https://doi.org/10.26682/ajuod.2021.24.1.3

Journal of University of Duhok., Vol. 24, No.1 (Agri. and Vet. Sciences), Pp 32-40, 2021

EFFECT OF PLANTING DATES AND DIFFERENT CONCENTRATIONS OF IBA ON ROOTING AND VEGETATIVE GROWTH OF HARDWOOD STEM CUTTING OF THREE SPECIES OF MULBERRY (*MORUS SPP.*)

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(Received: January 7, 2021; Accepted for Publication: March 7, 2021)

ABSTRACT

This study was conducted during the growing season 2020 in the nursery of the Horticulture Department, College of Agricultural Engineering Sciences, University of Duhok, Kurdistan region, Iraq. Stem cuttings of three species of mulberry are taken from gardens of University of Duhok located at Malta. This study include three factors. First factor was the effect of three different planting dates (22nd January, 5th February and 19th February). The second factor was the effect of three species of mulberry (black mulberry (*Morus nigra),* white mulberry *(Morus alba)* and red mulberry *(Morus rubra*)). And the third factor was the effect of three concentrations of IBA (0, 1500 and 3000 mg.L^{-1}). The results as the following; the first planting date on 22nd January gave the higher value of rooting percentage (61.19%). The cuttings of the black mulberry gave the higher rooting percentage (60.59%), and as IBA treatment had significant value of rooting percentage (45.70%) in (3000 mg. IBA L^{-1}) treatment. There were significant effect caused in species of mulberry and in concentration of IBA on vegetative growth (length of stem, diameter of stem and number of leaves) were in the black mulberry and in (3000 mg. IBA L^{-1}) treatment. While no significant effect of planting dates of three types of mulberry on the vegetative growth was recorded. The best result for rooting percentage (95.33%) was showed in triple interaction among (22nd January + (3000 mg.L^{-1}) IBA + type of black mulberry).

Keywords; *Mulberry, auxin IBA, stem cutting*

INTRODUCTION

Mulberry (*Morus sp*.) deciduous tree belong to the family *Moraceae*. It is perennial, fast growing fruit tree. There are approximately 68 to 100 mulberry species under the genus *Morus* in the world. The most common types are *Morus alba* and *Morus indica* **(Datta, 2000).** Mulberry has been cultivated over thousands of years and has been adapted to a wide area of tropical, subtropical, and temperate zones of Asia, Europe, North and South America, and Africa **(Ozgen *et al*., 2009).**

(Lu, 2002) noticed different factors like genotype, environment and physiological state of the cuttings play a significant role in determination of success of rooting.**(Chojnowska, 2004)** mentioned the most important factors that can influence the rooting ability of stem cuttings of most ornamental shrubs are the date or the time of cuttings collection. The time of cuttings collection plays a significant role in the rooting success and the cuttings development, this may be due to changes in the endogenous plant growth regulators or carbohydrate situation of cuttings and the environmental conditions present in nursery **(Abdou *et al.*, 2004; Elgimabi, 2008)**.The ability of stem cuttings of various species of plant to produce adventitious roots is different greatly **(Beyl and Trigiano, 2014)**. Some of them form roots much more easily than others **(Hartman *et al*., 2014)**.

(Singh *et al.*, 2015) revealed that the August was the most favorable planting date for hardwood cuttings of *Morus alba* when they studied three planting dates, which caused percentage of rooted cutting, the best shoots number, leaves number, dry weight of shoots and percentage of rooted cutting, followed by September.

