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CLONAL PROPAGATION OF *JATROPHA CURCAS* L. INFLUENCED BY GROWTH HORMONES AND DIFFERENT TREATMENT OF ROOT MEDIA

Kundan Singh[1], Syed Afrayeem[2*] and Giggyasa Wasnik[3]

[1]Faculty of Agriculture, Mandsaur University, Mandsaur, Madhya Pradesh, India.
[2]Faculty of Agriculture, Madhyanchal Professional University, Bhopal, Madhya Pradesh, India.
[3]Oriental University, Indore Madhya Pradesh, India.
*Corresponding author E-mail: syedafrayeem@gmail.com
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ABSTRACT

An experiment was conducted at Research and Development farm, Ruchi Biofuel Private Limited Maheshwer (situated between $24^0\ 22^o12'25''$ N latitude, $75^035'26''$ E longitudes, at an elevation of 600 m above the mean sea level) to determine the clonal propagation of *Jatropha curcas* L. influenced by growth hormones and different treatment of root media. Perusals of data are revealed that maximum survival was obtained in IBA 150 ppm (59%) treated cutting and minimum survival was recorded in those were treated by Neem cake (37 %) it is 17 % less then control. The highest mean percentage of cuttings sprouting, number of cutting sprouts per cuttings, number of primary roots, average length of sprout and root were observed in root media as compared to auxin treated cuttings. On average mean sprouting percentage (32 %) and number of sprouts per cuttings (3.3) was found maximum in root media as compared to control *i.e.*, 29.33% and 2.75 respectively. It is suggested that the level of endogenous auxins and rooting media factor increased after bud breaking stage (February-March) in *Jatropha curcas,* which subsequently activates the cambium and plant dynamic associated with rooting.

***Key words*: Auxin, Cambium, Plant dynamic and Growth hormones.**

Introduction

Jatropha curcas L. is a large perennial shrub belongs to the family *Euphorbiaceae*. It is believed to be a native of South America & Africa but later spread to other continents of the world by the Portuguese settlers. *Jatropha curcas* has the advantage that not only is it capable of growing on marginal land, but it can also help to reclaim problematic lands and restore eroded areas (Balderrama, *et al.*, 2005; Biswas, *et al.*, 2006; Kundan Singh *et al.*, 2022). As it is not a food or forage crop, it plays an important role in deterring cattle, and thereby protects other valuable food or cash crops. *Jatropha* seeds can be pressed into bio-oil that can be used to run diesel engines, which in turn can drive pumps, food processing machinery, or electricity generators. The bio-oil can also be the basis for soap making. The pressed residue of the seeds is a good fertilizer and can also be used for biogas production. Today it is found in almost all the tropical & subtropical regions of the world. In India, *Jatropha curcas* is found in almost all the states and is generally grown as a live fence for protection of agricultural field from damage by livestock as it is not eaten by cattle (Feike, *et al.*, 2007; Henning, 2008; Singh, *et al.*, 2007 and Kundan Singh *et al.*, 2022, Bambang Gunawan *et al.*, 2021).

Non-edible vegetable oil of *Jatropha curcas* has the requisite potential of providing a promising and commercially viable alternative to diesel oil since it has desirable physicochemical and performance characteristics comparable to diesel. Oil also has a very high saponification value and is being extensively used for making soap. It is also used as an external application for skin diseases and rheumatism and for sores on domestic livestock. In addition, the tender twigs of the plant are used for cleaning teeth, while the juice of the leaf is used as an external application for piles (Coll, *et al.*, 2005; Feike, *et al.*, 2007; Henning, 2008; Jongschaap, *et al.*, 2007; Singh, *et al.*, 2007, Bambang Gunawan *et*

Table 1: Effect on growth (± SD) of stem cuttings of *Jatropha curcas* as influence by different treatment of root media and plant growth regulator.

