

Original Research Article

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Vegetative Propagation of *Adina cordifolia* through Branch Cuttings

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ABSTRACT

The present study was aimed to study the response of cuttings to sprouting and to study the rooting behavior of the Haldu (*Adina cordifolia*) in nursery conditions. The trials for vegetative propagation through branch cutting were done in the low cost poly house, low cost vegetative propagation chamber and in the natural conditions. The branch cuttings were graded into two diameter classes viz. (a) 1 to 2 cm and (b) 2 to 3 cm. and treated with 5,000 ppm; 10,000 ppm; 20,000 ppm IBA for 10 seconds. From the results, it can be concluded that the concentration of growth hormone IBA and the environmental conditions affect the number of sprouts, sprouting percentage, shoot length and diameter of *Adina cordifolia* cuttings positively. The application of IBA at the concentration of 20,000 ppm and use of low cost vegetative propagation chamber condition provided better environment for sprouting of *Adina cordifolia* cuttings and their growth. More than 3 months period is required for rooting in this species. Open bed (natural) condition is not suitable for multiplication of *Adina cordifolia* through cutting. Cutting diameter of 1 to 2 cm was found to be better than other diameter class tested in the study.

Keywords

Branch cutting,
Adina cordifolia,
IBA, Propagation

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Introduction

Adina cordifolia (Roxb.) Hook. f. ex Brandis, syn. *Haldina cordifolia* (Roxb.) commonly known as Haldu is large deciduous tree species of family Rubiaceae. The tree may attain 40 m height and straight clean bole of 18 m and a girth of 7 m and over, with a large high crown, erect trunk and horizontal branches (Anon, 1985). The species is heavily exploited for fuelwood and fodder in its distribution ranges by the local people.

Natural regeneration of this species is very difficult as the minute seeds (about 11 million seeds/kg) as well as young seedlings in forests are easily washed away the proportion of seedlings which survive and establish themselves in forests is relatively very small. Further heavy browsing by wild animals causes tremendous damage to the young seedlings and saplings. Haldu is largely used for structural work. It is one of the best Indian Timbers suitable for flooring and for panelling railway carriages.

Materials and Methods

Experimental site

The experiment was conducted at LKTS Nursery, Silviculture Division, Forest Research Institute, Dehradun during the year 2012. F.R.I. Dehradun situated at 30° 20' N latitude, 77° 52' E longitude and 640.08 meter altitude above the mean sea level and lies in a narrow belt under the foothills of Shivalik range of Himalaya.

Source and preparation of cuttings

The branch cuttings of *Adina cordifolia* were taken from healthy mother trees in the area of F.R.I. campus (near I.G.N.F.A., Clutterbuck Road), Dehradun in the month of February. The cuttings selected were free from any insect or disease damage. The branch cuttings were graded into two diameter classes *viz.* (a) 1 to 2 cm and (b) 2 to 3 cm using digital Vernier callipers. The stem diameter was taken at the middle of the cuttings.

The branches are cut keeping the lower edge slanting so as to get more exposure to the cambium for better root initiation. Wax was applied at the top end of the cuttings to prevent loss of moisture. This application of wax also prevents the cuttings being exposed to the possible attack of disease from the cut part of the stem.

Types of growth regulators and its concentration

The growth regulators/ hormones and used concentrations were as follows:

Name of growth regulator: Indole-3-butyric acid (Auxin)
Concentrations (ppm): 5,000 ppm, 10,000 ppm, 20,000 ppm

Environment conditions

The trials for vegetative propagation through branch cutting were done in the low cost poly house, low cost vegetative propagation chamber and in the natural conditions.

Layout of experiment

Experiment 1

The trials for vegetative propagation through branch cutting were done in the low cost poly house. The experiment was laid out in Randomised block design (RBD). Total number of 120 cuttings planted under low cost poly house and treated with different hormonal concentrations which were replicated 4 times.

The details of experiment are given below:

Experiment 2

The experiment was laid out as Randomised Block Design (RBD) under low cost vegetative propagation chamber. Twenty-seven cuttings were taken for experiment and thus treated with different hormonal concentrations (IBA) which were replicated three times.

Experiment 3

The experiment was laid out as Randomised block design (RBD) under open condition or open bed. Sixty cuttings were taken for experiment and thus treated with different hormonal concentrations (IBA) which were replicated four times.

Method of treatment and planting of cuttings

The cuttings were treated with 5,000 ppm; 10,000 ppm; 20,000 ppm IBA for 10 seconds.

