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EVALUATION OF VEGITATIVE GROWTH AND COMPARATIVE STUDIES OF BIOMASS OF SOME *Eucalyptus species* SEEDLINGS PLANTED IN DIFFERENT GROWING MEDIA

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ABSTRACT

This trial was carried out at Experimental area of Ornamental Plants Department Faculty of Agriculture Cairo University throughout two successive seasons of 1996 and 1997. Four months uniform seedlings of 4 introduced *Eucalyptus species* namely *Eucalyptus incana, E.camaldulensis, E.citriodora* and *E.gomphocephala* were planted in 4 different growing media i.e. sand, clay, the mixture of them 1:1 and 2:1 (v/v).

The obtained results demonstrated that the mixture of sand and clay 1:1(v/v) enhanced the growth parameters viz. plant height, leaves area, root length, fresh and dry weight of stems and fresh weight of roots where the increases were 10.4, 62.09, 27.99, 99.2, 17.3, and 44.2% respectively attributed to those detected corresponding to sandy growing media while seedlings growing in clay media gave the superior values in stem diameter, branches number, fresh and dry weight of leaves and dry weight of roots since the increases attained 11.6, 52.15, 53.5, 52.3, and 51.0% respectively more than sandy soil which diminished all growth parameters. Mixture of 2:1 resulted in the intermediate values irrespective the effect of different species. Biomass of both *E.gomphocephala* and *E. incana* increased to maximized values due to clay or the mixture of 1:1 (v/v) whereas the mixture of 2:1 or clay media enhanced much more the biomass of *E. citriodora*. On the other hand *E. camaldulences* had the superior biomass due to the mixture of 1:1 or 2:1.

Evaluation of *Eucalyptus species* revealed that *E. camaldulensis* had the best values in plant height and fresh and dry weight of roots. *E. gomphocephala* pronounced the maximum values in branches number, root length and fresh and dry weight of leaves, branches, and stems. *E. incana* had the superior values in stem diameter while *E. citriodora* gave the least values of growth with leaf area exception.

From the heretofore results it can be concluded that *E. camaldulensis* seedlings should be planted in the mixture of sand and clay at portion 1:1 or 2:1(v/v). Both of *E.incana and E. gomphocephala* being best in clay or the mixture of 1:1whereas *E. citriodora* preferable to be planted in the mixture of 2:1(v/v)

Clay and the mixture of sand and clay 1:1 media performed the highest values of chlorophyll A, B and total sugars compared with those of sandy soil which declined them. Leaves of *E. gomphocephala* contained highest chlorophylls.

Therefore it might be recommended to improve the physical and chemical properties of sandy media by adding clay as portion of 1:1 or 2:1 and also to enhance the traits of clay media by adding sand to make a suitable growing media

INTRODUCTION

The genus of Eucalyptus belong to Myrtaceae family and it well represented in Australia, widely distribution in the warmer parts of the world and extend from moist coastal to deserts area and from cool temperature to equatorial climates.

There are some familiar of *Eucalyptus species* introduced into Egypt and planted increasingly as exotic trees viz: *Eucalyptus camaldulensis* Dehn, *E. citriodora* Hook, *E.gomphocephala* Dc and new *Eucalyptus incana*. *Eucalyptus camaldulesis* is the most wide spread species in the genus to be used for rehabilitation of moderately saline sites Criag *et al* (1990) and for the stabilization of sand dunes, as windbreaks and shelter belts as well as the numerous species of trees are useful for planting. In hospitable environment

The wood is hard and durable and has been used for many purposes, including railway sleeper, flooring fencing, plywood, veneer, turnery and firewood, the trees are good producers of pollens and nectar for honey.

Because of increasing the desert lands as a sandy soil in which the sand is the major component and poor in nutrient content, many investigations were conducted to improve the characteristics of sandy soils by mixing it by clay. In this respect, Shehata (1972) on *Eucalyptus camaldulensis* and *Casuarina equisetifolia* and El-Bana (1979) on *E. camaldulensis, Casuarina. cunninghamiana*, *Tipuana speciosa* and *Taxodium distichum* cleared that the tallest seedlings and heaviest dry weight obtained in clay soil but the least values exhibited in sandy soil. El Tantawy (1981) found that the mixture of sand + clay (1:1) improved the vegetative growth of *Casuarina equisetifolia* and *Cupressus sempervirens* compared to sandy soil. El-Khteeb(1983) recorded similar results on *Eucalyptus torquata* and *Eucalyptus angulosa*, also Farahat (1986) on *Eucalyptus camaldulensis* pointed out that the mixture of sand and clay produced the best vegetative growth compared to sand soil, Gupta *et al* (1986) demonstrated that clay soil improved the vegetative growth of *E. tereticornis*

Mohamed, (1993) on some ornamental plants indicated that the mixture of sand + clay (1:1) had an effect on increasing plant height, and fresh and dry weight of roots, stems and leaves

MATERIALS AND METHODS

This trial was carried out at the Experimental area of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University in two successive seasons of 1996 and 1997

The objectives of this investigation are the classification and evaluation of vegetative growth for some introduced *Eucalyptus species* viz. *Eucalyptus incana* *E.cmaldulensis,E .citriodora* and *E. gomphocephala* seedlings growing in different media namely, sand, clay, and the mixture of both at 1:1 and 2:1 (v/v) and to determine the biomass of plants through the experiment period.