Treatment	Number of days to first sprouting	Number of cuttings sprouted	Number of sprouts per cutting	Number of primary roots	Length of sprout (cm)	Average length of root (cm)
IBA 50 ppm	22.66±1.53	30.33±6.67	3.25 ±0.87	11.25 ±1.56	46.00 ±9.41	29.17±10.34
IBA 100 ppm	23.66±0.97	29.00±4.58	3.25 ±0.43	12.67 ±2.74	56.92±17.10	27.50±4.82
IBA 150 ppm	24.00±0.58	32.33±4.51	3.50 ±0.90	11.58 ±2.16	50.58±5.93	33.42±6.04
NAA 100 ppm	23.33±1.15	31.33±7.02	3.25 ±0.43	13.33 ±2.57	53.17±9.23	28.00±7.86
NAA 200 ppm	23.00±0.58	29.67±5.03	3.25 ±0.25	11.75 ±2.82	42.67±11.00	29.00±10.01
NAA 300 ppm	23.33±2.08	29.33±6.66	3.33 ±1.01	11.42 ±3.09	42.58±8.93	34.08±9.17
FYM 25 t.ha^{-1}	22.33±3.21	28.00±1.00	2.83 ±0.46	11.75 ±0.43	44.33±4.80	26.25±4.02
Neem cake 10 t. ha^{-1}	16.00±0.58	34.33±5.03	2.83 ±0.61	12.33 ±2.08	70.67±8.04	31.17±4.05
Vermicompost 10 t. ha^{-1}	22.00±1.73	34.67±1.53	3.25 ±4.30	12.25 ±1.09	47.18±4.78	29.75±2.46
Poultry manure 10 t.ha^{-1}	17.00±0.59	33.33±3.21	2.75 ±0.90	12.92 ±1.38	82.58±9.93	31.00±2.50
Chemical fertilizer (N P K) 0.5 t. ha^{-1}	22.66±1.53	29.67±2.00	3.50 ±0.83	12.17 ±1.42	48.33±8.50	30.00±7.65
Control	21.66±2.08	29.33±2.52	2.75 ±0.56	14.17 ±2.63	52.75±13.64	20.25±10.50
CD at 5%	2.53*	2.45*	4.35*	2.49*	NS	NS
Significant at P=0.05*						

al., 2021, M. Qasim *et al.*, 2021). Finally, the roots are reported to be used as an antidote for snake-bites. *Jatropha* oil cake is rich in nitrogen, phosphorous and potassium and can be used as organic manure. *Jatropha curcas* or *Ratanjyot*, can prove itself a miracle plant by turning waste land into a moneymaking land. It can help to increase rural incomes, self-sustainability and alleviate poverty for women, tribal communities and small farmers. Looking at the high value of this plant species, efforts have been made to introduce and to develop suitable agro-technique for the commercial cultivation of this crop (Hundessa Gudeta, *et al.*, 2020).

It can be easily propagated on massive scale by direct seeding as well as stems cuttings. At present, considerably good improved strains of *Jatropha* are available in our country for large scale planting. However, the required quantity of genetically pure seed material for commercial plantings is still not available. A lot of genetic variation exists in the available seed material, which obviously necessitates vegetative reproduction for the multiplication of desireds trains. Stem cutting is easiest method to develop the vegetative propagates. Therefore, the present study was undertaken to develop the appropriate protocols for mass production through clonal propagation (stem-cutting) in order to maintain genetic purity, uniformity and gainful exploitation of useful variation, and also to meet the required demand for high-quality planting material at commercial scale.

Materials and Methods

The present study was carried out at the research and demonstration farm of Ruchi Bio Fuels Pvt. Ltd. at Gawla Talab, Maheshwar located between 22°12'25" N latitude, 75°35'26" E longitude with an elevation of 600 meter at sea level at Khargon district of Madhya Pradesh, India. Elite progenies of healthy and uniform cuttings of 20-25 cm long and 2-3 cm thick of *J. curcas* were taken from the middle portion of one-yr-old branches of three-yr-old plants during the month of February. Cuttings were dipped in 0.1% bavist in fungicide for 2-3 min and subsequently washed in distilled water before giving hormonal treatment. These were divided into 12 groups of 120 cuttings each. Group 1 was treated with distilled water as control. Groups 2-7 were treated with 50, 100 and 150 ppm of in dole-3-butyric acid (IBA) and 100, 200 and 300 ppm naphthaleneacetic acid (NAA). Cuttings were treated by submersing about 3 cm basal portion in each treatment solution for 24 h. Cuttings were then transferred into well prepared ridge bad as rooting

Fig. 1: Overview of Experimental Field.

Table 2: Effect on biomass (± SD) of stem cuttings of *Jatropha curcas* as influence by different treatment of root media and plant growth regulator.