These treated cuttings were planted immediately after the treatment in the beds prepared from a mixture of soil, sand and farmyard manure (2:1:1 ratio). All the cuttings were given same cultural practices such as irrigation, manuring, hoeing, weeding etc. during the experiment.

Observation recorded

Number of days taken for sprouting

Number of days taken for sprouting was recorded by counting the number of the sprouted cuttings on alternate day till the total number of sprouted cuttings become constant in each treatment.

Sprouting per cent

Sprouting per cent was calculated after one month of raising cuttings using the formula:

$$\text{sprouting per cent} = \frac{\text{number of cuttings sprouted}}{\text{numbers of cuttings planted}} \times 100$$

Rooting per cent

Rooting per cent was calculated by uprooting the cuttings. Following formula was used for calculating the rooting per cent.

$$\text{rooting per cent} = \frac{\text{Numbers of cuttings rooted}}{\text{Numbers of cuttings raised}} \times 100$$

Shoot length

Shoot length was measured in centimetres with the help of a meter rod from the collar region to tip of main shoot.

Shoot diameter

Shoot diameter was taken with the help of electronic digital Vernier calliper at the ground level and mean of two values at right angles to each other per seedlings was recorded.

Statistical analysis of data

The experimental data obtained during the various studies were analysed statistically following the standard procedure for randomized block design. The data were analysed using software package SPSS version 11.0 for analysis of variance. The procedures describe by Gomez and Gomez (1984) was employed for transformation of data to satisfy the condition of homogeneity of variance for analysis of variance. The value F (variance ratio) and CD (Critical difference) was also calculated by the procedure described by Gomez and Gomez (1984). The effect use in the analysis of data was assumed to be significant if the Null Hypothesis could be rejected at a significance level of 5 percent ($\alpha=0.05$).

Results and Discussion

The results of the present investigation entitled “Vegetative propagation of *Adina cordifolia* through branch cuttings” to determine a appropriate hormonal concentration and growth parameters of cuttings in the open and control condition (Low cost poly house and low cost vegetative propagation chamber) for root induction is presented in this chapter.

The data recording of sprouted branch cuttings was started from the 25 days after plantation and subsequent data was collected thereafter at 7 days interval. At the beginning, the branch cuttings show a slow rate of sprouting. The observation recorded reflected that the branch cuttings in open environment completely failed to show sprouting response in comparison to the branch cuttings of control condition.

Hence, the data pertaining to the observation made in low cost polyhouse and low cost vegetative propagation chamber has been put to statistical analysis and presented hereafter:

Effect of different hormonal concentration on sprouting behaviour, shoot length and shoot diameter of branch cuttings under low cost polyhouse condition

Number of sprouts and sprouting percentage

The growth parameters viz. no. of sprouts, sprouting percentage of *Adina cordifolia* was affected by the growth hormone IBA at different concentrations under low cost poly house condition. The data presented in table 4 showed that the average number of sprouts of treated cuttings of *Adina cordifolia* after 25 days of planting ranged from 0.25-0.50. The maximum number of sprouts (0.50) was observed in treatment 3 (IBA at 20,000 ppm) and no sprouting occurs in treatment 2, 4, 6 after 25 days of planting. At 25 days after planting, the highest sprouting percentage (5%) was recorded in treatment 1, 3, 5 under low cost poly house condition (Table 1).

The effect of growth hormone at different concentrations on average number of sprouts and sprouting percentage of *Adina cordifolia* after 32 days of planting presented in table 4 revealed that the highest no. of sprouts 2.08 per cutting was occurred in treatment 3 and maximum sprouting percentage (25%) was also observed in treatment 3 under low cost poly house condition. No sprouting was observed in Tp4 and Tp6 after 32 days of planting.

It can be seen that there was effect of growth hormone at different concentrations on average no. of sprouts and sprouting percentage and increases with increase in IBA hormone concentration after every subsequent growth period interval and up to 74 days of planting (Table 4).

After 74 days of planting, the results showed (Table 4) that the maximum number of sprouts

(2.25) and sprouting percentage (25%) is recorded with IBA concentration of 20,000 ppm (Tp3). The minimum no. of sprouts (0.50) and sprouting percent (10%) was observed in Tp1 and Tp2.

It is evident from table 4 that under low cost poly house condition highest value of number of sprouts and sprouting percentage was found with IBA concentration of 20,000 ppm and lowest value occurred at lower concentration of IBA i.e. 5,000 ppm. The number of sprouts decreased at 74 days after planting than at 60 & 67 days after planting because of mortality in sprouts. No sprouting was occurred in treatment 4 and 6 under low cost poly house condition.

