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Summary and Conclusions

From 1860 to 1980, there has been 15% rise in CO_2 content of the atmosphere. The light from the sun comes through CO_2 envelope without any difficulty and is converted into heat when it strikes the earth i.e. 'Green house effect' (Calvin, 1978) which results in overall increase in CO_2 content in atmosphere likely to double by 2025 (Gribbin, 1981). Therefore one has to look for a resource which is renewable and removes CO_2 from atmosphere and avoid the environmental pollution. The only convenient way to halt the increase is to increase the productivity of plants through photosynthesis.

Mangrove is a group of typical tropical and specialized trees growing in the saline and brackish water systems. These trees form a thick forest belt on the deltas, along the major estuaries and fringe the estuarine banks, as well as backwaters. These trees are highly productive and economical which also protect the shoreline from erosion and cyclonic conditions.This unique tree resource is used for various purposes like tannin extraction, paper pulp, firewood, timber, charcoal, fodder and several other by products. The mangrove swamps are rich in the larvae of many economically important fishes, prawns, crabs and bivalves. These are the most suitable areas for feeding, breeding and nursery grounds of these marine organisms and hence important for aquaculture purposes (Ray Choudhuri, 1991).

Indian mangroves have been deforested, and reclaimed to such an extent that the mangroves along the west coast are very much degraded. This has not only affected the coastline but also the fisheries to a large extent. E. agallocha has got its own importance because of its various economic uses, e.g. paper pulp, timber, fuel and floats.As it is a member of family euphorbiaceae bearing latex, in future possibly it may be useful for as a petrocrops. Day by day this plant is destroyed and the seed germination of this species is less.According to some workers, E. agallocha having a very good ability of coppicing. So attempt has been made to study the growth performance of E. agallocha cuttings and seedlings under fresh water condition. Afforestation of mangrove areas on a large scale is the most urgent need of today, if the coastal environment is to be brought back again to its earlier pristine glory. So a long term planning is urgently required to save mangrove species and propagate them on extensive scale.Considering all this, special attention needs to be paid to the problems of conservation and sustainable utilisation of mangrove areas for multiple uses and to the research needed as a sound basis for their management.

In the light of the above views it was thought that E. agallocha which grows as a mangrove which has been never tried in our laboratory will be a good material to study its response under fresh water conditions by nursery techniques. Attempt has been made in the present investigation by studying the response of stem cuttings as well as seedlings by various parameters described in

the following pages :

I) Sprouting potential study :

This study has been carried out with respect to effect of length variation, effect of girth-size variation, effect of plant growth regulators (PGR), effect of keradix treatment and effect of morphological positions.

A) Effect of length variation-

To study the effect various lengths of cuttings were selected. It is observed that as the length increases, there is increase in percent of sprouting, along with the increasing number of sprouts. L_{20} and L_{25} shows equal sprouting potential. But the survival per cent of L_{20} cuttings is more as compared to other lengths. So L_{20} cuttings has been considered as suitable length for further studies.

B) Effect of girth-size variation -

The stem cuttings of various girth-size were used for the present study. Ga and Gb groups show more number of sprouts along with the increasing sprouting potential. But afterwards Gb group shows highest sprouting potential. From these observations it is clear that Gb group cuttings were suitable for further studies.

C) Effect of plant growth regulators (PGR)-

During the sprouting potential study it is observed that, at lowest concentration of IAA as well as IBA the sprouting potential is lower than that of highest concentrations i.e. 1000 ppm IAA and IBA shows highest sprouting potential and 75 ppm IAA and IBA shows low sprouting potential. And the stem cuttings showed vigorous rooting at highest concentrations i.e. 1000 ppm IAA and 1000 ppm IBA. So it seems that highest concentrations of plant growth regulators gives maximum sprouting as well as vigorous rooting.