(Zenginbal and Demir, 2018) planted hardwood cuttings of both white (*Morus alba* L.) and black (*Morus nigra* L.) types of mulberries,

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found that there was a higher percentage of rooting of white species in comparison with black 6^{-1}) then buried about 2/3 their height in the media (River soil) in black plastic bags (30 x 35 cm) (9kg River soil) in order to rooting. Randomized Complete Block Design (RCBD) as factorial experiment was used, including three factors (3*3*3*3) with three blocks and 15 cuttings for each replication, the total number of treated cuttings is (1215) cuttings. Statistical analysis were performed by using program SAS **(SAS, 2002)**.The means are compared according to Duncan's multiple rang test at (5%) level **(Duncan, 1955).** In the end of the experiment the following characteristics were studied **(**rooting percentage (%), average length of stem (cm)/cutting, average of stem diameter (mm)/cutting and average number of leaves /cutting.

RESULTS AND DISCUSSIONS

Success percentage of rooting (%)

Table (1) show that the planting date had a significant effect on the rooting percentage of three species of Mulberry species, the planted cuttings on 22nd January (first planting date) gave the higher significant value of rooting percentage (61.19%), while the lowest percentage was (47.26%) when cuttings were planted on 5th February (second planting date). The type of three species of mulberry was significantly varied, superior value was black mulberry type (*Morus nigra*) cuttings in the rooting percentage which gave (60.59%), while the lowest value was (43.70 %) in red mulberry type (*Morus rubra*). As for (IBA) treatments is also had a significant value, it was noticed that the highest one in the rooting percentage was (65.48%) in (3000mg.L^{-1}) IBA, while the lowest rooting percentage (36.30%) was for value planted in control treatment.

As for the dual interaction between planting dates and the type of cuttings is also had a significant effect on the rooting percentage, the highest rooting percentage (73.56%) was recorded in black mulberry (*Morus nigra*) cuttings were planted on first date (22nd January), while the least rooting percent (36.67%) was in red mulberry (*Morus rubra*) cuttings in second planting date (5th February). On the other hand, the interaction between the planting dates and treatments were had a significant value, the highest rooting percentage (75.11 %) was obtained when cuttings were planted in first planting date (22nd January) with treatment IBA (3000mg.L^{-1}) in comparison with those planted in control treatment and third planting date (19th February) gave the least rooting percentage (31.11%). The last dual interaction between cutting types of (Mulberry spp.) and treatment treatments showed that the planting of cuttings in IBA (300mg.L^{-1}) in black mulberry (*Morus nigra*) gave significantly the best value of rooting percentage (80.89%) as compared with other interactions and the lower value is (31.11%) was in red mulberry (*Morus rubra*) cuttings planted with treatment (control).

Table (1): Effect of planting dates and different concentration of IBA in rooting percentage (%) of three species of mulberry (Morus nigra, Morus alba and Morus rubra).

Rooting percentage (%)						
Date	**Type**	(IBA) mg.l^{-1}			Date * Type	Date effect
		0	1500	3000		
22nd January	**Black M.**	53.33 b-f	72.00 a-c	95.33 a	73.56 a	61.19 a
	White M.	40.00 d-f	56.00 b-f	69.33 a-d	55.11 b	
	Red M.	40.00 d-f	64.00 b-e	60.67 b-e	54.89 b	
5th February	**Black M.**	40.00 d-f	56.00 b-f	69.33 a-d	55.11 b	47.26 b
	White M.	33.33 e f	56.00 b-f	60.67 b-e	50.00 b c	
	Red M.	26.67 f	40.00 d-f	43.33 c-f	36.67 c	
19th February	**Black M.**	33.33 e f	48.00 b-f	78.00 a b	53.11 b	47.56 b
	White M.	33.33 e f	56.00 b-f	60.67 b-e	50.00 b c	
	Black M.	26.67 f	40.00 d-f	52.00 b-f	39.56 b c	
Date * IBA	**22nd January**	44.44 c-e	64.00 a b	75.11 a	Type effect	
	5th February	33.33 d e	50.67 b c	57.78 b c		
	19thFebruary	31.11 e	48.00 b-d	63.56 a b		
Type * IBA	**Black M.**	42.22 c-e	58.67 b	80.89 a	60.59 a	
	White M.	35.56 d e	56.00 b c	63.56 b	51.70 b	
	Red M.	31.11 e	48.00 b-d	52.00 b c	43.70 b	
IBA effect		36.30 c	54.22 b	65.48 a		

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Means of each factor and their interactions followed by the same or shared letters are not significantly different from each other according to Duncan's multiple range at 5% level.

