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Response of PGRs on rooting potential in soft wood stem cutting of CPTs of *Pongamia pinnata* under spring-summer condition

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Pongamia pinnata is a oil producing tree species with multiple uses and considerable potential as a bioenergy crop. In this experiment efficacy of plant growth regulators *viz.*, IBA, NAA and rootax powder with different concentrations were studied on rooting ability, growth and survival of stem cuttings of *Pongamia*. The results revealed that PGR particularly IBA @ 1500 ppm had significantly (P=0.05) effect on maximum number of primary roots (30.00), success of rooting percentage (92.50) and more number of new shoots per stem cutting. Similarly this PGR treated cuttings showed higher survival percentage as compared to rest PGRs. In regard to minimum (28 days) taken to first sprouting per cutting was also recorded with IBA @ 1500 ppm followed by NAA @ 1500 ppm. This information would help in large scale production and multiplication of genuine planting material for further improvement in elite genotypes of *Pongamia*.

Key words : *Pongamia*, Cuttings, Rooting, Plant growth regulators, Vegetative propagation

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INTRODUCTION

India has the fifth largest vegetable oils country in the world next only to USA, China, Brazil and Argentina, oil seeds accounts for about 1.5 per cent of GDP and 8 per cent value of all agricultural products (NOVOD, 2010). Diesel fuel has essential function in the industrial economy of a developing country and used for transport, industrial and agricultural sectors. The requirement of petrodiesel in India is expected to grow from 55 MMT to 67 MMT in 2011-12 (Pandey *et al*., 2010). The domestic supply of crude oil will satisfy only about 22 per cent of demand and the rest will have to be met from imported crude oil (Mandal, 2005). India is a big importer of crude oil and spends about 341887 crores of foreign exchange every year to meet 75 per cent of its oil needs. Due to stagnating domestic crude production, India imports approximately 72 per cent of its petroleum requirement. The huge gap between demand and supply may be met out only by import. Fluctuating global prices, depletion of reserves dependence on imports and environmental pollution are major concerns associated with fossils fuel energy. Therefore, need to search for alternative sources of energy which are renewable, safe and non polluting oils as latter has a tremendous demand for using as a food and also the high expense for production. Amongst many species, which can yield oil as a source of energy has been found to be one of the most suitable species in India.

Pongamia pinnata (Linn.) Pierre is an arboreal legume tree under family Fabaceae and high potential for oil. The seeds of *Pongamia* contain viscous, non edible oil (30-40 %) are a potential source of biodiesel and are also of ethno and modern medicinal importance (Meera *et al*., 2003). In spite of being a highly valued agroforestry tree, research on cultivation and propagation of *Pongamia* is limited. It can be propagated by seeds or root suckers. The major drawback of this tree species is that it exhibits a long flowering cycle of 4-7 years. Seed originated *Pongamia* plants cannot maintain the genetic purity of genotype due to segregation and recombination of characters during sexual reproduction. In the contrary, vegetative propagation of *Pongamia* can be considered to avoid the segregation of genotype and maintain the quality. This method also ensures quick genetic gain through mass multiplication of selected genotypes and establishment of clonal seed orchards. Thus, the growing out of cuttings through vegetative means offers cost effective mass production of pathogen free uniform plants of elite genotypes (Kesari *et al.*, 2010). It is thus a safer, cheaper and most convenient method of propagation of *Pongamia*. Recently, the role of plant growth regulators in accelerating the root primordial and root development has been recognized in many forest tree species. PGRs used in proper concentration is also most important factor because their use in the excessive strength for the plant species gives injuries results (Krisantini *et al.*,2010) while low concentrations may inhibit the growth, higher concentration may become toxic and this range of action is very narrow. The information on the practical utility of PGRs and their concentrations of *Pongamia* under spring-summer conditions of central India is very limited. Keeping the above point of view, the aim was to determine the optimum concentration of different plant growth regulators (PGRs) on the rooting of semi hardwood cuttings of *Pongamia* for better rooting success and survival and also develop a suitable technique for large scale production of superior clonal stock for testing and plantation.

RESEARCH METHODOLOGY

Plant growth regulators performance trials were conducted at Dusty Acre Forestry Research farm, Department of Forestry, JNKVV, Jabalpur (M.P.) during spring-summer condition (April-June). It is situated at 23.9^{o}N longitude and 79.5 ^{o}E latitude and at 412 m above the mean sea level. The average annual rainfall of the region is 1516 mm, average maximum and minimum temperature are 42.2 and 7.4^{o}C with relative humidity of 77.78 (morning) and 35.00 (evening). *Pongamia* seeds (pods) were collected from different parts of Madhaya Pradesh. Seeds were sown in nursery and plants were transplanted in the field at age of 45 days. Hence, multiplication to increase the rooting potential in pongamia, an attempt has been made to try different PGRs on their cuttings. Five year old healthy, high vigour, uniform, well matured, pest and disease free trees of Pongamia were selected for this study.

