RESEARCH ARTICLE **(Open Access)**

Study of the Rooting Ability of the "Kushan" Olive Cultivar (*Olea Europaea L.*)

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Abstract

The "Kushan" cultivar is an native cultivar which holds very precious qualities; high oil radius, very good stability against the olive fly and a reduced development of the crown, which provides the adaptation for intensive forms of cultivation. But, anyway it has stayed isolated in a narrow area and no studies have been conducted before to evaluate the opportunities of vegetative propagation. It's propagation and distribution will be very valuable for farmer economies. The tests have been conducted during 2011 and 2012, at the DEE-Valias (Didactic Experimental Economy); property of AUT Tirana. The cuttings have been treated with different concetrations of IBA, in total 6 variants (from 0 to 6000 ppm). Also, 4 different time periods of cuttings collection were tested (from 5th of March until 6th of April). For their propagation, the cuttings were put in a perlite substrate , while the bottom up warming in the working table was maintained on a 22-24^{o}C regime, and air humidity was maintaned at 85-95 by mist irrigation. According to reference classifications of Dettori [19] and Di Vaio [20], Kushan belongs to cultivars with a high rooting ability. The best results were obtained by treatments with 3000, 4000, 5000 ppm IBA. Treatment with higher concentration decreases significantly the rooting ability. The best time frame for collecting of vegetative cuttings seems to be the period from the second week of March up till the first week of April.

Keywords: cultivar, cutting, substrate, rooting ability.

1. Introduction

The first classical studies about the ways of multiplying olives through semi-dendric cuttings go back to the middle of the last century [8, 25, 29] The following studies clarified the impact of some specific factors, (the basal heating regime, the fog irrigation regime and the treating with stimulants of the rooting etc), on the rooting performance [19, 27, 28, 32, 33, 34, 41]

Such studies set the foundations of the new technology, and at the same time pointed out that the genetic abilities of the cultivar impact heavlily its rooting ablility [6, 7, 9, 11, 13, 19, 20, 45, 56]. Also it has been found that the best period for rooting is when the mother plant has started an intensive vegetative activity; spring or autumn (after the dormancy period of summer). Meanwhile the best substrate is perlite, which offers a perfect drainage [1, 3, 14, 21, 31, 37, 42, 45, 51]. A strong impact on the rooting ablility is been also shown by the fisiological condition of the mother plant from where the cuttings weretaken, and the nature of the cuttings (number of nodes, number of leafs and buds, level of carbohydrates etc). [14, 16, 17, 18, 23, 31, 43, 50]. Other more thorough studies have shown that infrared rays, woundsat the end of the cutting, the combination of different auxins or the use of some bacterial induced auxins, have increased significantly the rooting performance even in the cultivars with a poor rooting [2, 10, 18, 35, 38, 41, 46, 47, 48]. Thanks to numerous studies, today the propagation technique using semi-dendric cuttings is replacing that of grafting. Currently in the Mediterrainean countries, over 70% of the saplings are being produced through this technology [20] In Albania exists a rich germoplasm which inculdes centuries-oldolive trees with biological and environmental interess [52, 53, 54]. There are a lot of local biotypes which have a capacity of adapting to the pedo-climatic conditions as a result of a gradual selection, which spanned several centuries. The "Kushan" cultivaris one of them, but anyhow it is isolated in a small area and no studies were conducted before about the ways of vegetative propagation. It's propagation and distribution would be with a considersable impact for farmers economies.

The aim of this study was to estimate the rooting ability of the cultivar in relation to the time of the

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collection of the cuttings, the nature of cuttings and the concetration of the IBA, which is used as a stimulant for rooting.

2. Material and Method

The study was conducted in the greenhouse in Valias, property of the Agricultural University Of Tirana. The propagationmaterial is receivedfrom three year-old mother plants of cultivar “Kushan”. “Kushan” clutivar is used for oil and is part of the native germoplasm fund.[4,54]. The plants have been selected with homogeneous vegetative growth. To secure healthy material, the plants for two consecitive years were subject toa specific agrotechnique; performing renewable prunning, organic and chemical fertilization, antiparasitic treatement etc.

Collection of planting material, preparation of cuttings and transplanting were all done within a day. The used substrate was perlit, meanwhile the basal heating in the banks was maintained in the 20-24^{o}C regime and the air humidity at the cuttings level was kept to85-95%by fogging. Thecollection and transplanting of cuttings was conducted on06/03, 15/03, 28/03 and 06/04 (2012). Alltimes the treatment of cuttings with IBA was done with 4000ppm concentration. To estimate the impact of IBA treatment on rooting, the cuttings were treated with the following concetrations: V0 = distiled water; V1 = 2000ppm; V2=3000ppm; V3=4000ppm; V4=5000ppm and V5=6000ppm.

