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Vegetative propagation of Eucalyptus microtheca F. Muell. by stem cuttings

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ABSTRACT: A major problem of arid and semi-arid regions is environmental stresses like salinity. To study the effect of salinity on germination characteristics of basil, a completely randomized experiment was conducted under controlled conditions (germinator) with three replications in Department of Agronomy, Birjand Branch of Islamic Azad University, Birjand, Iran in 2011. The experimental treatments included different salinity levels (0, 2, 4, 6 and 8 ds m^{-1}). The studied traits included seedling length and dry weight, germination percentage and rate and seed viability index. It was found that salinity significantly decreased germination rate and percentage and seed viability index of basil, but its effect on seedling length and weight was not different in levele of 0, 2, 4 and 6 ds m^{-1}. In total, it can be concluded that salinity stress mainly decreased germination percentage and rate and seed viability index of basil.
Keywords: Eucalyptus sups. Eucalyptus microtheca, Vegetative propagation stems cuttings.

INTRODUCTION

Eucalypts are Austro-Malayan trees with natural latitudinal range 7º N to 43º-39"S. Recent trials showed that provinces grow north of Tropic Capricon are of increasing importance in low latitude countries (FAO, 1981). Large scale planting of forests was restricted to few species of which eucalypts are widely planted for biomass, pulp and paper industry. The other uses of eucalypts are for farm plantation for wind breaks and shelterbelts, for ornamental hedges, in addition to firewood and production of essential oils from the leaves (Hartney, 1980). In Sudan by the year 1969 there was a total area of 7500 hectares of Eucalypts. Large irrigated plantations known are of Eucalyptus camaldulensis, E. microtheca and E. citriodora in Nuba Mountains (FAO, 1981), South Kordofan (FRCR, 1980), Elgazira and Kenana Sugar Cane schemes. E. microtheca is small to medium tree with a single trunk from inland can grow large in optimum condition, tolerates flooding, heavy soils, alkaline soils and a hot dry site.

Long life cycles of most forest tree often display changes with time in growth and features that are reflected in growth performance and yield. Also the inverse relationship that existed between ageing and ease of rooting of cuttings arise as major problem in vegetative propagation techniques. Therefore it was reported that these maturation-related changes in performance are development changes triggered by programmed activation or inactivation of differed genes (Libby and Rauter, 1984). Vegetative propagation techniques were introduced in tree planting to overcome problems prevent successful efficient propagation of economic forest tree species. The work will emphasizes the importance of suitable nursery techniques for improving the ability for true-totype cloning by rooted cuttings of forest trees clones. The physiological changes induced which are responsible of the plant material selected to be mass clonally propagated will be investigated on more basic level. However, the practical benefits are, first for clone selection, then for large-scale production and utilization of the

clones selected. Moreover the techniques practiced will put answers of how to determine and control appropriate physiological conditions of propagated plant materials. These include age of plant material, size, suitable growth medium and growth regulators (Rajas, *et al.*, 1987). Therefore rooted cuttings in tree improvement programme were preferred than other methods (Libby and Rauter, 1984). Vegetative propagation aspects were well documented and published (Longman and Jenik, 1990; Hartman, *et al.*, 2002). The success of rooting of cuttings was more or less affected by a number of factors, physiological such as, age, early selection of desired characters, interaction with the environment (Reuveni, *et al*., 1990; Ali and El-Tigani, 2003), and internal anatomy of stem cuttings (El-Tigani, 2003). Techniques of rooted cuttings were developed fast with intensive work on *Eucalyptus spp*. (Hartney, 1980; Ali, 1986). The work on rooting cuttings in forestry and specifically of eucalypts showed that, it is time to propose clones plantations of superior genotypes in forestry as alternative to conventional seedling-based forestry ones (MWFSP, 1984; Longman and Jenik, 1990; Ali and El-Tigani, 2003), for production of woody biomass and energy transducer. This also due to reports that commercial hardwood forests are existing in Africa and Southeast Asia for solid wood products Therefore the main objectives are to investigate propagation of *Eucalyptus microtheca* by using stem cuttings from nursery stock plants, and to determine the suitable concentration of Indole-3- butyric acid (IBA).

