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Full Length Research Paper

Effect of IBA and age of cuttings on rooting behaviour of *Jatropha Curcas* L. in different seasons in western Himalaya, India

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Present study deals with the effect of different concentrations of IBA on rooting behaviour of *Jatropha curcas* L. stem cuttings in different seasons. The study was carried out in Western Himalayan region in Uttarakhand, India during 2005-2006 in spring, monsoon and winter season. The juvenile and mature cuttings of *J. curcas* were treated with different concentration of IBA (0, 500, 1000, 1500, 2000 and 2500 ppm) for 12 h and rooting behaviour was observed 60 days after planting. Juvenile and mature cuttings treated with IBA at1500 and 2000 ppm respectively showed highest rooting response. The sprouting in juvenile cuttings varied from 34.2% in winter to 100.0% in monsoon season while the mature cutting varied from 24.6% in winter to 64.3% in monsoon season. The rooting % in juvenile cuttings varied from 24.1% in winter to 90.5% in monsoon and the mature cutting from 21.7% in winter to 60.8% in monsoon. The IBA treated juvenile cuttings showed the rooting behaviour in the order: 1500ppm > 2000 ppm > 1000 ppm > 500 ppm > 2500 ppm > control and the IBA treated mature cuttings showed the order: 2000 ppm > 1500 ppm > 1000 ppm> 2500 ppm > 500 ppm >control.

Key words: Juvenile cutting, mature cutting, indole-3-butyric acid (IBA), sprouting percentage, rooting percentage, number of roots, root length.

INTRODUCTION

Jatropha curcas L., commonly known as physic nut belongs to family Euphorbiaceae is a useful tree which is in immense consideration for the biofuel in the present time. Jatropha is distributed throughout the world mainly in tropical region (Chopra et al., 1958) while it is native to Mexico and Central America and now being naturalized in most of the parts of India. Jatropha is perennial, deciduous 3 - 5 meter small tree with smooth grey bark having 8 to 12 centimeter long heart shape green to pale green coloured leaves with 3 to 5 lobes in the leaves. It is a fast growing species which grows approximate 4 meter in 4 to 5 years.

The maximum and minimum average temperature in the natural zone of *J. curcas* is 46°C and 12°C. The annual rainfall ranges between 900 to 1200 mm which is mostly reached during monsoon whereas summer months are generally dry. The tree can grow in barren, gravelly, poor, sandy, loam and shallow soil whereas it can not grow properly in the water stagnant area because it is sensitive to water logged condition.

Recently, it has been found that in a country like India, where there is paucity of indigenous fossil fuel with limited resources, the *J. curcas* seems to be an economical and environmental friendly approach (Euler and Gorriz, 2004). Mass multiplication of *J. curcas* seedlings for the elevated need for the plantation of this crop seems

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Table 1. Rooting performance of *Jatropha curcas* cutting during Monsoon season.

IBA con.	Sprouting %		Rooting %		No. of roots /cutting		Root length (cm)	
(ppm)	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature
500	79.6 (61.1)	43.8 (41.4)	74.4 (59.6)	40.5 (39.5)	3.0	1.6	7.6	3.9
1000	83.2 (65.8)	57.2 (49.1)	80.0 (63.4)	57.0 (49.0)	4.0	2.6	8.2	4.0
1500	100.0 (90.0)	59.8 (50.7)	90.5 (72.1)	58.7 (50.0)	6.3	2.8	9.6	4.8
2000	87.3 (69.1)	64.3 (53.3)	82.8 (65.5)	60.8 (51.2)	5.8	3.2	10.7	5.9
2500	81.4 (64.5)	45.5 (42.4)	74.4 (59.6)	43.8 (41.4)	3.8	2.6	8.8	4.6
control	74.7 (59.8)	48.4 (44.1)	70.6 (57.2)	40.5 (39.5)	3.6	1.9	9.5	3.8
CD 5%	11.843	6.968	10.583	8.493	0.867	0.593	3.612	0.683

Figure in parenthesis are transformed values.

to be worthwhile.

Apart from various methods of its propagation, vegetative propagation by stem cuttings has received lot of attention in recent years. It is most simple, easiest and widely used tool for establishment of clonal plantations. The vegetative propagation initiated the early commencement of reproductive phase, produce true to type genotypically/phenotypically plant, it is disease free and reduces the variability in the seeds to be produced (Nanda and Kochhar, 1987).

The treatment of juvenile and mature cuttings in order to evaluate the sprouting, rooting response and root length is an important study therefore, it was considered to be useful to undertake a study on the vegetative propagation of *J. curcas*. The property of Jatropha to grow on marginal lands and to reclaim and restore eroded areas is also proved worthwhile (Jones and Miller, 1992).

