MITTEILUNGEN KLOSTERNEUBURG
64(2014) 9
www.mitt-klosterneuburg.com
Bimonthly ISSN: 0007-5922

Effect of various concentrations of indole butyric acid (IBA) on olive cuttings

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Abstract

The research study was conducted at Pakistan Oilseed Development Board Tarnab Research Center Peshawar to evaluate the effect of different concentrations of indole butyric acid (IBA) at 0, 100, 200 and 300 ppm on hardwood and semi hardwood cuttings of olive. Cuttings were taken in the month of October from an eight-year-old mother plant and dipped for 5 seconds in the required IBA solutions. The highest survival percentage, shoot length, shoot diameter, number of leaves shoot^{-1}, number of branches shoot^{-1}, number of roots plant^{-1}, root length and root diameter were recorded in both types of cuttings treated with IBA 300 ppm. The maximum number of branches shoot^{-1} was observed in hardwood cuttings as compared to softwood cuttings. Also hardwood cuttings treated with IBA (100 ppm) gave the highest number of branches shoot^{-1}. On the basis of overall performance either type of olive cutting treated with IBA solution (300 ppm) showed best results to propagate olive.

Keywords: Olive, IBA concentrations, plant survival, roots initiation, cuttings.

INTRODUCTION

Olive (*Olea europea*) locally called Zaitoon or Khuna belongs to the family Oleaceae. The olive can be consumed as a fruit or oil extracted from of it can be used for various purposes. Olive oil accounts for 20-30 percent of the fresh weight of the fruit and is well known throughout the world for its nutritive and medicinal properties. The oil is nutritious because of the higher contents of oleic acid with therapeutic effect (Ashrafi, Sadeghi, Mashhadi, & Hassan, 2008). In human history, the domestication of olives started approximately 6500 years ago (Loukas & Krimbas, 1983). Olives originated from Palestine, Lebanon, Syria and Cyprus and latterly cultivation was spread to Italy, Spain and North Africa (Simmonds, 1976).

Olive can be grown from seed with high success rate of germination; however, growing from seed is very slow process and takes time to become a plant that is fit for budding, grafting or to fruit. Therefore, Baloch, (1994) suggested that other methods of propagation are to be tried to get fruits as quickly as possible. Cuttings is one of the simplest and most rapid ways of propagation, using hardwood and semi hardwood cuttings (Siddiqui & Hussain, 2007). Plants can synthesize 3-types of endogenous auxins for root initiation at early stages of development (Aini, Goh, & Ridzuan, 2009; Rashotte, Poupart, Waddell, & Muday, 2003; Simon & Petrasek, 2011). For the last few decades many researchers have been involved in determining the role of IAA and IBA in root initiation and development. While the development of primary root received a lot of attention, the formation of lateral and adventitious roots is not well understood (Casson & Lindsey, 2003). However, it is known that IBA effectively induces lateral rooting, adventitious rooting and acrobasal type of the rooting system in other species (Chhun, Taketa, Tsurumi, & Ichii, 2003, 2004; Ludwig-Muller, Vertocnik, & Town, 2005; Stefancic, Stampar, & Osterc, 2005; Wang et al., 2003).

In Pakistan, millions of wild olive trees (*Olea cuspidate* & *Olea ferrugenea*) are found in Federally Administrated Tribal Area, Khyber Pakhtunkhwa, Potohar region and Northern Baluchistan. The presence of such large numbers of wild olive trees indicates that the agro-climatic conditions of these areas are favorable for olive cultivation. Additionally, a small number of different olive varieties belonging to *Olea europea* that yields high number of fruits were introduced into various parts of the country. Currently, there is a demand for the establishment of a large number of olive varieties in these regions in shortest possible time. The present study is therefore, planned to evaluate the performance of different types of olive cuttings treated with different concentrations of Indole Butyric Acid (IBA).

MATERIALS AND METHODS

All the experiments were conducted at Pakistan Oilseed Development Board Tarnab, Peshawar. A Randomized Complete Block Design (RCBD with split plot arrangement was used for experimentation, having three replications (Steel, Torrie, & Dickey, 1997). Two types of cuttings (Hardwood and Semi hardwood) from an eight year old olive tree were treated with four different IBA concentrations (0 ppm = control, 100, 200 and 300 ppm). The experiment was performed in the month of October and twenty cuttings of uniform length (5 to 6 inches) and leaf number were used for each treatment. The cuttings were planted in polyethylene bags with media of sand, silt and farmyard manure in combination of 1:1:1. The growing media and all agronomic practices were kept constant for all the treatments. The data was recorded for plant survival percentage (%), Number of days to bud sprout, Number of shoot plant^{-1}, Shoot length (cm), Shoot diameter (cm), Number of leaves shoot^{-1}, Number of branches shoot^{-1}, Number of root plant^{-1}, Root length (cm) and Root diameter (cm).

