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Vegetative propagation in *Celtis australis* : Effect of season and auxin treatment

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ABSTRACT

Celtis australis is one of important multipurpose tree species of north western Himalayas. The natural regeneration of the tree is very poor owing to huge biotic pressure. The tree therefore needs to be propagated by vegetative means. An experiment was conducted to ascertain the effect of season and IBA concentrations on rooting behaviour of *Celtis australis*. Cuttings collected in three different seasons, *viz*. spring, summer and rainy were subjected to different lndole-3-Butyric Acid (IBA) treatments, *viz*. 250, 500, 750, 1000ppm and control. Maximum rooting (30.6%) was observed in rainy season. Rooting was higher (49.4%) in 250 ppm IBA concentration. Interaction effect of season × treatment revealed that maximum rooting (59.3%) was recorded during rainy season when cuttings were treated with 250 ppm IBA. The results of the study are useful for mass multiplication and cloning the species for enhancing productivity.

Key words: IBA; Mass multiplication; Rooting; Season; Sprouting

Celtis australis L. (family Ulmaceae) locally known as *kharik* is an important tree species of north western Himalaya, Mediterranean region and south-western Asia (Quattrocchi 2000). It grows well at 500-2500 m above sea level (Gaur 1999), at its lower limits it is often found in moist situations near naula's or springs and rivers, hedges, banks and sandy places (Polunin 1969). The tree is commonly found on agriculture lands in Jammu & Kashmir, Himachal Pradesh and Uttarakhand. Being multipurpose, the tree plays a vital role in socioeconomic structure of hill people by providing fodder, fuel and timber (Negi and Todaria 1994; Bhatt and Verma 2001). The tree provides tannin free highly nutritious fodder with protein content of approximately 18% (Yadav and Bisht 2013). Under favourable conditions, the tree attains a height of 25 m and diameter of 50 cm (Yadav and Bisht 2015).

It prefers well drained loamy soil but can also survive on shallow, gravelly and rocky sites along stream banks, on sloping hillsides (Gaur 1999). This species requires mild winters and can be grown from below freezing temperature to 38ºC with annual rainfall of 1200-2500 mm. The species has deep spreading roots (Chiej 1984) and is frost and drought hardy which make it ideal species for afforestation in mid Himalayan region.

The current destructive harvesting practice is seriously reducing seed production, introducing pathogenic infections to standing healthy trees and causing physiological stresses resulting in gradual erosion of the natural populations of this tree species. The species therefore needs to be protected and regenerated on large scale. Commercially, the species is mainly propagated through seeds. However, the seeds remain viable for 3-4 months after which it fails to germinate. In this context, vegetative propagation assumes greater significance. Vegetative propagation of *C. australis* can be helpful in providing the plants of the desired genetic constituent and improve growth, yield, fodder and wood quality, and resistance to pests and diseases. Given the economic and ecological importance of the species, the present study was therefore conducted to study the effect of different seasons and IBA concentrations on the rooting ability of the species.

MATERIALS AND METHODS

The present investigations were conducted in the nursery area of Plant Science Division at Research Centre, Selaqui. The farm is located at 300 21' N latitude, 700 52' E longitude and at an altitude of 517 m above m.s.l. The climate of the study area is sub tropical with an average

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annual rainfall of 1625.3mm. About 81 % of the total rainfall is received in 80 rainy days during the monsoon season between mid June to mid September. Occurrence of high intensity storms even exceeding 100 mm hr^{-1} is a common feature during the monsoon season leading to severe erosion problems. The mean maximum temperature of 37.2ºC and mean minimum temperature of 3.8ºC have been recorded in the month of May and January, respectively.

Branch cuttings of *Celtis australis* were collected from superior candidate plus clumps centralized at Selaqui Research farm at Dehradun. Cuttings were collected in three different seasons, *viz*. spring (1 March), summer (1 May) and rainy (1 July). Lateral branches were collected from the middle portion of the crowns. After removing the distal ends of each branch, branch cuttings (of 0.6 to 0.75 cm diameter and 20.0 cm length) were prepared. Five sets of 27 cuttings were made up, selected at random from the mother trees. Cuttings were subjected to different treatments, *viz*. 250, 500, 750, 1000 ppm aqueous solutions of lndole-3-Butyric Acid (IBA) and control. IBA treatment was given by soaking the basal portion (1/3) in the respective solution for 24 hr. The control comprised a comparable number of cuttings treated only with distilled water. One set was dipped at their distal end in distilled water to serve as a control. The cuttings were inserted obliquely into a polythene bag containing a standard rooting medium of sand, soil and farmyard manure in I: 2: I ratio. The whole experiment was set up in randomized blocks design with three seasons and five treatments with 27 cuttings in each plot replicated thrice. Cuttings were weeded and watered regularly as and when required. Observations on sprouting-rooting percent, average root-sprout numbers/cutting and average root - sprout lengths per cutting were recorded after 90 days of planting the cuttings.

