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EFFECT OF PLANT SPECIES, STEM CUTTING TYPE AND PLANTING DATE ON PROPAGATION OF *Eranthemum* PLANT

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ABSTRACT

An experiment was conducted to find out suitable cutting types and planting dates on the success of vegetative propagation of some *Eranthemum* species. The treatments were four species namely *Eranthemum reticulatum* , *E. nigrum* , *E.albo-marginatum and E. tricolor,* three different types of stem cuttings *viz*. soft wood , semi- hard wood and hard wood , two planting dates *viz*. the second week of February and May at the Nasser's Faculty of Agriculture Sciences under shelter house during the two seasons of 2008 and 2009 . The interaction effect between species , cutting types and planting dates showed a decisive result of 100% rooting percentage in soft wood cuttings of *E. reticulatum* , *E. nigrum* , *E.albo-marginatum* planted in February , while the highest rooting percentages (95.0 and 97.5) were achieved in the semi- hard wood cuttings of *E. tricolor* in February plantation. It was observed that February plantation was favorable for root formation , the maximum numbers of roots (15.33 and 14.60) were produced with soft wood cuttings of *E. reticulatum* , while , the longest roots (44.80 and 44.98 cm) ,the highest fresh weights (10.98 and 7.93gm) and the highest dry weights (2.38 and 2.32 gm) were recorded in hard wood and semi-hard wood cuttings of *E. reticulatum; E.albo-marginatum* and *E. reticulatum,* respectively. The highest number of shoots (5.32 and 4.97) were observed in semi- hard wood and hard wood cuttings of *E.albo-marginatum* planted in May , while , the lowest numbers of shoot were (1.25 and 0.0) in the soft wood cuttings of *E. reticulatum* planted in February ,the longest shoots (25.37 and 21.49 cm) were recorded in hard wood cuttings of *E. tricolor* and *E. nigrum* in February plantation , whereas ,the maximum number of leaves (39.20 in the first season and 36.83 in the second season) were found in hard wood cuttings of *E. tricolor* and *E.albo-marginatum* planted in February and May, respectively.

Key word *: eranthemum species, planting dates, rooting, type of stem cuttings,vegetative propagation.*

1. INTRODUCTION

Eranthemum, Fam. Acanthaceae is a genus including 15 species of erect semi-woody shrubs, natives of south –eastern Africa .A popular foliage shrubs in Yemen , small to medium 1to 2 m best suited for hot and humid tropical plains , grown in shade or semi- shade. In our conditions, *Eranthemum* sp. does not produce seed so it is usually propagated through soft wood stem cuttings. Information on the propagation and production of *Eranthemum* species in Yemen is not available. Our objective was to determine the use of different types of stem cuttings and standardize the planting date to propagate *Eranthemum* species with emphasis on how species , cutting type and planting date affect cutting rooting and success of growth in order to provide a theoretical and technical basis for nursery stock production . Previous studies on the effect of species have been reported by various scientists (Paul *et al*.,1992 and Kibblen *et al*.,2004) who found strong influence on rooting percentage, but (Tetsumura *et al*.,2001) reported that there were no significant differences on rooting percentage, while, (Aminul *et al*., 2010) reported that there were no significant differences on longest shoot , leaves number, number and length of root among species. However , broad variation among species for root number , root length , root dry weight were noticed by (Zalesny and Wiese, 2006) . Using different types of cutting are other factors known to increase rooting and success. However, according to Christopher *et al.*,(2006)

type of cutting is not an important factor. According to Yeboah *et al*., (2009) the number of roots was not effected by the type of cutting . Various scientists (Palanisany 1997, Kamal and Hamad, 2006 and Aini Nor *et al*.,(2010) found the highest rooting for soft wood cuttings , whereas, Aminul *et al.*,(2010) found the minimum rooting percentage in soft wood cuttings . Regardless to root growth (Christopher *et al*., (2004 , Koyuncu and Senel (2003) recorded that the number of roots and length of root were significantly influenced by the type of cutting , whereas, Yeboah *et al.,* (2009) recorded that there were no significant influences on the number of roots . However , Laura *et al*., (1994) showed that hard wood cuttings had the highest root count , total root length and root dry weight. While , Araya *et al*.,(2007) found that better root length , root number from apical than from basal cuttings. Type of cutting can influence shoot and root growth . Agbo and Obi (2007) found that hard wood cuttings had longer vine as well as higher number of shoots and leaves per cutting Aminul *et al.*,(2010) recorded similar results , whereas Bannister and Watt,(1995) observed that shoot length was unaffected by the type of cutting . Several researchers investigated the influence of planting date on the rooting percentage,total shoot length,root number and length of root stem cuttings *e.g.*,Urszula *et al* .(2003),Bannister and Watt,(1995), Bhardwaj (2005), Yoo *et al*., (1996) and Araya *et al.* (2007). They showed that cuttings gave the best results when planted in February . The results of two factors interaction recorded by Francois *et al*., (2010) indicate that the number of roots was significantly affected by the interaction between species and cutting type. Stankova and Panetosos,(1997)found significant effect between species and planting date on rooting percentage and root length . Rooting percentage was greatest with hard wood cutting planted in mid- May according to Paula *et al*.,(2002)).While , Kraiem *et al*. (2010) recorded that the weight of the root depended on the cutting type and planting date, whereas, Zalesny and Wiese, 2006) found that root numbers were achieved when soft wood cuttings were collected in February, and the interaction between species , cutting type and planting date were also significant in terms of root number and dry weight.

2. MATERIALS AND METHODS

The experiment of the present study was carried out under shelter house of Nasser's Faculty of Agriculture Sciences during 2008 and 2009 . Stem cuttings were collected from four species *Eranthemum reticulatum* , *E. nigrum* , *E.albo-marginatum* and *E. tricolor* growing in the faculty campus. It was decided to check rooting percentage and growth of soft wood , semi- hard wood and hard wood cuttings. They are classified into three groups according to maturity or age of wood. Cuttings were prepared from vigorous one- year – old shoots , stems were recut between 15-20 cm in length for soft wood and semi-hard wood and hard wood cuttings , respectively and planted in polythene bags of 10 cm size filled with soil during February and May. The experiment consisted of four species , three stem cutting types and two planting dates which gave twenty- four treatment combinations , in a split – split plot design with four replicates ,40 cuttings for each treatment were used and ten cuttings for each replicate. After 90 days, all cuttings were lifted from the polythene bags and evaluated for rooting percentage. The obtained data on shoot and root parameters were recorded as following:

