PROPAGATION OF CHIR PINE (*PINUS ROXBURGHII* SARG.) THROUGH JUVENILE CUTTINGS

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Abstract

The study is an attempt to develop an appropriate technique for rooting juvenile cuttings of chirpine (*Pinus roxburghii* Sarg.) under nursery conditions. Top shoot cuttings of 2-0 seedlings were treated with various concentrations of Indole-butyric acid (IBA) in talc formulation and tested for root initiation in three different seasons i.e. March, July and October using sand media by following randomized complete block design.

The results indicated maximum rooting (85.4%) with 4000 ppm IBA treatment. Maximum average rooting was observed in October (78.0%). The untreated cuttings showed lowest rooting percentage of 15.4 and 28.6 in March and July seasons respectively. Interestingly more than 70% rooting was obtained in October without any hormone treatment. The analysis of variance indicated significant differences for rooting between treatments (F = 9.3) and seasons (F = 18.2). The observations on average root length/cutting (cm), average number of roots/cutting and average number of secondary roots were non-significant. The highest average root length/cutting (8.90 cm) was attained in October whereas maximum average number of roots/cutting (2.90) and maximum average number of secondary order roots (4.42 cm) were observed in March.

Introduction

Forest trees are mostly propagated sexually but vegetative propagation is preferred because superior characteristics are maintained better than by sexual propagation due to avoidance of assortment and recombination. In contrast to propagation by seed, vegetative propagation enables to transfer to the offspring the integral genetic material of the donor tree from which they derive. This is of paramount importance, bearing in mind that in many species, certain traits of major economic significance such as higher growth etc. are largely the result of non-additive gene effect which can not be reproduced through propagation by seed. Higher genetic gain is expected through vegetative propagation compared with sexual propagation. The genetic gain obtained by raising Norway Spruce (*Picea abies*) vegetatively was estimated as 12-31% after seven years and 33-54% in Sitka Spruce (*Picea sitchensis*) (Roulund, 1977). In view of this several other coniferous and broad leaf species like Poplars, Willows, Monterey pine and cryptomerias are some of the outstanding leafless at global level.

Besides, through vegetative propagation, a number of difficulties

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connected with the use of seed are avoided and thus, indirectly a better use of the genetic potential is attained. In some species, seed supply is also limited and variable because of bad seed years. The vegetative propagation provides means to overcome these problems and maintains regular supply of planting stock for afforestation.

Coniferous forest tree species of Pakistan are important commercial timber species and Chirpine (*Pinus roxburghii*) is one of the important species extensively planted in Pakistan. The main problem with this species is uncertainty of seed availability every year from superior genetypes. Moreover the seed does not remain viable if not properly stored. These problems hinder in achieving the planting targets fixed every year in the country. Successful production of plants by means of vegetative propagation would not only solve the problem of seed collection and handling but could also bring about economic benefits in afforestation programmes. The present cost of raising plantations through seed could also be greatly reduced.

Attempts made in the past were not successful as Chirpine (*Pinus roxburghii*) is difficult to be raised through cuttings. The main objective of initiation of this study was to determine appropriate techniques for raising the species through cuttings.

Materials and Methods

Top shoot cuttings of 15 cm size were excised from 1 and 2 year old nursery raised seedlings during March, July and October, 1997. Needles were removed from the lower 6-7 cm portion of the cuttings and the lower 2.5 cm portion of the cuttings was girdled at base by removing the bark. Cuttings were treated with three concentrations (each of 2000, 4000, 6000 ppm in talc of Indole-butryric acid (IBA). These treatments were compared with control stock (untreated) of the same species.

The basal girdled portion of cuttings was treated with above concentrations and placed in hydrobeds. The experiment was laidout in randomized complete block design with three replications having 15 cutting in each replication. A total of 180 cuttings were planted in the experiment. The trial was initiated in March, 1997 and repeated the same year in July and October.

The hydrobeds were prepared by excavating 60 cm deep soil from 3x1.2 m size beds. 45 cm excavated portion of the bed was filled with broken bricks, stones and gravels and the remaining 15 cm was filled with coarse sand. The beds were then irrigated. Having placed the cuttings in moist sand, the beds were covered with polythene sheet to increase humidity level which is one of the major factors in the initiation of rooting. The humidity in the beds were monitored

through a hygrometer upto 80% ± 5 by watering beds daily throughout the trial period. Polythene sheet was removed from one side of the bed during day time in March and July seasons to maintain the temperature between 28-30°C. Data on rooting percentage, root length, number of roots and number of secondary roots were recorded in each successfully established propagule upto 6 months for each of the three seasons.