Treatment	Fresh weight of sprout (g)	Fresh weight of root (g)	Dry weight of sprout (g)	Dry weight of root (g)
IBA 50 ppm	244.67±45.07	32.83 ±10.79	55.08 ±8.66	8.08 ±2.50
IBA 100 ppm	274.58±63.65	32.58 ±21.16	61.00 ±12.11	8.08 ±4.11
IBA 150 ppm	315.75±106.91	32.92 ±11.63	69.08 ±20.43	18.33 ±2.75
NAA 100 ppm	298.00±155.03	37.17 ±17.16	65.83 ±29.38	9.33 ±3.74
NAA 200 ppm	246.42±41.67	29.33 ±12.05	56.00 ±8.05	7.75 ±2.61
NAA 300 ppm	254.75±84.69	28.75 ±10.75	57.25 ±12.77	7.25 ±2.67
FYM 25 $t.ha^{-1}$	176.58±28.72	26.25 ±6.56	42.75 ±5.17	7.25 ±1.73
Neem cake 10 $t.ha^{-1}$	173.33±32.46	64.42 ±22.26	40.25 ±11.17	5.00 ±4.34
Vermicompost 10 $t.ha^{-1}$	225.67±88.07	27.67 ±3.83	51.75 ±16.73	7.33 ±1.13
Poultry manure 10 $t.ha^{-1}$	200.92±29.17	67.25 ±2.54	50.25 ±3.97	15.42 ±0.38
Chemical fertilizer (N P K) 0.5 $t.ha^{-1}$	264.50±105.84	28.92 ±11.69	53.33 ±14.69	7.58 ±2.18
Control	263.17±100.40	23.92 ±23.82	58.25 ±19.82	6.50 ±4.52
CD at 5%	32.90*	24.49*	6.28*	4.98*
Significant at P=0.05*				

medium. 40 cuttings were planted in each bad and randomly 3 beds were selected for each treatment. Rest of the 5 groups were also treated with distilled water and planted in next 15 beds 3 beds for each group. These beds had 5 different soil treatments *i.e*., FYM 25 t. ha^{-1}, neem cake @ 10 $t.ha^{-1}$, vermicompost @ 10 $t.ha^{-1}$, poultrymanure 10 $t.ha^{-1}$ and chemical fertilizer (NPK) @ 0.50 $t.ha^{-1}$. Irrigation and other operational practices were applied as per weather conditions and soil moisture status. The cuttings were started sprouting after ten days of planting and the data for complete sprouting were taken daily up to 21 days after planting. The data on growth *i.e.,* sprout length; root length and dry biomass of shoot and root were taken at weekly interval for 30 days onwards upto the 90 days of planting to compare the growth performance of seedlings as influenced by different treatments.

Fig. 2: Stem cuttings of *Jatropha curcas* in root media.

The data was statistically analyzed for Factorial Randomized Design and analysis of variance (ANOVA) was done for all trials and simple correlation (r) was calculated following the method of Shnedecor and Cochran (1967).

Result and Discussion

The Survival percentage of stem cuttings of *Jatropha curcas* as influence by different treatment of root media and plant growth regulator is mentioned in Fig. 1.

The perusal of data revealed that maximum survival was obtained in IBA 150 ppm (59%) treated cutting and minimum survival was recorded in those were treated by Neem cake (37%) it is 17 % less then control. Overall analysis of survival of cutting is shown that the cuttings were treated by auxin (56.2 %) are performed far better than cutting treated by root media (44.5 %).

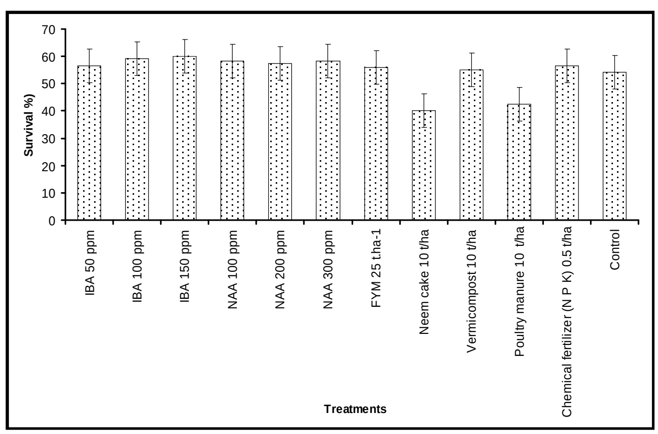

Fig. 3: Survival percentage of stem cuttings of *Jatropha curcas* as influence by different treatment of root media and plant growth regulator.