MATERIALS AND METHODS

The study was carried out at the Mother nursery of Matrichhaya Parvatiya Vikas Samiti, Gaja, Tehri Garhwal under the Western Himalaya of Uttarakhand, India in 2005 - 2006 during the monsoon, spring and winter season. The experimental station falls in 78°14' E longitude and 30°18' N latitudes with an altitude of 1300 m and an average annual rainfall of the 1240 mm. The mean annual temperature of the station ranged from 9° to 33°C. In the experiment the 15 cm long cuttings having 3 - 5 buds and 2 – 3 cm thickness (diameter) were taken from juvenile and mature shoots during spring, monsoon and winter seasons. The base and apex portion of the cuttings were demarcated in the different cuts in both the edges. The basal portion of the cuttings was treated (dipped) in the different concentrations of indole-3-butyric acid (IBA) as 500, 1000, 1500, 2000 and 2500 ppm for 12 h. The treated cuttings were also compared with the control (treated with distilled water only). The treated cuttings were planted in Soil: Sand: FYM (2:1:1) in polythene bags (15 x 23 cm). There were five treatments each in four replications for juvenile and mature cuttings and a control for both the stages. The cuttings were watered alternately as per the climatic condition and need of the plant. During the experiment the observations were taken on the sprouting percent, rooting percent, number of roots per cutting and root length after the 60 days of planting (DAP). Due to two types of cutting (juvenile and mature), three seasons and five IBA concentration, the experiment was placed under the factorial CRD design and collected data were analyzed in the PC environment.

RESULTS

The performance of cutting of *Jatropha curcas* varied with the concentration level of IBA, age of cuttings (juvenile/ mature) and the season of cutting. In monsoon season the maximum sprouting (100.0%), rooting (90.5%) and number of roots/cutting (6.3) were recorded in the juvenile cuttings treated with 1500 ppm of IBA solution whereas root length (10.7cm) recorded to be highest in 2000 ppm of IBA solution. In the same season the performance of mature cutting treated with IBA showed highest sprouting (64.3%), rooting (60.8%) and number of roots/cutting (3.2) and root length (5.9 cm) in 2000 ppm solution of IBA. The values of above parameters recorded to be significantly higher over the control (untreated) and other concentration of IBA solution (Table 1). The position of cutting and the age of ortet (mother plant) also play a significant role in sprouting and rooting. Cutting made from juvenile plant (cutting taken from the branch of current season growth) exhibited to be better rooting as compared to mature plant. It was observed that some cuttings did not have any root formation only some callusing was found in the basal portion in the cutting.

The number of roots per cutting also increased with the application of IBA and the effect of IBA recorded to be more pronounced. In addition, it was seen that cuttings taken from the middle portion of the branches showed more rooting and better response to IBA application compared to the extreme apical or basal cuttings.

In the spring season the highest values recorded for sprouting % and root length as 54.4% and 7.1 cm in juvenile cuttings treated with 1500 ppm while the rooting % and number of roots/cutting were found to be highest as 35.8% and 3.4 with 2000 ppm of IBA solution. The mature cutting showed maximum sprouting (34.8%), number of roots/cutting (2.2) and root length (4.8 cm) in cuttings treated with 2000 ppm while the rooting (25.4%) was found to be highest in 1500 ppm of IBA during monsoon season (Table 2). In winter season the juvenile cuttings when treated with 2000 ppm of IBA solution showed maximum rooting (29.8%) and number of roots/ cutting (3.8) while the sprouting (39.2%) and root length

Table 2. Rooting performance of *Jatropha curcas* cutting during spring season.

IBA con.	Sprouting %		Rooting %		No. of roots /cutting		Root length (cm)	
(ppm)	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature
500	40.4 (39.5)	33.2 (35.2)	31.7 (34.3)	22.8 (28.5)	3.2	1.4	3.8	2.7
1000	42.2 (40.5)	34.4 (35.9)	32.6 (34.8)	22.8 (22.5)	2.7	1.7	4.2	3.6
1500	54.4 (47.5)	34.1 (37.5)	34.8 (36.2)	25.4 (30.3)	3.2	2.1	7.1	3.7
2000	41.8 (40.3)	34.8 (36.2)	35.8 (36.8)	25.2 (30.1)	3.4	2.2	6.6	4.8
2500	43.8 (41.4)	33.6 (35.4)	32.0 (34.5)	25.1 (30.1)	3.0	1.8	5.6	3.8
control	44.0 (41.6)	33.8 (35.6)	33.4 (35.3)	23.6 (29.1)	2.8	2.0	4.8	2.9
CD 5%	5.844	3.103	3.897	1.653	0.443	0.284	0.799	0.642

Figure in parenthesis are transformed values.

