

Original Research Article

EFFECTS OF INDOL-3-BUTYRIC ACID (IBA) CONCENTRATIONS AND TYPE OF CUTTING ON ROOTING OF TEA (*Camellia sinensis* L.)

ABSTRACT: ~~In this study,~~ The objectives of this study were to determine the ~~best type of cutting type~~ and the effect of IBA

(Indol-3-butyric acid) ~~hormone~~ on rooting of Turkish tea (*Camellia sinensis* L.) clone (“Fener-3”) ~~cultivars cuttings~~. The

cuttings ~~were~~ collected ~~on at~~ 1 September. After pre-treating with 0, 2000, 4000 and 6000 ppm IBA, the cuttings

with full leaf and half leaf ~~cuttings were~~ rooted in perlite medium ~~at in~~ the unheated trays under but-
misting-propagated in

glasshouse. Semi-hardwood leafy cuttings were exposed to the rooting media for 70 days. ~~As a result of all these~~

~~findings, a~~ Among all parameters the best type of cutting was full leaf cutting and, 6000 ppm IBA was the most

appropriate dose. The lowest rooting and rooting quality ~~were taken~~ from control (0 ppm IBA) treatment.

Key Words: Turkish Tea, Fener-3, IBA, cutting type, rooting

1. INTRODUCTION

The tea has received considerable interest in recent years as a medicinal agent. Young shoots of tea bushes are mainly processed into black tea, green tea, and oolong tea. Among these, green tea is most beneficial to human health. Recently reported pharmacological properties, e.g., antioxidant, anti-inflammatory, anti-mutagenic, and anti-carcinogenic effects also served to increase the popularity of green tea (Higdon and Frei, 2003; Cabrera et al., 2006; Pharn-Huy et al., 2008; Yuan et al., 2011).

Yield of tea crop is very low in Turkey according to per producing although it is fifth tea producing country

in the world (Anonymous, 2013a,b) (What do you mean, it is not clear). Possible causes for lower production are likely insufficient field

applications, absence of high quality sapling and other reasons for sapling production and distribution.

Turkish tea clone Fener-3 was selected in Rize, Turkey, 20 m in elevation in 1963. It is a hybrid exhibiting *Camellia sinensis* L. kind of peculiarities. It has a strong structure and is durable to environmental conditions. Its

28 leaves are dark green in color and ribbed appearance. Shoots are succulent, fragile and heavy. Shoot and first leaf
29 are covered in plume let. Among Turkish tea clones, it is considered as second after Derepazarı-7 clone in terms
30 of yield, and the values of bud shoot and polyphenol content (Anonymous, 2014).

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31 In tea gardens of the Turkey, mostly the genetic purity of seeds has not existed because of seed replicated
32 plant seedlings. Generally Chinese varieties have dominated in the gardens and, in addition, many of other types
33 occurred with different forms of morphology, physiology, quality, and yield. Continuing tea production by seed
34 would unavoidably result in new low yielding and quality types (Özbek et al., 1961; Ayfer et al., 1987a,b;
35 Altındal and Balta, 2002). For these reasons today, tea has been farmed by vegetative propagation (cutting and
36 tissue culture).

37 Cutting on rooting success has been affected by many factors such as type of plant material, hormone use,
38 collection times, use of shade, rooting mediums and materials structural factors, some chemical treatments, and
39 environmental factors etc. (Hartmann et al., 2002). In the present study, ~~the-we aimed was~~ to determine the
40 type of cuttings, and the effect of plant growth regulators (IBA) on rooting percentage and quality of a hardly rooting of
41 Turkish tea clone “Fener-3”.

42 43 2. MATERIAL AND METHOD

44 The research was performed in ~~Atatürk Tea and Horticultural Research Center~~~~tea-garden~~ in Rize. In
this study, ~~cuttings taken from the tea plant material~~ Fener-3 clones ~~were~~

~~45 used.~~ The ~~Fener-3 clone bushes~~ garden ~~providing the cuttings was~~ established on a flat field (North: 41°
01', East: 40° 30', Altitude:

46 106). Soil structure was sandy – loamy. Soil analyses on soil taken in 20 cm below of soil surface were the
47 following:

48 pH: 4.65 - 5.35; organic matter : 0.14 - 3.96 %; total nitrogen content: 0.14 – 0.24; available P₂O₅: 13 -30 ppm;
49 exchangeable K₂O: 80-370 ppm

50 The 20-year-old ~~stud-Fener-3 clone bushes~~~~plants~~ for cuttings were pruned in December and cuttings were
taken from newly