Shoot length and shoot diameter

The average shoot length value of *Adina cordifolia* varied with increase in IBA hormone concentration and increases with every growth period interval ranges from 0.25cm to 0.76cm under low cost poly house condition (Table 5). At 53 days after planting, the maximum value of average shoot length (0.76 cm) was observed with IBA concentration of 20,000 ppm (Tp3) and lowest shoot length was recorded with IBA concentration of 5,000 ppm (Tp1). The trend of growth was same with every growth period interval.

At 74 days after planting, the highest shoot length (0.83 cm) was observed with IBA concentration of 20,000 ppm (Tp3) and lowest shoot length (0.18 cm) was recorded with IBA concentration of 5,000 ppm (Tp1).

The average shoot diameter value of *Adina cordifolia* also varied with increase in IBA hormone concentration and increases with every growth period interval ranges from 0.18 mm to 2.12 mm under low cost poly house condition. At 53 days after planting, the

maximum value of average shoot width (1.96 mm) was observed with IBA concentration of 20,000 ppm (Tp3) and lowest shoot diameter was recorded with IBA concentration of 5,000 ppm (Tp1). The trend of growth was as similar as in case of shoot length at every growth period interval (Table 5).

The data presented in Table 5 and Figure 2 revealed that at 74 days after planting, the highest shoot diameter (2.12 mm) was recorded with IBA concentration of 20,000 ppm (Tp3) and lowest shoot width (0.35 mm) was recorded with IBA concentration of 5,000 ppm (Tp1).

Effect of different hormonal concentration on sprouting behaviour, shoot length and shoot diameter of branch cuttings under low cost vegetative propagation chamber

Number of sprouts and sprouting percentage

The data presented in Table 6 showed that the growth parameters viz. no. of sprouting, sprouting percentage of *Adina cordifolia* was increased significantly by the application of growth hormone IBA at increasing concentration under low cost vegetative propagation chamber. The data presented in table 6 showed that the average number of sprouts of treated cuttings of *Adina cordifolia* after 25 days of planting ranged from 1.0 to 2.0. The maximum number of sprouts (2.00) was observed in treatment 3 (IBA at 20,000 ppm) and less number of sprouting recorded with IBA concentration of 5,000 ppm. At 25 days after planting, the highest sprouting percentage (5%) was recorded in Tvp2 under low cost vegetative propagation chamber (Table 2).

The effect of growth hormone at different concentrations on average number of sprouts and sprouting % of *Adina cordifolia* after 32 days of planting presented in table 6 revealed

that under low cost vegetative propagation chamber, the highest number of sprouts 3.33 was occurred in Tvp3 and maximum sprouting percentage (33.33 %) was also observed in Tvp2.

It can be seen that there was significant effect of growth hormone at different concentrations on average number of sprouts and sprouting percentage and increases with increase in IBA hormone concentration after every subsequent growth period interval and up to 74 days of planting (Table 6). After 74 days of planting, the results showed (Table 6 and Fig. 3) that the maximum number of sprouts (3.33) and sprouting percentage (44.44 %) is recorded with IBA concentration of 20,000 ppm (Tvp3).

The minimum number of sprouts (1.17) was recorded with Tvp2 and lowest sprouting percent (11.11 %) was observed in Tvp1 under low cost vegetative propagation chamber.

It can be observed from table 6 that under low cost vegetative propagation chamber, highest value of number of sprouts was found with IBA concentration of 15,000 ppm and highest sprouting percentage was with IBA concentration of 20,000 ppm. The number of sprouts decreased at 74 days after planting than at 60 days after planting because of mortality in sprouts.

Shoot length and shoot diameter

The average shoot length value of *Adina cordifolia* varied with increase in IBA hormone concentration and increases with every growth period interval ranges from 1.12 cm to 1.53 cm under low cost vegetative propagation chamber. At 53 days after planting, the maximum value of average shoot length (1.15 cm) was observed with IBA concentration of 20,000 ppm (Tvp3) and lowest shoot length was recorded with IBA concentration of 5,000 ppm (Tvp1). The trend

of growth was same with every growth period interval.

At 74 days after planting, the highest shoot length (1.53 cm) was observed with IBA concentration of 20,000 ppm (Tvp3) and lowest shoot length (1.19 cm) was recorded with IBA concentration of 5,000 ppm (Tvp1) under low cost vegetative propagation condition.