In order to estimate the effect of the type of cutting on the rooting ability, we took cuttings from the tip of shoots (excluding the two upper nodes), cuttings from the middle of the shoots and cuttings from the shoots of the suckers.Even in this case the cuttings were treated with 4000ppm concetration of IBA.For all variants the cuttings were choosen with 2.5-3.5mm diameter, with lenghths of 12-15cm and with 4 nodes. The leafs of the two lower nodes were removed leaving them with only 4 leafs. The cutting in the base of the cutting was done at the level of node’s diaphragm. The duration of the treatment with IBA was around 5 seconds. The treatment was conducted only at the base of the cutting, around 1cm. For each variant, 100 cuttings were put for rooting. The following data were recorded:

The required time for the callusation of the cutting

The percentage of the rooting for every cultivar and time-frame.

Number of the formed roots

Length of the roots up to the transplantation moment.

3. Results and Discussion

The effect of the receivaltimeofthe cuttings

From the periodical observatios of the process of callusation and differentiation of the roots was noticed that after 40 days, most of the cuttings have completed not only the callusation but even the differentiation of the adventive roots, meanwhile all the cuttings thatwere put to test have completed full callusation. (Figure 1)

Figure 1. Cutting of the cultivar "Kushan" after 40 days that have formed a satisfactory number of roots being prepared for transplant.

The results have shown that there are noticable changesin the rooting percentage depending on the time of collection and transplanting of the cuttings. The highest percentage of rooting is received when the cutting is recived in the second and third decade of march, and it can even continue up to the first decade of April (54-65%). The availability and the movement of carbohydrates toward the base of the cutting or their biochemical transformations seem to be important factors on the olive rooting [1, 3, 16, 22].

In this period, the mother plant has entered in an active vegetation state, rapid movement of the lymph, and together with it also the available carbohydrates.In the first week of april, when the movement of the meristem of the bud, eventhough the temperatures are more stabilized, there is adecrease in the percentageof the rooting based on the second timeframe, which coincides with the middle of march. (Figure 2; Table 1).

Figure 2. Oneway analysis of % of rooting by the variant

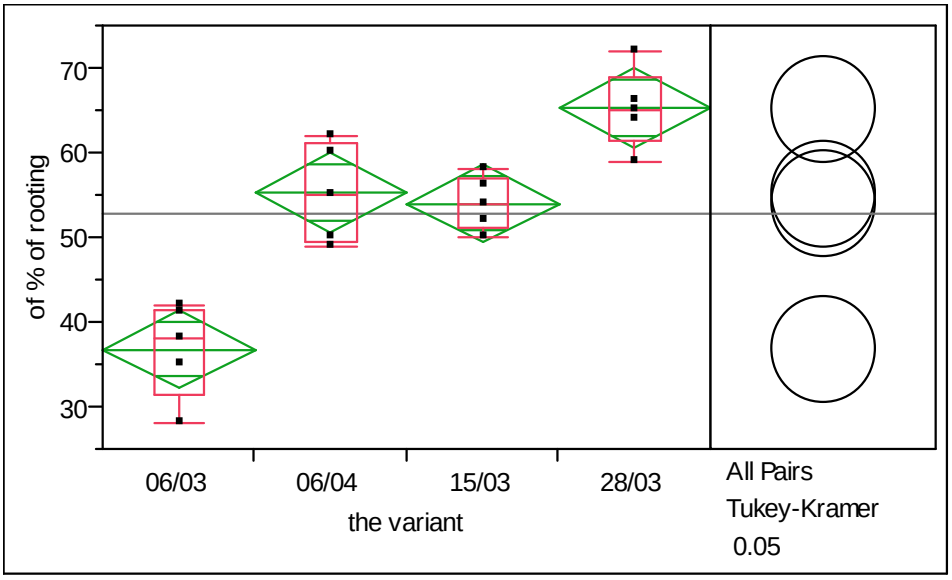

Table 1. Percentage ofrootingdepending onsettingdatesfortransplanting ofcuttings.
(Positive values show pairs of means that are significantly different)

Level				Mean
28/03	A			65.200000
06/04		B		55.200000
15/03		B		54.000000
06/03			C	36.800000

This decrease, apparently comes as a result of the movement of a part of the carbohydrates towards themeristem of the bud in order to prepare its blossom.This causes that between the dates 15/03 and 06/04, there are no statistical differences.

As for the avarage number of formed roots per cutting, it results that there are some insignificant changes, meanwhile regarding the length of the roots it results that the earliest timeframe offers the biggest growth and statistically verified. (Figure 3; Table 2 and 3). Similar results are reported also from other authors [1].