MATERIAL AND METHODS

The experiments was carried out during the seasons w*inter*, s*ummer* and s*utumn in* the Botany Garden Nursery at the University of Khartoum and Forest research centre at Soba. Stem c*uttings* were taken from nursery stock plants (8-24 month-old) grown in *polyethylene bags* (*20×30cm*) and from old plantations (>10year-old) from Soba Forest in Khartoum State. Mixed cuttings of 0.5-1.0*cm* in *diameters* and 20-30cm in length taken from *medium and basal parts of the* branches, were defoliated leaving *3-5 pairs* of leaves with protected axillary's buds. The culture medium was course sand prepared by sieving in sieve No.30. The rooting hormone was *Indole-3-butyric acid (IBA)* from Sigma Chemical Co. Ltd. The *concentration*s of *0, 10,* 50 *and 100 mg/l* applied by the dilute dip method *(Ali*, 1986*)*. They were *prepared by dissolving the concentrations in few drops of ethanol (80%) and then made up to the required volume*. Cuttings were dipped vertically to a depth of about *3-5 cm* from the distal *in* glass *containers*, *covered with perforated polythene bags to reduce* evaporation. The sets were placed *in a* laboratory *room at 25 ± 2 °C* for 18-20 *hours* t*hereafter*, *cuttings were washed under running tap water,* wiped *and planted* early morning, one cutting per bag *in moist* course *sand* contained *in perforated polyethylene bags* (20×30cm). The cuttings were kept under diffused day light. Humidity was maintained by water spraying every three hours while watering was done early morning and afternoon. Four sets each of 20 cuttings each in three replicates from nursery stock plants and each treatment (0, 10, 50 and 100 mg/l IBA) were arranged in a randomized complete block design in the shaded traditional nursery.*Data were* made weekly during each experimental periods (4 months) where; cuttings carefully lifted to record *number of rooted cuttings, total length of lateral roots and main roots length.* The data were subjected to analysis of variances by using JMP where the statistical differences were based on arcsine transformed value of percentage rooting cuttings.

RESULTS AND DISCUSSION

The study elucidates a successful method of propagation of *Eucalyptus microtheca* from nursery stock plants. Stem cuttings of *E. microtheca* were treated with Indole-3-butyric acid (IBA) of concentrations; 0, 10, 50, and 100 mg/l. The concentrations significantly affect rooting of stem cuttings of *E. microtheca* during all seasons of young ages (Table 1). The significant effects of IBA were clear on cuttings of the young plants only when their shoots were well developed rather than when their axillary's buds remained dormant. That it seems to be prominent signs of rooting of stem cuttings. Table 2, Fig 1 and Fig 2, showed effects of IBA concentrations on the adventitious root growth and development on its length and intensity. It is clear that the increase in both parameters has a relation with increase of IBA concentration despite the other factors.

Table1. Effects of Indole-3-butyric acid (IBA) mg/l on percentages rooting of stem cuttings of E. microtheca.

Concentration IBA mg/l	Percentage	Mean	Probability
0	20	6.7	
10	40	16.6	0.28
50	50	36.7	
100	30	36.7	

Statistical significance difference of percentage rooting of E. microtheca was based on arcsine-transformed values* using JMP
SE± 10.11

Table 2. Effects of seasons on percentage rooting of stem cuttings of E. microtheca.

Season	Percentage rooting	Probability
Winter	12	
Summer	14.4	0.06
Autumn	36.6	

Statistical significance difference of percentage rooting of was based on arcsine- transformed values* using JMP. SE± **7.2**

Fig. 1 (a) **Fig. 1 (b)**

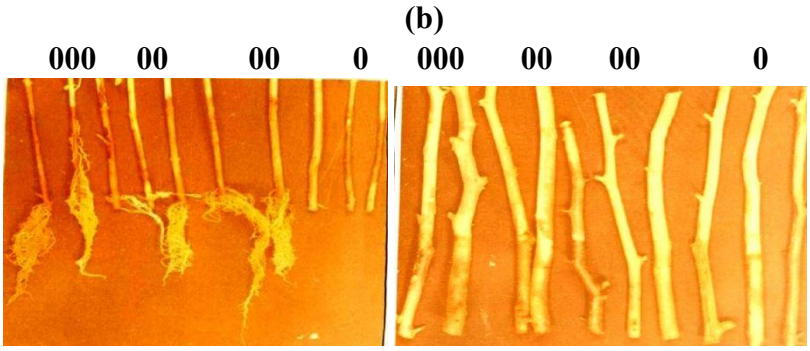
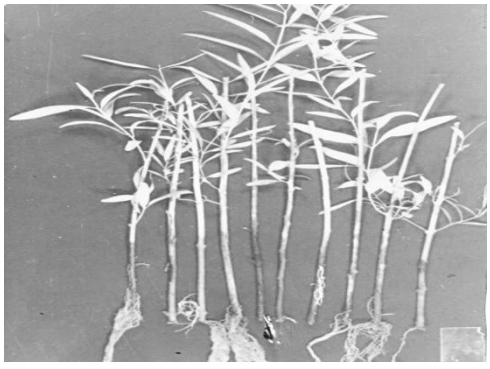


Fig 1 (a) Show the positive effects of Indle-3-butyric acid (IBA) concentrations on rooting of cuttings of Eucalyptus microtheca stock nursery plants. **Fig.1 (b**) Show the negative effects of Indole-3-butyric acid concentrations on rooting of cuttings of Eucalyptus microtheca old plants.