D) Effect of keradix treatment -

Keradix powder is a rooting medium. Keradix powder treated cuttings shows better sprouting response i.e. upto 38%. Number of roots are induced by the treatment of this powder. The cuttings having less girth size i.e. Ga group as well as the cuttings having more girth-size i.e. Gd group produced roots.

E) Effect of morphological position -

'M' region cuttings shows highest sprouting potential while less number of sprouts and sprouting potential are observed in 'A' region cuttings.But the 'A' region cuttings failed to survive may be possibly due to ill developed conducting strand. Only 'M' and 'B' region cuttings can survive upto final stage. 'M' region stem cuttings showed highest sprouting potential resulted into vigorous

rooting which has been survived for ever and considered as suitable position for culture technique.

II) Response of cuttings to fresh water conditions :

Various types of cuttings were planted under laboratory condition and studied their growth parameters, whenever they attained a stable condition. Survival percentage is highest in 500 ppm and 1000 ppm IAA 4 months old and lowest in 'M' position 8 months old. It is clear that the 4 months old cuttings show better response than 8 months old cuttings. And it is significant that 1000 ppm IBA although are of 2 months old showed very good response.

Highest number of branches are seen in 'M' position, while lowest has been found in keradix treatment. It is significant that the 1000 ppm IBA 4 months old showed the best response.

Highest length of branches have been achieved in 'M' position, while lowest is observed in 500 ppm IBA. But it can not neglected that 1000 ppm IAA and IBA 2 months old showed the increase in length within very short duration.

Number of leaves are highest in 'M' position and lowest in keradix treatment. It cannot be denied that , 1000 ppm IAA and IBA cuttings although 2 months old showed remarkable response.

More thickness of leaf is observed in 500 ppm IAA while

lowest observed in 75 ppm IAA. But it is a fact that, 1000 ppm IAA and 1000 ppm IBA 4 months old and 2 months old cuttings showed significant increase in thickness within limited time.

It can be conducted that the response of cuttings to fresh water condition is best for 1000 ppm IAA and 1000 ppm IBA. While better response is observed for 'M' region which can be confirmed by their extensive rootings.

III) Response of seedlings to fresh water condition :

Seed germination of E. agallocha is very low. During September to October number of seedlings occur and only few could survive under natural condition. So it was thought to study the response of seedlings under fresh water condition in laboratory.

A) Survival percentage

E. agallocha seedlings can be successfully grown under fresh water condition. It is concluded that there might be some biological factors which affected in the growth and survival of E. agallocha seedlings in laboratory condition.

B) Growth performance

It was concluded from the results that as there is increase in the age of the seedlings, there is also increase in the height, girth-size, number of branches, number of leaves and leaf thickness

i.e. the seedlings show better growth performance upto final stage without any infestation. Our results of seedlings growth were supported Bhosale's (1978) statement that, majority of propagules of mangroves required fresh water condition or less salinity condition for propagules or seedlings growth.

C) Distribution of organic constituents -

The investigation reveals that chlorophyll synthesis under garden conditions is more efficient in E. agallocha like other glycophytes than other mangroves.

Seasonal variation occurs in the content of chlorophylls. Salinity affects the chlorophyll content in E. agallocha seedlings. Amount of chlorophyll content is more in the leaves which are planted in nursery and less in case of the leaves collected from the natural population. i.e. chlorophyll content is directly related with salinity. Highest chlorophyll values are obtained in monsoon. Amount of chlorophyll 'b' is more than chlorophyll 'a' in E. agallocha. Chlorophyll a/b ratio automatically increases in case of fresh water seedlings as compared to natural population which is less than 1 or near to 1 during all the seasons in our results. 'Mg' plays an important role in the synthesis of chlorophyll, in case of E. agallocha possibly 'Mg' is responsible for chlorophyll synthesis.

In case of E. agallocha monsoon is the favourable season

for polyphenol synthesis. Fresh water seedlings synthesis less polyphenols as compared to natural one. E agallocha seedlings under fresh water conditions receive sufficient light and no salinity. Hence the values obtained are towards the response to enough light.