Figure 3. Number of roots and length of roots by setting deadlines for anchoring cuttings

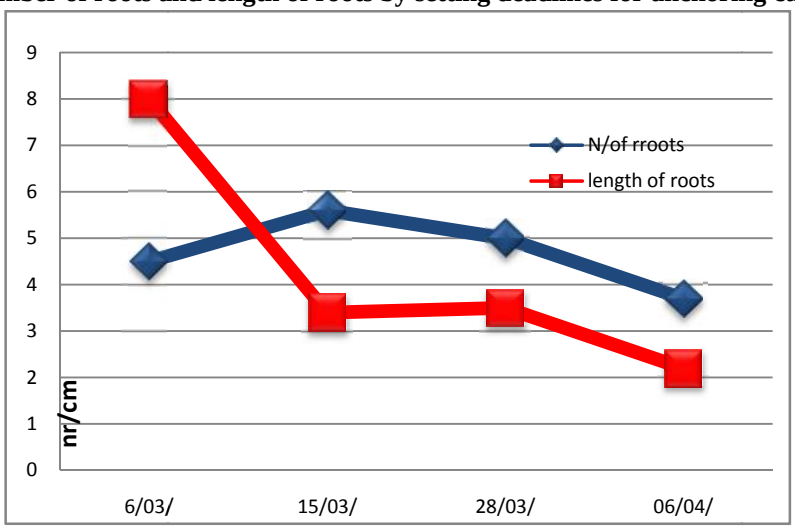

Table 2. Average of root cuttings according to the time of withdrawal.
(Positive values show pairs of means that are significantly different)

Level		Mean
15/03	A	5.6500000
28/03	A	5.0500000
06/03	A	4.5000000
06/04	A	3.7000000

Table 3. Average length root cuttings according to the time of sampling
(**Positive values show pairs of means that are significantly different)**

Level			Mean
06/03	A		7.8000000
28/03		B	4.4250000
15/03		B	4.3250000
06/04		B	4.1500000

The impact of theconcentration of IBA

Various authors have tried to find the best concetration of IBA treatment for each cultivar and timeframe of collection of the cuttingsforrooting [2, 18, 24, 48, 49].

In our study, the prepared cuttings from the previous year's sprouts, were treated with different concetrations of the auxina (IBA) and then were put on the banks with perlit 15/3.

The obtained data show that the rooting performance increases with the increase of the concentration up to level of 5000ppm, meanwhile north of this boundry we have a noticable decrease of the rooting performance. So, in the treatments with 6000ppm, the rooting performance decreases significantly approaching V0 which is treated with distiled water. Anyhow, we can point out that the "Kushan" cultivar has shown good rooting ability even without IBA treatment (about 46%). Such performance is classified as good according to international classifications[11, 20, 45].

The IBA treatment with concentrations between 2000 and 5000ppm have given similar results, forming a statistical group, (50, 52.2, 53,8 and 52%), meanwhile the most noticable changes are found in the treatments with distiled water and the 6000ppm concetration of IBA. Fig.4. Table 4.

Figure 4. Oneway analysis of % rooting by variant

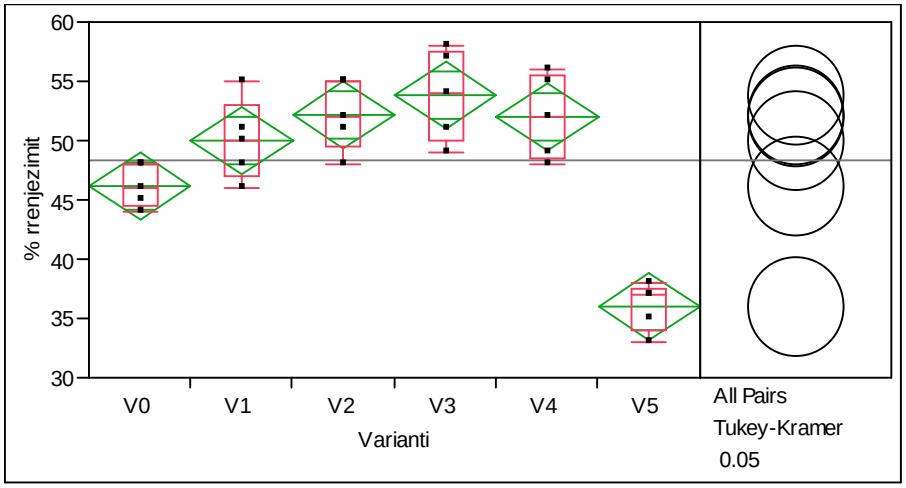

Table 4. Percentage of rooting depending on the concentration of treatment with IBA. (**Positive values show pairs of means that are significantly different)**

Level				Mean
V3	A			53.800000
V2	A			52.200000
V4	A	B		52.000000
V1	A	B		50.000000
V0		B		46.200000
V5			C	36.000000

Data received from th evariant of 6000 ppm differ form those found from Mousa [40], but are similar to those reported from Rahman et al [44].The differences seem to be explained by different collection times.In our case those are collected in march while Mousa has taken them in december.