Four months old uniform seedlings *of Eucalyptus species* were planted individually on February, 1st 1996 and 1997 in 30 cm (diameter) plastic pots.

The physical and chemical analysis of these growing media (Table, A) were performed as described by Piper (1947)

The soil surface was covered with sheets of thick polyethylene to prevent the penetration growing roots into soil under pots. The following data were recorded after 10 months from seedlings planting

Table (A) Physical and Chemical Analysis of used growing media

Analysis	Sandy	Clay	1:1	2:1
Coarse sand %	40.30	11.10	29.60	36.40
Fine sand %	47.80	37.90	33.50	40.80
Clay %	5.30	38.40	26.70	15.60
Silt %	6.60	12.60	10.20	7.20
E.C.(mmhos /cm)	0.36	0.31	0.73	0.42
pH	7.70	8.00	7.90	7.80
Field capacity	28.00	42.00	36.00	32.
Mineral content (ppm)				
Nitrogen	11.3	52.7	33.4	26.3
Phosphorus	16.5	37.4	22.2	18.6
Potassium	2.3	5.7	6.4	5.5
Sodium	53.8	73.5	68.2	59.7
Calcium	43.5	54.1	48.3	45.6
Magnesium	26.6	38.4	31.8	29.4

I-Vegetative growth

1 -Plant height (cm)

2 -Stem diameter (mm)

3- Leaf area (cm^2) where samples of *Eucalyptus species* leaves were taken from the medium part of seedling. Each sample comprise 30 leaves from each treatment the leaf area was estimated by a plane meter

4- Branches number/ plant

5- Root length (cm) where the roots were carefully washed and the root length have determined from soil surface to the farthest point

6- Fresh and dry weight (g) of leaves, stems and roots were determined

7-Biomass of seedlings was determined for the different *Eucalyptus species* (g/plant).

II-Chemical composition

1-Chlorophyll A and B content in leaves were determined (mg/g F.W) according to Saric (1976)

2-Total sugars percent in leaves were determined by method of Smith *et al* (1956)

The lay out of the experiment was completely randomized design of two affecting factors (4 growing media and 4 species of *Eucalyptus*). Each treatment embodied 30 plants in 3 replicates. The statistical analysis of mean values were conducted by L.S.D according to Steel and Torrie (1980)

Table (1) :Effect of growing media on plant height (cm), stem diameter (mm) and leave area (cm^2) of some *Eucalyptus species* in 1996 and 1997 seasons

H1996															
Grown media (A)	Plant height (cm)					Stem diameter (mm)					Leave area (cm^2)				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean
E. incana	86.88	84.26	89.98	92.84	88.49	11.50	13.02	11.67	9.93	11.53	8.53	6.93	13.29	11.05	9.95
E. camaldulensis	107.20	116.36	122.30	101.28	111.79	11.04	12.44	10.24	11.14	11.21	5.17	11.88	11.35	9.05	9.36
E. citriodora	89.56	117.73	91.80	99.03	99.53	9.71	10.88	10.74	10.31	10.41	11.50	14.93	22.58	16.59	16.40
E.gomphocephala	73.26	75.07	90.10	85.42	80.96	10.36	11.24	10.84	10.97	10.84	13.00	17.85	17.95	14.45	15.85
Mean	89.22	98.35	98.54	95.37		10.65	11.89	11.37	11.33		10.05	12.89	16.29	13.53	
L.S.D at 0.05 for (A)			2.30				1.82				2.17				
L.S.D at 0.05 for (B)			2.72				1.91				2.34				
L.S.D at 0.05 for (AxB)			3.46				1.95				2.51				

1997															
Grown media (A)	Plant height (cm)					Stem diameter (mm)					Leave area (cm^2)				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean
E. incana	84.28	84.04	93.40	90.10	87.95	11.11	13.11	11.06	9.60	11.22	9.06	8.12	12.83	10.12	10.03
E. camaldulensis	104.48	112.68	111.17	102.43	107.69	11.34	11.02	11.34	10.55	11.06	5.96	10.82	10.17	10.66	9.40
E. citriodora	82.13	116.56	91.80	93.10	95.85	10.05	10.41	10.30	10.52	10.32	13.08	14.31	22.07	20.67	17.53
E.gomphocephala	72.74	74.86	89.16	85.46	80.55	10.51	11.67	10.07	10.62	10.71	14.12	16.08	17.08	13.20	15.12
Mean	85.90	97.04	96.38	92.77		10.75	11.55	11.19	11.07		11.05	12.33	15.53	14.41	
L.S.D at 0.05 for (A)		2.05					1.74				1.74				
L.S.D at 0.05 for (B)		2.34					1.79				2.91				
L.S.D at 0.05 for (A.B)		3.69					1.93				3.11				

RESULTS AND DISCUSSION

I- Vegetative growth

1- Plant height

Data presented in Table (1) illustrated that using clay soil and the mixture of sand and clay (1:1) or (2:1) as growing media induced the best height of investigated *Eucalyptus species* seedlings in which produced the tallest seedlings(98.35, 98.54 and 95.37 cm respectively) while sandy soil resulted the shortest height 89.22 and 85.9cm in the first and second season respectively regardless the effect of different species and there are significant differences between clay and sandy soils or the mixture while there are no significant differences between clay soil and the mixture of sand and clay either the portion of (1:1) or (2:1) in the first season but in the second one the significance different exhibited between the two later media.

