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A STUDY ON EFFECTS OF CUTTING LENGTH ON ROOTING OF *POPULOUS NIGRA* TREE, COMMON AGROFORESTRY SPECIES OF AFGHANISTAN

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ABSTRACT:

Populous nigra is one of the deciduous tree species of Afghanistan. People grow this tree as a common agroforestry species for different purposes like fodder, timber, fuel wood, ornamentals etc. The unsexual propagation (cutting) of the species is the common and easy technique, but people use different length of cutting (20 cm up to 2 m). The different lengths of cutting causes extra cost and sometimes fail to achieve the best results. This investigation was conducted to assess the different cutting lengths (20, 25, 30, 35, and 40 cm) on rooting under Randomized Completely Block Design (RCBD) with three replications. The parameters studied under this experiment were: percentage of cutting which produce roots, number of leaves, number of branches, and number of roots, root lengths, dry weight of roots, and fresh weight of roots, per cutting. The results of our study shows that the cutting lengths had significant effects on rooting and the highest values for different parameters under investigation were achieved from 30cm length.

Keywords: ***Afghanistan, Populous nigra, Fodder, RCBD, Agroforestry***

INTRODUCTION:

The genus Populus (poplar species) is composed of more than 74 species classified into six Populus section (Lin et al., 2006). Populus spp. is one of the most important economical tree species in temperate regions of the world due to its desirable attributes in adaptability, growth rate, woody biomass, and versatility of its wood for industry (Confalonieri et al., 2003; Lin et al., 2006). Populus nigra is one of the most important species of populus genus which is found in different Asian countries. In Afghanistan this species is the most important and common agroforestry species which have fast growing rate so people are interested to use this tree as a most important

agroforestry tree to produce fodder, fuel, small timber in short period of time. This species produce medium size trees with 35m height, leaves of the trees have triangular shape and leaf blade have teeth with sharp margins and arranged in alternative sequence, upper surface of leaves have dark green and lower surface have light green colour. They are dioecious, with male and female catkins on separate trees. Seeds of the trees are covered by woollen materials (Alam, 2011). Cutting is the common and easy method for propogation of populus species specially *Populus nigra*, but there are different physiological, environmental factors which affect rooting process of the tree (Zhao, et al., 2013). The physiological condition of stock plants is pivotal for the initiation of rooting process of cuttings. Seasonal variation in the level of carbohydrates and hormones in the stock materials could affect the regeneration of the cuttings (Frey et al. 2003).Shoot position and cutting length also play important roles in rooting process of poplar hardwood cuttings because the regeneration of cuttings requires energy. The Carbohydrate and hormonal content were found to be related to the size of the cutting (length and diameter) and to the original location of the cutting on the stock plant (Desrochers and Thomas 2003). It was reported that there is a strong relationship between root initiation and growth, and soil and air temperature (Zalesny et al. 2005). There are studies which report that most common soil temperature threshold for poplar planting is 10^0C (Landhausser et al., 2001; Wan et al., 1999). Bloomberg (1963) in his study reported that the numbers, lengths and weight of initial roots increased following the elevation of cutting moisture content and temperature. In another study (Ibrar, et al., 2011) it was reported that environmental conditions are the important factors for rooting. It was also reported that beside these factors cutting length also have effect on rooting (Alam, 2011). In Afghanistan people use different lengths (20 cm up to 200 cm) of cutting for propagation of this tree which caused extra coasts and sometime fail to achieve good result. It was reported (Hussain and khesraw, 2011**)** that the number of buds and catting diameter have significant effects on rooting. In another study (Singh, Prawal and Verma, 2015) on the effects of different growing media on survival and growth performance of sativa tree cuttings the researchers observed that vermicompost + soil + FYM was best media since the survival of cutting and development parameters. A study (Rena, and Kishor, 2012) to show the effects of cutting diameter and use of different growth regulation hormones on rooting of ficus roxburghi species the results showed that high diameter cutting had better performance and among different hormones IBA shows better result on rooting. The study (Denaxa, Vemmos and Roussos, 2012) on the effects of indigenous CHO amount, indole-3-butyric acid and seasonal variation of rooting ability of cuttings of an easy and a hard to root olive cultivars (*Olea europaea* L.) results indicate that soluble sugars are more important than starch in rooting of olive. The study (Hussain and khesraw, 2011**)** on the effects of numbers of buds and cutting diameter on rooting of populus tree revealed that cutting with high diameters (16-25mm) showed high rooting (94%) and the numbers of buds had not significant difference of rooting. In another study (Aminah, et al., 2015) on the effect of hormone (control 0.1%, 0.3% IBA) and cutting Length (7.5 cm, 15 cm and 22.5 cm) on the rooting of Tinospora