51 emerged shoots ~~in-at~~ 1 September. Well-developed disease free cuttings with full-~~leaf~~ and half-~~leaf~~ ~~shoots, are~~ 3.5
to 4

52 cm in length were prepared and disinfected by a fungicide (Benomyl) against fungus infections. Cuttings, after
53 treated by IBA doses of 0 (control), 2000, 4000, and 6000 ppm, were transferred to ~~rooting~~-perlite medium for 70
54 days. Rooting was performed in unheated glasshouse and the upper part rooting media was shaded by using of
55 porous polyethylene with 70% light transmittance. For rooting, time-dependent automatic mist-propagation
56 system was set at 70-90% level. At the end of rooting period, survival rate (%), rooting rate (%), root number
57 (unit/cutting) quantity), root length (cm), root diameter (mm) and root quality were determined. In this trial
58 place, relative humidity and temperature were also recorded.

59 Experimental design was a randomized complete block design in a split plot arrangement with three

60 replications, each replication having 20 cuttings. Data expressed as percentage (rooting rate and survival rate) were

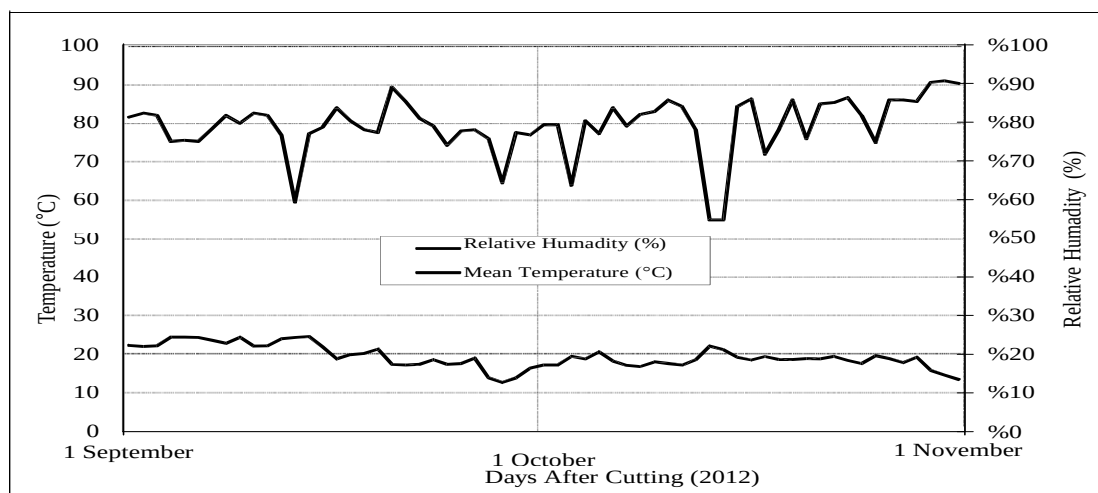
61 transformed using the $\arcsin\sqrt{x}$ transformation, and statistical analyses of transformed data were done by

MSTAT-C pocket program (Russell D. Freed, Crop and Soil Sciences Department, Michigan State University). Duncan's Multiple Range Test was used to indicate the differences between the averages. The differences between the level of significance in evaluating the results were explained at 5% as important and 1% as very important.

3. RESULTS AND DISCUSSION

Experiment carried out in the glasshouse where relative humidity (%) and mean temperature ($^{\circ}\text{C}$) were recorded during 1 September to 1 November in 2012 years (Table 1). As shown in Table 1 mean daily temperatures varied from 12.7°C to 24.6°C . Mean daily relative humidity varied from 54.7% to 90.7%. These temperature and relative humidity values were compatible with those reported previously (Anonymous, 2013c).

Table 1. Changing of mean temperature and relative humidity during the days after cutting



The effect of the treatment (IBA and type of cutting) on survival, rooting, root numbers, root length, root diameter and the root quality (0-4 points) of tea semi hardwood cutting are summarized in Table 2. In terms of survival rate, significant differences were detected through IBA application ($P < 0.01$). The type of cutting had no effect on????insignificant effect. The survival percentages varied from 70.0% to 90.0%. The best results for IBA treatments

were 4000 ppm IBA applications (87.5%). The rooting rate was very significant effect ($P < 0.01$) of IBA

application. Rooting percentage varied from 43.3% to 78.3%. (Wrong sentence, meaning is different) (IBA doses had significantly effect on rooting percentage???) The best results were obtained for rooting (78.3%),

which is 6000 ppm IBA doses, was gathered with full leaf cutting. The control group had the lowest results for

rooting. Based on these results, the root length was significant ($P < 0.01$) effect type of cutting. The root lengths

varied from 9.8 to 14.8 cm. The best results (14.8 cm) were taken 6000 ppm IBA doses based on the full leaf

cuttings. The root diameter IBA of application and type of cutting were very important effect ($P < 0.01$). The root