Regarding the triple interaction among the studied factors, it was clear that there was a significant difference. The planting of black mulberry (*Morus nigra*) cuttings in treatment IBA (3000mg.L^{-1}) in first planting date (22nd January) gave the highest rooting percentage (95.33%) as compared with other interactions; while the lowest percent (26.67%) was for red mulberry (*Morus rubra*) cuttings planted in control in both second planting date (5th February) and third planting date (19th February).

In this study the data and results indicated that the effect of three factors (planting dates, species of mulberry and IBA concentration) had significantly effect on success rooting percentage. Table (1) explain that the planting dates had significant difference in rooting percentage of mulberry, the first planting date of cuttings was on 22nd January gave the higher rooting percentage (61.19%) while the lowest percentage (47.26%) was in treatment second planting date on the 5th February .This may be correlated with the presences of suitable temperature degree during the months, temperature is one of the factor of rooting of cutting. The time of cuttings collection plays a significant role in the rooting success and the cuttings development. This may be due to changes in the endogenous plant growth regulators or carbohydrate situation of cuttings and the environmental conditions present in nursery **(Abdou *et al*., 2004; Elgimabi, 2008)**.

The species (Types) of mulberry also affected significantly in the rooting percentage therefore the result in table (1) reveals that had significant effect on rooting percentage the highest value in black mulberry reach (60.59%) and the lowest value in rooting percentage was in red mulberry reach (43.710). These variations in the rooting percentage are related to the genetic effect of the species, some species are root much more readily than others **(Hartmann *et al*., 2014)**.Species varied in terms of morphology, anatomy and adaptation of stock plant to environmental conditions, all these factors together affect the ability of the rooting of stem cuttings **(Leakey, 2004; Husen and Pal, 2007)**.

The data in table (1) indicated the IBA concentration had significant effect on rooting percentage of mulberry species cutting. IBA concentration (3000mg.L^{-1}) had the highest percentage (57.78%) which significant effect from the concentration (1500mg.L^{-1}) reach (50.67%) and control treatment which gave the least percentage of rooting reach (33.33%). This result are agreement with the result of **(Polat, 2008)** and **(Kalyoncu *et al*., 2009).**This is an obvious evidence that appropriate IBA concentration were absorbed by cuttings, which caused induce of early and better initiation of roots **(Patel, 2018).**

Average length of stem per cutting (cm)

The results appeared from table (2), obtained that there was no significant differences between planting dates of cuttings. Types of mulberry effect investigated that was a significant differences among types of cuttings of mulberry, the longest stem length/cutting was (54.45cm) from black mulberry (*Morus nigra*) and the shortest one was got (32.78cm) from red mulberry (*Morus rubra*). The other factor (IBA) clarify meaningfully, the best stem length was (52.98cm) from IBA treatment (3000mg.L^{-1}) and the shortest stem length was (31,16cm) from control treatment.

From the effect of the dual interaction between planting date and type of mulberry effect significantly on length of stem per cutting, when cuttings were planted on 22nd January they produced the longest stem length (63.56cm) in black mulberry (*Morus nigra*), but shorter stem length (25.22cm) were observed when the cuttings of red mulberry (*Morus rubra)* was planted on19th February. It can be shown the significantly best stem length per cutting duel treatment was (57.74cm) from cuttings grown on 22nd January in IBA (3000mg.L^{-1}), whereas, lowest stem length value (25.72cm) was noticed from control on 19th February. The cuttings from black mulberry (*Morus nigra*) treated with IBA contain (3000mg.L^{-1}) in duel interaction was the highest value (71.22cm) stem length a significant difference compared to other data, whereas red mulberry (M*orus rubra*) was the lowest value reach (26.09cm) in control treatment.