RESULTS AND DISCUSSION

Plant survival percentage (%)

The data (Table 1) regarding plant survival percentage showed that there is a significant effect of different IBA concentration on the plant survival percentage, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The highest plant survival (69.17%) was found in plots having cuttings treated with 300 ppm of IBA, followed by cuttings treated with 200 ppm of IBA, whereas minimum number of plant survived in control. These results are in accordance with that of Marshall and Warring, (1985) and Siddiqui and Hussain, (2007). The survival of the cuttings treated with high concentration of IBA may be directly linked with the capacity of the growth regulator to stimulate the generation of adventitious roots. The adventitious roots absorb mineral nutrients from the soil, which helps in the survival of the cuttings. Evidence for the involvement of IBA, but not IAA, in lateral root or adventitious root development was reported in rice by Wang *et al.*(2003). Chhun *et al.* (2003, 2004) observed that IBA was also able to induce adventitious roots or lateral roots, while IAA gave the same response at 20-fold higher concentrations.

Number of days to bud sprout

It is indicated from the results that IBA concentration applied to different type of olive cuttings may not increase or decrease the number of days to sprouting (Table 1). The reason for this phenomenon is that the IBA or auxin application does not have a direct effect on bud sprout and shoot development but is mainly responsible for inducing lateral roots or adventitious roots. Wahab *et al.* (2001) and Mitra and Bose, (1990) also reported that there is no effect of IBA application on number of days to bud sprout. Bud sprouting may be due to the stored food materials (Carbohydrates) in the cuttings.

Number of shoot cutting^{-1}

The statistical analysis of the data showed that there is no significant effect of IBA concentration, cutting type and the interaction between IBA concentration and cutting type on number of shoot cutting^{-1} (Table 1). It is indicated that the IBA concentration and type of cutting have no significant effect on number of shoot cutting^{-1}. Siddiqui and Hussain, (2007) observed the same effect of IBA on the number of shoot cutting^{-1} in *Ficus hawaii*. The reason for this may be that there was equal length of the cutting above the soil surface and hence equal number of nodes.

Shoot length (cm)

The data regarding shoot length showed that there is a significant effect of IBA concentration on shoot length, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The highest shoot length (21.55 cm) was recorded in plots treated with 300 ppm of IBA while, minimum shoot length (4.96 cm) was recorded in control (Table 1). This significant effect of IBA concentration on shoot length is in accordance with that of Naghmouchi *et al.* (2008). As a growth promoter IBA promotes cell division, which results in early rooting leading towards efficient absorption of mineral nutrient and hence maximizes shoot length.

Shoot diameter (cm)

The data showed that there is a significant effect of IBA concentration on shoot diameter, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The maximum shoot diameter (0.29 cm) was recorded in plots treated with 300 ppm of IBA concentration, followed by 0.26 cm where 200 ppm of IBA was used, whereas the minimum shoot diameter (0.14 cm) was recorded in control (Table 1). The significant effect of IBA on shoot diameter might be due to high number of roots and leaves. These results are in accordance with those of Siddique and Hussain, (2007).

Table 1: Effect of IBA concentrations and type of cuttings on plant survival percentage, number of days to bud sprout, number of shoot plant^{-1}, shoot length (cm) and shoot diameter (cm) of olive.

Treatments	Plant survival percentage	Number of days to bud sprout	Number of shoot plant^{-1}	Shoot length (cm)	Shoot diameter (cm)
Type of Cutting					
Hardwood	46.67	31.33	2.67	16.28	0.26
Semi Hardwood	36.25	31.17	1.92	13.10	0.23
Significance Level	NS	NS	NS	NS	NS
IBA conc. (ppm)					
0	5.00c	30.33	1.83	4.96d	0.14b
100	42.50b	31.33	2.17	13.42c	0.26a
200	49.17b	32.00	2.50	18.84b	0.29a
300	69.17a	31.33	2.67	21.55a	0.29a
LSD α 0.05	5.40	NS	NS	1.74	0.04
Level of Significance Interaction (C x I)	NS	NS	NS	NS	NS

Mean followed by similar letter(s) in column do not differ significantly from one another and NS = Non Significant at 5 % level of probability.
C × I = Interaction of types of cutting and IBA concentration

Number of leaves shoot^{-1}

There was significant effect of IBA concentration on number of leaves shoot^{-1}, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The maximum leaves shoot^{-1} (49.17) was recorded in cuttings where IBA concentration was used at the rate of 300 ppm, whereas the minimum leaves shoot^{-1} (9.33) were recorded in control (Table 2). IBA plays a direct role in enhancing root development, which, in turn increases shoot length and hence number of leaves, the result is similar to that of Wahab *et al.* (2001). An increase in number of roots due to IBA application may necessitate the increased activity of photosynthesis, transpiration and respiration in leaves and thus may results in the increase in number of leaves per cutting Muhammad, (1987).

