Research Article

Olive Cuttings as Affected by Different Concentrations of Indole Butyric Acid

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Abstract | To study the effect of different concentrations of indole butyric acid (IBA) on olive cuttings, a greenhouse study was conducted, at Agricultural Research Institute, Tarnab during the growing season 2016. Completely randomized design (CRD) was used with four treatments that were replicated three times. The IBA concentrations used were (T1: control, T2: 1000 mgL^{-1}, T3: 2000 mgL^{-1}, T4: 3000 mgL^{-1}). Data were recorded on days to 50% sprouting, number of sprouts $cutting^{-1}$, sprouts length $cutting^{-1}$, number of leaves $cutting^{-1}$, days to rooting, and survival percentage. Significant differences ($P \leq 0.01$) were observed among olive cultivar treated with different IBA concentrations for days to 50% sprouting, days to rooting, and survival percentage, while non-significant differences were observed for the number of leaves $cutting^{-1}$, number of sprouts $cutting^{-1}$ and sprouts length $cutting^{-1}$. The cuttings treated with IBA @ 3000 mgL^{-1} took fewer days to sprout (25.00), and rooting (46.66), showed high value for the number of sprouts $cutting^{-1}$ (3.33), and survival percentage (39.67), while the maximum number of leaves $cutting^{-1}$ (7.33), and maximum sprout length $cutting^{-1}$ (5.00) was recorded with IBA @1000 mgL^{-1} and 2000 mgL^{-1} respectively. As most of the studied parameters had improved by IBA @ 3000 mgL^{-1}, therefore it can be used effectively as propagating material for olive cuttings.

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Introduction

Olive (*Olea europea*) in Pashto language called Zaitoon or Khuna, is the oldest plant cultivated by man in the world, belongs to the family Oleaceae, used for its fruits and oil production (Brito *et al.*, 2019). Olive has been originated from North West Syria, Palestine, Lebanon and Cyprus (Murkovic *et al.*, 2004). Olive is an evergreen tree with a medium to tall size that can gain up to 15 m. It is a vigorous tree having the ability to promptly regenerate if cut or injured above ground. The olives live for hundreds of years with good production. The trees have dark green, leathery, thick and oppositely arranged leaves (Munir, 2009). The oil of olive is known for its nutritive values and other benefits. It is used in cooking and other preparations such as in massaging creams, pharmaceuticals and cosmetics. Olive oil contains polyunsaturated fatty acids, it is an oil source that is free of cholesterol, and has several health benefits (Awan *et al.*, 2012). In Pakistan olive has not been grown for oil production since the 1970s when its first grooves were established, therefore very negligible research studies have been carried

out on its cultivation and management. The presence of wild trees of olives in the northern areas of KPK, Balochistan and Potohar region indicates that the climate of these areas is favorable for olive cultivation. Hence, olive cultivation can be successfully initiated in these areas on commercial basis for income generation, and to lowers the country bills on edible oil imports (Breton *et al.*, 2006). Olive can be propagated through different methods; it can be grown from seeds as well as by vegetative methods, but trees grown from seeds take a long time to come into bearing, while asexually propagated trees have genetic uniformity and also come into bearing earlier, than those raised from seeds (Awan *et al.*, 2012). Therefore vegetative methods such as, cutting, grafting, budding or taking rooted suckers from top of the trees etc. can be used for rapid propagation. Among these methods, cutting is most widely used method because of its practicability and simplicity for mass production in a short period of time. Based on the nature of the tissue, there are different types of stem cuttings such as hardwood cuttings, semi-hardwood, softwood and herbaceous (Hartmann *et al.*, 2002; Joshi, 2008). Reduced rooting ability of cuttings is widely attributed to the aging of the mature shoots, and in most cases cuttings taken from mature shoots had lessen ability of rooting (Vidal *et al.*, 2003; Husen and Pal, 2006). Cuttings of various sizes are used which usually ranges from 15 to 25 cm, depending on the cultivar used; these cuttings are then treated with different types of rooting hormones for rapid production of roots (Awan *et al.*, 2012). Under the light of above literature, the present research was intended with the aim to determine the optimum dose of IBA for successful propagation of olive semi hardwood cuttings.

Materials and Methods

The experiment entitled "Olive cuttings as affected by different concentrations of Indole butyric acid" was conducted at, The Agriculture Research Institute Tarnab, Peshawar Khyber Pakhtunkhwa during 2016. Olive variety (FS-17) was used as a study material. Completely randomized design (CRD) was used with three replications. IBA concentrations used were i.e., T1: control, T2: 1000 mgL^{-1}, T3: 2000 mgL^{-1}, T4: 3000 mgL^{-1}. There were a total of 28 cuttings (Semi-hard wood cuttings) in each treatment. The cuttings were planted in polyethylene bags on 30th July, 2016.

Data analysis

The data were analyzed by using statistics software Statistix (ver: 8.1), while for graphical presentation of the main values SigmaPlot (ver: 10.0) were used.