Concerning the species of Eucalyptus, the results presented in Table (1) apparently cleared that *Eucalyptus camaldulensis* seedlings were considerable the tallest 111.79 and 107.69 cm followed by *E.citriodora* 99.53 and 95.85 cm, whereas *E. incana* was the intermediate 88.49 and 87.95 cm. On the other hand *E.gomphocephala* was the shortest seedling 80.96 and 80.55 cm in the first and second season respectively. All the investigated species differed significantly in between in both seasons.

Regarding the interaction between the different species and different growing media the results showed that the differences were highly significant and *E.camaldulensis* seedlings cultivated in mixture of sand and clay (1:1 v/v) were the superior in height 122.3 cm in the first season while *E. citriodora* planted in mixture of sand and clay(1:1 v/v) exhibited the tallest 116.56 cm. in the second one

From the above mentioned results it can be concluded that the mixture of sand and clay (1:1 v/v) gave the preferable results than clay or sand alone, meaning that adding clay to sand improved the characteristics of sandy soil in agreement with the findings of El-Bana (1979) on *E. camaldulensis, Casuarina. cunninghamiana* and *Cupressus sempervirens*, Townsend (1984) on *Gleditcia triacanthos*, Farahat, (1986) on *E. camaldulensis* and Mohamed, (1993) on some ornamental shrubs

2- Stem diameter

Data presented in Table (1) showed that grown media had an effect on stem diameter, the mean values of stem diameter ranged from 10.65mm in sandy soil to 11.89mm in clay soil. Plants grown in clay and mixture of sand and clay 1:1 v/v media produced significantly the thickest stems (11.89 and 11.37mm) respectively compared with those in sandy soil, which gave the thinnest stem 10.65mm.In the second season a similar trend was recorded.

Concerning stem diameter of *Eucalyptus species* it can be noticed from Table (2) that *Eucalyptus incana* seedlings had the thickest stem followed by *E. camaldulensis*, while *E. gomphocephala* was the intermediate the *E. citriodora* was the thinnest stem, and the results were confirmed in both seasons.

Table (2): Effect of growing media on branches number, root length (cm) and fresh weight of leaves on some *Eucalyptus species* in 1996 and 1997 seasons

1996															
Grown media (A)	Branches number					Root length (cm)					Fresh weight of leaves (gm)				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	9.25	10.57	10.60	7.60	9.50	59.50	78.54	62.50	70.50	67.76	28.31	32.80	23.37	20.62	26.27
E.camaldulensis	6.00	11.33	7.25	8.57	8.28	55.45	60.87	73.52	57.14	61.74	30.25	41.56	22.22	22.02	29.01
E. citriodora	4.40	7.00	7.20	5.80	6.10	45.50	43.25	76.45	57.36	55.64	20.98	22.73	18.84	10.05	18.15
E.gomphocephaL	13.80	19.00	15.00	10.33	14.53	69.23	67.15	84.12	104.2	81.18	44.52	90.23	73.30	42.62	70.16
Mean	8.36	12.72	10.01	8.57		58.17	62.45	74.64	72.31		31.02	46.83	34.43	23.82	
L.S.D at 0.05 for (A)		1.60				3.41				1.82					
L.S.D at 0.05 for (B)		1.86				3.36				2.45					
L.S.D at 0.05 for (AxB)		2.11				3.73				2.67					

1997															
Grown media(A)	Branches numbers					Root length (cm)					Fresh weight of leaves (gm)				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	9.80	10.00	9.00	7.00	8.95	46.89	45.78	67.21	69.58	57.36	35.15	42.12	32.69	27.84	34.45
E. camaldulensis	6.50	11.00	9.25	9.00	8.93	66.54	72.21	93.15	63.51	73.85	21.90	46.91	35.94	30.o1	33.69
E. citriodora	5.20	7.16	7.80	5.60	6.44	62.53	53.15	49.36	54.56	54.90	15.07	15.14	14.59	15.82	15.15
E.gomphocephala	13.75	17.66	13.60	12.00	14.25	74.23	97.55	96.25	82.53	87.64	68.49	95.19	97.91	52.17	78.44
Mean	8.81	12.20	9.91	8.90		62.55	67.17	76.49	67.54		52.26	49.84	45.28	31.46	
L.S.D at 0.05 for (A)		1.35				2.64				1.14					
L.S.D at 0.05 for (B)		1.49				3.21				1.59					
L.S.D at 0.05 for (AxB)		1.76				3.85				2.73					

The interaction between different species and soil types it might be observed that *E. incana* planted in clay media produced the thickest stem (13.o2 and 13.11mm) in both seasons respectively, while *E. citriodora* grown in sandy soil resulted in the thinnest stem 9.71 and 10.o5mm in both seasons.