1-Rooting %
2- Number of roots/cutting
3- Root length
4- Fresh and dry weight of roots/cutting
5- Number of shoots/cutting
6- Length of the longest shoot/cutting
7- Number of leaves/cutting

The data were subjected to an analysis of variance , comparison of mean was performed using (least significant difference LSD) at p= 0.05

The rooting percentage was obtained by the following formula:

$$\text{Cuttings rooted percentage} = \frac{\text{Number of cuttings rooted}}{\text{Total No. of cuttings planted}} \times 100$$

Monthly temperature during the rooting and growth are presented in Table (1) as recorded by Civil Aviation & Meteorology Authority – Aden

3. RESULTS AND DISCUSSION

3.1.Rooting percentage

It was evident from Table (2) that species were not significantly different from each other. Such results have also been observed by Tetsumura *et al*.,(2001) on Japanese persimmon. Whereas, Paul *et al* .(1992) on eastern red cedar

Table(1): Monthly meteorological parameters during rooting and growth.

Month	Temperature (°C)					
	First season (2008)			Second season (2009)		
	Max.	Min.	Mean	Max.	Min.	Mean
Feb.	29.8	20.5	25.9	29.2	23.6	25.9
March	32.0	20.5	26.7	29.9	23.9	26.5
April	33.7	21.5	28.4	31.7	25.4	28.1
May	39.0	24.5	31.7	35.4	28.0	31.4
June	39.0	28.2	31.7	37.5	29.5	32.7
July	38.0	28.0	32.6	36.8	29.2	32.2
Aug.	38.2	27.2	32.3	35.8	28.5	31.7
Sept.	38.2	26.2	31.6	36.4	28.5	31.9

Table(2): Single effect of species ,stem cutting type and planting date on rooting percentage.

Treatment	Rooting percentage	
	First year 2008	Second year 2009
Species		
E. reticulatum	**76.7**	**78.7**
E. nigrum	**83.3**	**75.0**
E. albo marginatum	**80.4**	**72.9**
E. tricolour	**82.9**	**74.2**
LSD(P>0.05)	**n.s.**	**n.s.**
Cutting type		
Soft Wood S. W	**92.8**	**85.6**
Semi hard Wood S.HW	**85.3**	**78.1**
Hard wood H W	**64.4**	**61.9**
LSD(P>0.05)	**6.50**	**6.06**
Planting date		
February	**87.1**	**83.7**
May	**74.6**	**66.7**
LSD(P>0.05)	**5.31**	**4.95**

and Kibblen *et al*.(2004) on *Backhousia cibriodora* found a strong influence of species on rooting percentage. The significant variation in rooting percentage was noticed between the cuttings with different type Table(2) such as the highest (92.8 and 85.6 %) were found with S.W. cutting in the first and second years, respectively, probably due to higher endogenous auxin which stimulates root initiation from stem cuttings . These results are in agreement with those obtaind by Palanisany (1997) on neem, Kamal and Hamad (2006) on *Cordia mixa* and Aini Nor *et al.* (2010) on *Gonystylus bancanus*, but contrary to the finding of Christopher *et al.* (2006) on *Murraya paniculata* and *Tecoma stans* who reported that there was no significant influence in rooting percentage and with Aminul *et al*.(2010) on *Jatropha curcas* who found a lowest rooting percentage for soft wood cuttings, when only the planting date was considered. The rooting percentage was the highest (87.1 and 83.7%) in February plantation in the first and second years, respectively Table(2) ,which is in a close conformity to the finding of Urszula *et al*.(2003) on *Azalea*. The differences in rooting percentage in different planting dates might be due to different production of endogenous auxin in different seasons and in different environmental conditions under which the stock plants are grown .

Interaction between species and cutting type had significant effect. Rooting percentage was the highest (96.2%) in *E. nigrum* with S.W. cuttings in the first year while, the highest (92.5%) was recorded in *E. reticulatum* with S.W .cutting followed by *E. nigrum* with S.W.cutting (91.2%) in the second year Table (3). The interaction between species and planting date had a significant effect Table (3) .This result corroborated the earlier report of Stankova and Panetosos (1997) on *Cupressus sempervirens*.Table (3) shows that species have different rooting percentage at different planting date ,the highest rooting percentages (97.5 and 92.5%) were recorded in cuttings of *E. nigrum* and *E. reticulatum* in February plantation in the first and second years, respectively .There were significant effects of the interaction between cutting type and planting date. Table (3) shows a lower percentage of rooting (57.5 and 53.1%) with H.W. cuttings planted in May compared to the highest (96.9 and 93.1%) with S.W. cuttings planted in February in the first and second seasons, respectively . This result is in contrary to the finding of Paula *et al.* (2002)on *Juglans cinerea*.

The interaction between species, cutting type and planting date Table (4) showed that (100% rooting) was obtained with S.W. cuttings of *E. nigrum* ,*E.albo-marginatum* and *E. reticulatum* planted in February. However , the highest rooting percentages (97.5) 97.5 and 97.5% were achieved in S.H.W cuttings of *E. tricolor* planted in February in the second year, in S.H.W. cutting of *E. nigrum* planted in Feb. in the first year with *E. reticulatum* in Febrauary in the second year, respectively.

3.2.Root growth

3.2.1.Number of roots per cutting

Table(5) revealed that there was a significant difference between species in the number of roots , which is in a close conformity to the finding of Zalesny and Wiese (2006). The highest number of roots (11.16 and 10.37) were observed in cuttings of *E. albo-marginatum* in

Table (3): Interaction effect between species , stem cutting type and planting date on rooting percentage (Ineraction between two factors).