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Table (2): Effect of planting dates and different concentration of IBA in stem length (cm) of three species of mulberry (*Muros nigra, Morus alba and Morus rubra*).

Stem length (cm)/cutting						
Date	**Type**	(IBA) mg.l^{-1}			Date * Type	Date effect
		0	1500	3000		
22nd January	**Black M.**	40.66 c-h	61.76 b c	88.25 a	63.56 a	47.09 a
	White M.	37.33 c-h	35.19 d-h	51.26 b-f	41.26 b c	
	Red M.	33.44 d-h	42.24 c-h	33.70 d-h	36.46 c d	
5th February	**Black M.**	35.33 d-h	48.15 b-g	55.76 b-e	46.42 b c	39.69 a
	White M.	30.83 e-h	30.40 e-h	46.76 b-g	36.00 d c	
	Red M.	25.67 h g	33.12 d-h	51.17 b-f	36.65 c d	
19th February	**Black M.**	33.33 d-h	57.12 b c d	69.66 a b	53.37 a b	40.21 a
	White M.	24.67 h g	52.70 b-d	48.73 b-g	42.03 b c	
	Red M.	19.17 h	24.96 h g	31.55 d-h	25.22 d	
Date * IBA	**22nd January**	37.15 b c	46.40 a b	57.74 a	Type effect	
	5th February	30.61 c	37.22 b c	51.23 a		
	19thFebruary	25.72 c	44.93 a b	49.98 a b		
Type * IBA	**Black M.**	36.44 c d	55.68 b	71.22 a	54.45 a	
	White M.	30.94 d	39.43 c d	48.92 b c	39.76 b	
	Red M.	26.09 d	33.44 d	38.81 c d	32.78 b	
IBA effect		31.16 c	42.85 b	52.98 a		

Means of each factor and their interactions followed by the same or shared letters are not significantly different from each other according to Duncan's multiple range at 5% level.

The triple interaction in the same table showed as clearly, there is a positive influence in its data, the longest stem length is (88.25cm) where planting on 22nd January in IBA (3000mg.L^{-1}) from black mulberry (*Morus nigra*), while, the shortest stem length is (19.17cm) where planting on 19th February in control from red mulberry (*Morus rubra).*

Average of stem diameter per cutting (mm)

The data in table (3) indicated there was no significant differences between three planting dates on the stem diameter/cutting for this parameter. As well the stem diameter significantly increased when type of cuttings was used as gave (5.39mm) from black mulberry (*Morus nigra*) in contrast to decreased (3.86mm) from red mulberry (*Morus rubra*) cuttings. When cuttings planted in IBA (3000mg.L^{-1}) (5.06mm) had not differ from IBA (1500mg.L^{-1}) but had meaningful significant difference with control treatment was (3.94mm).

Caused meaningful increase in stem diameter per cutting which reached (5.78mm) from black M. (*Morus nigra*) on 19th February in the interaction between date and type, while lower diameter value was (3.46mm) from red M. (*Morus rubra*) on 22nd January. Variation occurred when cutting planting in date with using IBA treatment, increased stem diameter (5.24mm) were from Second planting date 5th February in IBA (3000mg.L^{-1}), while the least value was (3.56mm) in control on 22nd January. Likewise, had variation in its data where the interaction type of mulberry with IBA were used, the thickest diameter was (6.26mm) in (3000mg.L^{-1}) from black M. (*Morus nigra*), and the thinner stem diameter was (3.44mm) in control from type of red mulberry (*Morus rubra).* The triple interaction (date, type and auxin) were had a positive differences in the stem diameter parameter per cutting, the thickest diameter was (7.13mm) from black M. *(Morus nigra)* in IBA (3000mg.L^{-1}) on 19th February, while the thinnest diameter was (2.85mm) from red M. (*Morus rubra*) in control on 22nd January.