From the above-mentioned results it can be concluded that clay soil or the mixture of sand+ clay 1:1 (v/v) as a favorable media for *Eucalyptus* planting were in accordance with those obtained by Singh and Sharama (1984) on *Populus ciliata.* Gupta *et al.* (1986) on *Leucaena leucacephala, Peltphorum pterocarum, Eucalyptus tereticornis, Azaderachta indica* and *Albizzia lebbeck*

3-Leaf area

Data of Table (1) indicated that leaf area was affected by growing media as the plants grown in mixture of sand and clay (1:1 v/v) and (2:1 v/v) media produced significantly the largest average leaf area 16.29 and 13.53 cm^2 respectively followed by clay media 12.89cm^2 whereas sandy soil reduced leaf area to 10.o5 cm^2. The same trend approximately exhibited in the second season.

Regarding the effect of *Eucalyptus species* on leaf area it can be noticed that *E. citriodora* and *E.gomphocephala* had significantly the biggest leaf area (16.4 and 15.81cm^2 v/v) in first season respectively compared with *E. camaldulensis* and *E. incana* which had the smallest leaf area. The results of the second season have taken the same trend nearly.

The interaction between *Eucalyptuses species* x growing media, the results cleared that *E. citriodora* planted in mixture of sand+ clay (1:1 v/v) resulted the maximum leaf area 22.58cm^2 whereas *E. camaldulensis* planted in sandy soil had the smallest leaf area 5.17 cm^2. The obtained results of the second season were similar to those of the first one.

4-Branches number/ plant

As shown in Table (2) it is evident in the first season that the plants, which planted in clay soil, attained to significantly the maximum mean value (12.72) of branches number/ plant compared to sandy soil which produced the least value of 8.36.

The mixture of sand and clay (1:1 v/v)as growing media gave also branches number/ plant more than those produced from sandy soil. The results of second season have taken the same trend of the first one regardless the effect of different species.

In this regard *E. gomphocephala* had the largest branches number/ plant followed by *E. incana* and *E. camaldulensis* while *E. citriodora* produced the lowest one.

The interaction between *Eucalyptus species* and growing media revealed that *E. gomphocephala* seedlings which were planted in clay soil resulted the highest branches number/ plant while *E. citriodora* seedlings planted in sandy soil had the least value.

5-Root length

Data presented in Table (2) obviously cleared in the first season that grown media had a pronounced effect on root length where the seedlings grown in mixture of sand and clay (1:1 and 2:1 v/v) produced significantly the longest roots 74.64 and 72.31 cm respectively compared to those obtained from clay media which had the intermediate value of 62.45 cm, whereas sandy soil gave the shortest roots of 58.17 cm. These results were emphasized in second season as the same trend was found nearly.

The former results coincided with those obtained by Singh and Sharama (1984) on *Populus ciliata,* Witt (1987) on *Taxus baccata* where all of them confirmed that root length improved by adding clay or peat moss to sandy soil.

As for the *Eucalyptus species*, the results indicated that the longest roots appeared in *E.gomphocephala* 81.18 cm followed by *E.incana* 67.76 cm whereas *E.camaldulensis* was the intermediate and *E. citriodora* had the shortest roots.

Concerning the interaction between *Eucalyptus species* x growing media the results illustrated that the differences were highly significant and *E.gomphocephala* planted in mixture of sand and clay (2:1 v/v) had the longest roots 104.25 cm while *E. citriodora* grown in clay soil resulted in the shortest roots 43.25 cm

6-Fresh and dry weight of leaves

It is cleared from Table (2) that both fresh and dry weight of leaves was significantly the heaviest in clay soil (46.83and 49.84 gm) for fresh weight and (15.32 and 15.10 gm) for dry weight in first and second season respectively compared with those obtained by sandy soil which produced the lightest fresh (30.51 and 35.15) and dry weight (10.06 and 11.49 gm) while the mixture of sand and clay either I: 1 or 2:1 (v/v) resulted in the intermediate in fresh and dry weight.

Concerning the effect of *Eucalyptus species,* the results showed that *E.gomphocephla* gave significantly the heaviest fresh (70.16 and 80.94 gm) and dry weight (20.53 and 25.39 gm) in both season respectively compared with the others species, while both of *E.camaldulensis* and *E. incana* had the intermediate values, meantime, *E. citriodora* had the lightest fresh (18.15 and 15.16 gm) and dry weights (8.47 and 8.09 gm) in both seasons regardless the effect of different soils.

In this regard, the interaction between *Eucalyptus species* and growing media, it can be concluded that *E. gomphocephala* grown in either clay or the mixture of sand and clay 1:1 v/v produced the heaviest fresh and dry weight.

The previous results were in harmony with the findings of Mohamed (1993) on some ornamental plants that reported that the mixture of sand and clay 1:1 v/v had an effect on increasing fresh and dry weight of leaves.