Comparing the rooting performance of the 4000ppm concetration, which is widely used for rooting of the olive cuttings, it results that one year old cuttings have given a performance of about 4% better then in the 2000ppm concentration, but without proving that this is the best variant for this cultivar.

An overall phenomenon for all the variants (timeframes or treatments) is the link between the number of roots per cutting and their length; with the increase of the number of roots, their length decreases. This comes from the fact that the roots grow from the food reserves that the cuttings hold, because the substrate doesn't offer nutritional material. Fig.5,6.

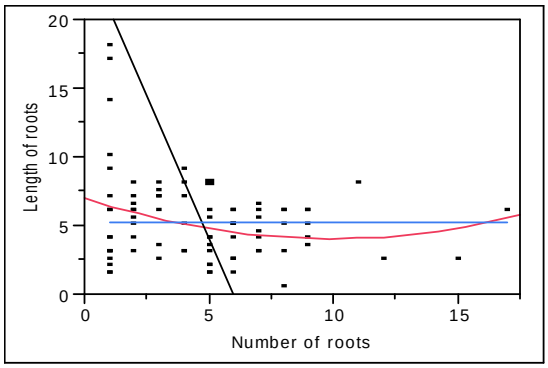

Figure 5. Bivariate fit of length of roots by number of roots

Interactiv echanges between the number of roots and root length

Figure 6. Varying the lengthof the rootsas a function oftheirnumber**; -a small number;** b-**large number of** roots

Impact of the type ofcuttings

While in a lot of studies we can find data about the impact of the youth period on the time of fructification [39], we do not have data about the impact of the youth period on the rooting of the cuttings. Also, other authors have found that the cuttings taken from the upper part of the sprout offer better rooting ability compared with those taken from the base of the sprout. [20,42,45]

In our study we observed cuttings taken from the tip of the sprout, removing the first two nodes, cuttings from the middle of the sprout and cuttings prepared from one year old sprouts of the suckres

The obtained data show that as for the above authors, the cuttings prepared from the tip of the sprout have the lowest rooting ability (35,5%), compared with th cuttings from the middle (50.5%). Interesting is the fact that the cuttings prepared from one year old sprouts of the suckers have shown a better rooting ability (76%). Figure 7. Table 5.

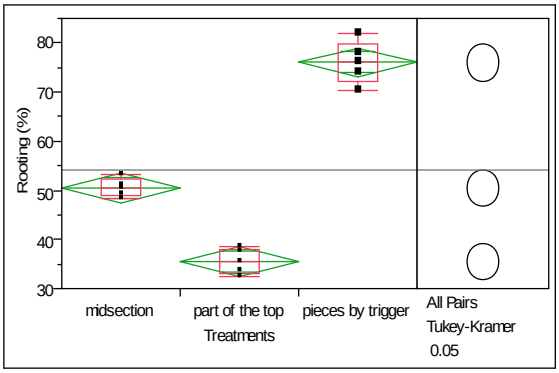

Figure 7. Oneway Analysis of Rooting (%) By Treatments

The differences are very highlighted and this could be related to the state of the carbohydrates in the cutting, because we do not only have better rooting performance, but also a strong fromation and growth of the roots. Figure 8. Their use can be an alternative for the cultivars with poor rooting ability, using the centuriesl-old olive groves, propagated in a vegetative manner.

Table 5. Rooting percentagedepending on the typeof cuttings.
(Positive values show pairs of means that are significantly different)

Level		**Mean**
cuttings from suckers	A	76.000000
cuttings from themidscion	B	50.500000
cuttingsfrom thescionapikale	C	35.520000

Figure 8. Cuttingspreparedbysuckers**,** withthick andwell-developedroot

4. Conclusions

Based from the obtained data about the time of collection of the cuttings, concetration of the IBA treatment and the type of the cutting, it results the following:

The "Kushan" cultivar holds a high natural rooting ability (about 45-50%)

In the conditions of Central Albania, the best time for collecting and transplanting the cuttings for rooting is the second and third decade of March up until the first decade of April.

The best concetration for the IBA treatment is between 3000 and 5000ppm.

The cuttings prepared from the suckres have the best rooting ability (about 30% more than the cuttings prepared from the yearly growth)

With the increase of the number of roots we have a decrease of their length.

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