IV) Response of male and female cuttings to fresh water condition-

There is no major morphological difference in the male and female plants during vegetative stage. Male and female plants can identify only during flowering period. Male inflorescence having 2 celled, yellow anthers, after mounting of these anthers plllen-grains are seen. Another inflorescence having three lobed structure. In T.S., trilocular ovary like structure is seen, each locule contains only one ovule.

Response of female cuttings :

Female cuttings showed healthy growth when treated with IAA. Sprouting potential as well as rooting response of female cuttings is better as compared to male cuttings, while male cuttings show lethal response. As the concentrations of IAA increases sprouting potential increases. Rate of survival and sprouting percentage is more in female plants as compared to male plants. Rooting response is also more in IAA treated female plants.

It is significant that 'M' and 'B' region cuttings survive, very well as compared to 'A' region cuttings. Possibly the reason

is that, 'M' and 'B' region cuttings having more girth-size and well developed conducting strand.

Response of male cuttings :

Male cuttings showed better response to IBA than female cuttings. In case of 1000 ppm IBA the response of male cuttings is more i.e. 66 % as compared to female cuttings. But these IBA treated male cuttings failed to produce roots. IBA treatment shows remarkable survival percentage in 'A' region cuttings of male plants and others are not.

The 'B' region cuttings of female survive in 500 ppm IBA treatment. It is significant that, in case of IAA treated cuttings only 'M' and 'B' region cuttings survive while 'A' region cuttings are not. But in case of IBA treated cuttings only 'A' region cuttings were survive others are not survived in male.

V) Biomass Study :

The cuttings which showed better response to various parameters, those are selected for studying the biomass.

In L_{20}, 'M' region and keradix treated cuttings ;showed better response in moisture content keradix is found to be superior in all respects except length of root which is somewhat less than others.

In case of IAA treated cuttings, as the concentration of IAA increases the performance in the parameters such as, fresh weight, dry weight, moisture content, number of roots and length of root increases while at 1000 ppm IAA it showed less performance.

In case of IBA treated cuttings, as the concentration increases, there is increase in fresh weight, dry weight and moisture content. While number of roots and length of root is maximum at lower and highest concentrations.

In case of seedlings, the seedlings which are planted in big pots show more biomass as compared to the seedlings which are planted in small polythene bags. So it was concluded that, this may be due to availability of the space to the seedlings. If the sufficient space is given to the seedlings for its growth, it can grow upto full extent giving good biomass.

To cultivate biomass in and harvest, which also receives solar energy. The biomass, thus harvested can be converted into food for animals and also human beings. Synthetic natural gas (methane), synthetic liquid fuel, electric energy, fertilizer, plastic, lubricants and nearly most of the products obtained from the agricultural sector (Wilcox, 1976).

The potential of bioconversion is indeed vast. 10 % of the world's yearly biomass production when used efficiently can easily meet the requirements of foood and energy. It involves two steps-

photosynthetic production of biomass and its subsequent conversion into more useful or desirable energy forms i.e. gaseous, liquid or solid fuels, heat and electricity. The first aspect of the biomass production i.e. the photosynthetic production has already considered. The maximum yield of biomass is 13 to 15 mg. by weight/K.Cal. For India, with an average solar radiation of 240/watt/m^2 a maximum yield of 230 to 270 tonnes/hectare/year can be expected (Ghosh, 1978). To achieve this aim E. agallocha seedlings as well as cuttings may be planted in large scale, as a photosynthetic model which will possibly help to reduce the CO_2 in the atmosphere and ultimately check the environmental pollution. This will help to increase in the productivity which will be a source of energy, used for fuel, timber as well as petrocrops.

If the trees are not planted at a reasonably rapid pace, it is estimated that by 2000 A.D., nearly 250 million additional people will be without fuel for cooking and heating.Therefore not our survival, but also to boost the local energy sources, fire/fuel wood plantations needs to an urgent attention and quick solution.