7-Fresh and dry weight of stem

Data of Tables (3,4) illustrated that grown media was more effective on fresh and dry weights of stem where the mixture of sand and clay media 1:1v/v resulted in significantly the heaviest fresh (68.91 and 61.34 gm) and dry weight (22.71 and 20.33 gm) in first and second season respectively

Table (3): Effect of growing media on fresh weight of stems and roots(g/plant) of some *Eucalyptus species* in 1996 and 1997 seasons

1996															
Grown media (A)	Fresh weight of branches					Fresh weight of stems (gm)					Fresh weight of roots				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	11.02	17.47	27.87	10.37	16.68	24.35	49.00	64.88	39.34	44.39	39.60	58.86	28.11	31.87	39.61
E. camaldulensis	13.67	11.95	11.08	22.04	14.68	39.26	64.14	57.59	89.97	62.74	60.58	52.48	102.22	47.46	65.68
E. citriodora	3.59	3.77	3.40	6.72	4.37	35.64	47.05	57.60	67.10	51.84	28.55	65.87	42.34	51.28	48.26
E.gomphocephala	24.02	19.79	10.11	17.52	17.86	39.15	90.40	95.58	31.07	64.05	40.16	84.99	35.15	55.15	53.80
Mean	13.07	13.24	13.11	14.16		34.60	62.64	68.91	56.87		42.22	65.55	53.21	46.44	
L.S.D at 0.05 for (A)			N.S			3.51				3.47					
L.S.D at 0.05 for (B)			2.37			3.84				3.55					
L.S.D at 0.05 for (AxB)			2.85			4.12				3.84					

1997															
Grown media (A)	Fresh weight of branches (gm)					Fresh weight of stems (gm)					Fresh weight of roots				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	18.76	18.25	23.36	19.97	20.08	26.35	50.58	54.31	40.50	42.93	39.12	55.25	32.41	38.66	41.36
E. camaldulensis	14.55	14.15	13.02	23.06	16.19	42.07	63.68	50.40	84.23	60.10	52.14	44.27	113.18	53.19	65.69
E. citriodora	2.14	3.40	3.91	5.20	3.66	42.33	37.60	40.60	76.53	49.27	35.80	70.54	31.15	58.39	48.97
E.gomphocephala	17.52	23.30	15.86	10.97	16.91	32.61	80.10	100.06	36.14	62.23	30.40	82.15	65.26	55.56	58.34
Mean	13.24	14.77	14.03	14.80		35.83	57.99	61.34	59.35		39.36	63.05	60.50	52.20	
L.S.D at 0.05 for (A)			N.S			3.84				3.84					
L.S.D at 0.05 for (B)			2.41			3.85				3.72					
L.S.D at 0.05 for (AxB)			2.61			4.29				3.96					

Table (4): Effect of growing media on dry weight of leaves, stems and roots (g/plant) of some *Eucalyptus species* in1996 and 1997 seasons

1996															
Grown media (A) / Species (B)	Dry weight of leaves (gm)					Dry weight of stems (gm)					Dry weight of roots (gm)				
	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	9.43	10.93	7.44	6.87	10.91	8.21	16.11	21.62	13.15	14.77	13.20	18.65	10.62	9.27	12.93
E. camaldulensis	10.00	13.58	7.30	7.34	9.55	13.18	21.38	19.10	29.30	20.74	20.00	17.30	34.17	15.52	21.74
E. citriodora	6.32	7.37	2.97	17.21	8.47	11.75	15.68	18.80	22.17	17.10	9.41	20.95	15.51	15.16	15.25
E.gomphocephala	14.52	29.41	24.11	14.00	20.53	13.50	30.13	31.35	10.22	21.30	13.18	27.33	11.21	18.18	17.74
Mean	10.06	15.32	10.45	11.34		19.36	20.82	22.71	18.71		13.94	21.05	18.37	15.28	
L.S.D at 0.05 for (A)		1.21				1.72					1.92				
L.S.D at 0.05 for (B)		1.96.				1.85					2.14				
L.S.D at 0.05 for (AxB)		2.26				2.29					2.48				

1997															
Grown media (A) / Species (B)	Dry weight of leaves (gm)					Dry weight of stems (gm)					Dry weight of leaves (gm)				
	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	11.73	9.28	10.89	13.14	11.26	8.34	16.20	18.00	14.66	14.30	13.14	18.14	10.12	12.55	13.48
E. camaldulensis	7.30	15.25	11.98	10.00	11.13	13.17	21.30	16.64	28.31	19.85	17.38	14.11	37.22	17.31	21.50
E. citriodora	5.12	5.14	4.86	17.27	8.09	13.32	12.50	13.95	25.37	16.28	11.51	22.51	9.39	19.46	15.72
E.gomphocephala	21.83	30.73	31.61	17.27	25.39	10.11	14.88	32.75	11.14	17.22	10.10	20.75	9.38	18.52	14.68
Mean	11.49	15.10	14.83	17.39		11.23	16.22	20.33	19.87		13.03	18.78	16.52	16.96	
L.S.D at 0.05 for (A)		2.39				1.85					1.16				
L.S.D at 0.05 for (B)		1.10.				1.40					2.02				
L.S.D at 0.05 for (AxB)		2.51				2.11					2.38				

compared to sandy soil which gave the inferior values of fresh (34.16 and 35.83 gm) and dry weight (19.36 and 11.23 gm) in both seasons respectively.