It might be the stage of endogenous auxin factors influencing to increase subsequently activates the cambium and plant dynamic associated with rooting and initial buds' germination. The phenomenon is supported by the finding of earlier workers (Dhillon *et al.,* 2006, Salazar-Villa, *et al.,* 2021, Vijay S., *et al.,* 2023).

The branch cutting responded differently to various growth hormones, their concentration levels and with different rooting media is exhibited in Table 1. The highest mean percentage of cuttings sprouting, number of cutting sprouts per cuttings, number of primary roots, average length of sprout and root were observed in root media as compared to auxins treated cuttings. On average mean sprouting percentage (32 %) and number of sprouts per cuttings (3.3) was found maximum in root media as compared to control *i.e.,* 29.33% and 2.75 respectively.

It is suggested that the level of endogenous auxins and rooting media factor increased after bud breaking stage (February-March) in *Jatropha curcas*, which subsequently activates the cambium and plant dynamic associated with rooting. The phenomenon is supported by the finding of earlier workers (Anand and Herbarlein, 1975; Palanisamy and Kumar, 1997 and Dhillon *et al.,* 2006; Fazeli-Nasab *et al.,* 2021; Rahmatullah Jan, *et al.,* 2022).

In application of IBA in different concentration (50, 100 and 150 ppm) was also found equally responsive in sprouting of cuttings and higher sprouting (32.33 %) was found in higher concentration of IBA (150 ppm) as compared to lower concentration *i.e.,* 50 and 100 ppm. However lower concentration of NAA (100 ppm) treatment inhibited (31.33 %) sprouting. Hartmann *et al.,* (1997) reported that the most of the cases, the higher concentration of auxins are not favorable for shoot growth but encouraging growth of root. In present study the observable fact was found similar as higher concentration of NAA (300 ppm) induced maximum root growth (38.08 cm) with minimum shoot growth (42.58 cm) with comparison of other concentration of NAA (100 and 200 ppm). On average over all impact of the investigation shown that the application of auxin producing maximum root growth (30.12) and minimum shoot length (48.65), however root media (shoot length 58.62 cm; root length 29.63 cm) exhibiting inverse performance (Azimah Hamidon, *et al.,* 2020; Rasha *et al.,* 2023 and Naveen Gaurav *et al.,* 2023).

Ali *et al.,* (2007) made an attempt to standardize the technique of vegetative propagation by stem cutting of *Jatropha curcas* with varying thickness *viz*. <1 cm, 1-1.5 cm and >1.5 cm. Juvenile and mature stem cuttings of this plant were tested for their rooting and sprouting ability. Cuttings were treated with different concentrations (50, 100, 200, 400, 600, 800 and 1000 ppm) of auxins (IBA and NAA) along with distilled water (control). IBA and NAA at 100 ppm showed the best result compared to other treatments. NAA treatment responded better as compared to IBA for optimal level of auxins treatment causing reduction in rooting.

The data for the biomass of *Jatropha* recorded after 60 days of germination are mentioned in Table 2. Dry weight of shoot and root was found maximum in IBA 150 ppm treated cuttings (69.08 gm and 18.33 gm, respectively) whereas as it was found minimum in the cutting treated by Neem cake 10 t.ha^{-1} (40.25 gm and 5.00 gm, respectively). Statistical analysis of data are revealed that the non-significant (P=0.05) variation among various treatment. Overall comparison of different media, biomass is very much influencing by auxin treatment as comparison of different root media. It is because of plant growth hormones may generally be grouped into five recognized categories. These are: ethylene and like molecules that promote ripening; abscisic acids that are involved in dormancy and abscission; auxins that stimulate cell extension (typically in actively growing regions); gibberellins that are involved in shoot extension in light; and cytokinins that are often found in roots and involved in cell division and interact with auxin to determine whether dividing cells become root or shoot cells. Auxin is used to overcome apical dormancies and increase axillary shoot production (Banko and Stefani, 2006). IBA also acts as an anti-auxin or regulator of auxin metabolism suggesting the possibility that it may increase Ck levels in lateral buds and stimulate shoots elongation (Hoffman and Parups, 1964; Ito *et al.*, 2000; Azimah Hamidon, *et al.,* 2020; Rasha *et al.,* 2023 and Naveen Gaurav *et al.,* 2023).

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