Treatments	Rooting percentage	
	First year	Second year
Species x Cutting type		
E.reticulatum **X S. W**	**87.5**	**92.5**
E. reticulatum **X S.HW**	**81.2**	**82.5**
E. reticulatum **X HW**	**61.2**	**61.2**
E.nigrum **X S. W**	**96.2**	**91.2**
E. nigrum **X S.HW**	**85.0**	**76.2**
E. nigrum **X HW**	**68.7**	**57.5**
E.albo marginatum **X S. W**	**95.0**	**85.0**
E.albo marginatum **X S.HW**	**81.2**	**67.5**
E. albo marginatum **X HW**	**65.0**	**66.2**
E.tricolour **X S. W**	**92.5**	**73.8**
E. tricolour **X S.HW**	**93.7**	**86.2**
E. tricolour **X HW**	**62.5**	**62.5**
LSD(P>0.05)	**13.0**	**12.12**
Species x Planting date		
E. reticulatum **X Feb.**	**85.8**	**92.5**
E. reticulatum **X. May**	**67.5**	**65.0**
E. nigrum **X Feb.**	**97.5**	**78.3.**
E. nigrum **X May**	**69.2**	**71.7**
E. albo marginatum **X Feb.**	**81.7**	**78.3**
E. albo marginatum **X May**	**79.2**	**67.5**
E. tricolour **X Feb.**	**83.3**	**85.8**
E. tricolour **X May**	**82.5**	**62.0**
LSD(P>0.05)	**10.62**	**9.90**
Cutting type x Planting date		
S. W X Feb.	96.9	93.1
S. W X May	88.7	78.1
S.HW X Feb	93.1	87.5
S.HWX May	77.5	68.8
HW X Feb	71.2	70.6
HW X May	57.5	53.1
LSD(P>0.05)	**9.19**	**8.57**

Table(4):Interaction effect between species, stem cutting type and planting date on rooting percentage. (Interaction between three factors together).

Treatments	Rooting percentage	
	First year	Second year
E. reticulatum **X S. WX Feb.**	**92.5**	**100**
E. reticulatum **X S. WX May**	**82.5**	**85.0**
E. reticulatum **X S.HWX Feb**	**90.0**	**97.5**
E. reticulatum **X S.HWX May**	**72.5**	**67.5**
E. reticulatum **X HW X Feb.**	**75.0**	**80.0**
E. reticulatum **X HWX May**	**47.5**	**42.5**
E. nigrum **X S. WX Feb.**	**100**	**95.0**
E. nigrum **X S. WX May**	**92.5**	**87.5**
E. nigrum **X S.HWX Feb**	**97.5**	**80.0**
E. nigrum **X S.HWX May**	**72.5**	**72.5**
E. nigrum **X HW X Feb.**	**95.0**	**60.0**
E. nigrum **X HWX May**	**42.5**	**55.0**
E. albo marginatum **X S. WX Feb.**	**100**	**95.0**
E. albo marginatum **X S. WX May**	**90.0**	**75.0**
E. albo marginatum **X S.HWX Feb**	**90.0**	**75.0**
E.albo marginatum **X S.HWX May**	**72.5**	**60.0**
E. albo marginatum **X HW X Feb.**	**55.0**	**65.0**
E. albo marginatum **X HWX May**	**75.0**	**67.5**
E. tricolour **X SWX Feb**	**95.0**	**82.5**
E. tricolour **X S. WX May**	**90.0**	**65.0**
E. tricolour **X S.HWX Feb**	**95.0**	**97.5**
E. tricolour **X S.HWX May**	**92.5**	**75.0**
E. tricolour **XHWX Feb**	**60.0**	**77.5**
E. tricolour **X HWX May**	**65.0**	**47.5**
LSD(P>0.05)	**18.39**	**17.14**

the first and second years, respectively whereas , the minimum (9.35 and 8.04) in cuttings of *E. tricolor* in the first and second years, respectively . Significant effect of cutting type was observed Table (5). This result is in accordance with those of Koyuncu and Senel (2003) and in contrary to the finding of Yeboah *et al.* (2009). The highest numbers of roots (11.46 and 9.77) were obtained with S.W. cuttings whereas ,the minimum (9.45 and 8.84) in H.W. cuttings in the first and second years, respectively , Araya *et al.* (2007) also obtained similar result. The increase in the number of roots with S.W. cuttings may be due to indol actic acid (IAA) which is synthesized in the shoot tip and translocated to the basal portion and is active in inducing root formation. The results in Table (5) showed that the number of roots was significantly influenced by planting date in both years, and the highest numbers of roots (10.87 and 10.46 cutting) were recorded in February plantation in the first and second years, respectively. Similar effect of planting date was also reported by Bhardwaj (2005).The interaction effect of species and type of cutting having significant influence (Table 6). Such result has also been observed by Francois *et al.*(2010) , S.W. cuttings of *E. reticulatum* produced the highest number of roots (13.0 and 11.84) in the first and second years, respectively. The interaction between species and planting date had significant effect on the number of roots Table (6) , cuttings of *E. albo-marginatum* planted in February produced the highest number of roots (12.50 and 11.48) in the first and second years respectively while , cuttings of *E. tricolor* planted in May recorded the least number of roots (8.28 and 6.11) in the first and the second seasons, respectively.The interaction effect of cutting type and planting date significantly affected the number of roots Table (6).S.W.cuttings planted in February had the highest values 12.56 and 11.02 in the first and second years, respectively. This result corroborated the earlier report of Zalesny and

Table (5): Single effect of species ,stem cutting type and planting date on root parameters per cutting.

Treatments	Root parameters							
	Number of roots		Length of roots (cm)		Fresh weight of roots (gm)		Dry weight of roots (gm)	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
Species								
E. reticulatum	**10.26**	**9.63**	**35.65**	**31.16**	**6.40**	**5.0**	**1.48**	**1.69**
E. nigrum	**9.76**	**9.02**	**30.68**	**28.18**	**4.38**	**4.15**	**1.26**	**1.06**
E. albo marginatum	**11.16**	**10.37**	**36.73**	**34.29**	**6.19**	**4.93**	**1.70**	**1.12**
E. tricolour	**9.35**	**8.04**	**31.55**	**30.59**	**4.04**	**3.55**	**1.42**	**0.99**
LSD(P>0.05)	**1.13**	**1.10**	**3.01**	**2.83**	**1.16**	**0.70**	**0.33**	**0.35**
cutting type								
S. W	**11.46**	**9.77**	**35.09**	**30.83**	**5.30**	**4.40**	**1.35**	**1.24**
S.HW	**9.48**	**9.18**	**32.23**	**31.32**	**5.31**	**4.78**	**1.50**	**1.33**
HW	**9.45**	**8.84**	**33.64**	**31.02**	**5.14**	**4.04**	**1.55**	**1.08**
LSD(P>0.05)	**0.98**	**n.s.**	**2.61**	**n.s.**	**n.s.**	**0.61**	**n.s.**	**n.s.**
planting date								
February	**10.87**	**10.46**	**39.82**	**34.84**	**7.39**	**6.0**	**1.72**	**1.43**
May.	**9.40**	**8.07**	**27.49**	**27.27**	**3.11**	**2.82**	**1.21**	**1.01**
LSD(P>0.05)	**0.80**	**0.78**	**2.13**	**2.0**	**0.82**	**0.50**	**0.24**	**0.25**

Table(6): Interaction effect between species , stem cutting type and planting date on root parameters per cutting.(Interaction between two factors).