The average shoot diameter value of *Adina cordifolia* also varied with increase in IBA hormone concentration (Table 7 and Fig. 4) and increases with every growth period interval ranges from 2.08 mm to 3.90 mm under low cost vegetative propagation

chamber. At 53 days after planting, the maximum value of average shoot width (2.90 mm) was observed with IBA concentration of 20,000 ppm (Tvp3) and lowest shoot width was recorded with IBA concentration of 5,000 ppm (Tvp1). The trend of growth was as similar as in case of shoot length at every growth period interval.

At 74 days after planting, the highest shoot diameter (3.90 mm) was recorded with IBA concentration of 20,000 ppm (Tvp3) and lowest shoot width (2.29 mm) was recorded with IBA concentration of 5,000 ppm (Tvp1) under low cost vegetative propagation chamber (Table 7).

Table.1 Details of vegetative propagation through branch cutting done in the low cost poly house

Date of planting	Cutting diameter	Hormonal treatment (IBA)	Concentrations	No. of cuttings taken in each replication
2-03-2012	1 to 2 cm	Tp1	5,000 ppm	20
		Tp2	10,000 ppm	20
		Tp3	20,000 ppm	20
	2 to 3 cm	Tp4	5,000 ppm	20
		Tp5	10,000 ppm	20
		Tp6	20,000 ppm	20

Table.2 Details of vegetative propagation through branch cutting done in the low cost vegetative propagation chamber

Date of planting	Cutting diameter	Hormonal treatment (IBA)	Concentrations	No. of cuttings taken in each replication
2-03-2012	1 to 2 cm	Tvp1	5,000 ppm	9
		Tvp2	10,000 ppm	9
		Tvp3	20,000 ppm	9

Table.3 Details of vegetative propagation through branch cutting done in the open bed (natural) condition

Date of planting	Cutting diameter	Hormonal treatment (IBA)	Concentrations	No. of cuttings taken in each replication
2-03-2012	1 to 2 cm	To1	5,000 ppm	10
		To2	10,000 ppm	10
		To3	20,000 ppm	10
	2 to 3 cm	To4	5,000 ppm	10
		To5	10,000 ppm	10
		To6	20,000 ppm	10

Table.7 Effect of different growth hormones and their concentrations on shoot length (cm) and shoot diameter (mm) after different days of planting under low cost vegetative propagation chamber

Treatments	Average shoot length (cm)				Average shoot diameter (mm)			
	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP
Tvp1	1.12	1.14	1.15	1.19	2.08	2.12	2.35	2.29
Tvp2	1.15	1.20	1.26	1.29	2.15	2.36	2.68	2.75
Tvp3	1.15	1.25	1.50	1.53	2.90	2.92	2.98	3.29
CV	0.94	0.94	0.65	0.68	2.36	2.36	2.72	2.72
SEm±	0.81	0.80	0.48	0.48	0.80	0.80	0.94	0.94
CD	NS	NS	NS	NS	NS	NS	NS	NS

Table.5 Effect of growth hormones at different concentrations on shoot length (cm) and shoot diameter (mm) under low cost poly house condition

Treatment	Average shoot length (cm)				Average shoot diameter (mm)			
	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP
Tp1	0.12	0.13	0.15	0.18	0.25	0.26	0.31	0.35
Tp2	0.25	0.25	0.28	0.28	0.80	0.81	0.84	0.86
Tp3	0.76	0.80	0.80	0.83	1.96	1.98	2.00	2.12
Tp4	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tp5	0.43	0.44	0.46	0.49	1.68	1.69	1.73	1.75
Tp6	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CV	581.23	584.6	571.14	576.38	542.67	541.67	541.89	541.89
SEm±	0.36	0.37	0.38	0.38	0.98	0.98	0.98	0.98
CD	NS	NS	NS	NS	NS	NS	NS	NS

Table.4 Effect of growth hormones at different concentrations on number of sprouts and sprouting % under low cost poly house condition