The experiment was laid out in Randomized Complete Block Design (RBD) having three replications and following treatments T_1- (IBA 200 ppm), T_2- (IBA 500 ppm), T_3- (IBA 1000 ppm), T_4- (IBA 1500 ppm), T_5- (NAA 500 ppm), T_6-(NAA 1000 ppm), T_7– (NAA 1500 ppm), T_8- (Rootax). Semi hardwood cuttings were treated by 200 ppm IBA as a control treatment. The leaves and shoot apices were excised and uniform leafless semi hardwood (15-25 cm long and 1-1.5 cm diameter) comprising 2-3 nodes were prepared.

The cuttings were dipped in 0.1 per cent aqueous bavistin fungicide (BASF India Ltd.) for 10 minutes, subsequently washed with distilled water treated with root promoting PGRs. The basal portion of the cutting dipped in the solutions of these PGRs and rootax powder for five seconds. They were then planted in potting medium (FYM, soil and sand in 1:1:1 ratio) filled in polythene bags and total 240 cuttings were placed under shade hut house condition. The cuttings were given blunt cut at lower side and a slant cut on upper side. At the time of planting, it was kept in mind that slanting position was kept towards east. 10 cuttings per treatment were used for the experiment under each replication. Observations were recorded on root and shoot forming characters like success in rooting percentage, number and length of primary and secondary roots (cm), number and length of sprouted shoots (cm), number of leaves and survival percentage after 75 days of planting, except the observation of days taken to first sprouting.

The collected data were analyzed statistically by using Fisher's analysis of variance technique and individual treatment means were separated by using least significant difference (LSD) test at 5 per cent probability level (Steel *et al.,* 1997).

RESEARCH FINDINGS AND ANALYSIS

The experimental findings obtained from the present study have been discussed in following heads:

Rooting behaviour :

A critical view of the results in Table 1 exhibited the some pronounced and significant effect of plant growth regulators on all the quantitative rooting parameters of cuttings. Among all the PGRs, IBA @ 1500 ppm concentration was found highly suitable for getting higher success of rooting percentage and significantly superior over rootax (50.00) treated cuttings (Fig. 1). This could be due to the optimum concentration of the exogenous auxins must have caused the mobilization and utilization of carbohydrates and nitrogen fraction with the presence of co-factors at the cut position of cuttings which helped in healthy root initiation. These results are in agreement with the findings of Kesari *et al.* (2009) who observed almost similar trend in rooting response in *Pongamia* cuttings when different physical and chemical treatments were applied in spring season.

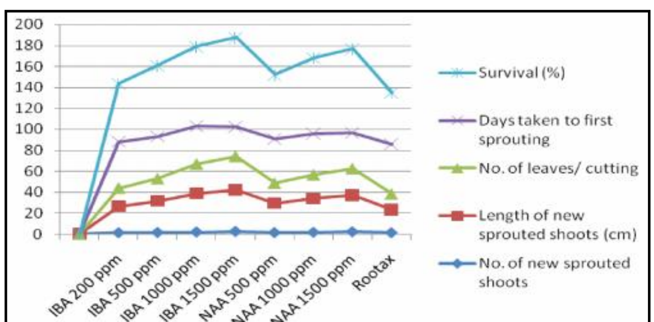

Fig. 1: Graphic representation of PGRs on growth parameters of *Pongamia* cuttings

The data presented in Table 1 clearly revealed that all applied plant growth regulators were significant in producing larger number and length of roots per treated cuttings. The treatment T_4 (IBA @ 1500 ppm) produced more number of primary and secondary roots per cutting (30 to 35) and their length was (17.25 and 11.75 cm), respectively (Fig.1). The probable reason for increasing the number of primary and secondary roots may be due to basipetal (downward) accumulation of essential internal substances and hormones help to faster callusing resulted in more rooting in cuttings reacts with auxins, wherever the specific enzymes is present giving rise to the complex "Rhizocline". This confirms by the findings of Mesen *et al*. (2001) in leafy stem cuttings of *Albizia guacapale*. According to Moe and Anderson (1988) exogenous applied auxin in high concentration is believed to act as accelerator of respiration and cell mitosis such as indole-phenol complex may promote the initiating of root cell expansion and leading to length and thickness of formed roots.

Growth behaviour :

The morphological observations of stem cuttings of *Pongamia* are presented in Table 2. As regards growth parameters, the treatment T_4 (IBA@1500 ppm) gave maximum number (2.75) and length (39.5 cm) of sprouted shoots per cutting was also noted with IBA@1500 ppm. Whereas number (1.50) and length (21.75 cm) of sprouted shoots/cutting and lowest number of leaves per cutting (15.0) were observed in rootax treated cuttings (Fig. 2). This is possibly due to the fact that IBA@1500 ppm encourages the cell division and elongation by modifying the physiological process on one hand and early sprouting due to synergistic effect of optimum concentration of applied plant growth regulator on the other hand. Similar observations were recorded by Thakur (2009) who found significantly more increased number and length of new sprouts in girdled cuttings of white mulberry. The maximum number of leaves per cutting with the aid of synthetic plant growth regulators has been reported by Eganathan *et al*. (2000) in mangroove tree species cuttings. This might be due to the rapid multiplication of new cells, finally helps in increasing in terms of number of leaves.

