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GROWTH RESPONSE OF VARIOUS OLIVE CULTIVARS TO DIFFERENT CUTTING LENGTHS

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The experiment was conducted to study growth response of five olive cultivars to different cutting lengths. Hardwood stem cuttings of 15, 20, 25, 30 and 35 cm were taken from cultivars Azarbaijan, Uslu, Improved Nabali, Manzallino and Leccino. Maximum number of shoots (5.51), shoot length (22.29 cm), root length (12.60 cm) and survival rate (65.55%) was recorded by cultivar Azerbaijan at 20 cm cuttings length, while the first sprouting (33.24 days) and maximum number of roots (15.39) was found in cultivar Azarbaijan at 15 cm cuttings length.
Keywords: Olive, *Olea europea*, cultivars, cuttings, length and growth

INTRODUCTION

Olive *(Olea europea* L.), Family *Oleaceae* is used for its fruit and oil. The olive oil is well known all over the world for its nutritive value and other characteristics. Olive oil is consumed in cooking in preparation of perfumed soap. It is not only tasty but also nutritious, free of cholesterol and having polyunsaturated fatty acids. Olive oil has nourishing effect on the skin and massaging with it is useful to respite the muscular pains and provide warmth during cold weather. It was under cultivation in times long before recorded history, originated in the eastern Mediterranean area. The cultivation in Italy, Spain and North Africa began later than in the eastern Mediterranean region (Seyhan and Gezerel, 2005).Commercial production of olive is found in belts around the world between 30^{o}-45^{o} north and south of the equator. Pakistan is located in this region due to its various climatic and soil factors, all sorts of tropical, subtropical and temperate zone fruit trees can be grown. Olive being a sub-tropical can be cultivated successfully in the subtropical mountainous region of KPK (Khyber Pukhtunkhawa) and Balochistan (Baloch, 1994). Cutting is a simple and rapid method of propagation to maintain genetic uniformity and come into bearing earlier than those raised from seeds. The yield is uniform and stable in vegetative propagated plants. Olive can be propagated by hard wood or semi hard wood cuttings (Hartmann *et al.,* 2002; Fabbri *et al.*, 2004). The length of cuttings varies from 15 to 25 cm depending on the cultivar. The cuttings are then treated with IBA (Indole Butyric Acid). Seyhan and Gezerel (2005) discovered that dipping the cuttings in 2000, 4000 and 6000 ppm IBA could increase the root number and the effect increased gradually with IBA concentration. It was found that above mentioned concentration of IBA gave the highest survival percentage of rooted cuttings to different cultivars. Murat and Elmas (2008) observed maximum rooting and field survival in 20 cm long semi-hardwood cuttings treated with IBA 5000 ppm. Awan *et al*. (2001) studied 20-25 cm long cuttings of Azarbaijan, Earleeg, Leccino, Coratina and Sufiada. It is observed that Azarbaijan and Earleeg showed significantly maximum number of leaves per cutting and shoot length. Azarbaijan showed a high sprouting rate and shoot number. The shoot diameters of these varieties were no significantly difference. Rehman *et al*. (2002) investigated hard wood cuttings of variety Coratina with 3000 ppm concentration of IBA resulted in the maximum root number, root length, rooting percentage, survival percentage and shoot length as compared to the control treatment. Abousalim and Mansouri (1991) conducted experiments on semi hard wood cuttings of olive cultivars Picholine and Marocanie, prepared in autumn, and propagated in 3x6x0.4 m trench covered with transparent plastic film, then a 10 cm layer of sand and gravel rooting medium was placed on the top. The rooting medium was consisted of yellow and sphagnum peat + yellow sand. A relative humidity was maintained 95-97% inside the plantation. The temperature of the substrate varied from 17.2-20.7°C. The cuttings were treated with 4000 mg per liter with 25% Capton before being placed in the rooting medium. The highest rooting percentage was 95% which obtained from the cutting taken from the middle parts of shoot and rooted in yellow sand. Rooting was the least successful for apical axillary cutting in either rooting medium.

Keeping in view the above points, the present study was conducted with the aim to find out the best cultivar at the most suitable cutting length in the agro ecological conditions of Peshawar valley.