Treatments	Root parameters							
	Number of roots		Length of roots(cm)		Fresh weight of roots (gm)		Dry weight of roots (gm)	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
Species x Cutting type								
E.reticulatum **X S. W**	**13.0**	**11.84**	**35.67**	**30.63**	**6.59**	**5.53**	**1.75**	**1.93**
E. reticulatum **X S.HW**	**8.46**	**8.71**	**33.19**	**32.13**	**5.70**	**5.61**	**0.99**	**2.0**
E. reticulatum **X HW**	**9.33**	**8.33**	**38.10**	**30.72**	**6.90**	**3.85**	**1.70**	**1.15**
E.nigrum **X S. W**	**10.62**	**9.25**	**32.73**	**27.02**	**6.35**	**4.13**	**1.49**	**0.97**
E. nigrum **X S.HW**	**10.03**	**9.33**	**30.89**	**29.18**	**4.21**	**4.02**	**1.45**	**0.91**
E. nigrum **X HW**	**8.63**	**8.50**	**28.43**	**28.34**	**2.59**	**4.30**	**0.85**	**1.30**
E.albo marginatum **X S. W**	**11.88**	**9.95**	**37.06**	**34.43**	**4.92**	**4.20**	**1.29**	**0.82**
E. albo marginatum **X S.HW**	**10.46**	**10.33**	**35.78**	**35.66**	**6.70**	**5.81**	**1.79**	**1.51**
E. albo marginatum **X HW**	**11.15**	**10.82**	**37.35**	**32.78**	**6.94**	**4.78**	**2.03**	**1.02**
E.tricolour **X S. W**	**10.35**	**8.04**	**34.91**	**31.23**	**3.35**	**3.75**	**0.88**	**1.23**
E. tricolour **X S.HW**	**8.99**	**8.38**	**29.06**	**28.32**	**4.64**	**3.69**	**1.76**	**0.89**
E. tricolour **X HW**	**8.71**	**7.70**	**30.69**	**32.22**	**4.12**	**3.23**	**1.63**	**0.86**
LSD(P>0.05)	**1.95**	**1.90**	**5.22**	**4.89**	**2.0**	**1.22**	**0.58**	**0.60**
Species x Planting date								
E. reticulatum **X Feb.**	**10.60**	**10.81**	**41.69**	**33.98**	**9.30**	**6.73**	**1.82**	**1.82**
E. reticulatum **X. May.**	**9.93**	**8.44**	**29.62**	**28.34**	**3.49**	**3.27**	**1.13**	**1.56**
E. nigrum **X Feb.**	**9.95**	**9.58**	**36.63**	**31.77**	**6.60**	**6.22**	**1.43**	**1.40**
E. nigrum **X May.**	**9.57**	**8.48**	**24.73**	**24.59**	**2.17**	**2.08**	**1.09**	**0.73**
E. albo marginatum **X Feb.**	**12.50**	**11.48**	**45.17**	**40.49**	**8.69**	**6.71**	**1.83**	**1.48**
E. albo marginatum **X May.**	**9.83**	**9.25**	**28.28**	**28.09**	**3.68**	**3.14**	**1.58**	**0.75**
E. tricolour **X Feb.**	**10.42**	**9.97**	**35.79**	**33.13**	**4.96**	**4.33**	**1.79**	**1.0**
E. tricolour **X May.**	**8.28**	**6.11**	**27.32**	**28.05**	**3.12**	**2.78**	**1.05**	**0.99**
LSD(P>0.05)	**1.59**	**1.55**	**4.26**	**4.0**	**1.64**	**1.0**	**0.47**	**0.49**
Cutting type x Planting date								
S. W X Feb.	**12.56**	**11.02**	**41.46**	**34.64**	**7.64**	**6.32**	**1.67**	**1.57**
S. W X May.	**10.36**	**8.08**	**28.73**	**27.01**	**2.96**	**2.49**	**1.03**	**0.91**
S.HW X Feb.	**10.24**	**10.76**	**37.89**	**36.05**	**7.12**	**6.25**	**1.57**	**1.50**
S.HWX May.	**8.73**	**7.60**	**26.56**	**26.60**	**3.51**	**3.31**	**1.42**	**1.15**
HW X Feb.	**9.79**	**9.59**	**40.12**	**33.83**	**7.40**	**5.42**	**1.91**	**1.21**
HW X May.	**9.11**	**8.08**	**27.16**	**28.20**	**2.88**	**2.66**	**1.19**	**0.96**
LSD(P>0.05)	**1.38**	**1.34**	**3.69**	**3.46**	**1.42**	**0.86**	**0.41**	**0.43**

Table (7): Interaction effect between species , cutting type and planting date on root parameters per cutting.(Interaction between three factors together).