We found best results of leave number per cuttings and significant differences during the triple interaction, the maximum leave number obtained (26.65) leaves from white mulberry (*M. alba*) where cuttings planting date on 22nd January in auxin contained of (3000mg.L^{-1}) IBA, while the minimum leave number found (9.78) leaves from black mulberry (*M. nigra*) where cuttings planting on 22nd January in control treatment.

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Table (3): Effect of planting dates and different concentration of IBA in stem diameter (mm) of three species of mulberry (*Muros nigra, Morus alba and Morus rubra*).

Stem diameter (mm)						
Date	**Type**	(IBA) mg.l^{-1}			Date * Type	Date effect
		0	1500	3000		
22nd January	**Black M.**	4.29 b-e	5.68 a b c	5.87 a b	5.28 a b	4.43 a
	White M.	3.53 d e	5.35 a-d	4.79 b-e	4.56 b-d	
	Red M.	2.85 e	3.92 b-e	3.60 d e	3.46 e	
5th Februay	**Black M.**	4.58 b-e	5.00 b c d	5.77 a b	5.12 a-c	4.49 a
	White M.	3.95 b-e	4.01 b-e	5.16 b c d	4.37 b-e	
	Red M.	3.47 d e	3.72 c-e	4.79 b-e	3.99 d e	
19th Februay	**Black M.**	4.46 b-e	5.76 a b	7.13 a	5.78 a	4.66 a
	White M.	4.33 b-e	3.52 d e	4.30 b-e	4.05 c-e	
	Red M.	3.99 b-e	4.26 b-e	4.16 b-e	4.13 c-e	
Date * IBA	**22nd January**	3.56 c	4.98 a b	4.76 a b	Type effect	
	5th February	4.00 b c	4.24 a b c	5.24 a		
	19th February	4.26 a-c	4.51 a-c	5.20 a		
Type * IBA	**Black M.**	4.44 c d	5.48 a b	6.26 a	5.39 a	
	White M.	3.93 c d	4.29 c d	4.75 b c	4.33 b	
	Red M.	3.44 d	3.97 c d	4.18 c d	3.86 b	
IBA effect		3.94 b	4.58 a	5.06 a		

Means of each factor and their interactions followed by the same or shared letters are not significantly different from each other according to Duncan's multiple range at 5% level.

Average of leave number per cutting

In table (4), the planting date did not impact on increase of leaves number per cutting; therefore, had not a significant effect. Furthermore, the leaves number increased due to the effect of type, increased number (20.06) leaves found from the white M. (*Morus alba*) type while decreased number (16.68) leaves obtained from red M. (*Morus rubra*) type. In the application of IBA the cuttings were influenced and gave significant variation, the higher leave number was (18.94) leaves from (3000 mg.L^{-1}) and the lowest leave number was (15.60) leaves from control treatment. The duel interaction between planting date and mulberry type gave the clearly difference in its data, the best leave number/cutting was (23.27) leaves from white (*Morus alba*) where planting on 22nd January, while the least leave number was (12.10) leaves from black M. (*Morus nigra*) where planting on 5th February. Moreover, interaction of planting date with IBA didn't gave a significant differences among them. While type of mulberry with IBA treatment, the results showed a big variation on number of leaves/cutting, the higher leave number was (22.29) leaves from white M. (*M. alba*) with treatment IBA (3000mg.L^{-1}); but, least leave number was (12.16) leaves from black mulberry (*Morus nigra*) in control treatment.

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Table (4): Effect of planting dates and different concentration of IBA in leave number of three species of mulberry (*Muros nigra*, *Morus alba and Morus rubra*).

