cuttings (84.5%) and the lowest percentage was observed in control (46.667%). It is notable that the excessive increase in hormone concentration decreased the percentage of rooted cuttings. Last et al. (1991) and Rose et al. (1992) showed that inducing adventitious rooting under IBA concentrations of 3-10 M can induce rooting. Rahman et al. (2002) reported that IBA at the concentration of 3000 ppm resulted in 70% rooting of olive cuttings.Cutting season had significant effect on the percentage of rooted cuttings. Cutting in spring gave the highest percentage of rooted cuttings (80.667%) as compared to winter which had the lowest per centage (67.427%). It may be associated with the adequate heat and higher radiation in spring. Briccoli (1989), too, reported that the cuttings taken from intermediate propagation in spring and autumn responded to 2000 ppm IBA, particularly in spring. The highest mean number of roots (8.517) was observed at IBA level of 3000 ppm and the lowest one (4.683) in control. Muller et al. (2005) reported that the cuttings of Arabidopsis treated with IBA clearly produced adventitious roots from their cambium which were, at first, different for callus formation but it was followed with the formation of roots and so, they grew. It was specified with extra callus region which accelerated new adventitious roots. But, no such structures were observed in control. Among the effect of season on mean number of the roots in olive cuttings, it was revealed that the highest number of olive cutting root number (7.467) was observed in spring and the lowest number (6.433) in winter. Ibrahim et al. (1991) treated hardwood cuttings of olive with 500 and 1000 ppm IBA that resulted in their better rooting. They reported that cuttings taken in March had better rooting than those taken in late summer and early autumn. The highest mean root length (8.9 cm) was obtained under the treatment of 4000 ppm IBA and the lowest one (5.067 cm) in control. Khattak et al. (1981) reported 22.5% rooting in the semi-hardwood cuttings of olive cv. Lisino and stated that treatment with 6000 ppm IBA accelerated rooting and treatment with 9000 ppm hormone increased the number of length of root.

In terms of the effect of time on mean root length, the longest (7.433 cm) and lowest (6.78 cm) root lengths were obtained in spring and winter, respectively. It was related to the fact that in spring the appropriateness of cutting conditions and planting bed temperature, callusization of cutting and as a result, their rooting was increased. Given that branch length of rooted cuttings is directly related to the rooting rate and the hormone level in plant and auxin generation can be induced by IBA hormone resulting in increased branch length, branch length in the present study was increased as a result of the increase in hormone level up to 3000 ppm (17.7 cm) and then, started to decrease. However, control had the lowest branch length (12.683 cm). Rahman et al. (2002) reported that the maximum branch length was observed in cuttings treated with 3000 ppm IBA whereas the minimum one was observed in control. Since olive needs higher temperature for rooting and forage formation, planting seasons had significant effect on the length of the first branch in the present study. It was higher in cuttings planted in spring (16.907 cm) than those planted in winter (15.227 cm). Results of mean root fresh weight revealed that IBA hormone at the rate of 3000 ppm had the highest effect on root fresh weight (10.317 g) and the lowest effect was observed in control (4.567 g). Rahman et al. (2002) reported that the maximum number of roots in each cutting was recorded when the cuttings were treated with 300 ppm IBA while the minimum one was observed in control implying that IBA hormone affected the resilience potential of cellular wall and accelerated cellular division. Root fresh weight of the rooted cuttings of olive was influenced by planting season. Root fresh weigh was higher in spring (7.641 g) than in winter (6.2 g).

Among the interaction between IBA level and planting season, the highest root fresh weight (11.8 g) was obtained in spring under the treatment of 3000 ppm IBA and the lowest one (4.133 g) in winter under control treatment. The effect of IBA was so that the highest mean root dry weight (2.097 g) was observed under the treatment of 4000 ppm IBA. This concentration of hormone inhibits the growth of roots but it can bring about the accumulation of dry matter in root and/or shoot. Control had the lowest root dry weight (0.828 g). Planting season, too, can affect mean root dry weight of rooted cuttings of olive. Cuttings rooted in spring had the highest root dry weight (1.5227 g), while cuttings rooted in winter had the lowest one (1.17 g) which can be related to hotter environment and evapotranspiration of leaves and consequently, the increase in the concentration of minerals in plant parts, particularly in roots.

Table 1.

Analysis of variance of the measured traits of rooting of olive cuttings

	df	Percentage of rooted cuttings	Root number	Root length	Branch length	Root fresh weight	Root dry weight
Replication	2	0.02	1.02	0.82	0.06	0.63	0.03
Planting season	1	640.492^{**}	30.824^{**}	3.201^{**}	23.168^{**}	155.66^{**}	0.912^{**}
Main plot error	2	6.369	0.246	0.032	0.219	1.426	0.0069
IBA concentration	4	1517.582^{**}	16.607^{**}	14.001^{**}	23.154^{**}	32.352^{**}	1.583^{**}
Planting seasons × IBA	4	6.67^{ns}	0.55^{ns}	0.19^{ns}	0.26^{ns}	1.426^{*}	0.08^{ns}
Sub-plot error	18	3.30	0.42	0.39	0.2	0.42	0.05
Coefficient of variation		11.14	15.11	12	13.33	23	6.4

CONCLUSION

Since IBA concentration can influence the rooting of olive cutting, its low or high levels may inhibit the rooting of olive cuttings and/or it may have no effect. The present study showed that 3000 ppm IBA increased such traits as the number of roots, the percentage of rooted cuttings, branch length and root fresh weight by 20-50%. In terms of such traits as root length and root dry weight, the highest impact was observed under the treatment of IBA at the rate of 4000 ppm and control had the lowest effect on the traits of rooting of olive cuttings (by 5-10%) and even produced weaker seedlings. It can be said that if the cuttings are intended to root with no hormone application, they should be propagated in a longer time to have more uniform and healthier seedlings which is not time-effective. Cuttings planted in spring exhibited higher effect on the evaluated traits and showed 5-15% significant difference as compared to cuttings rooted in winter. According to the results, the interaction between hormone and cutting seasons was not significant for the studied traits unless root fresh weight. Although the interaction between hormone and seasons was stronger for some traits, analysis of variance did not reveal any significant differences in these traits.

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