Treatments	Root parameters							
	Number of roots		Length of roots(cm)		Fresh weight of roots (gm)		Dry weight of roots (gm)	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
E. reticulatum **X S. WX Feb.**	**15.33**	**14.60**	**42.85**	**32.24**	**9.00**	**7.29**	**2.18**	**2.18**
E. reticulatum **X S. WX May.**	**10.67**	**9.08**	**28.50**	**29.02**	**4.17**	**3.78**	**1.33**	**1.68**
E. reticulatum **X S.HWX Feb.**	**8.0**	**9.33**	**37.42**	**37.18**	**7.92**	**7.93**	**0.97**	**2.32**
E. reticulatum **X S.HWX May.**	**8.93**	**8.08**	**28.95**	**27.08**	**3.47**	**3.30**	**1.00**	**1.68**
E. reticulatum **X HW X Feb.**	**8.48**	**8.50**	**44.80**	**32.52**	**10.98**	**4.98**	**2.32**	**0.97**
E. reticulatum **X HWX May.**	**10.18**	**8.17**	**31.40**	**28.92**	**2.82**	**2.73**	**1.08**	**1.33**
E. nigrum **X S. WX Feb.**	**9.93**	**8.50**	**39.90**	**32.04**	**10.88**	**6.82**	**2.03**	**1.39**
E. nigrum **X S. WX May.**	**11.13**	**10.0**	**25.55**	**22.0**	**1.82**	**1.45**	**0.95**	**0.55**
E. nigrum **X S.HWX Feb.**	**11.15**	**11.90**	**35.28**	**30.82**	**5.55**	**5.08**	**1.43**	**0.95**
E. nigrum **X S.HWX May.**	**8.90**	**6.75**	**26.50**	**27.55**	**2.87**	**2.95**	**1.48**	**0.88**
E. nigrum **X HW X Feb.**	**8.78**	**8.32**	**34.73**	**32.46**	**3.37**	**6.76**	**0.85**	**1.86**
E. nigrum **X HWX May.**	**8.48**	**8.67**	**22.13**	**24.22**	**1.80**	**1.85**	**0.85**	**0.75**
E. albo marginatum **X S. WX Feb.**	**12.75**	**11.15**	**44.23**	**40.73**	**7.15**	**6.32**	**1.45**	**1.07**
E. albo marginatum **X S. WX May.**	**11.0**	**8.74**	**29.90**	**28.12**	**2.70**	**2.08**	**1.13**	**0.58**
E. albo marginatum **X S.HWX Feb.**	**12.25**	**11.58**	**45.30**	**44.98**	**9.03**	**7.66**	**1.65**	**2.10**
E.albo marginatum **X S.HWX May.**	**8.68**	**9.08**	**26.25**	**26.35**	**4.37**	**3.95**	**1.93**	**0.93**
E. albo marginatum **X HW X Feb.**	**12.50**	**11.73**	**46.0**	**35.77**	**9.90**	**6.17**	**2.38**	**1.29**
E. albo marginatum **X HWX May.**	**9.80**	**9.91**	**28.70**	**29.80**	**3.98**	**3.40**	**1.68**	**0.75**
E. tricolour **X S. WX Feb.**	**12.25**	**9.83**	**38.85**	**33.58**	**3.55**	**4.84**	**1.03**	**1.64**
E. tricolour **X S. WX May.**	**8.45**	**6.25**	**30.97**	**28.87**	**3.15**	**2.65**	**0.73**	**0.83**
E. tricolour **X S.HWX Feb.**	**9.58**	**10.25**	**33.58**	**31.22**	**5.97**	**4.35**	**2.25**	**0.65**
E. tricolour **X S.HWX May.**	**8.40**	**6.50**	**24.55**	**25.42**	**3.30**	**3.02**	**1.28**	**1.13**
E. tricolour **XHWX Feb.**	**9.43**	**9.83**	**34.95**	**34.58**	**5.35**	**3.79**	**2.10**	**0.70**
E. tricolour **X HWX May.**	**8.0**	**5.58**	**26.43**	**29.85**	**2.90**	**2.67**	**1.08**	**1.03**
LSD(P>0.05)	**2.76**	**2.68**	**7.38**	**6.92**	**2.83**	**1.72**	**0.82**	**0.85**

Wiese (2006). While, S.HW. cuttings planted in May had the lowest values (8.73 and 7.60) in the first and second years, respectively .

From Table (7) the interaction between species,cutting type and planting date significantly affected the number of roots . S.W. cuttings of *E. reticulatum* planted in February recorded the highest root numbers 15.33 and 14.60 in the first and second years, respectively. While , H.W. cuttings of *E. tricolor* planted in May recorded the lowest root numbers (8.0 and 5.58) in the first and second seasons, respectively **.**

3.2.2.Length of roots per cutting (cm)

Species showed significant variation in the length of roots in Table (5) , the findings are in conformity with the work of Zalesny and Wiese (2006) ,the maximum length (36.73 and 34.29 cm) were recorded in cuttings of *E. albo-marginatum* in the first and second seasons, respectively .There were no significant differences in cutting type in the second year, However, no significant differences were observed between S.W. cuttings which recorded the maximum length (35.09cm) and H.W. cutting in the first season (33.64 cm) Table (5), Whereas, Christopher *et al*.(2004) stated that cutting type had significant effect. The length of roots was significantly affected by planting date Table (5). These are in line with the results obtained by Yoo *et al*. (1996) who reported that planting date caused significant difference in root length , the greater root lengths (39.82 and 34.84 cm) were noticed in February.The interaction of species and cutting type was found to be significant Table (6). The length of roots was maximum in H.W. cuttings of *E. reticulatum* in the first year and with S.H.W. cutting of *E.albo-marginatum* in the second year which produced (38.10 and 35.66 cm) in the first and second years, respectively. Table (6) indicated that the interaction between species and planting date significantly affected the root length. The longest root lengths (45.17 and 40.49 cm) were recorded in cuttings of *E. albo-marginatum* planted in February , while ,the least values (24.73 and 24.59cm) were recorded in cuttings of *E. nigrum* planted in May in the first and second years respectively .The interaction between cutting type and planting

date had significant effect on the length of roots. Table (6) .The data showed that S.W. and S.HW. cuttings in February plantation produced the longest root lengths (41.46 and 36.05cm) in the first and second years, respectively .

The interaction between species , cutting type and planting time significantly affected the length of the roots Table (7) , longest roots (46.0 and 44.98cm) were produced with H.W. and S.HW. cuttings of *E. albo-marginatum* planted in February in the first and second years, respectively .

3.2.3.Fresh and dry weight of roots (gm)

It was revealed from Table (5) that fresh and dry weight of roots were significantly affected by species. Zalesny and Wiese (2006) also made similar observation, *E. reticulatum* and *E.albo-marginatum* achieved the highest root fresh weights (6.40 and 6.19gm) and the highest dry weight (1.48 and 1.70gm) in the first year ,while the higthest fresh weight of roots in the second year (5.0 and 4.93gm) and the highest dry weight of roots in the second year were 1.69 and 1.12gm, respectively . Table (5) showed that cutting type did not have any significant effect on fresh and dry weight of roots in the first year. However , significant effect on fresh weight of roots was noticed in the second year which is in close conformity to the finding of Laura *et al*. (1994). Table (5) revealed that planting date had significant effect, the highest fresh and dry weights (7.39 and 1.72gm) were obtained in the first year and 6.0 and 1.43gm in the second one in February plantation .The differences in the weight of roots might be due to the fact that as the cuttings planted in February got favorable climatic condition hence, increased the number of roots and root length were recorded which resulted in heavier root weight . Table (6) showed that there was significant interaction of species and cutting type. More fresh and dry weight were achieved in H.W. and S.HW. cuttings of *E. albo-marginatum* and *E. reticulatum* in the first and second years, respectively . The interaction between species and planting date was significant. Table (6) indicated that cuttings of *E. reticulatum* and *E.albo-marginatum* planted in February achieved the highest fresh and dry weight of roots in the first season, while the least value of fresh and dry weight was noticed in cuttings of *E. tricolor* and *E. nigrum* planted in May in both years . The interaction between type of cutting and planting date was also found to be significant , similar to the finding of Kraiem *et al*.(2010) . Table (6) indicated that S.W. cuttings in February plantation recorded the highest fresh weight of roots while the highest dry weight of roots was obtained with H.W. cutting planted in Feb. in the first season followed by S.W. cutting planted in Feb. in the second year.