Statistical analysis was carried out with the Statistical Package for Social Sciences (SPSS) windows software package using two factors, i.e. season and treatments. The mean values of each replication were estimated in the analysis of variance (ANOVA) for studied parameters. For the comparison of different means of different treatment, the critical differences (CD) were calculated at the $P \leq 0.05$ level. For analysis of variance (Table 1), the value for each replication was used based on all available cuttings and subjected to the model:

$$Yij = \mu + ci + tj + (ct)ij + eij$$

where, i = 1….5, j = 1….3, Y_{ij} = response, μ = overall mean, c_i = effect due to ith IBA treatment, t_j= effect due to jth treatment of season, $(ct)_{ij}$ = interaction effect due to of ith IBA treatment with jth treatment of season and e_{ij}= error term distributed N ~ (0, σ^2).

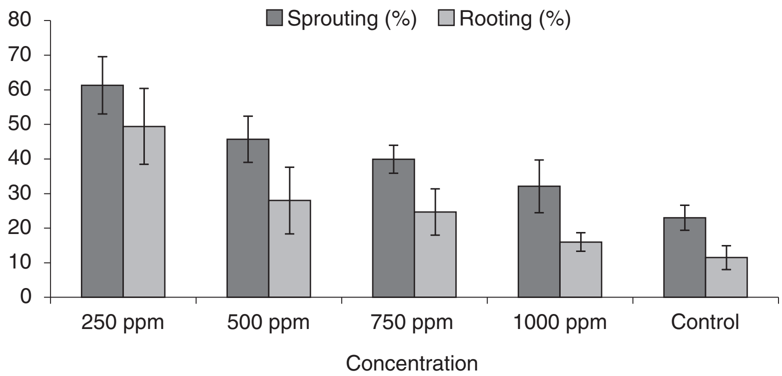

Fig 1 Effect of different treatments on sprouting and rooting of Celtis australis.

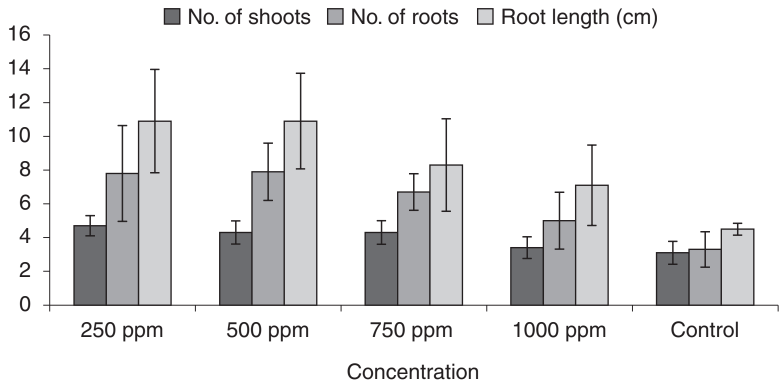

Fig 2 Effect of different treatments on sprouting and rooting parameters of *Celtis australis*.

RESULTS AND DISCUSSION

Rooting responses of cuttings was found to influenced by season, IBA concentrations and interaction effects of treatment × season. IBA treatment irrespective of season significantly influenced sprouting of cuttings (Fig 1). The maximum sprouting (61.3 %) was observed in 250 ppm IBA concentration. Highest numbers of shoots were also observed in 250 ppm IBA concentration (Fig 2). Rooting was also higher (49.4%) in 250 ppm IBA concentration (Fig 1). Rooting response was significantly at par with 500 ppm and 750 ppm concentration. Minimum rooting (11.5%) was observed in control treatment. Number of roots and length of root were also higher in 250 ppm IBA concentrations and lowest in control treatment (Fig 2).