Whole nursery plant stock cuttings giving plantable plantlets.

Stem cuttings from nursery stock plants significantly affected by 50mg/l IBA that gave the highest value of 50 percent rooting while during both summer and autumn, it gave 20 percent rooting. In spite the different responses on rooted cuttings; it seems that no significant effects showed by the various concentrations of IBA on the percents of rooting (arcsine transformed) (Table 1 and 2). The result

showed that winter season seems to affects cuttings of nursery stock plants irrespective to IBA concentration and the control. Hence all nursery stock plants rooted during summer only with treatments 50 and 100mg/l IBA giving 20 and 50 percent respectively. Similarly in autumn 50mg/l IBA gave 20 percent whereas 10 and 100mg/l gave 10 and 30 percent respectively. This variability in rooting percentages and type of cuttings suggests that rooting of stem cuttings seems to respond to different stimulus other than hormonal treatment on different seasons (Fig 2, b). The results are similar to (McComb and Worth ,1986) work on *E. resinifera and E. maculate* demonstrating effects of seasonality on rooting. (Similarly Paton ,1984) work on Eucalypts species, confirmed that the loss of rootability varies with species as well as with their ages. It was confirmed further in the interaction effects (Table 3) by the probability level for significant difference in three seasons and the existence of variations in rooting abilities with IBA concentration. It seems that rooting percentage (arcsine transformed) affected by IBA treatments at various concentration due to their different responses on rooted cuttings. In winter and summer both types of stem cuttings formed adventitious roots with 10mg/l and 100mg/l Indole-3-butyric acid (IBA) and they gave 40 and 10 rooting percentage respectively. This means that *E. microtheca* nursery stock plants cuttings responded to very low and to high concentrations of IBA in all seasons. The low percentage of rooted cuttings indicated the slowing down of growth in shoots, and it was probably due to low rootability during that period and other unforeseen cofactors. (Similarly Zobel and Talbert ,1984) related the rootability of stem cuttings to morphological status of the parent tree and these variations presumably attributed to the hormonal contents of the shoots from which the cuttings were obtained. Therefore it could be assumed that the formation of adventitious roots is probably initiated or affected by another factor that interacts with hormone translocation from buds or shoots. It may also be attributed to anatomy structures or physiological processes unforeseen or known as was noticed at that mode or age as suggested by (Hetherington and Orme ,1989) work on root variation on E, globulus. Treated and untreated stem cuttings with exogenous auxin IBA exhibited seasonal variations in their rooting response where its use probably enhanced rooting in some seasons. The effectiveness of auxin concentrations for root formation may also be related to changes in bud activity during different seasons, to levels of contents of internal nutrient such as carbohydrates, nitrates and phenol compounds in stem cuttings as was shown by (Bonga ,1982) and (Ali ,1986) works. It seems therefore that young E. microtheca shoots contain appropriate ratio of these complex compounds and hence help young cuttings root readily when compared to old ones. Hence it could be concluded that better rooting occurs during winter season after bud sprouting and formation of branches. Whereas in summer the inhibitors do not attain toxic or inhibitory levels in essence to destroy life processes in cuttings. In contrast during autumn season some chemical compound inhibitors might accumulate in high toxic levels that inhibit formation and initiation of adventitious roots in cuttings. It could be assumed that, during rainy season nutrients and growth regulators of stem tissue probably are available in appreciable quantities that decrease rootability comparable to other ones. The conclusion reached is that rooted cuttings can be used successfully for large-scale, health, free-disease and uniform plantations of E. microtheca. The advantages of container grown stock plants to field established ones for achieving this goal can be summed up as follows: Better control and therefore optimization of stock plant environment with regard to light, watering, soil fertility, wind, etc. Proximity to the misting area resulting in shorter time and distance for collecting the cuttings that can be set sooner with less stress under proper rooting conditions.

Table 3. Interactions of seasons and growth regulators on rooting percentage of stem cuttings of E. microtheca

	Indole -3-butyric acid concentrations			
Seasons	0	10	50	100
Winter	14.0	14.0	10.8	14.0
Summer	14.0	4.0	10.7	34.0
Autumn	34.0	44.5	40.7	14.0

Statistical significance difference of percentage rooting based on arcsine-transformed values* using JMP. SE± 18.3 Probability = 0.9

Table 4 Effects of IBA concentrations on mean length and intensity of roots on cuttings of E. microtheca

concentration	Adventitious roots performance	
IBA mg/l	Mean Main length	Intensity
0	1.2 ± 0.04c	+ Very low
10	6.5 ± 0.2b	++ Low
50	7.0 ± 0,08b	+++ Medium
100	10.5 ± 1.0a	+++++ Very high

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