International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **4(5),** 15-18, May **(2015)** *Int. Res. J. Biological Sci.*

Vegetative Propagation of *Eucalyptus* Hybrids through Water Culture Method

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Available online at: www.isca.in, www.isca.me
Received 27th January 2015, revised 5th April 2015, accepted 9th May 2015

Abstract

In Industrial forestry, purpose of vegetative propagation is to consolidate the genetic gain and to mass multiply superior trees like Eucalyptus, Casuarinas, etc. Vegetative propagation by cuttings (called macro propagation) is the main tool in Eucalyptus breeding program by which is possible to multiply the plants quickly and to retaining the characteristics of same plant. Macro propagation requires rooting medium like vermiculite, composed coir pith, root trainer, root trainer stands, poly tunnels and irrigation and is expensive. To simplify this rooting technique in Eucalyptus, the water culture experiment (hydroponics) was carried out in control pollinated Eucalyptus hybrids (E. camaldulensis (Ec 7) x *E. tereticornis (Et88) and (E. camaldulensis (Ec 111)* x *E. tereticornis (Et86). Mini cuttings of both hybrids were placed in the transparent disposable plastic cups using tap water as media after systematic treatments like fungicide application (Bavastin 0.1%), dipping in 100ppm IBA hormone. Cuttings without systematic treatment were used as control. These cuttings were kept in the polythene tunnels for rooting with single shade net provision. It was recorded that the maximum rooting percentage 76 % in control cuttings followed by 63 % in hormone treated cuttings for the hybrid Ec 111 x Et 86. In hybrid Ec7x Et88 a maximum of 95% was recorded in the hormone treated cuttings and 91% in control cuttings. This results shows that the water culture technique is cost effective tool than existing macro propagation methods to get multiplication of Eucalyptus hybrids through cuttings.*

Keyword: *Eucalyptus* hybrids, hydroponics, IBA, vegetative propagation.

Introduction

Eucalypts has a long cultivation history in India[1,2]. It was first planted around 1790 by Tippu Sultan in the Nandi hills near Bangalore. Over 170 species and various intra specific variations were tested in India. Currently, India is one of the largest Eucalypt growing countries in the tropics with an estimated area of over 20 million hectares[3]. To meet the demand of the planting stock, eucalyptus plants are being produced by means of vegetative propagation. Vegetative propagation technique is the handiest way to multiplying Eucalyptus in industrial forestry as well as in forest research institutes. Horticultural crops are also being produced in short periods through this technique. Vegetative propagation is a tool that consolidates genetic gain, interim or permanent within breeding program. Mass multiplication of superior trees selected after undermining diversity and the genetic potential are then clonally propagated towards farming, breeding or conservation[5]. The responses of different tree crops to this method vary considerably according to their genetic constitution[4]. Moreover, plant propagation by means of seeds will yield segregated plants and these plants may susceptible to disease whereas propagation by means of vegetative parts offer genetically identical and disease free plants. Vegetative propagation like grafting, budding, layering and cuttings are the methods used in various tree crops. Vegetative propagation through stem cuttings, check the segregation and it secure the heterotic nature of seedlings for more periods. Many methods of propagation through cuttings are known i.e. leafy cuttings, cladode cuttings; stem cuttings (branch cuttings), etc. in tree species. In eucalyptus stem cuttings are used worldwide in propagation for commercial plantings. But the operating cost of existing vegetative propagations methods through stem cuttings are very expensive for multiplying eucalyptus because of the requirement of raw materials like vermiculite, coir pith, root trainers, stands, fungicides, hormones etc. To avoid this sort of operating cost in agriculture practices Water culture (*Hydroponics)* is used as very broad spectrum. Hydroponics includes vegetative propagation, planted aquariums, ponds, planted water gardens. Water culture has been in practice since ancient history. In 1627 Francis Bacon published Sylva Sylvarum, first book dealing with experiments in plant physiology and growing terrestrial plants in water. In 1860, two German Botanists coined the term Solution Culture along with a technique of growing terrestrial plants without soil in a mineral solution. The term Hydroponics came into use in 1937, used by William Gerick[6] at the University of California during his experiments where no rooting media were used and plants were grown in complete water solution[7]. Hydroponics is not as complicated as it is sometimes portrayed and is becoming more popular for growing common houseplants, window sill herb gardens, and vegetable gardens. It is versatile, cost-effective, and space-saving. Currently hydroponic systems are used all over the world.