Table 3. Rooting performance of *Jatropha curcas* cutting during winter season.

IBA con.	Sprouting %		Rooting %		No. of roots /cutting		Root length (cm)	
(ppm)	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature	Juvenile	Mature
500	34.2 (35.8)	28.6 (32.3)	27.6 (31.7)	22.7 (28.5)	2.9	1.3	3.3	2.7
1000	36.4 (37.1)	26.5 (30.9)	28.5 (32.3)	21.8 (27.8)	2.9	1.4	4.0	3.2
1500	39.2 (38.8)	29.3 (32.8)	28.8 (32.5)	27.4 (31.6)	3.4	1.7	5.8	2.9
2000	37.9 (38.0)	29.6 (32.9)	29.8 (33.1)	28.4 (32.2)	3.8	2.0	4.2	3.6
2500	36.4 (37.1)	26.7 (31.1)	28.6 (32.3)	24.9 (29.9)	3.4	1.4	4.0	3.1
control	34.8 (36.2)	24.6 (29.7)	24.1 (29.4)	21.7 (27.8)	3.1	1.2	3.0	2.6
CD 5%	4.749	3.853	2.079	1.46	0.342	0.278	0.528	0.332

Figure in parenthesis are transformed values.

(5.8 cm) were recorded highest in juvenile cuttings treated with 1500 ppm of IBA solution. In mature cutting the maximum sprouting (29.6%), rooting (28.4%), number of roots/cutting (2.0) and root length (3.6 cm) were recoded in cuttings treated with 2000ppm of IBA solution (Table 3).

The untreated (control) cuttings were also sprouted properly, however it was quite low compared to IBA (1500 and 2000 ppm) treated cuttings. Sprouting % in juvenile cuttings varied from 34.2% in winter to 100.0% in monsoon season while the mature cutting varied from 24.6% in winter to 64.3% in monsoon season. The rooting % in juvenile cuttings varied from 24.1% in winter to 90.5% in monsoon and the mature cutting from 21.7% in winter to 60.8% in monsoon. The number of root/cutting varied from 2.7 in spring to 6.3 in monsoon season in the juvenile cutting and 1.2 in winter to 3.2 in monsoon season in the mature cutting while the root length varied from 3.0 cm in winter to 10.7 cm in monsoon of juvenile and 2.6 cm in winter to 5.9 cm in monsoon season of mature cutting.

DISCUSSION

Among different concentrations 1500 ppm of IBA in juvenile cuttings and 2000 ppm of IBM in mature cuttings was most effective. The IBA treated juvenile cuttings showed the following order: 1500 ppm > 2000 ppm > 1000 ppm > 500 ppm > 2500 ppm > control and the IBA treated mature cuttings showed the order: 2000 ppm > 1500 ppm > 1000 ppm> 2500 ppm > 500 ppm >control. In the rooting process changes takes place in both physiological and biochemical levels and the enzymatic activities that may become more regulated. Further it has been evident that IBA is more effective in case of *J. curcas* which increased the number of sprouts per cutting in J. *curcas* and *J. glandulifera* and the effect was pronounced throughout the experiment up to 45 days (Kochhar et al., 2005).

It has been observed that sprouting percent declined beyond the range of optimum concentration. These results are in conformity with the results reported by Tewary et al. (2004) for *Vitex negundo*. The season play an important role in rooting, moreover, cutting size (length, thickness and number of buds/cutting) and cutting age also play an important part in rooting response of shoot cuttings. Nanda et al. (1968) have also found seasonal variation in rooting response in the shoot cuttings of some forest species. Nanda et al. (1969 and 1970) showed the effectiveness of exogenously applied auxins (IBA) changes with seasons and further governed by morphophysiological conditions related to bud dormancy. The supply of IBA from the base of the cuttings

appears to stimulate rooting in this species. The enrichment of rooting may perhaps a transformation of auxin after absorption. Auxin play multifarious roles related to the division and elongation of meristematic cells, differentiation of cambial initials into root primordial and in the mobilization of reserve food material, thereby enhancing the activities of the hydrolyzing enzymes (Nanda, 1970; Nanda and Kochar, 1985).

Most of the IBA treated cuttings produced greater number of roots as compared to control. The cuttings taken and propagated during monsoon season performed excellent, this might be due to sufficient soil moisture content and favourable growth condition to the plants. In addition to promoting the rate of adventitious roots development, IBA application has been found to increase the number of roots per rooted cutting (Palanisamy and Kumar, 1996; Chauhan et al., 1994). IBA gives good results in root elongation in *J. curcas* which is in agreement of Teklehaimanot et al. (1996) and Chauhan et al. (1994).

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