Crispa it was reported that cutting with 22.5 cm had high rooting percentage and they conclude that Hormone and length of cuttings are among the important factors that affect the rooting ability of cuttings. In the light of the literature cited above, we conducted our study on effects of cutting length on rooting of Populous tree, common agroforestry species of Afghanistan.

MATERIAL AND METHOD:

This experiment was conducted in agriculture faculty research farm of Paktia University which is located in 33^0 $38^{'}$ $53^{"}$ N and 69^0 $13^{'}$ $58^{"}$ E during 2017. The experiment design was RCBD and five treatments of cutting length (20, 25, 30, 35 and 40 cm), in each treatment 60 cutting were used and each treatment had 3 replications. Cuttings were collected from healthy and one year old branches which was located in sun shining side of populous trees in university campus during January. All cuttings had same diameter (±3) Varner calliper were used for diameter measurement. Cuttings were arranged in different bundles treated with TERM pesticide and cover by sand in shade and keep up to end of March. In March the area were divided in three blocks and each blocks were divided in five plots and treatments were allotted randomly to each plots. Cutting were cultivated in such a way that 2/3 parts of the cutting was under ground and the distance between cutting was 10cm and between line was 15 cm. after cultivation cuttings were irrigated according to their need for water by flood irrigation system. After two weeks cutting buds start growth so the upper ground data (leave number, branches) were collected every day during experimental period. After twelve weeks we observe significant difference in different upper ground parameters. For the measurement of underground parameters, I removed all cutting carefully from soil to measure number of root, length of root, fresh weight of root, weight of root and percentage of cutting which produce roots. The roots was dried in 45 C^0 in oven for 48 hours For the measurement of fresh and dry weight of roots and leaves we used electronic scale and for root length we have sued scale. Data was analysed by Statistical Analysis Software (SAS) and Ms Excel software was used for drawing graphs.

RESULTS

The experiment result shows that cutting length had significant effects on different parameters under investigation. The results obtained from our study for different parameters are presented below:

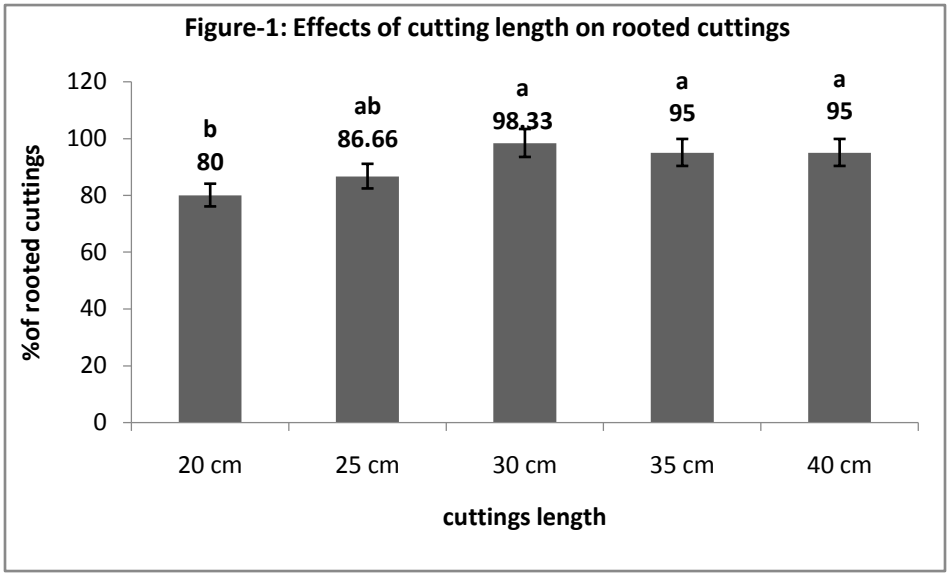
1- Percentage of cutting which produce roots

The ANOVA table of data determine that cutting length had significant effects on cutting viability percentage at 5% level of significance.