Treatment	Average number of sprouts per cutting								Sprouting percentage (%)							
	At 25 DAP	At 32 DAP	At 39 DAP	At 46 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP	At 25 DAP	At 32 DAP	At 39 DAP	At 46 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP
TP1	0.25	0.50	0.25	0.25	0.25	1.25	1.25	0.50	5.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
TP2	0.00	0.75	0.02	0.25	1.38	2.25	2.25	1.25	0.00	5.00	10.00	10.00	15.00	15.00	15.00	15.00
TP3	0.50	2.08	2.49	2.50	2.50	3.08	2.75	2.25	5.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
TP4	0.00	0.00	0.63	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TP5	0.50	0.75	1.32	1.38	1.59	1.38	0.88	0.88	5.00	5.00	15.00	15.00	15.00	15.00	15.00	15.00
TP6	0.00	0.00	0.08	0.00	0.80	0.00	0.00	0.00	0.00	0.00	2.50	0.00	2.71	2.71	2.71	2.71
CV	527.56	503.4	426.2	453.9	403.8	411.9	429.1	472.2	489.9	557.80	424.3	424.30	400.6	400.6	400.60	400.60
SEM±	0.46	0.78	1.07	0.50	1.62	1.56	1.46	0.99	5.32	9.52	10.65	10.65	11.23	11.22	11.23	11.23
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table.6 Effect of different growth hormones and their concentrations on average no. of sprouts and sprouting % after different days of planting under low cost vegetative propagation chamber

Treatments	Average number of sprouts per cutting								Sprouting percentage (%)							
	At 25 DAP	At 32 DAP	At 39 DAP	At 46 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP	At 25 DAP	At 32 DAP	At 39 DAP	At 46 DAP	At 53 DAP	At 60 DAP	At 67 DAP	At 74 DAP
Tvp1	1.00	2.00	2.00	2.00	2.00	1.58	1.58	1.58	33.33	22.22	22.22	33.33	33.33	33.33	11.11	11.11
Tvp2	1.75	2.00	2.83	2.67	2.17	1.83	1.17	1.17	55.56	33.33	44.44	44.44	44.44	33.33	33.33	33.33
Tvp3	2.00	3.33	5.50	5.67	5.67	3.67	3.33	3.33	44.44	22.22	33.33	44.44	44.44	44.44	44.44	44.44
CV	0.85	2.49	5.17	5.44	5.63	3.34	2.09	2.08	61.24	113.39	57.74	72.16	72.16	94.87	37.50	37.50
SEm±	0.53	0.99	1.42	1.49	1.63	1.34	1.34	1.34	2.22	2.40	1.57	2.40	2.40	2.86	0.91	0.91
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Fig 1: Effect of growth hormone concentration on number of sprouts of Adina cordifolia under low cost poly house condition

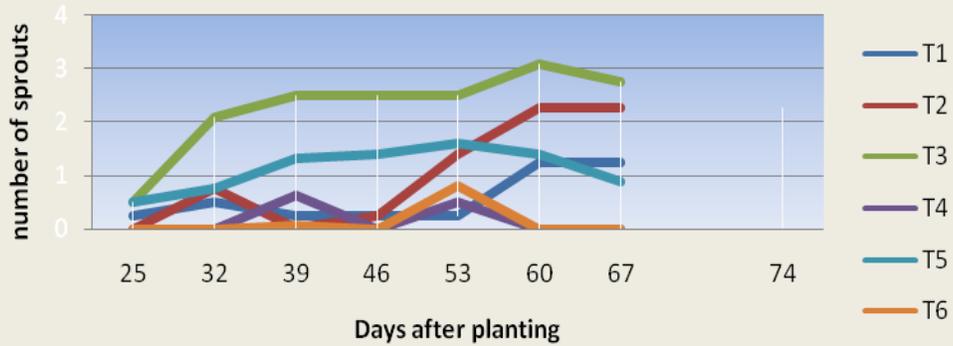


Fig 2: Effect of growth hormone concentration on sprouting percentage of adina cordifolia under low cost poly house condition