Regarding the effect of *Eucalyptus species*, the results apparently cleared that *E. gomphocephala* seedlings had significantly the highest values in fresh (64.05 and 62.23 gm) and dry weight (21.3 and 19.85 gm) in both seasons respectively comparable with those of *E. incana* and *E. citriodora* which produced the least values while *E. camaldulensis* seedlings were the medium in fresh and dry weight.

The interaction between *Eucalyptus species* x growing media indicated that *E. gomphocephala* seedlings growing in the mixture of 1:1 (v/v) had the superior values in fresh and dry weight of stems while *E. incana* grown in sandy soil had the inferior values.

The previous results were in accordance with those obtained by El-Afghany (1981) on *E. camaldulensis*, El-khateeb (1983) on *E. angulosa*, Chong *et al* (1991) on *Cornus alba, and Potentilla fruticosa* and Mohamed (1993) on *Nerium oleander*, and *Adhatoda vasica*. All of them confirmed that the mixture of sand and clay or peat moss increased fresh and dry weights of stems compared with sandy soil alone.

8-Fresh and dry weight of roots.

It is obviously cleared from data of Tables (3,4) that both fresh and dry weights of roots were more affected by different growing media as the averages of fresh weight ranged from 42.22 and 39.36 gm in sandy soil to the maximum 65.55 and 63.05 gm in the clay soil followed by the mixture 1:1 (v/v) which was preferable than either the mixture of 2:1 (v/v) or sandy soil alone. The results were confirmed in the second one.

Dry weight of roots was the best significantly in clay soil compared with sandy soil where the mean values were 21.05 and 18.78gm in both seasons respectively followed by the mixture of sand and clay 1:1 or 2:1 while the least values 13.94 and 13.o3 gm were accompanied with sandy soil alone.

As for *Eucalyptus species* effect it can be resulting that *E. camaldulensis* seedlings had significantly the heaviest fresh (65.68 and 65.69 gm) and dry weight (21.74 and 21.50 gm) in both season respectively compared with the others species followed by *E. gomphocephala* and *E. citriodora* while *E. incana* produced the lightest fresh and dry weight.

In this respect *E. camaldulensis* seedlings planted in the mixture of sand and clay 1:1 as growing media induced the maximum fresh (102.22 and 113.18 gm) and dry weight (34.17 and 37.22 gm) in first and second season respectively, while the minimum fresh weight of roots exhibited in *E.incana* planted in sandy soil which gave 28.11 gm in the first season.These results were in the same line of those obtained by Heikal *et al* (1978) on *E. citriodora*,Tesi and Tosi (1985) on *Chamaedorea elegans*, Chong *et al*(1991) on *Cornus alba* and *Physocarpus* and Mohamed (1993) on *Lantana camara* and *Adhatoda vasica* where both of them indicated that the mixture of sand + clay as growing media improved the characteristics of sandy soil and increased the fresh and dry weight of roots.

Table (5): Effect of growing media on chlorophyll A, B and total sugars of some *Eucalyptus species* in 1996 and 1997 Season

1996															
Grown media (A)	Chlorophyll A (mg/g F.W)					Chlorophyll B (mg/g F.W)					Total sugars mg/g D.W				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	1.08	1.24	1.15	1.09	1.14	o.63	0.84	0.71	0.67	0.71	89.50	8.0.86	79.91	80.13	80.15
E. camaldulensis	1.21	1.39	1.32	1.28	1.30	0.67	0.86	0.81	0.78	0.78	81.20	94.31	87.00	84.10	86.56
E. citriodora	1.07	1.11	1.09	1.08	1.09	0.65	0.87	0.81	0.76	0.77	76.20	80.10	85.00	76.60	79.58
E.gomphocephala	1.52	1.91	1.69	1.61	1.68	0.68	0.87	0.81	0.79	0.79	81.50	83.34	82.16	82.41	82.36
Mean	1.22	1.41	1.31	1.26		0.65	0.86	0.78	0.75		79.60	84.65	83.51	80.74	
L.S.D at 0.05 for (A)		N.S				0.20				1.18					
L.S.D AT 0.05 for (B)		0.30				N.S				1.18					
L.S.D at 0.05 for (AXB)		0.60				N.S				1.76					

1997															
Grown media (A)	Chlorophyll A (mg/g F.W)					Chlorophyll B (mg/g F.W)					Total sugars (mg/g D.W)				
Species (B)	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2:1	Mean
E. incana	1.15	1.47	1.33	1.19	1.29	0.65	0.74	0.67	0.66	0.68	77.30	78.59	94.10	77.23	77.89
E. camaldulensis	1.31	1.55	1.40	1.43	1.42	0.60	0.74	0.64	0.61	0.65	99.60	109.82	109.2	95.2	104.38
E. citriodora	1.08	1.42	1.32	1.19	1.25	0.59	0.65	0.63	0.60	0.62	78.60	91.90	90.54	90.22	87.82
E.gomphocephala	1.32	1.87	1.72	1.31	1.56	0.73	0.81	0.76	0.75	0.76	77.90	81.93	81.56	81.80	80.80
Mean	1.21	1.57	1.44	1.28		0.64	0.73	0.67	0.65		83.35	90.56	93.85	86.11	
L.S.D at 0.05 for (A)		0.31				N.S				2.89					
L.S.D at 0.05 for (B)		0.24.				0.12				2.53					
L.S.D at 0.05 for (AxB)		0.68				N.S				3.10					