Table 1: ANOV table showing effects of cutting length on rooting percentage

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	70	35	0.89	4.46	8.65
Treatment	4	676.60	169.16	4.32*	3.84	7.01
Error	8	313.33	39.16			
CV	6.80					

The ANOV table-1 shows that at 5% level of confidence based on LSD test there was significant difference between treatments. The highest (98.33%) percentage of cutting which produce roots was obtained from 30 cm length and the lowest percentage (80%) of cutting which produce roots was in 20cm. Further, it was observed that in 30 cm length more cutting produce roots but there was non-significant difference between 30, 35 and 40cm. It was also observed that there was a significant difference between 20 and 30 cm as shown in Figure 1.



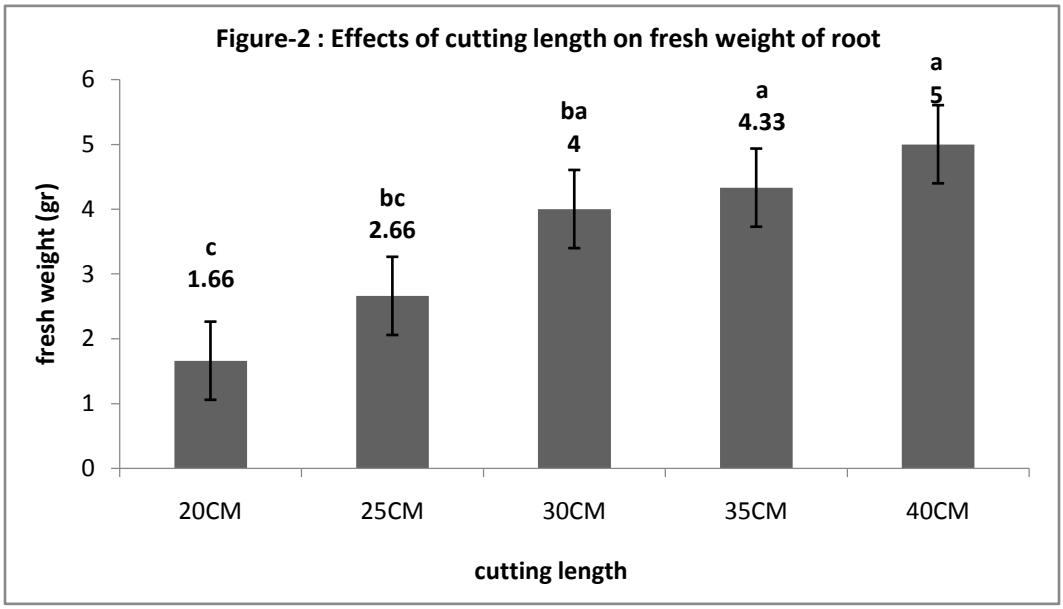
2- Effects of cutting length on fresh

Based on the achieved data, the cutting length had significant effects on fresh weight of roots. The results presented in ANOVA Table 2 shows that at 5% level of significance based on LSD test there was significant deference between treatments ($P<0.05$).

Table 2: ANOVA table showing effects of cutting length on fresh weight of roots per cutting

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	0.533	0.266	0.39	4.46	8.65
Treatment	4	21.733	5.433	7.95**	3.84	7.01
Error	8	5.466	0.683			
CV	23.39					

The results of our study revealed that the highest (5 gr) fresh weight of roots per cutting were obtained from 40 cm length and the lowest (1.66 gr) of fresh weight of roots per cutting was achieved from 20 cm length but there was non-significant difference between 30, 35 and 40 cm and also the difference between 25 and 30cm was not significant but between 20 and 30 cm there was significant difference so 30 cm is the best length for this parameter (Figure- 2)