Table (7) showed that the three factors interaction between species , cutting type and planting date had significant effect ,(Zalesny and Wiese, 2006). They also obtained similar results. H.W. and S.HW. cuttings of *E. reticulatum* in February plantation recorded the highest fresh weight (10.98 and 7.93gm) in, the first and second years, respectively , while the highest dry weight (2.38 and 2.32gm) recorded in H.W. and S.HW. cuttings of *E. albo-marginatum* and E. *reticulatum* planted in February in the first and second years, respectively .

3.3.Vegetative growth

3.3.1.Number of shoots per cutting

The results in Table (8) indicated that species had significant effect on the number of shoot, cuttings of *E.albo-marginatum* produced the highest number of shoots (4.20 and 3.32/ cutting) while,cuttings of *E. reticulatum* produced the lowest number of shoots (2.87 , 2.33) in both seasons, respectively . There were significant differences in cutting type on the average number of shoots produced , the number of shoots produced from H.W. and S.H.W. were not significantly different from each other but was higher than the number obtained from S.W cuttings Table (8) .These are in the line of the results obtained by Agbo and Obi (2007) on *Gongronema latifolia*. This implies that the cutting from basal part develops more shoots probably because of its higher carbohydrate reserve .The planting date also had significant effect , May plantation produced the highest number of shoots(3.64 and 3.52/ cutting) in the first and second seasons, respectively Table (8) .

The interaction between species and cutting type had significant effect, *E. albo- marginatum* with H.W and S.HW produced the highest number of shoots (4.91 and 4.75) in the first season and (4.20 and 4.17) in the second one, respectively Table (9). Significant effect between species and planting date was also observed , *E.albo-marginatum* and *E. tricolor* planted in May produced the highest number of shoots (4.62 and 4.20) and (3.89 and 3.97) in the first and second seasons, respectively Table (9).

The interaction between cutting type and planting time (Table 9) showed that H.W.

Table (8): Single effect of species , stem cutting type and planting date on the vegetative parameters per cutting.

Treatments	vegetative parameters					
	Number of shoots		Length of longest shoot (cm)		Number of leaves	
	First year	Second year	First year	Second year	First year	Second year
Species						
E. reticulatum	**2.87**	**2.33**	**16.34**	**14.60**	**22.08**	**17.50**
E. nigrum	**2.95**	**2.36**	**17.73**	**17.81**	**23.19**	**18.38**
E. albo marginatum	**4.20**	**3.32**	**14.30**	**13.22**	**28.86**	**25.05**
E. tricolour	**3.44**	**3.04**	**20.38**	**14.89**	**32.16**	**25.90**
LSD(P>0.05)	**0.63**	**0.56**	**2.22**	**1.75**	**3.40**	**2.59**
cutting type						
S. W	**2.41**	**1.60**	**16.61**	**15.15**	**20.74**	**17.0**
S.HW	**3.75**	**3.23**	**17.65**	**16.16**	**28.15**	**22.92**
HW	**3.93**	**3.46**	**17.31**	**14.08**	**30.83**	**25.19**
LSD(P>0.05)	**0.54**	**0.40**	**n.s.**	**1.51**	**2.94**	**2.24**
planting date						
February	**3.09**	**2.01**	**18.22**	**14.05**	**26.51**	**17.54**
May.	**3.64**	**3.52**	**16.16**	**16.20**	**26.64**	**25.88**
LSD(P>0.05)	**0.44**	**0.40**	**1.57**	**1.24**	**n.s.**	**1.83**

Table (9): Interaction effect between species ,stem cutting type and planting date on the vegetative parameters per cutting (Interaction between two factors).

Treatments	vegetative parameters					
	Number of shoots		Length of longest shoot (cm)		Number of leaves	
	First year	Second year	First year	Second year	First year	Second year
Species x Cutting type						
E.reticulatum **X S. W**	**2.09**	**1.34**	**16.05**	**16.16**	**20.04**	**16.41**
E. reticulatum **X S.HW**	**3.39**	**2.76**	**15.44**	**14.68**	**23.54**	**17.0**
E. reticulatum **X HW**	**3.14**	**2.90**	**17.54**	**12.95**	**22.66**	**19.08**
E.nigrum **X S. W**	**1.86**	**1.39**	**15.70**	**16.08**	**17.50**	**22.37**
E. nigrum **X S.HW**	**3.12**	**2.62**	**21.23**	**20.29**	**26.53**	**19.45**
E. nigrum **X HW**	**3.85**	**3.09**	**16.28**	**17.06**	**25.55**	**22.37**
E.albo marginatum **X S. W**	**2.95**	**1.60**	**13.37**	**14.01**	**19.34**	**17.95**
E. albo marginatum **X S.HW**	**4.75**	**4.17**	**14.70**	**13.35**	**30.11**	**27.07**
E. albo marginatum **X HW**	**4.91**	**4.20**	**14.84**	**12.30**	**37.13**	**30.12**
E.tricolour **X S. W**	**2.75**	**2.07**	**21.32**	**14.33**	**26.09**	**20.33**
E. tricolour **X S.HW**	**3.74**	**3.38**	**19.24**	**16.33**	**32.41**	**28.16**
E. tricolour **X HW**	**3.82**	**3.68**	**20.57**	**14.01**	**37.98**	**29.20**
LSD(P>0.05)	**1.09**	**0.98**	**3.84**	**3.03**	**5.88**	**4.49**
Species x Planting date						
E. reticulatum **X Feb.**	**2.47**	**1.64**	**18.58**	**12.99**	**23.49**	**13.83**
E. reticulatum **X. May.**	**3.27**	**3.02**	**14.10**	**16.20**	**20.67**	**21.17**
E. nigrum **X Feb.**	**3.11**	**1.86**	**18.94**	**19.69**	**26.14**	**16.57**
E. nigrum **X May.**	**2.78**	**2.87**	**16.53**	**15.93**	**20.24**	**20.19**
E. albo marginatum **X Feb.**	**3.78**	**2.44**	**13.68**	**10.24**	**25.13**	**21.0**
E. albo marginatum **X May.**	**4.62**	**4.20**	**14.93**	**16.20**	**32.58**	**29.10**
E. tricolour **X Feb.**	**2.98**	**2.11**	**21.68**	**13.30**	**31.27**	**18.75**
E. tricolour **X May.**	**3.89**	**3.97**	**19.07**	**16.48**	**33.05**	**33.05**
LSD(P>0.05)	**0.89**	**0.80**	**3.14**	**2.47**	**4.80**	**3.66**
Cutting type x Planting date						
S. W X Feb.	**1.76**	**0.21**	**16.26**	**13.13**	**19.06**	**12.68**
S. W X May.	**3.06**	**2.99**	**16.97**	**17.16**	**22.42**	**21.33**
S.HW X Feb.	**3.76**	**2.84**	**18.19**	**15.27**	**27.85**	**18.98**
S.HWX May.	**3.74**	**3.63**	**17.11**	**17.06**	**28.44**	**26.87**
HW X Feb.	**3.74**	**3.0**	**20.21**	**13.76**	**32.61**	**20.96**
HW X May.	**4.13**	**3.93**	**14.40**	**14.39**	**29.04**	**29.43**
LSD(P>0.05)	**0.77**	**0.69**	**2.72**	**2.14**	**4.16**	**3.17**