10-Biomass of plant

As shown in Table (5) biomass of *Eucalyptus species* planted in either clay or mixture of 1:1 v/v attained significantly the maximum values that recorded (187.35 and 169.67 gm/ plant) respectively in the first season compared to those obtained from sandy soil (120.91 gm/plant), whereas the mixture of 2:1 growing media was the intermediate 141.13 and 157.06gm in the first and second season respectively.

Concerning the influence of *Eucalyptus species* on biomass. The results indicated that *E. gomphocephala* had the highest values (198.44 and 215.92 gm/plant followed by E. camaldulensis 172.2 and 175.68 while *E. 1ncana* was the intermediate126.96 and 138.83 gm. / plant then E. citriodora was the last one in the first and second season respectively regardless the effect of different growing media

The interaction between growing media and *Eucalyptus species* illustrated that clay soil or the mixture of 1:1 was preferable growing media for *E incana* and *E. gomphocephla* where both of them recorded maximum biomass whereas clay and the mixture of 2:1 was the favorable growing media for *E. citriodora* on the other hand the mixture of 1:1 or 2:1 was optimum for *E.* camaldulensis where the biomass of plants was the highest (193.11 and 215.92 gm./ plant) respectively

II- Chemical constituents

1-Chlorophyll leaf contents

Data which are given in Table (6) indicated that both chlorophyll a and b increased to maximum in clay soil (1.41 and 0.86 mg/g F.W) followed by the mixture of sand and clay 1:1 or 2:1 while the minimum values were recorded in sandy soil (1.22 and 0.65 respectively. The same trend was obtained in second season nearly.

Eucalyptus species differed significantly in chlorophyll a or b content as *E. gomphocephala* achieved significantly the heaviest values of chlorophyll a (1.68 mg/g. F.W) more than any of the other taxa in first season, whereas in the second seas on the differences were significant between *E.gomphocephala* and *E. citriodora or E. incana.*

In this respect it is realized that Eucalyptus species did not vary significantly in chlorophyll b between different the 4 taxa of Eucalyptus, however *E. gomphocephala* was surpassed (81 mg/g. F.w) while *E.incana* seedlings had the lowest values of

0.71 mg /g. F.w. The same trend was obtained in the second season as of first one approximately ..

The interaction between *Eucalyptus species* x growing media, it is obviously that *E. gomphocephala* planted in clay soil recorded the highest mean values of chlorophyll A (1.91 and 1.87 mg /g. F.W) while *E. citriodora* planted in sandy soil contained the lowest values of 1.07 and 1.08 mg/g. F.W in both seasons respectively. In this regard chlorophyll b content in leaves was the maximum (0.87 and 0.81 mg/g. F.W)

In *E. gomphocephala* cultivated in clay soil whereas the inferior values (0.65 and 0.59 mg/l) in both season respectively were recorded in *E. citriodora* planted in sandy soil

As inferred previously it can be stated that both chlorophyll A and B were exceeded as inference to cultivating *Eucalyptus species* in clay soil and adding clay to sand ameliorated the growing media subsequently chlorophyll a and b raised up in leaves in agreement with those obtained by Farahat (1986) on *E.camaldulensis,* Mohamed, (1992) on *Asparagus spengeri* and Mohamed (1993) on *Nerium oleander* and adhatoda vasica where they found that the seedlings grown in clay or the mixture of sand and clay 1:1(v/v) increased the chlorophylls in leaves.

2-Total sugars

As shown in Table (6) it is evident that different growing media were more effective on total sugars since clay or the mixture of sand and clay 1:1 (v/v) significantly increased total sugars comparable with sandy soil, which deduced the minimum values in both seasons. In this regard it can be noticed that *E. camaldulensis* produced significantly the maximum values of 86.56 and 104.38 mg/g D.W, in first and second season respectively compared to *E. citriodora*, which had the minimum values of 79.58 mg/g D.W in the first season while *E. gomphocephala* was the intermediate

E. camaldulensis seedlings, which were cultivated in clay soil, resulted significantly the highest values of total sugars 94.31 and 109.82 mg//g D.W in the first and second season respectively whereas the minimum values were recorded in leaves of *E. citriodora* planted in sandy soil.

From the heretofore results it might be concluded that planting *Eucalyptus species* in clay soil resulted in an increase sin soluble, non-soluble and total sugars whereas the planting in sandy soil decreased the here above chemical characteristics, herewith adding clay to sand enhanced the properties of sandy soil and resulted excessive values of sugars in the leaves.