Leave number						
Date	Type	(IBA) mg.l^{-1}			Date * Type	Date effect
		0	1500	3000		
22nd January	**Black M.**	9.78 g	15.19 c-g	14.87 c-g	13.28 c	17.62 a
	White M.	19.11 a-g	24.06 a b c	26.65 a	23.27 a	
	Red M.	16.17 b-g	15.73 b-g	17.04 a-g	16.31 c	
5th February	**Black M.**	10.55 g-f	11.46 g f	14.30 c-g	12.10 c	16.77 a
	White M.	25.67 a-b	16.73 a-g	23.76 a-d	22.05 a b	
	Red M.	12.33 e f g	14.73 c-g	21.37 a-e	16.14 c	
19th February	**Black M.**	16.14 b-g	16.10 b-g	20.88 a-f	17.70 b c	16.71 a
	White M.	13.44 d-g	14.66 c-g	16.46 a-g	14.86 c	
	Red M.	17.22 a-g	20.40 a-f	15.09 c-g	17.57 b c	
Date * IBA	**22nd January**	15.02 a	18.33 a	19.52 a	Type effect	
	5th February	16.18 a	14.31 a	19.81 a		
	19th February	15.60 a	17.05 a	17.48 a		
Type * IBA	**Black M.**	12.16 c	14.25 b c	16.68 a b c	14.36 b	
	White M.	19.41 a b	18.49 a b	22.29 a	20.06 a	
	Red M.	15.24 b c	16.95 a b c	17.84 a b	16.68 b	
IBA effect		15.60 b	16.56 a b	18.94 a		

Means of each factor and their interactions followed by the same or shared letters are not significantly different from each other according to Duncan's multiple range at 5% level.

We found best results of leave number per cuttings and significant differences during the triple interaction, the maximum leave number obtained (26.65) leaves from white mulberry (*Morus alba*) where cuttings planting date on 22nd January in (3000mg.L^{-1}) IBA, while the minimum leave number found (9.78) leaves from black mulberry (*Morus nigra*) where cuttings planting on 22nd January in control treatment.

The data and results in table (2, 3, and 4) explain caused no significant difference between planting date of mulberry on the (length of stem, diameter of stem and number of leaves). While the species of mulberry effect significant variation in most characters of vegetative growth of mulberry table (2, 3 and 4). The treatment of cuttings with IBA concentrations as seen in table (2-4) caused a significant difference over control treatment (0 mg.L^{-1}) and for all the studied characters. As the highest value (length of stem, diameter of stem and number of leaves) per cuttings was observed from effect of IBA (3000 mg.L^{-1}).

CONCLUSION

This conclusion explained according to the results that were obtained from the study that was conducted: The first planting date (22nd January) was the best date for planting which increased rooting percentage. The Black mulberry was the effective type to rise of (rooting percentage, length of stem, diameter of stem and number of leaves). Auxin IBA (3000 mg.L^{-1}) was the effective concentration to get best results of (rooting percentage, length of stem, diameter of stem and number of leaves) .The triple interaction among (planting dates, types and IBA) significantly affected on all characteristics which was study.

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كارتێكرنا ژڤانێت چاندنێ و جورێت تيبا و رێكخستنا جياواز يا ئوكسينى لسەر رەهدانێ و گەشەكرنا كەسكاتى يێت قەلەمئن قەدى يێن رەق لسەر سێ جورێن تيبا.

پوختە

ئەف فەكولينە هاتە ئە نجامدان ل دە مێ وە رزێ كە شە كرنێ ل سالا (2020) ێ ل نەمامكە ها بە شێ بيستانكارى ل كوليزا زانستێن ئە ندازيارييا جاندنێ / زانكويا دهۆك / هەرێما كوردستانێ / عيراق.ئە ف فە كولينە بيك دهات ز كارتيكرنا سى زفانئت جاندنئ(ل 22ى جريا دووێ و ل 5ى شوباتێ و ل 19ى شوباتێ) , و هەروەسا كارتێكرنا سێ جورێت تيبا (تيبا رەش و تيبا سبى و تيبا سور) و كارتيكرنا سێ رێكخستنيت جياواز يا ئوكسينى (0_1500_ 3000) ملغم .ل -1 لسەر رە هێت قە لە ما وكە شە كرنا كە سكاتى لسە ر سێ جورێت تيبا.