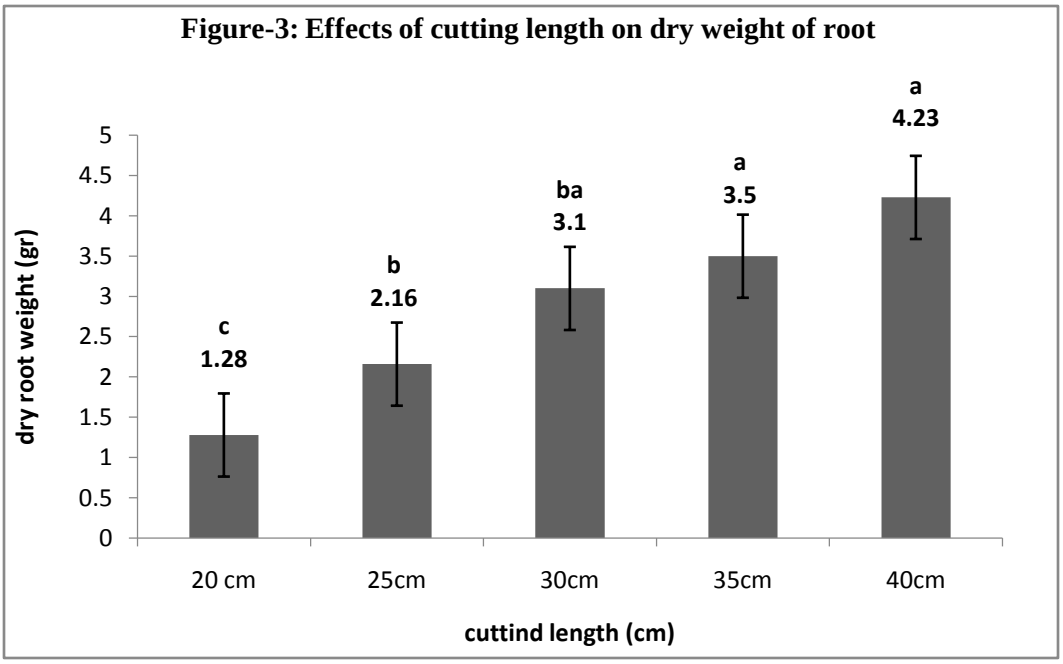
3- Effects of cutting length on dry weight of roots per cuttings

Based on our data collected, the cutting length have significant effects on dry weight of roots per cuttings as the ANOVA Table 3, shows that on 5% level of confidence and based LSD test there was a significant difference between treatments

Table 3: ANOVA table, showing effects of cutting length on dry weight of roots per cuttings

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	0.766	0.383	0.77	4.46	8.65
Treatment	4	15.95	3098	8.06**	3.84	7.01
Error	8	3.95	0.49			
CV	24.62					

The cuttings with 40 cm length produce highest (4.23 gr) dry weight of roots per cutting but cuttings with 20cm length produce lowest (1.28 gr) dry weight of roots per cutting that is also observed that 40 cm cuttings produce high amount of dry weight of root but there was non-significant difference between 25, 30 and 35 cm (Figure- 3).



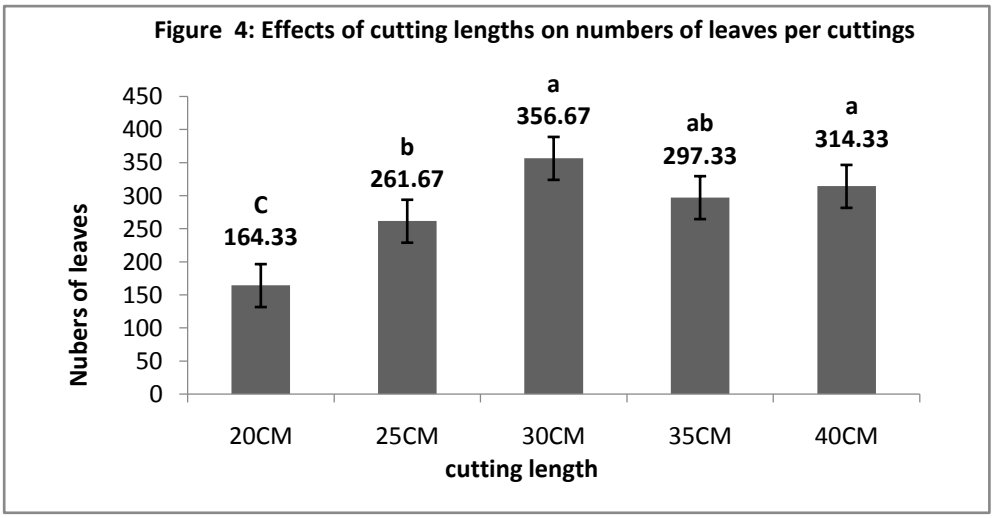
4- Effects of cutting length on the number of leaves per cuttings