MATERIALS AND METHODS

An experiment on growth response of various olive cultivars to different cutting length was conducted at Agricultural Research Institute, Tarnab, Peshawar. The experiment was carried out in randomized complete block design with split plot arrangement replicated four times. Olive cultivars were allotted to main plot while hard wood stem cutting length to sub plots. Hard wood stem cuttings of different lengths, i. e. 15, 20, 25, 30 and 35 cm were taken from five cultivars Azarbaijan, Uslu, Improved Nabali, Manzallino and Leccino. The cuttings were taken from 1-3 years old branches of olive trees in the March. The cuttings were treated with 3000 ppm IBA for 5 second and then buried in trenches for callus formation up to the end of April. The cuttings were planted in nursery beds in the first week of May. A distance of 5 cm between cuttings was maintained while rows were kept 45 cm apart with two-third portion buried in soil for partial shade, cuttings were planted in plastic tunnels covered with nylon shade cloth. The cuttings were planted with the help of dipper. All the cultural practices, irrigation, fertilizers, weed control and inter culture practices were applied uniformly during the experiment. Data was collected on days for sprouting, number of shoot plant^{-1}, shoot length (cm) and number of roots plant^{-1}, rooting length (cm) and survival rate.

RESULTS AND DISCUSSION

***Days for sprouting*:** Data regarding days to sprouting of cuttings is presented in Table 1. Statistical analysis of the data indicated a significant difference among cultivars and cutting length. The interactions of the two factors were also significant. Uslu cultivar sprouted earlier (36.05 d) followed by Azarbaijan (36.88 d), while the lowest was Leccino (39.74 d). In the case of cutting length, the maximum days for sprouting (38.79 d) were taken by 35 cm cutting while minimum days for sprouting (35.35 d) were taken by 15 cm cutting. The interaction of the two factors indicated that Azarbaijan sprouted earlier (33.24 d) with 15 cm cuttings length, while cultivar Leccino sprouted later (41.75 d) with 35 cm length. This variation in the sprouting is due to the effect that both cultivar and length had contributed significantly. All the cultivars sprouted earlier when the smallest (15 cm) lengths were used. Shakir *et al.* (2004) also recorded similar results in cultivated and wild olive cuttings.

***Number of shoot plant^{-1}*:** Azarbaijan cultivar recorded the maximum number of shoot plant^{-1} (4.27) followed by Leccino (4.17) while minimum number of shoot plant^{-1} (3.90) was recorded in Uslu cultivar (Table 2). For the cutting length the highest number of shoot plant^{-1} (5.30) was observed in 20 cm cutting length followed by 25 cm cutting length (4.49), while the lowest number of shoot plant^{-1} (3.58) was recorded in 30 cm cutting length. For interaction of two factors indicated that cultivar Azarbaijan, Leccino and Uslu produced maximum number of shoot (5.51, 5.43, 5.38) with 20 cm cuttings length, while cultivar Uslu produced minimum number of shoot (2.65) with 35 cm length was used. This may be due to the fact that more area for shooting was there in 20 cm length as compared to 15 cm length, while the area of remaining length was greater than 20 cm, but those lengths could not survive themselves because of the higher transpiration. These results are lower than that from Shakir *et al*. (2004) who recorded up to 8.30 number of shoots plant^{-1}.

***Shoot length (cm)*:** Shoot length plant^{-1} was significantly affected by different cultivars, cutting lengths and also in the interaction of cultivars and lengths (Table 3). Azarbaijan produced maximum shoot length (17.50 cm) followed by Improved Nabali (17.01 cm), while minimum (14.90 cm) was produced by Manzallino. Cutting length of 20 cm produced the highest shoot length (21.6 cm) followed by 25 cm cutting length (18.28 cm). The lowest shoot length (15.80 cm) was recorded by 30 cm cutting length. In case of interactions of the two factor indicated that cultivar Azarbaijan produced the longest shoot (22.29 cm) with 20 cm cutting's length, while cultivar Leccino produced the shortest shoot (8.43 cm) with 35 cm cutting length. This may be due to the fact that there was a competition among more shoots (as respond earlier) and have tried to capture more resources, hence long shoots developed. The Shakir *et al.* (2004) recorded (25.97 cm) maximum shoot length which is 3.68 cm longer than the results obtained from cultivar Azarbaijan.