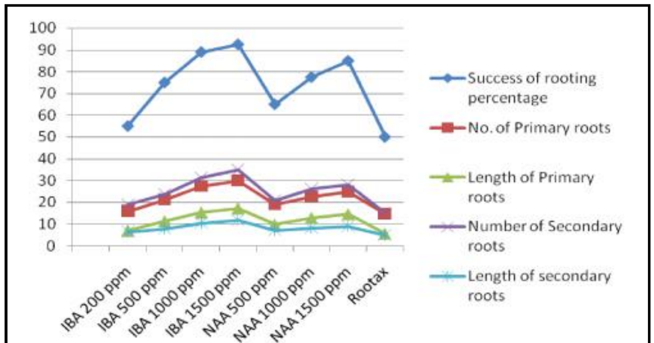

Fig. 2: Graphic representation of PGRs on growth parameters of *Pongamia* cutting

Table 1: Effect of plant growth regulators on quantitative rooting parameters of *Pongamia* cuttings

Treatments	Success of rooting percentage	No. of primary roots	Length of primary roots	Number of secondary roots	Length of secondary roots
IBA 200 ppm	55.00 e	16.00 c	7.00 e	19.00 e	6.50 e
IBA 500 ppm	75.00 c	21.25 b	11.25 c	23.75 d	8.00 c
IBA 1000 ppm	89.00 ab	27.50 ab	15.25 ab	31.25 b a	10.50 b
IBA 1500 ppm	92.50 a	30.00 a	17.25 a	35.00 a	11.75 a
NAA 500 ppm	65.00 d	19.05 bc	9.75 d	21.00 d	7.25 d
NAA 1000 ppm	77.50 c	22.75 b	12.75 bc	26.25 c	8.25 c
NAA 1500 ppm	85.00 b	25.00 b	14.50 b	28.25 bc	9.00 bc
Rootax	50.00 e	14.75 d	5.50 f	15.00 f	5.00 f
LSD Value	5.21	3.82	1.94	3.27	0.91

Note: The difference is not significant in the same letters and significant in the different letters of the same column ((P<0.05)

Table 2: Effect of pant growth regulators on growth parameters of *Pongamia* cuttings

Treatments	No. of new sprouted shoots	Length of new sprouted shoots (cm)	No. of leaves/ cutting	Days taken to first sprouting	Survival (%)
IBA 200 ppm	1.50 d	25.00 d	17.50 e	44 a	55.42 d
IBA 500 ppm	1.75 c	29.75 bc	21.50 cd	40 b	67.52 bc
IBA 1000 ppm	2.21 b	36.75 ab	28.00 b	36 bc	75.65 ab
IBA 1500 ppm	2.75 a	39.50 a	32.00 a	28 d	85.25 a
NAA 500 ppm	1.60 d	27.75 c	19.25 d	42 ab	61.28 c
NAA 1000 ppm	1.90 c	32.00 b	22.75 cd	39 b	72.36 b
NAA 1500 ppm	2.42 b	34.50 b	25.50 c	34 c	80.12 a
Rootax	1.50 d	21.75 e	15.00 c	47 a	49.52 e
LSD value	0.51	3.18	2.95	3.21	7.14

Note: The difference is not significant in the same letters and significant in the different letters of the same column ((P<0.05)

In case of survival, amongst the different plant growth regulators, the treatment T_4 (IBA @ 1500 ppm) was significantly superior as compared to remaining treatments of PGRs. More survivality of cuttings were noted with IBA @ 1500 ppm (Fig.2). It was due to formation of more number of primary roots under this treatment favouring the better establishment and facilitating ideal absorption of food material and water from the soil to the plants resulting in higher percentage of survivality. This result is supported by the findings of Shamet and Sharma (2004) and Puri and Verma (1996) who reported maximum survival percentage of cuttings of red cedar by using IBA. The survival percentage was minimum (49.52) in rootax powder treated cuttings. Similar reports have also been reported in other tree species like *Dalbergia sissoo* Roxb. that has relatively poor survival response in presence of this applied treatment.

Conclusion :

It may be concluded from the present study that among the eight treatment, T_4 (IBA @ 1500 ppm) has proved most superior treatment on the basis of rooting, growth and survival parameters during spring-summer conditions. *Pongamia* plantations established by vegetative propagation (stem cuttings) can be considerably more profitable than those using conventional seed propagation techniques. The profitability of cuttings in terms of economic gains can be raised further if the cuttings are obtained from an elite genotype due to its inherent positive characteristics. The procedure presented here provides rapid mass multiplication by vegetative propagation technique for CPTs of *Pongamia* for raising populations of superior clones in cost effective and efficient methods, especially in tropical and sub-tropical areas where they are grown.

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