The here above obtained results were in harmony with many investigators such as El-Tantawy (1981) on *Casuarina equesitifolia* and *Cupressus sempervirens* who reported that soluble and non-soluble sugars increased by using clay as growing media, Farahat (1986) *on E.camaldulensis* stated that plants growing in clay soil performed the highest content in non-soluble and total sugars also the highest content of soluble sugars of leaves, stems and roots had been shown in plants grown in the mixture of clay and sand, also Nabil and El-khateeb (1991) cleared that soluble sugars content decreased due to planting in sandy soil.

Table (6): Effect of different growing media on biomass (g/plant) of some *Eucalyptus species* in 1996 and 1997 seasons

Grown media (A) / Species (B)	1996					1997				
	Sandy	Clay	1 :1	2 :1	Mean	Sandy	Clay	1 :1	2 :1	Mean
E. incana	103.28	158.13	144.23	102.20	126.96	119.37	166.20	142.77	126.87	138.83
E. camaldulensis	143.76	170.45	193.11	181.49	172.20	130.66	169.01	212.54	190.49	175.68
E. citriodora	88.76	135.42	127.18	139.15	122.62	95.34	126.68	90.25	155.94	117.05
E.gomphocephala	147.85	285.41	214.14	146.36	2o5.19	149.02	280.74	279.09	154.84	215.92
Mean	120.91	187.35	169.67	141.13		123.60	185.66	181.16	157.06	
L.S.D at 0.05 for (A)	8.54					9.65				
L.S.D at 0.05 for (B)	6.37					7.98				
L.S.D at 0.05 for (AxB)	8.12					11.24				

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تقييم النمو الخضري ودراسات مقارنة للكتلة ا لحية لبعض أنواع الكافور النامية في أوساط نمو مختلفة

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أجريت هذه التجربة في مشتل قسم بساتين الزينة بكلية الزراعة جامعة القاهرة خلال موسمي ١٩٩٦و١٩٩٧ حيث زرعت شتلات متجانسة لأربعة أنواع من ا لكافور ا لمدخلة لمصر بعمر أربعة شهور وهي:- gomphocephala – citriodora– camaldulensis--1ncana في أربعة أوساط زراعة هي ا لرمل – ا لطين خليط منهما بنسبة ١: ١ و ٢-١ بالحجم.

أوضحت النتائج أن زراعة ا لشتلات في تربة مكونة من الرمل والطين بنسبة ١:١ قد حسنت من عناصر النمو مثل ارتفاع النبات– المساحة الورقية– طول الجذر– الوزن الطازج والجاف للسيقان – الوزن الطازج للجذور حيث زادت هذه العناصر بنسبة ٤و١٠-٩٠و٦٢-٩٩و٢٧-٢و٩٩-٣و١٧-٢و٤٤%على الترتيب عن تلك النباتات المزروعة في التربة الرملية بينما الشتلات المزروعة في التربة الطينية قد أعطت أفضل القيم في قطر الساق،عدد الفروع لكل نبات،الوزن الطازج والجاف للأوراق،الوزن الجاف للجذور حيث بلغت الزيادة٦و١١-١٥و٥٢-٥و٥٣- ٣و٥٢-٥١% على الترتيب عن تلك المنزرعة في التربة الرملية والتي خفضت كل عناصر النمو وأعطت التربة الخليط ١:٢ قيم متوسطة للصفات المدروسة.

زادت الكتلة الحية لكلا النوعين gomphocephala, Incan للدرجة القصوى عند الزراعة في التربة الطينية أو في الخليط من الرمل والطين بنسبة ١:١ بينما الزراعة في التربة الطينية أو الخليط بنسبة ١:٢ قد حسن كثيرا من الكتلة الحية للنوع citriodora. في حين كانت الكتلة الحية للنوع camaldulensis أفضل عند الزراعة في التربة الخليط بنسبة ١:١ أو ١:٢.

وبتقييم أنواع الكافور المختلفة وجد أن الكافور camaldulensis كان احسن ا لأنواع في ارتفاع ا لنبات– الوزن الطازج و الجاف للجذر – طول الجذر– الوزن الطازج والجاف للأوراق وعدد الأفرع والسيقان ولكن ا لنوع incana كانت سيقانه اكثر سمكا وان أوراق الكافور الليموني citriodora كانت اكثر مساحة ، ومن النتائج السابقة يمكن أن نستنتج انه يجب زراعة ا لكافور ا لعادى camaldulensisفي التربة لخليط من الرمل والطين بنسبة ١:١ أو ١:٢ بينما يفضل زراعة كلا ا لنوعين gomphocephala, incana في التربة الطينية أو التربة الخليط بنسبة ١:١ أما الكافور ا لليموني citriodora يفضل زراعته في تربة خليط من الرمل و الطين بنسبة ١:٢ أعطت التربة الطينية و الخليط ١:١ أعلى ا لقيم في نسبة ا لكلوروفيل وكذلك في نسبة السكريات الكلية إذا ما قورنت بالتربة الرملية وان الكافور ا لعادى camaldulensis أعطى أعلى النسب لهذه المكونات.

و يمكن التوصية بإضافة الطين إلى التربة الرملية حتى نحسن من صفاتها ا لطبيعية والكيماوية وكذلك إضافة الرمل إلى التربة ا لطينية لنحسن من خواصها لإيجاد وسط مناسب للنمو.