84 diameters varied from 0.99 mm to 1.30 mm. The best result (1.30 mm), prepared the full leaf cuttings, 6000 ppm

IBA doses has been application. When looked at the impact on the root number of type cutting and IBA doses had a significant effect ($P<0.01$). The number of root varied from 3.4 to 6.4 units. The best results (6.4 units) were taken 6000 ppm IBA doses based on the full leaf cuttings. Analyzed data on the root quality the type of cutting was important effect ($P<0.01$). The quality of the root varied from 1.9 to 3.5. The best results (3.5) were taken 6000 ppm IBA doses based on the full leaf cuttings. (Sentences must re-write)

Table 2. Effect of different cutting type and IBA concentrations on the rooting of???

Criteria	IBA Doses (ppm)	Type of Cutting		Mean	LSD 1%
		Half – Leaf	Full – Leaf		
Survival Rate (%)	Control	70.0 ¹	73.3	71.7 b	7,5
	2000 ppm	76.7	78.3	77.5 ab	
	4000 ppm	76.7	80.0	78.4 ab	
	6000 ppm	85.0	90.0	87.5 a	
	Mean	77.1	80.4	78.8	
Rooting Rate (%)	Control	45.0	43.3	44.2 c	9,5
	2000 ppm	55.0	63.3	59.2 bc	
	4000 ppm	71.7	75.0	73.4 ab	
	6000 ppm	75.0	78.3	76.7 a	
	Mean	61.7	65.0	63.4	
Root Length (cm)	Control	9.9	12.9	11.4	NS
	2000 ppm	9.8	14.1	12.0	
	4000 ppm	12.0	14.0	13.0	
	6000 ppm	13.2	14.8	14.0	
	Mean	11.2 a*	14.0 b*	12.6	
Root Diameter (mm)	Control	1.20	1.27	1.23 a	0,13
	2000 ppm	1.03	1,21	1.12 ab	
	4000 ppm	0.99	1,12	1.05 b	
	6000 ppm	1.18	1,30	1.24 a	
	Mean	1,10 a**	1,23 b**	1.16	
Root Number (unit / cutting)	Control	4.2	5.0	4.6 b	1,17
	2000 ppm	3.4	5.4	4.4 b	
	4000 ppm	4.8	5.6	5.2 ab	
	6000 ppm	5.9	6.4	6.1 a	
	Mean	4.6 a**	5.6 b**	5.1	
Root Quality (0-4 points)	Control	2.5	3.0	2.8	
	2000 ppm	1.9	3.0	2.5	
	4000 ppm	2.8	3.0	2.9	
	6000 ppm	3.2	3.5	3.4	
	Mean	2.6 a*	3.1 b*	2.9	

¹ Original data

* Values not associated with the same letter are significantly different ($P<.005$)

** Values not associated with the same letter are significantly different ($P<.001$)

NS: No significant

As a result of all these findings, among all parameters the best type of cutting was full leaf cutting, 6000 ppm IBA was the most appropriate dose. Applications of IBA increased rooting. Indeed, Weaver (1972) stated that growth regulators changed the number and the type of root and IBA was a manufacturer of the strong fringe root. Also, Khan *et al.* (1991) and Gyana (2006) also reported that treating cuttings with auxins (IBA) increased the percentage of rooting, root initiation, root number and as well as uniformity of roots in *Camelia sinensis*. Researchers, who studied the cutting reproduction of tea and other fruits (Ayfer *et al.*, 1987a; Zenginbal and Özcan, 2013) obtained similar results. In terms of type of cutting in cutting to the full-leaf cutting had better results than a half-leaf cuttings. In cutting the leaves and buds, prepared had a positive effect on the number of root and root formation, Hartmann *et al.*, (2002), the presence of leaf cuttings physiological and morphological report of activities carried out more quickly. In addition, Zenginbal and Özcan (2014), the presence of a leaf cuttings rooting and root state that has a positive impact in terms of number.

As a result of this study, rooting of Fener-3 Turkish tea clones cuttings for rooting in order to ensure a successful, good selection of cuttings and appropriate conditions must necessary. Therefore misting and shading systems unit cutting should be rooting under system with. In addition, as a single full leaf should be prepared and 6000 ppm IBA should be applied. Perlite is used then as the rooting environment.

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