Almost all terrestrial plants can be grown using hydroponics. One way to improve the success of a hydroponic system is to understand the science behind it[8]. Moreover, research on propagation of Eucalyptus and its hybrids is vast but propagation through water culture (Hydroponics) has not been that much reported yet. Hence, the water culture experiment was conducted to develop a vital technique to multiplying of Eucalyptus hybrids in large scale production of planting stock through stem-cuttings without any expensive rooting media like vermiculite, coir pith and to reinstate the existing vegetative propagation methods of eucalyptus hybrids in industrial forestry.

Material and Methods

Cuttings of control pollinated eucalyptus hybrids clones of *Eucalyptus camaldulensis* (Ec 111) x *E. tereticornis* (Et 86) and E. *camaldulensis* (Ec 7) x *E. tereticornis* (Et 88) were used for this experiment. Mini-cuttings of these two hybrids were collected during June 2014 from the mother bed chamber of hybrids of eucalyptus at the Institute of Forest Genetics and Tree Breeding. These cuttings immersed in 0.1% Bavastin (a systematic fungicide solution) for 10-15 minutes to avoid fungal problem. The basal portion of the cuttings was dipped in the 100ppm IBA solution for 10 minutes. After this treatment, cuttings were placed in transparent disposable tea cups using plain tap water as medium. Untreated cuttings were used as control for this experiment. Both treated and control cuttings were kept in polythene tunnels for rooting with single shade net provision. The tab water was replaced routinely (day by day) to avoid water contamination. The above experiment was carried out in replicates. Observations were recorded on rooting response of mini cuttings of *Eucalyptus* hybrids of *Ec 111* x *Et 86* and *Ec 7*x *Et*88 crosses under hormone and control treatments. Additional study like number of rooted cuttings per cross, number of roots per stem cutting, root length of the rooted cuttings for each stem was conducted at nursery, IFGTB. (figure-1 and 2).

Results and Discussion

Maximum of 76% rooting was observed in the cuttings of untreated (with hormone) for the hybrid Ec 111 x Et 86 cross followed by 63 % rooting percentage in the cuttings treated with 100ppm IBA (10minutes) for the same cross. In the cross *Ec 7* x *Et 88*, maximum rooting 95% was observed in the cuttings treated with IBA100ppm (10minutes) and 91% rooting was observed in the cuttings of untreated (table-1). A maximum of 3.93±0.86, 1.97±0.26 average number of roots and average root length of cuttings respectively were noticed in control followed by 3.83±0.86 and 1.77±0.23 respectively were recorded in cuttings treated with IBA100ppm. Whereas, in the cross EC 7x ET 88, a maximum of average 5.19±0.79, for number of roots and 3.91±0.56 for root length were noticed in the cuttings treated with IBA100ppm and followed by 4.39±0.92, 3.21±0.66 in control treatment for the period of 35 days. Average of rooted cuttings for the cuttings treated with IBA 100ppm and control for the *Eucalyptus* hybrids Ec *111 x Et86* and *Ec* 7x *Et*88 through water culture method is shown in (table-1). The photographs for rooted cuttings of *Eucalyptus* hybrids (Ec111 x Et 86 and Ec 7x ET 88 crosses) through water culture experiment are shown in (figures-3, 4, 5, 6, 7 and 8).

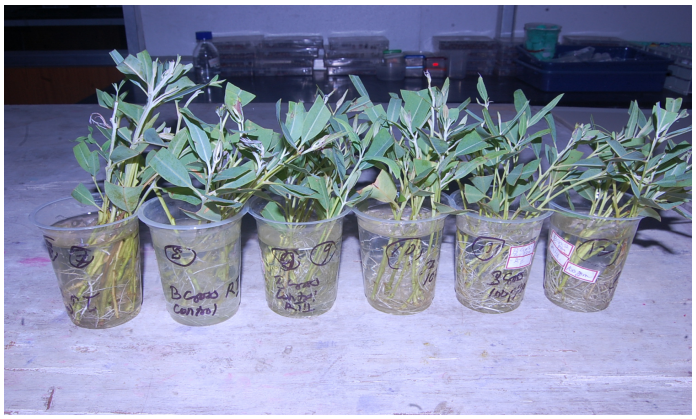
Figure-1 and 2
Water culture experiment carried out in IFGTB nursery