Table (10): Interaction effect between species ,stem cutting type and planting date on vegetative parameters per cutting (Interaction between three factors together).

Treatments	Vegetative parameters					
	Number of shoots		Length of longest shoot (cm)		Number of leaves	
	First year	Second year	First year	Second year	First year	Second year
E. reticulatum **X S. WX Feb.**	**1.25**	**0.00**	**16.63**	**13.43**	**20.57**	**11.50**
E. reticulatum **X S. WX May.**	**2.92**	**2.67**	**15.48**	**18.90**	**19.50**	**21.32**
E. reticulatum **X S.HWX Feb.**	**3.57**	**2.35**	**17.18**	**14.09**	**25.75**	**14.33**
E. reticulatum **X S.HWX May.**	**3.20**	**3.17**	**13.70**	**15.28**	**21.32**	**19.67**
E. reticulatum **X HW X Feb.**	**2.60**	**2.57**	**21.95**	**11.47**	**24.15**	**15.66**
E. reticulatum **X HWX May.**	**3.67**	**3.22**	**13.13**	**14.43**	**21.17**	**22.50**
E. nigrum **X S. WX Feb.**	**1.72**	**0.25**	**15.52**	**17.10**	**18.92**	**11.46**
E. nigrum **X S.FWX May.**	**2.0**	**2.52**	**15.88**	**15.08**	**16.07**	**15.17**
E. nigrum **X S.HWX Feb.**	**3.75**	**2.83**	**22.30**	**20.48**	**29.58**	**17.08**
E. nigrum **X S.HWX May.**	**2.50**	**2.40**	**20.15**	**20.10**	**23.48**	**21.82**
E. nigrum **X HW X Feb.**	**3.85**	**2.50**	**19.0**	**21.49**	**29.92**	**21.17**
E. nigrum **X HWX May**	**3.85**	**3.67**	**13.55**	**12.63**	**21.17**	**23.57**
E. albo marginatum **X S. WX Feb.**	**2.08**	**0.17**	**12.70**	**9.13**	**13.25**	**14.84**
E. albo marginatum **X S. WX May.**	**3.82**	**3.03**	**14.05**	**18.90**	**25.42**	**21.07**
E. albo marginatum **X S.HWX Feb.**	**4.18**	**3.75**	**13.80**	**11.42**	**24.98**	**24.75**
E.albo marginatum **X S.HWX May.**	**5.32**	**4.60**	**15.60**	**15.28**	**35.25**	**29.40**
E. albo marginatum **X HW X Feb.**	**5.10**	**3.42**	**14.53**	**10.17**	**37.18**	**23.42**
E. albo marginatum **X HWX May.**	**4.72**	**4.97**	**15.15**	**14.42**	**37.07**	**36.83**
E. tricolour **X S. WX Feb.**	**2.0**	**0.42**	**20.17**	**12.89**	**23.50**	**12.92**
E. tricolour **X S. WX May.**	**3.50**	**3.73**	**22.47**	**15.78**	**28.67**	**27.75**
E. tricolour **X S.HWX Feb.**	**3.55**	**2.42**	**19.50**	**15.08**	**31.10**	**19.75**
E. tricolour **X S.HWX May.**	**3.92**	**4.35**	**18.98**	**17.58**	**33.73**	**36.57**
E. tricolour **XHWX Feb.**	**3.40**	**3.50**	**25.37**	**11.92**	**39.20**	**23.58**
E. tricolour **X HWX May.**	**4.25**	**3.85**	**15.77**	**16.10**	**36.75**	**34.82**
LSD(P>0.05)	**1.53**	**1.39**	**5.43**	**4.28**	**8.32**	**6.35**

cuttings planted in May had the highest number of shoots (4.13 and 3.93) in the first and second seasons, respectively, while, S.W. cuttings planted in February produced the least number of shoots (1.76 and 0.21) in both years, respectively . Table (10) indicated that the three factors interaction significantly affected the number of shoots , the highest number (5.32 and 4.97) were produced with S.HW and H.W cuttings of *E.albo-marginatum* planted in May in the first and second seasons, respectively.

3.3.2.Length of the longest shoot per cutting(cm)

Table (8) showed that species were significantly different from each other in both seasons , it is noticed that it was the longest (20.38cm) in *E. tricolor* in the first year and (17.81cm) in *E.nigrum* in the second season. With regard to the type of cutting, significant differences were recorded . S.HW. produced the longest shoot (17.65 and 16.16 cm) in both seasons, respectively (Table 8) . The present result differs from the finding of Agbo and Obi (2007) on *Gongronema latifolia* who observed that H.W. cuttings had the longest shoot length .The significant effect of planting date was observed , which is in close conformity to the finding of Bannister and Watt (1995) on *Crataegus monogyna*. It was revealed from Table (8) that the greatest length (18.22 and 16.20cm) were achieved when cuttings were planted in February in the first year and in May plantation in the second,respectively. The obtained data revealed that the responses to the interaction between species and cutting type was significant Table (9) *E. tricolor* with S.W. cuttings gave the longest shoot length (21.32cm) in the first year, however, *E. nigrum* with S.HW. cuttings gave the longest shoot length (20.29cm) in the second season . Interaction between species and planting date had significant effect Table (9). *E. tricolor* and *E. nigrum* cuttings planted in February recorded the longest shoot length (21.68 and 19.69cm) in the first and the second seasons , respectively , while the lowest length of shoots (13.68 and 10.24) in *E.albo-*

marginatum were noticed in Feb. plantation. This might be due to that some species have different shoot length at different planting dates . Table (9) shows the interaction between cutting type and planting time significantly affected the longest shoot length. February plantation with H.W cuttings produced the longest shoot (20.21cm) in the first season , followed by May plantation with S.W. and S.HW. cuttings which produced the shoot length(17.16 and 17.06cm), in the second year, respectively.