Results and Discussion

Maximum rooting percentage was observed during October (85.4%) with 4000 ppm IBA treatment (Table 1). However, it was also observed that October seems to be the best season for rooting juvinile cuttings of chirpine (*Pinus roxburghii*) among all the treatments indicating an average rooting of 78.0% (Table 3). The lowest rooting percentage was given by untreated (control) cuttings with 15.4% and 28.6% in March and July seasons respectively. It is interesting to note that the rooting percentage in control is comparable (70%) with other three treatments during October which gave 80%, 85% and 76% rooting respectively (Table 1).

Table 1. Effect of various treatments and seasons on rooting of juvenile cutting of chirpine (*Pinus roxburghii* Sarg.) under nursery conditions

IBA Treatments (ppm)	Setting period	Rooting %	Av. Longest root length per cutting (cm)	Av. No. of roots per cutting	Av. No. of secondary order root > 1.0 cm
2000	March	54.3	8.7	4.6	5.6
	July	57.1	9.4	1.8	2.2
	October	79.9	9.0	1.0	3.5
4000	March	56.2	9.0	3.0	4.6
	July	71.4	7.1	1.4	6.0
	October	85.4	8.5	1.0	2.0
6000	March	52.4	7.6	2.0	4.5
	July	57.1	8.5	1.4	3.1
	October	76.4	9.1	3.0	5.2
Control	March	15.4	7.6	2.0	3.0
	July	28.6	8.5	1.6	3.5
	October	70.4	9.0	1.2	4.3
Mean		58.7	8.5	2.0	3.9
SE(m) ±		5.92	0.20	0.31	0.37

The rooting percentage in different treatments and seasons is also presented graphically in Fig.1.

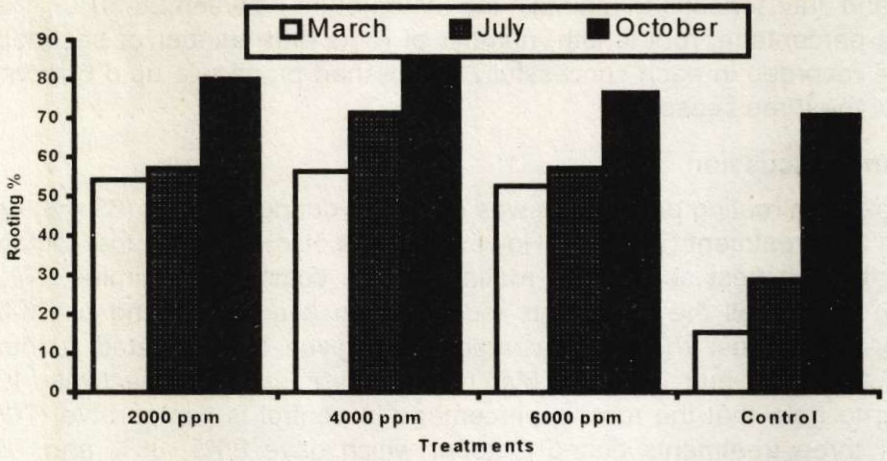

Fig.1. Effect of various treatments and seasons on rooting % of juvenile cuttings of chir pine (*Pinus roxburghii* Sarg.)

The effect of different treatments and seasons on rooting percentage, average root length per cutting, average number of roots per cutting and average number of secondary order root > 1.0 cm are presented in Table 2. The results indicated significant variation between treatments and seasons for rooting percentage, but the differences were non-significant for average longest root length, average number of roots per cutting and average number of secondary order root.

Table 2. Analysis of variance (F values) for various traits of chirpine (*Pinus roxburghii* Sarg.) propagules

Source of variation	Degree of freedom	Rooting %age	Root length	No. of roots	No. of secondary roots
Treatments	3	9.27*	0.73 NS	0.42 NS	0.12 NS
Seasons	2	18.20**	0.91 NS	2.37 NS	0.25 NS
Error	6	–	–	–	–
Total	11	–	–	–	–

Duncan's Multiple Range Test for rooting percentage was also performed to determine the differences between treatments and seasons. Test indicated two groups for treatments. The first group (group A) comprises three treatments of IBA and the second group (groups B) includes no treatment. The

differences within the group are non-significant but the differences between the groups are significant. The comparison demonstrated that the hormone treatments were better than the control. Similarly, the test showed same grouping for seasons. The first group (group A) consists of October season while the second group (group B) represents March and July seasons. The test clearly indicated that the month of October was significantly different from March and July (Tables 3a and 3b).

Table 3a. Duncan's Multiple Range Test four three treatments

IBS Treatments (ppm)	Mean rooting %
2000	71.000 A*
4000	63.787 A
6000	61.967 A
Control	38.133 B

Table 3b. Duncan's Multiple Range Test for three seasons

Seasons	Mean rooting %
October	78.0 A
July	53.5 A
March	44.5 A

* Mean with the same letter are not significantly different.