***Number of root plant^{-1}*:** Root number plant^{-1} was significantly different in cultivars, cutting length and also in the interaction of cultivars and lengths (Table 4). The highest number of roots plant^{-1} was produced by Azarbaijan (11.76), while the lowest number of roots plant^{-1} was recorded by Manzallino (8.46). Cutting length with 15 cm resulted in maximum number of roots (13.43) followed by 20 cm cutting length (11.25), while 35 cm cutting length resulted in minimum number of roots plant^{-1} (6.40). Interaction of the cultivar and cutting length revealed that Azarbaijan produced maximum number of roots (15.39) with 15 cm cutting's lengths; while cultivar Improve Nabali produced minimum number of roots (5.66) with 35 cm cutting length. This may be due to the fact that shorter length had less stress such as higher transpiration. Despite the relatively high rooting in IBA treated cuttings, the number and length of roots gave different results as previously reported by İsfendiyaroğlu and Özeker (2000).

***Root length (cm)*:** Root length differed significantly by cultivars, cutting lengths and also the interaction between cultivars and lengths (Table 5). Azarbaijan produced the longest root (8.73 cm) followed by Leccino (8.67 cm), while Improved Nabali resulted in the shortest root (7.78 cm). For cutting lengths the longest root (11.24 cm) was recorded by

20 cm cutting length, while 35 cm cutting length resulted in shortest root (5.20 cm). For the interaction of the two factors suggested that cultivar Azarbaijan produced maximum root length (12.60 cm) when 20 cm cutting's lengths, while cultivar Uslu produced the shortest root (4.40 cm) with 35 cm length. Maximum root length may be due to root and

Table 1. Days to sprouting in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azerbaijan	33.24	37.48	38.43	37.52	37.74	36.88 c
Uslu	34.95	35.72	36.43	36.87	36.28	36.05 d
Improved Nabali	35.03	37.47	37.76	38.41	39.20	37.57 b
Manzallino	34.90	36.30	36.32	38.47	38.97	36.99 c
Leccino	38.62	38.07	39.62	40.66	41.75 a	39.74 a
Mean	35.35 d	37.01 c	37.71 b	38.38 a	38.79 a	

LSD value (α=0.05) for cultivar =0.5; LSD value (α=0.05) for cutting length = 0.5;LSD value (α=0.05) for cultivar x length = 0.5; Means followed by the same alphabetical letter are statistically non-significant (α=0.05) according to LSD test.

Table 2. Number of shoot in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azarbaijan	4.28	5.51 a	4.56	3.65	3.33	4.27 a
Uslu	3.51	5.38 a	4.39	3.54	2.65 g	3.90 c
Improved Nabali	4.13	5.27	4.59	3.59	2.85	4.09 a b c
Manzallino	3.51	4.29	4.35	3.60	3.46	3.97 b c
Leccino	4.50	5.43 a	4.57	3.53	2.79	4.17 a b
Mean	3.99 c	5.30 a	4.49 b	3.58 d	3.02 e	

LSD value (α=0.05) for cultivar=0.1997; LSD value (α=0.05) for cutting length=0.1997; LSD value (α=0.05) for CxL= 0.45; Means followed by the same alphabetical letter are statistically non-significant (α=0.05) according to LSD test.

Table 3. Shoot length (cm) in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azarbaijan	17.32	22.29 a	19.58	17.24	11.07	17.50 a
Uslu	17.09	20.30	18.48	15.99	8.76	16.12 c
Improved Nabali	18.29	21.04	18.71	15.03	11.99	17.01 a b
Manzallino	13.74	21.26	15.55	13.55	10.70	14.90 d
Leccino	18.37	20.91	19.37	17.18	8.423 n	16.85 b
Mean	16.96 c	21.16 a	18.28 b	15.80 d	10.19 e	

LSD value (α=0.05) for cultivar=0.5; LSD value (α=0.05) for cutting length = 0.5; LSD value (α=0.05) for cultivar x length = 1.104; Means followed by the same alphabetical letter are statistically non significant (α=0.05) according to LSD test.