The result shows that cutting length have effects on the number of leaves per cuttings. The ANOVA table 4 express that on 5% level of confidence based LSD there was significant difference between treatments.

Table 4: ANOV table showing effects of cutting length on the numbers of leaves per cuttings

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	1795.73	897.86	0.85	4.46	8.65
Treatment	4	63196.40	15799.10	15.04**	3.84	7.01
Error	8	8405.60	1050.7			
CV	11.62					

The cuttings with 30cm length produce highest numbers of leaves per cuttings (356.67), and the lowest numbers (164.33) of leaves per cuttings were produced by 20cm so there was a significant difference (192.64) between these two treatments, as we saw 30cm produce highest numbers of leaves per cuttings but there is no significant difference between 25, 30, 35 and 40 cm (Figure - 4).



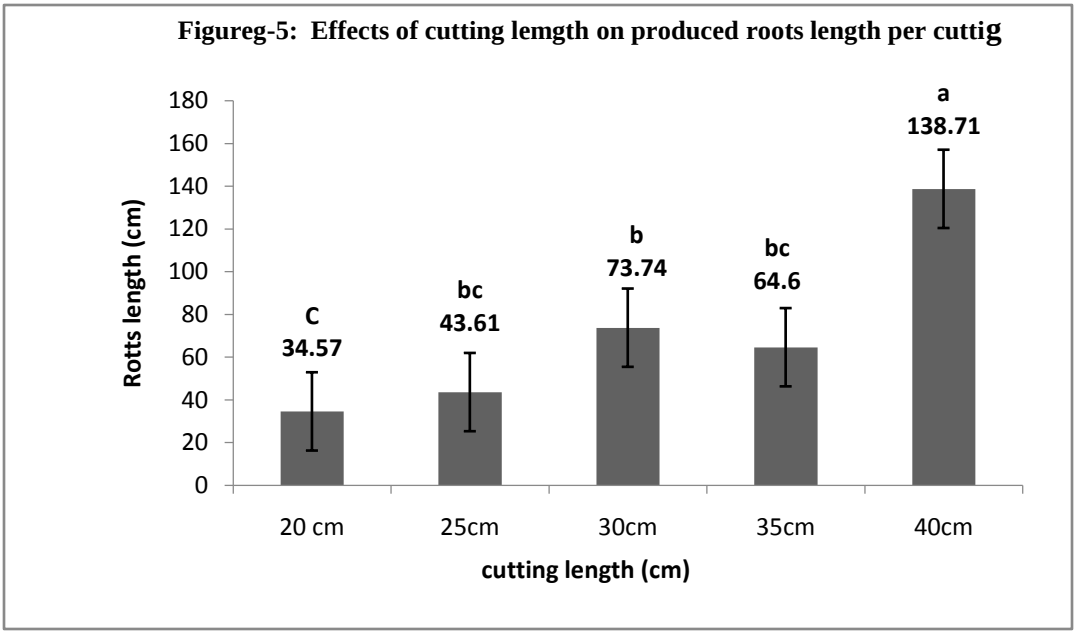
5- Effects of cutting lengths on the length of roots per cutting

The result shows that there is a positive relation between cutting length and the length of roots produced per cuttings. The data presented in Table 5 reveals that at 5% level of significance and based on LSD test there is a significant difference between treatments.

Table 5: ANOVA table, showing effects of cutting length on number of leaves

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	602.09	301.04	0.93	4.46	8.65
Treatment	4	20130.277	5032.56	15.48**	3.84	7.01
Error	8	2600.98	325.12			
CV	25.38					

The longest roots were produced by 40cm cuttings(138.71 cm) and the shortest roots were produced by 20 cm cuttings (34.57 cm) there was a significant difference(104.41 cm) between these two treatments on onother hand the shortest roots were produced by 20cm but there was non significant difference between 25, 30 and 35cm (Figure-5).