Number of branches shoot^{-1}

The statistical analysis of the data showed that there is a significant effect of IBA concentrations, cutting type and the interaction between IBA concentration and cutting type on the number of branches per shoot^{-1} (Table 2). The highest number of branches shoot^{-1} (5.33) was observed in response to 300 ppm of IBA, followed by 5.17 in response to 100 ppm of IBA, while minimum number of branches shoot^{-1} (1.00) was recorded in control. The highest number of branches shoot^{-1} (4.58) was recorded in hard woodcuttings, while the minimum number of branches shoot^{-1} (3.58) was recorded in semi hard woodcuttings. Stefancic *et al.* (2005) reported that IBA has significantly influenced the number of branches shoot^{-1}. It is a fact that IBA directly affect number of root and root growth and indirectly effect shoot length, which may result in high number of branches shoot^{-1}. Type of cutting has also shown significant effect on number of branches shoot^{-1}. It may be because the hard wood cutting of olive contains more food material than the soft wood cuttings.

Number of root plant^{-1}

Significant variation in number of root plant^{-1}was observed in relation to different IBA concentrations, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The maximum roots plant^{-1} (20.50) were recorded in cuttings where IBA concentration was used at the rate of 300 ppm, followed by 17.17 where IBA concentration was used at the rate of 200 ppm, whereas the least root plant^{-1} (3.33) were recorded in control (Table 2). The induction of maximum number of root plant^{-1} in the cuttings treated with high concentration of IBA was also reported by Qaddoury and Amssa, (2004) and Aini *et al.* (2009). This effect of IBA may be due to the fact that cambial activities involved in root induction is stimulated by increasing IBA concentration Daoud *et al.* (1989).

Root length (cm)

The statistical analysis of the data showed that there is a significant effect of IBA concentration on root length, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ. The highest root length (11.09 cm) was recorded in plots where IBA concentration was used at the rate of 300 ppm, followed by 9.80 cm where IBA concentration was used at the rate of 200 ppm, whereas the minimum root length (3.09 cm) was recorded in control (Table 2). The increase in root length may be due to maximum number of branches shoot^{-1} whose tips produces more auxin which results in root elongation, and the effect of metabolites translocation and carbohydrates metabolism. Bhatt and Tomar, (2010) also found increase in root length in *Citrus auriantifolia* with increasing IBA concentration.

Root diameter (cm)

IBA concentration has significantly affected the root diameter, whereas the effect of cutting type and the interaction between IBA concentration and cutting type did not significantly differ (Table 2). The maximum root diameter (0.16 cm) was recorded in plots treated with 300 ppm of IBA, followed by plots treated with 200 ppm of IBA, whereas the minimum root diameter (0.07 cm) was recorded in control. Olive cuttings showed positive response towards the increasing concentration of IBA regarding root diameter. The present findings can be confirmed by Singh and Singh, (2005), who also reported that IBA has significant effect on root diameter compared to all other growth regulators like Indole acetic acid and Naphthalene acetic acid.

CONCLUSION AND RECOMMENDATIONS

Based upon the findings of this study, it is recommended that the cuttings of olive should be treated with IBA 300 ppm or higher till maximum plant survival percentage, shoot length, shoot diameter, number of leaves shoot^{-1}, number of branches shoot^{-1}, number of roots plant^{-1}, root length and root diameter are achieved. There was no significant difference between using hardwood cutting and semi hardwood cutting except number of branches shoot^{-1}.

Table 2: Effect of IBA concentrations and type of cuttings on number of leaves shoot^{-1}, number of branches shoot^{-1}, number of root plant^{-1}, root length (cm) and root diameter (cm) of olive.

Treatments	Number of leaves shoot^{-1}	Number of branches shoot^{-1}	Number of roots plant^{-1}	Root length (cm)	Root diameter (cm)
Type of Cutting					
Hardwood	36.58	4.58a	14.42	8.15	0.12
Semi hardwood	31.17	3.58b	10.17	7.36	0.11
Significance Level	NS	*	NS	NS	NS
IBA conc. (ppm)					
0	9.33c	1.00b	3.33d	3.09d	0.07d
100	32.00b	5.17a	8.17c	7.04c	0.10c
200	45.00a	4.83a	17.17b	9.80b	0.13b
300	49.17a	5.33a	20.50a	11.09a	0.16a
LSD α 0.05	4.59	0.51	1.43	0.79	0.02
Level of Significance Interaction (C×I)	NS	*	NS	NS	NS

Mean followed by similar letter(s) in column do not differ significantly from one another, ns = Non Significant and *= significant at 5 % level of probability.
C × I = Interaction of types of cutting and IBA concentration

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