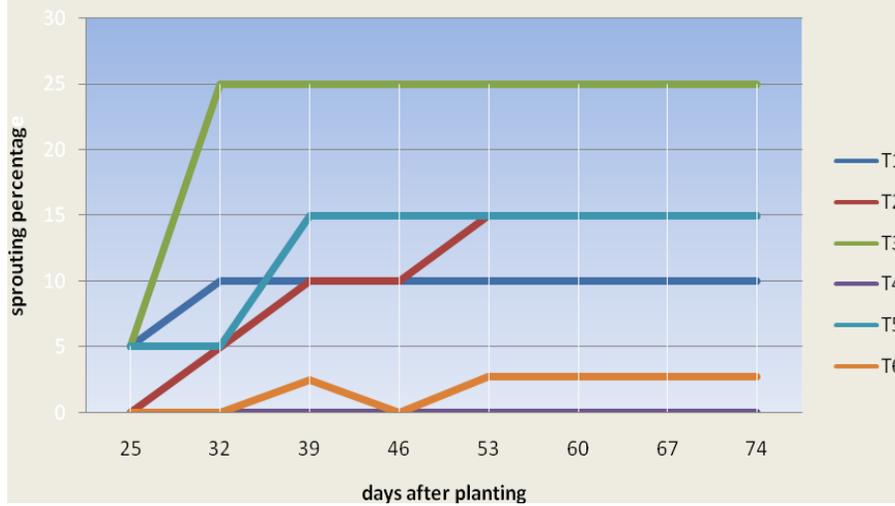
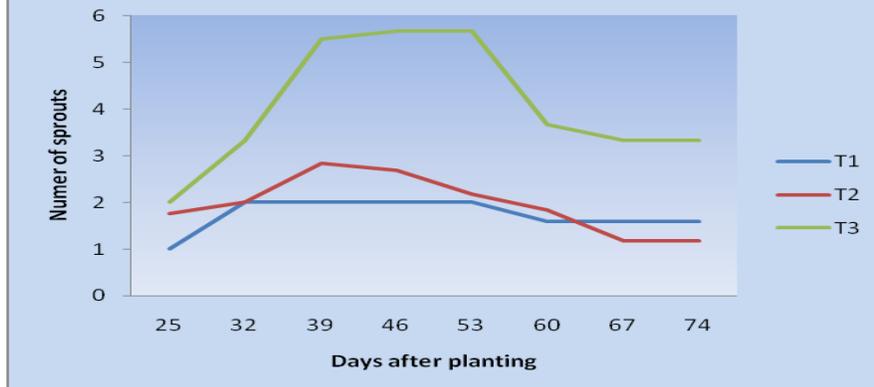
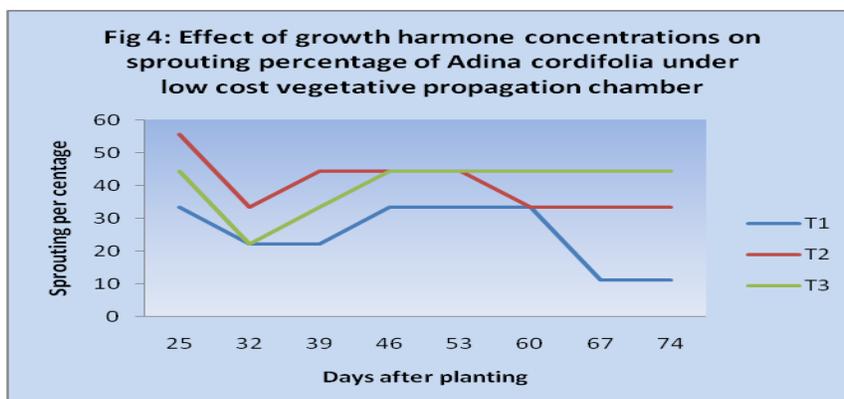


Fig 3: Effect of growth hormone concentrations on number of sprouts of Adina cordifolia under low cost vegetative chamber





Effect of different growing conditions on sprouting behaviour, shoot length and shoot diameter of branch cuttings under natural condition

Under natural condition at the field, the cuttings of *Adina cordifolia* did not sprout with any growth hormone concentration. It may be because of the reason that open bed (natural) conditions are not favourable for *Adina cordifolia* cutting propagation. Nagpal *et al.*, (1982), study indicates that better sprouting of February planted cuttings was the result of sufficient reserve food materials in them. But due to certain internal/external factors, *Adina cordifolia* although sprouted but failed to root. Under net house conditions it is impossible to maintain a sufficient moisture regime. It is well known that higher temperature and higher range of relative humidity promotes differentiation from callus layers to rooted layers, however, low temperature and lower range of relative humidity can only induce callus formation (Table 3).

On the basis of present study, it can be concluded that:

The concentration of growth hormone IBA and the environmental conditions affect the number

of sprouts, sprouting percentage, shoot length and diameter of *Adina cordifolia* cuttings positively.

The application of IBA at the concentration of 20,000 ppm and use of low cost vegetative propagation chamber condition provided better environment for sprouting of *Adina cordifolia* cuttings and their growth.

More than 3 months period is required for rooting in this species.

Open bed (natural) condition is not suitable for multiplication of *Adina cordifolia* through cutting.

Cutting diameter of 1 to 2 cm was found to be better than other diameter class tested in the study.

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