Data in Table (10) revealed that the three factors interaction was significantly different among the treatments , the longest shoot length (25.37 and 21.49 cm) were produced with H.W. cuttings of *E. tricolor* and *E. nigrum* planted in February, in the first and second seasons, respectively .

3.3.3.Number of leaves per cutting

Table (8) showed that the number of leaves was observed to be affected significantly by species. This result does not agree with the finding of Aminul *et al*.(2010) , it was the highest (32.16 and 25.90) for *E. tricolor* in both years respectively . Significant effect of cutting type was noticed , H.W. cuttings gave the highest number of leaves (30.83 and 25.19) in both seasons respectively Table (8). Similar results were obtained by Agbo and Obi (2007) . The highest number of leaves may be due to increased shoot development coupled with higher food reserve in hard wood cutting which resulted in significant higher number of leaves . Significant effect of planting date was observed in the the second year , it was the highest (25.88) in May plantation (Table 8). The data in Table (9) indicated that the interaction effect between species and type of cutting significantly effected the number of leaves. H.W. cuttings of *E. tricolor* and *E.albo-marginatum* produced the highest number of leaves (37.98 and 30.12) in the first and second years ,respectively . While, *E. nigrum* and *E.recticulatum* with S.W cuttings produced a minimum number of leaves (17.50 and 16.41) in the first and second seasons , respectively. The interaction effect between species and planting time (Table 9) was also found to be significant. *E. tricolor* cuttings planted in May resulted in more leaves (33.05 , 33.05) in both years, respectively. Perusal of Table (9) revealed that interaction effect between cutting type and planting date on the number of leaves concerned H.W. cuttings planted in February and May. produced the highest number of leaves (32.61 and 29.43) in the first and second years , respectively .

As far as the interaction between species, type of cutting and planting time were significantly effected Table (10) , H.W. cuttings of *E. tricolor* in February and *E.albo-marginatum* planted in May produced the highest number of leaves (39.20 and 36.83) in the first and second years, respectively.

Conclusion and Recommendation: It can be concluded that various species propagated through different types of stem cutting in different planting dates exhibited variability in rooting percentage and developed cuttings and can be important to multiply *Eranthemum* plant . The study suggests that the vegetative propagation of *Eranthemum* species of *E. albo-marginatum* and *E. nigrum* could be achieved by semi- hard wood cuttings , while *E. nigrum* by hard wood and semi- hard wood cuttings , However, vegetative propagation of *E. reticulatum* could be achieved by any type of cuttings particularly when cuttings of all species are planted in February.

4. REFERENCES

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تأثير النوع النباتى ، نوع العقلة الساقية وموعد الزراعة على التكاثر الخضري لنبات الكروتون *Eranthemum* sp.

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ملخص

ينتمى نبات *Eranthemum* للعائلة Acanthaceae التي تضم 15 نوعا ويطلق على النبات محليا اسم الكروتون وهو يعتبر من شجيرات الزينة التي يكثر استخدامها في الحدائق العامة والخاصة في اليمن ، يصل ارتفاع النبات من 1-2 متر وتجود زراعته في المناطق الحارة والرطبة ، تنمو وتزهر بشكل جيد تحت ظروف الظل وشبه الظل ، لا تنتج الشجيرات بذورا لذا فان الشائع إكثارها بالعقل الساقية الطرفية . ولدراسة تأثير بعض العوامل وتداخلها على تجذير ونمو العقل الساقية فقد أجريت هذه التجربة في كلية ناصر للعلوم الزراعية خلال الفترة من 2008-2009 لدراسة تأثير نوع العقل الساقية وموعد الزراعة على أربعة أنواع من نبات *Eranthemum* . تضمنت التجربة ثلاثة معاملات هي: أربعة أنواع نباتية من نبات *Eranthemum* sp. و هى: *E.reticulatum* و *E. nigrum* و *E.albo-marginatum* و *E. tricolor* ، ثلاثة أنواع من العقل الساقية هي العقل الغضة – العقل نصف الخشبية – العقل الخشبية ، وموعدين للزراعة هما موعد فبراير وموعد مايو . أظهرت النتائج أن تأثير التداخل بين المعاملات المختلفة على نسبة التجذير كان 100% في العقل الغضة في الأنواع *E.albo-marginatum* , *E. nigrum* , *E. reticulatum* التي زرعت في موعد فبراير بينما أعطى النوع *E. tricolor* أعلى نسبة تجذير (95.0 ، 97.5 %) عند استخدام العقل نصف الخشبية. كما أظهرت الدراسة إن الزراعة في موعد فبراير مناسبلتكوين الجذور ، حيث لوحظ أن اكبر عدد للجذور (15.33 ، 14.60) نتج من العقل الغضة في النوع *E. reticulatum* ، بينما اكبر طول للجذور(44.80 و 44.98 سم) واكبر وزن طازج (10.98 و 7.93جم) واكبر وزن جاف (2.38 و2.32 جم) كان في العقل الخشبية والعقل نصف الخشبية للنوع *E. reticulatum* وللنوعين *E.albo-marginatum* و *E. reticulatum* على التوالي . اظهر نمو العقل الناضجة (الشتلات) أن أكبر عد د للأفرع (5.32 و4.97) كان عند استخدام العقل نصف الخشبية والخشبية في النوع *E.albo-marginatum* في موعد مايو ، بينما أقل عدد للأفرع (1.25 ، 0.0) كان عند استخدام العقل الطرفية في النوع *E.reticulatum* في موعد فبراير ، ولوحظ أن اكبر طو ل لأطول فرع (25.37 و 21.49 سم) كان فى العقل الخشبية للنوع *E. nigrum* و *E. tricolor* في موعد فبراير ، بينما اكبر عدد لـلأوراق (39.20 فى الموسم الأول ، 36.83 فى الموسم الثانى نتج من العقل الخشبية في النوع*E.albo-marginatum* *E.tricolor* و في موعد فبراير ومايو على التوالى .

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