Parameters studied

Days to 50% sprouting: Days to 50% sprouting was counted from the date of sowing to when 50% cuttings in the treatment initiate sprouting.

Survival percentage (%): It was calculated by counting the survived plants after transplantation and the percentage was found.

Number of sprouts cutting^{-1}: It was calculated when cuttings were ready for transplantation the number of sprouts per cutting was recorded in each treatment.

Sprouts length cutting^{-1}(cm): Sprouts length was measured on five randomly selected cuttings in each treatment with the measuring tape and their average was taken.

Number of leaves cutting^{-1}: Number of leaves was counted on five randomly selected cuttings in each treatment and their average was calculated.

Days to rooting: Days to rooting was taken from date of sowing till initiation of roots.

Results and Discussion

The analysis of variance and mean values of the studied attributes are given in (Table 1) and (Table 2) respectively, while Figure 1 shows the graphics of the mean data.

Table 1: *Analysis of variance for various traits of olive variety.*

Traits	Mean squares	Error MS
Days to 50% sprouting	58.7778**	1.4167
Number of sprouts cutting^{-1}	2.30556^{NS}	0.91667
Sprout length cutting^{-1}	0.75000^{NS}	3.08333
Number of leaves cutting^{-1}	2.30556^{NS}	3.25000
Days to rooting	174.750**	0.583
Survival percentage	47.2222**	0.5000

**, **: significant at 1% and 5% level of probability respectively; NS: non-significant.*

Table 2: *Mean values for various traits of olive cuttings.*

Treatments	Days to 50% sprouting	No. sprouts cutting^{-1}	Sprout length cutting^{-1} (cm)	No. leaves cutting^{-1}	Days to rooting	Survival percentage (%)
Control	35.33 A	1.66	5.00	7.00	63.66 A	30.33 D
1000 mgL^{-1}	27.33 B	2.00	4.33	7.33	61.33 B	34.00 C
2000 mgL^{-1}	29.00 B	3.00	5.00	6.66	54.66 C	36.67 B
3000 mgL^{-1}	25.00 C	3.33	4.00	5.33	46.66 D	39.67 A

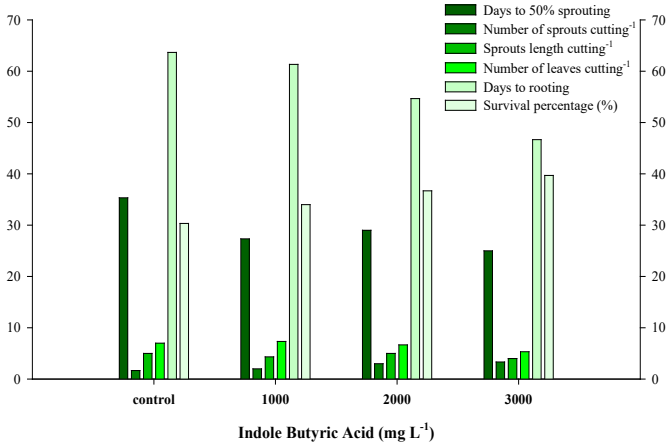

Figure 1: *The Effect of different IBA concentrations on olive cuttings.*

Days to 50% sprouting

Significant differences (P≤0.01) were observed among olive variety for days to 50% sprouting. Less number of days to 50% sprouting (25.00) were noted at 3000 mgL^{-1} IBA concentration, while maximum days (35.33) were recorded at control.

Number of sprouts cutting^{-1}

Non-significant differences were observed for the number of sprouts cutting^{-1}. Minimum number of sprouts cutting^{-1} (1.66) was recorded at control, while maximum number of sprouts (3.33) cutting^{-1} was recorded at 3000 mgL^{-1} IBA concentration.

Sprouts length cutting^{-1}(cm)

Non-significant differences were observed for sprouts length cutting^{-1}. Minimum sprout length cutting^{-1} (4.00 cm) was recorded at 3000 mgL^{-1} IBA concentration, while maximum sprout length (5.00 cm) was recorded at control and 2000 mgL^{-1} IBA concentration.

Number of leaves cutting^{-1}

Non-significant differences were recorded for number of leaves cutting^{-1}. Minimum number of leaves cutting^{-1} (5.33) were recorded at 3000 mgL^{-1} IBA concentration, while maximum leaves (7.33) cutting^{-1} were recorded at 1000 mgL^{-1} IBA concentration.

Days to rooting

Significant differences (P≤0.01) were noticed among different treatments for number of days to rooting. Minimum days to rooting (46.66) were recorded at IBA 3000 mgL^{-1}, while maximum value (63.66) was recorded for the control.

Survival percentage (%)

Significant variations (P≤0.01) were found among various treatments for survival percentage. Minimum value (30.33) of survival percentage was recorded at control, while maximum value (39.67) was recorded at 3000 mgL^{-1} IBA concentration.