Table 4. Number of root in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azarbaijan	15.39	13.83	13.16	8.79	7.65	11.76 a
Uslu	14.36	10.55	7.20	6.66	6.45	9.05 d
Improved Nabali	13.82	11.40	9.33	9.62	5.66 n	9.97 b
Manzallino	10.44	10.06	8.31	7.62	5.87	8.46 e
Leccino	13.16	10.42	9.50	7.83	6.38	9.64 c
Mean	13.43 a	11.25 b	9.50 c	8.11 d	6.40 e	

LSD value (α=0.05) for cultivar=0.34; LSD value (α=0.05) for cutting length=0.34; LSD value (α=0.05) for cultivar x length=0.8; Means followed by the same alphabetical letter are statistically non-significant (α=0.05) according to LSD test.

Table 5. Root length (cm) in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azarbaijan	8.28	12.60 a	8.99	7.66	6.13	8.73 a
Uslu	7.79	10.77	8.97	6.98	4.40 n	7.78 c
Improved Nabali	7.87	11.29	9.60	7.87	5.06	8.34 b
Manzallino	8.89	10.15	9.54	8.48	5.06	8.43 a b
Leccino	8.34	11.38	9.55	8.72	5.39	8.67 a
Mean	8.23 c	11.24 a	9.33 b	7.94 c	5.20 d	

LSD value (α=0.05) for cultivar = 0.3; LSD value (α=0.05) for cutting length = 0.3; LSD value (α=0.05) for C x L = 0.7; Means followed by the same alphabetical letter are statistically non significant (α=0.05) according to LSD test.

Table 6. Percent plant survival in response to different cutting's lengths in olive cultivars

Cultivars	15 cm	20 cm	25 cm	30 cm	35 cm	Mean
Azarbaijan	61.11	65.55 a	56.66	52.22	48.88	56.88 a
Uslu	56.66	61.11	55.55	47.77	36.66	51.55 c
Improved Nabali	58.66	58.89	51.11	48.69	18.89 k	47.25 d
Manzallino	58.89	58.89	55.55	28.89	21.11	44.66 e
Leccino	60.00	58.89	57.78	55.55	43.33	55.11 b
Mean	59.06 a	60.66 a	55.33 b	46.62 c	33.77 d	

LSD value (α=0.05) for cultivar = 1.7; LSD value (α=0.05) for cutting length = 1.7; LSD value (α=0.05) for C x L = 3.8; Means followed by the same alphabetical letter are statistically non-significant (α=0.05) according to LSD test.

shoot ratio (maximum response of shoot length). Root grows downward and is very effective in absorbing water and nutrients for plant growth. The results are not in line with Shakir *et al.* (2004) who found maximum root length (7.01 cm) in 15 cm cutting length.

***Survival rate*:** Data regarding plant percent survival is reported in Table 6. Perusal of the data showed that the plant percent survival was significantly different in cultivars, cutting lengths and interaction of cultivars and lengths. Azarbaijan resulted in maximum plant survival (56.88%) followed by Leccino (55.11%), while Improved Nabali resulted in the lowest plant survival (47.25%). Cutting length with 20 cm resulted in maximum plant survival (60.66%) followed by 15 cm (59.06%), which is statistically at same level with that of 20 cm. Minimum plant survival of (33.77%) was recorded by 35 cm cutting length. The interaction of cultivars and cutting length indicated that cultivar Azarbaijan plant survival (65.55%) in plant 20 cm cuttings length, while cultivar Improve Nabali had minimum plant survival (18.89%) with 35 cm length. This variation in the plant survival may be due to the fact that both cultivar and length had contributed significantly better for most of the parameters like shoot length, number of shoot and root length. Similar results were reported by Shakir *et al.* (2004) who investigated maximum plant survival (36.29%) in 15 cm cutting length and in cultivar *Olea euroeae* (38.64%) as compared to O*lea cuspidate*.

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