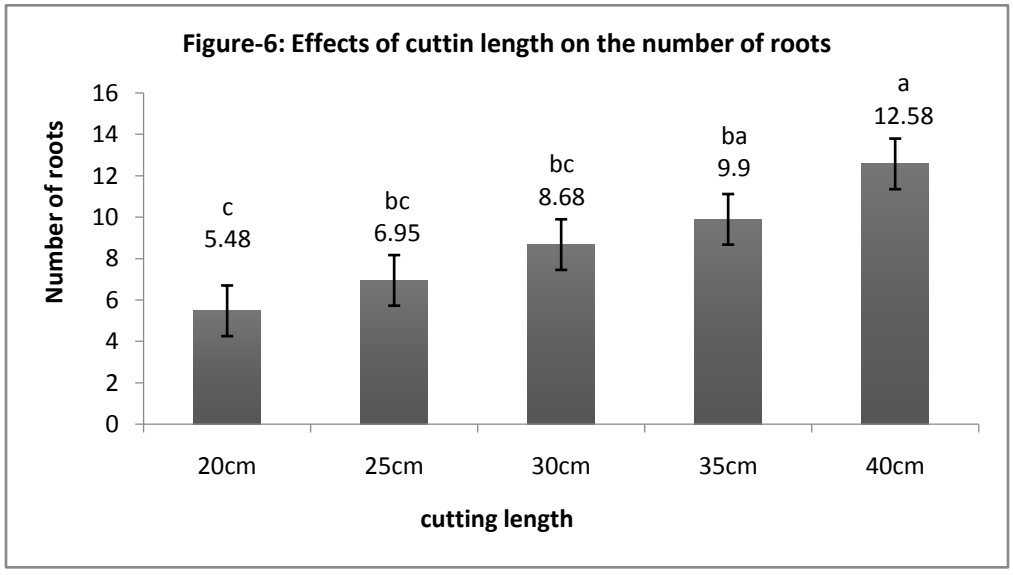
6- Effects of cutting length on the numbers of roots per cutting

The experimental results shows that cutting length have also effects on the number of roots per cuttings. According to the ANOVA Table-6 at 5% of level of significance and based on LSD test there is a significant difference between treatments (Table -6).

Table 6: ANOVA table showing relation between cutting length and number of roots per cuttings

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	2	3.72	1.86	0.54	4.46	8.65
Treatment	4	89.77	22.44	6.45*	3.84	7.01
Error	8	27.83	3.47			
CV	21.38					

The highest numbers (12.58) of roots were produced by 40 cm cutting and the lowest number (5.48 cm) of roots were produced by 20cm so there was a significant difference (7.1 cm) between these two treatments. The highest number of roots were produced by 40 cm but statistically, there was non-significant difference between 25, 30 and 35 cm (Figure-6).



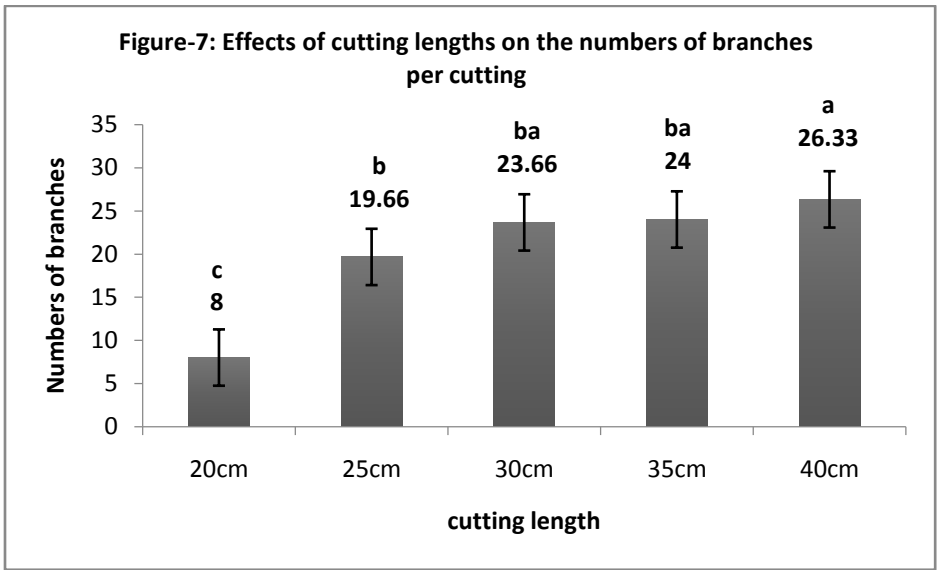
7- Effects of cutting lengths on the numbers of branches per cuttings.