In contrast to our results, a non-significant effect of IBA was found on the number of days to bud sprout; this can be due to the indirect effect of IBA on shoot development as these hormones are mostly responsible for root induction. In line with these results Wahab *et al.* (2001) also reported a non-significant effect of IBA on days to bud sprout. Sprouting of buds could be due to the presence of stored carbohydrates in the cuttings. Ibadullah *et al.* (2015) stated that IBA concentrations did not affect the number of shoots cutting^{-1}, a non-significant effect of IBA was also found by Siddique and Hussain (2007) in Ficus Hawaii. The total number of shoots produced per cutting could be attributed to the equal length of cutting above ground which had an equal number of nodes. Concerning shoot length a significant effect was observed at IBA 300 ppm with the highest shoot length of (21.5 cm), while the minimum value (4.9cm) was recorded at control. In line with these results Naghmouchi *et al.* (2008) stated that IBA a growth promoter improves cell division, which leads to early rooting and subsequently improves nutrients absorption that results an increasing shoot length. Hussein *et al.* (2017) reported that IBA treatments significantly influenced the number of leaves cutting^{-1} and shoot length; the highest number of leaves cutting^{-1}(14.40), and maximum shoot length (4.94 cm) was recorded with IBA @ 4000 mgL^{-1}. The improved shoot length and number of leaves can be

attributed to the auxins basic functions in cell division and cell elongation. IBA different concentrations influenced various rooting parameters of olive stem cutting (Khajehpour *et al*., 2014). There were significant differences among the treatments, at 3000 mgL^{-1} the highest rooting percentage (60%) were recorded, while at 4000 mgL^{-1} other parameters such as the average root number per cutting, and average root length was noted. The significant effect of IBA can be attributed to the hormonal balance in the cuttings which influenced the root formation (Kurd *et al*., 2010). John (2004) reported that root formation can be initiated at any injured or damaged stem end by the application of rooting compounds. The healing process will occur naturally in the cuttings and roots will grow, the delaying caused by the transport of auxins from top to the cut stem can be avoided through the treatment of a small but significant amount of synthetic rooting compound. IBA an auxin usually used for the formation and regeneration of roots in plants. Auxins have differential root-generating capacities, which may depend on their respective role in the synthesis of proteins needed for roots formation (Saini *et al*., 2013). The overall promotive influence of auxins on rooting of plants is the stimulation of cell division in the vascular cambium which ultimately results in the formation of root primordia (Rahman *et al*., 2002). Isfendiyaroglu and Ozeker (2008) also found a positive effect of IBA treatments on all rooting characters in an olive variety "Domat". Bayraktar *et al*. (2018) recorded the highest rooting percentage (70%) at 5000 ppm IBA and 5000 ppm NAA, while studying the effect of different auxins on the propagation of olive species (*Elaeagnus umbellata*) through cuttings, the longest root length, the highest root number, and first root formation was recorded with IBA 5000 ppm at the 20th day of the treatment. Bayraktar (2017) studied the influence of IBA (1000 ppm, 5000 ppm) along with different greenhouse media on softwood cuttings of olive same species, and among these treatments, 100% rooting percentage was recorded with IBA @ 1000 ppm. Ibadullah *et al*. (2015) noted that IBA significantly improved the survival percentage of different types of olive cuttings. The highest survival percentage was recorded at 300 ppm followed by a concentration of 200 ppm, whereas the lowest survival was recorded at control. These results are supported by Sukhjit (2017) who stated that the high survival rate might be due to the direct effect of IBA on growth regulators which stimulates the formation of adventitious roots, these in turn absorbs nutrients from the soil and help survives the plants. A similar effect of IBA on lateral root development in rice was also found by Wang *et al*. (2003).

Conclusions and Recommendations

The research work was carried out under a project headed by the Agricultural Research Institute Tarnab, Peshawar which aimed for the uplift of the oil industry through the integration and development of new and high yielding olive varieties and upgrading of existing olive orchards across the province. The current study that was designed to examine the effect of IBA concentrations on olive cuttings, revealed significant effects of the treatments on days to 50% sprouting, days to rooting and survival percentage while showed non-significant differences for number of leaves $cutting^{-1}$, number of sprouts $cutting^{-1}$ and sprout length $cuttings^{-1}$. Among different levels of IBA (1000 mg L^{-1}, 2000 mg L^{-1}, and 3000 mg L^{-1}), IBA @ 3000 mg L^{-1} proved to be more effective for the studied attributes. Hence, it is recommended to be used as propagating material for olive cuttings.

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Novelty Statement

As most of the olive cultivars are hard to root therefore for successful rooting of the olives different types of growth hormones are used. Indole butyric acid is an auxin mostly used for the same purpose. The present study also assesses the best IBA levels for olive propagation, which showed significant effects on the studied parameters, hence the treatment levels used in this study can be used for successful propagation of olive cuttings.

Author's Contribution

Faiza Aman supervised and designed the experiment. Noor Ayaz performed the experiment and analyzed the data and Sidra Saleem wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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