Table-1
Rooting response of *Eucalyptus* hybrid cuttings in Ec-111 x Et-86 and Ec7 x Et88

Cross ID	Treatment	No. of rooted cuttings	Average no of roots	Average Root length	Rooting %
EC 111 x ET 86	Control (Plain water)	15.33±1.33*	3.93±0.86*	1.97±0.26*	76
	IBA 100PPm	12.66±1.76*	3.83±0.86*	1.77±0.23*	63
EC 7x ET 88	Control (Plain water)	13.66±0.88*	4.39±0.92*	3.21±0.66*	91
	IBA 100PPm	14.33±0.66*	5.19±0.79*	3.91±0.56*	95

*(Mean ± SE)

(EC 111 x ET 86 cross)



(EC 7 x ET 88 cross)

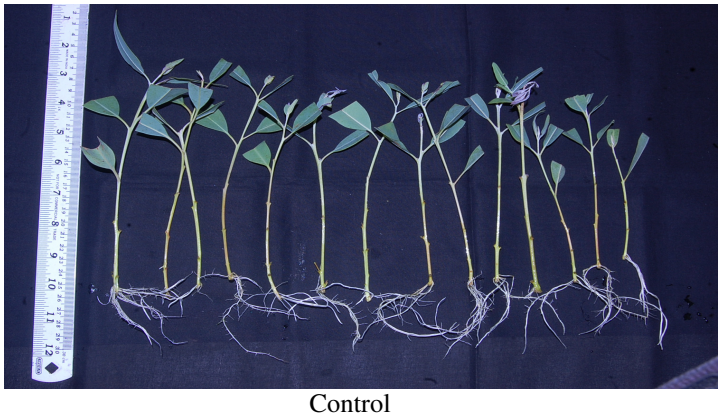
Figure-3 and 4
Rooted mini-cuttings of *Eucalyptus* hybrids through water culture method

Treated

Control

Figure-5 and 6
Rooted mini cuttings of *Eucalyptus* hybrids EC 7 x ET 88 through water culture

Treated



Control

Figure-7 and 8
Rooted mini cuttings of *Eucalyptus* hybrids *EC 111 x ET 86* through water culture

Discussion: To attain maximum rooting percentage through stem cuttings by existing propagation techniques in eucalyptus multiplication needs experience, skills and knowledge of propagation methods. The result of this experiment indicates better rooting responses through water culture for mini cuttings of eucalyptus hybrids. To carry out water culture technique, one no need to expertise. Specialized facilities like mist chambers, root trainers, rooting media, and more man power are require to producing large scale planting stock of eucalyptus through cuttings, thus existing protocols of eucalyptus multiplication

making difficult to the farmers to adopt the methods. But disposable plastic cups and tap water were used for this water culture method; better rooting results indicates that it is enough to perform this water culture technique and famers can get same sort of rooting results as existing commercial methods without much inputs. Reports say that some cuttings are rooted only in an aerated hydroponic system in the species like *Casuarin9*[8]. But in this experiment, no aeration was provided for the cutting of Eucalyptus hybrids (*Ec* x *Et*). The best results (60%) were achieved with mature softwood cuttings only after treated with 50 ppm IBA for 3 hrs in *Casuarina*[10]. But in water culture commercial rooting hormones treated only for 10mins (dipping the cuttings) to achieve rooting in eucalyptus hybrids. In existing commercial propagation methods, rooting hormones are unavoidable to massive propagation. Generally, macro propagation of *Eucalyptus* species were carried out through coppice shoots (25-30 days old) from the coppiced trees and made double node leafy cuttings for rooting and multiplication. But for water culture, mini cuttings (7-15 days old) were used and it shows better results in rooting. With this outcome, we are currently studying the rooted cuttings performance in nursery as well as in field.

Conclusion

In this experiment, significant results have been recorded for stem cuttings propagation of Eucalyptus hybrids in water culture. It shows that the water culture method minimizes the space of multiplication area, man power, cost of producing quality planting stock and time to the end user in *Eucalyptus* propagation. This method will help in studies on rooting without damaging standing plant. Above all, this method envisages that the vegetative propagation for *Eucalyptus* is also possible through water culture without using any growth hormones.

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