The result of this experiment revealed that cutting lengths have effects on the numbers of branches per cuttings. As the ANOVA table of this parameter shows that at 5% level of significance and based on LSD test there was a significant difference between treatments.

Table 7. ANOVA table, showing the effects of cutting length on the numbers of branches per cutting

Source of variation	Degree of freedom	SS	MS	F-CAL	F-table	
					5%	1%
Blocks	**2**	**3.73**	**1.86**	***0.19***	**4.46**	**8.65**
Treatment	**4**	**639.33**	**159.83**	***15.93****	**3.84**	**7.01**
Error	**8**	**80.26**	**10.03**			
CV	15.57					

The data shows that numbers of branches per cutting is increasing with the length of cuttings in such a way that highest numbers(26.33) of branches per cutting are produced by 40cm and the lowest number (8) are produced by 20cm so there is a significant (18.33) difference between these two treatments. On another hand cuttings with 40 cm length produce high number of branches per cutting but there was not a significant difference between25, 30, 35and 40cm(Figure-7).



DISCUSSION:

The result of our study shows that cutting length had significant effect on all parameter under investigation. The percentage of the cutting which produce roots was high in 30cm, but there was no significant difference between 25, 35 and 40 cm that mean the percentage of cutting which produce roots was increased with cutting length. Our results coincides with the results obtained by Okunlola and Ibiroke (2013). Similar results were also obtained by Naidu and Jones (2009) when they studied the effect of cutting length of Eucalyptus on rooting percentage of cutting. The fresh weight of roots per cutting was also increased with cutting length. The high amount of fresh weight was obtained from 40 cm but there was no significant difference between 40 and 35 on another hand 25 and 30 cm also did not have significant difference but there was significant difference between 20 and 35 cm that means

the fresh weight of roots increased with cutting length. Similar result was reported by Frey et al. (2003). The dry weight of roots and length of roots also had similar gradient and same result were reported by Zigene and Kassahun (2016) and Maria, Holonec and Truta (2015). The reported that dry weight of roots per cutting increased up to 30 cm after that there was no significant difference. Shakuria, Hussain and Alizdah (1393) reported that cutting length have effect on the number and length of roots per cutting, the reason might be high amount of carbohydrate which increase the number and length of roots and more roots will absorb more water and nutrients which increase the number of branches and leaves per cutting. Okunola, and Ibironke (2013) reported same results. Nicky and Jones (2011) obtained same facts. The results showed that cutting length had significant effect on the number of leaves per cutting in such a way that number of leaves per cutting increased up to 30 cm and after that there was not significant effect on leaves number. It was observed that same results were obtained by Okao, et al. (2016). Hussain and Khesraw (2011) reported that cutting length have effect on the numbers of leaves and numbers of roots per cuttings. The result shows that the numbers of branches per cutting was significantly affected by cutting length and same results were obtained by Sadius et al., (2015).

CONCLUSION

Populous nigra is one of the most important agroforestry species of Afghanistan which plays a very significant role in socio- economic development of community. The local name of this species is (har har) people are very interested to use this tree separately or combine with agriculture crops as a common agroforestry species in their agriculture lands because this tree is a fast growing tree which can produce high products in short period of time for different uses like fodder, fuel, small timber etc. the propagation of this tree true cutting is a common and easy method but using different length of cutting was the main problem in this research it is clarified that cutting length had effect on rooting and among different lengths 30cm length was the best because in this length almost parameter under investigation was in high level so researchers advise this length for propagation.

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