ئەنجام ب فى شێوە يێ ل خوارێ بوون ,زفانئت جاندنێ و جوريت تيبا و رێكخستنا جياواز يا ئوكسينى كارتێكرنەكا ئەرێنى هە بوو لسە ر رێزا سە دى يا رە هدانێ .زفانئ ئێكێ ل(22ى جريا دووێ) بلندترين بها هە بوو لسە ر رێزا سە دى يا رەهدانێ (61.19%) وقە لە مئت تيبا رەش بلندترين بها هە بوو لسە ر رێزا سە دى يا رە هدانێ (60.09%) و ئوكسينێ (3000ملغم / لتر-1) بهاترين بها هە بوو لسە ر رێزا سە دى يا رە هدانێ (45.70%) . كرێدای جياوازييا ئە رێنى بۆ جورێت قە لە ما و ئوكسينى لسە ر كە شە كرنا كە سكاتيێ (درێزبا قە دى , ستويراتييا قە دى و زرە يا بە لكا) ل جورێ تيبا رە ش و هە روەسا ئوكسينێ (3000ملغم / لتر-1) و جياوازييا ئە رێنى نەبوونافبە ينا زفانئت جاندنئ تيبا لسەر كە شە كرنا كە سكاتى و ئەو سالوخەتێت مە ئامازە داين . باشترين رێزە يا رە هدانێ (95.33%) لزفانئ ئێكێ + ئوكسينێ (3000ملغم\لتر-1) + تيبا رەش.

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تأثير موعد الزراعة ونوع التوت وتراكيز مختلفة من الاوكسين IBA على التجذيروالنمو الخضري للعقل الساقية الصلبة لثلاثة انواع من التوث(.Morus sp).

الخلاصة

اجريت هذه الدراسة خلال موسم النمو 2020في مشتل قسم البستنة/كلية علوم الهندسة الزراعية جامعة دهوك/اقليم كوردستان /العراق اخذت العقل الساقية لثلاثة انواع من التوث من حدائق جامعة دهوك موقع مالتا.اخذت. هذه الدراسة اشتملت تاثيرثلاثة مواعيد زراعة (22كانون الثاني و5 شباط و 19 شباط), وايضا تاثيرثلاثة انواع من التوث (التوث الاسود و التوث الابيض والتوث الاحمر) و تاثير ثلاثة تراكيز مختلفة من الاوكسين (صفر و 1500 و3000ملغم/ل$^{-1}$).

النتائج كانت كالاتي , موعد الزراعة وانواع التوث وتراكيزالاوكسين لها تاثير معنوي على النسبة المئوية للتجذير.الموعد الاول 22كانون الثاني اعطى اعلى قيمة في نسبة التجذير61.19%) وعقل التوث الاسود اعطى اعلى قيمة في التجذير بلغ (60.09%) . معاملات الاوكسين اعطت اعلى قيمة معنوية في التجذير(45.70%) في معاملة تركيز3000ملغم.ل$^{-1}$.فيما يخص الاختلاف المعنوي في انواع العقل وتراكيزالاوكسين على النمو الخضري (طول الساق,قطر الساق وعدد الاوراق) في نوع التوث الاسود وكذلك معاملة الاوكسين تركيز 3000ملغم/ل$^{-1}$ ولايوجد اختلاف معنوي بين مواعيد الزراعة للتوث على النمو الخضري وللصفات المذكورة.احسن نسبة تجذير(95.33%) كان في الموعد الاول+ اوكسين 3000ملغم/ل$^{-1}$+ التوث الاسود.

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