Table 4. Effect of seasons on different parameters

S.No.	Parameters	Seasons		
		March	July	October
1.	Rooting %	44.57	53.55	78.02
2.	Average logest root length per-cutting (cm)	8.22	8.37	8.90
3.	Average number of roots per cutting	2.90	1.55	1.55
4.	Average number of secondary order root > 1.0 cm	4.42	3.70	3.75

The effect of seasons and treatments on the rooting percentage are given in tables 4 and 5.

Table 5. Effect of treatments on different parameters

S.No.	Parameters	Treatments (ppm)			
		2000	4000	6000	Control
1.	Rooting %	63.77	71.0	61.97	38.13
2.	Average logest root length per-cutting (cm)	9.03	8.20	8.40	8.37
3.	Average number of roots per cutting	2.47	1.80	2.13	1.60
4.	Average number of secondary order root > 1.0 cm	3.77	4.20	4.27	3.60

It is evident from above data that maximum average rooting percentage was obtained in October (78.0%) and minimum was recorded in March (44.5%). The highest average longest root length per cutting (8.9 cm) was also attained in October, where as the maximum average number of roots per cutting (2.90) and maximum average number of secondary roots > 1.0 cm (4.42 cm) were observed in March. The data regarding the effect of treatments on different parameters (Table 4) indicated maximum average rooting (71.0%) in 4000 ppm IBA and minimum (38.1%) in control. 2000 ppm IBA treatment produced the highest average longest root length per cutting (9.0 cm) and maximum average number of roots per cutting (2.5), where as 6000 ppm IBA treatment ranked at the top for maximum average number of secondary order roots (4.3 cm).

Al-Kinany (1980) reported the effect of auxins in different concentrations on root formation of *Picea abies* and *Juniperus communis*. Maximum rooting (48.9%) in *Picea abies* was obtained with 4000 ppm IBA and 25% in *Juniperus communis* in sand media. The results are in conformity with the present study where maximum rooting (85.4%) was obtained with 4000 ppm IBA in sand media.

Other researchers working on vegetative propagation of pines by branch cuttings agree that rooting capacity decreases with the age (Doran *et al.*, 1940). It was also concluded that the optimum rooting conditions include the date of preparation of cuttings for treatment and physiological conditions of the shoots, atmospheric humidity, temperature of rooting medium and still more important is the ratio between the temperature of the rooting medium and that of atmosphere. Our results confirmed that if cuttings are prepared during October for treatments and the humidity and temperature of the medium is kept > 80% and 28-30°C respectively, then an average of 58.7% rooting can be obtained irrespective of the influence of treatments and seasons.

Armson *et al.*, (1975) described rooting of cuttings of juvenile seedlings (seedlings in their first three year of growth) of *Picea mariana* and *Pinus*

banksiana and obtained > 70% rooting in both species. Similar results have been obtained in chirpine. Juvenile cuttings of seedlings root better as compared to cuttings taken from old trees (unpublished data).

Mirov (1941) is of the view that pine shoots contain growth hormones and further application of these is not essential and beneficial. It implies that the creation of favourable conditions for cuttings to initiate root is more important than mere application of hormones. The present study confirmed that if juvenile cuttings of chirpine (*Pinus roxburghii* Sarg.) are planted during October with optimum humidity and temperature, more than 70% rooting can be obtained without application of hormones.

Joshi and Dhiman (1992) reported the results of multiplication of one year old Indian chirpine cuttings in nursery bed by applying 5% IBA-talc with 10% sucrose, 5% captaf (fungicide) and 25% perhydroxybenzoic acid (phenol) planted in August, 1989. 57.1% rooting and 91.7% callusing of non-rooted cuttings compared to 7.1% rooting and 53.3% callusing in control were obtained. Though the hormone concentration and setting period of cuttings slightly differ from the present study but can be compared with rooting percentage obtained in July with 4000 ppm IBA-talc (53.5%). However, the rooting % in control in the present study in all the seasons differ markedly from the results of above mentioned study. This variation can be mainly attributed to differences in setting period.

It is concluded that juvenile cuttings of 1-2 year old seedlings of chirpine can be vegetatively propagated and more than 70% rooting be obtained in the sand media at the nursery stage during October without using any hormone if proper humidity (>80%) and temperature (28.30°C) are maintained.

Due to shortage of forest resources in the country, there is an urgent need to increase productivity. A method of accomplishing this is by reforestation with superior genotypes. Unfortunately, the long life cycle of trees makes the development of superior varieties a very lengthy process. For this reason, apart from propagation by seed, vegetative propagation for raising superior individuals must also be considered. Fielding (1963) mentioned two possible advantages of commercial plantations of Monterey pine (*P. radiata*) raised by cuttings: a) superior genetic values of stock and b) uniformity of the logs and wood. Vegetative propagation techniques can therefore be employed for the establishment of clonal seed orchards, clonal banks, tree improvement, propagation of special breeding material like exceptional hybrids (heterosis) that are lost through sexual reproduction, sterile hybrids, mass propagation of

selected material and propagation of trees for conservation.

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