Season has no significant effect on sprouting (Fig 3). However, number of shoots were maximum (4.7) in rainy season (Fig 4). Numbers of shoots were statistically at par in spring and summer season. Different seasons influenced rooting behaviour significantly (Fig 3). The maximum rooting (30.6%) was observed in rainy season. Rooting during summer and spring season was at par. Number of roots were maximum (4.7) in rainy season which was followed by spring season (Fig 3). However, the differences in number of roots in spring and summer season mean were not statistically significant. Length of root was maximum (11.1) in rainy season which was followed by spring and rainy season (Fig 4).

Results from Table 1 revealed that interaction effect

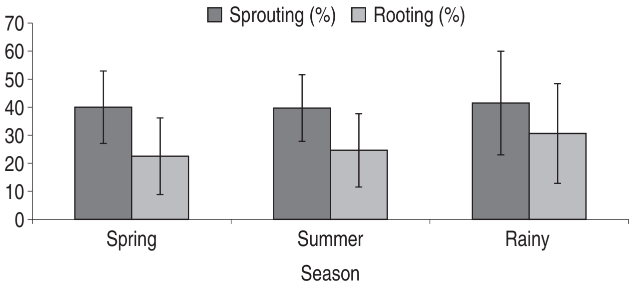

Fig 3 Effect of different season on sprouting and rooting of *Celtis australis*.

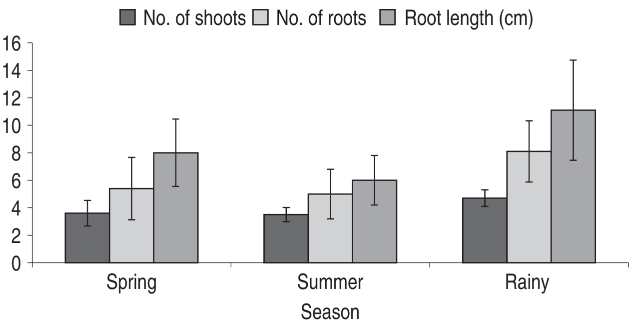

Fig 4 Effect of different season on sprouting and rooting parameters *Celtis australis*.

of season × treatment (S×T) revealed that sprouting was maximum (70.4%) in 250 ppm treatment (T1S3) during rainy season. Number of shoots were maximum (5.2) and statistically at par in treatment T1S3, T2S3 and T3S3. Rooting response was maximum (59.3%) during rainy season in 250 ppm IBA treatment (T1S3). Minimum rooting (8.6%) was observed during spring season in control treatment (T5S1) Number of roots were also maximum (10.6) in treatment T1S3. Length of longest root also depicted similar trend and was maximum in T2S3 and minimum in T5S2.

Number of external factors, such as season, temperature, light, water, humidity, aeration, composition and pH of rooting media, and internal factors like nutrition, genetic constitution, as well as exo-genously applied rooting stimulants affect the rooting behaviour. Season plays an important role in the physiological state of the parent plant and the cuttings (Swamy *et al.* 2002; Kaushal *et al.* 2011; Gulabrao *et al.* 2012). Role of external factors especially temperature and photoperiod in adventitious rooting is well established (Hartmann *et al.* 1997; Dhar *et al.* 1991 and Arce and Balboa1991). Period of rainy season during which maximum rooting in culm cuttings was obtained coincides with relatively higher temperature coupled with high humidity. It appears that high temperature prevailing during this period may have promoted more rooting. Agnihotri and Ansari (2000) also observed augmented adventitious rhizogenes is in bamboos during high temperature and long photoperiod.

Table 1 Interaction effect of treatment (T) × season (S) on sprouting and rooting of *Celtis australis*

Treatment	Sprouting (%)	No. of shoots	No. of roots	Root length (cm)	Rooting (%)
T1S1	59.3	5.0	8.7	11.4	44.4
T2S1	43.2	3.8	6.0	9.2	23.5
T3S1	38.3	4.0	6.0	8.5	18.5
T4S1	35.8	2.9	4.0	6.5	17.3
T5S1	23.4	2.5	2.2	4.5	8.6
T1S2	54.3	4.0	4.2	7.2	44.4
T2S2	45.7	3.9	7.9	8.8	22.2
T3S2	40.7	3.7	6.0	5.1	29.6
T4S2	34.6	2.9	3.7	4.7	14.6
T5S2	23.5	2.9	3.1	4.2	12.3
T1S3	70.4	5.2	10.6	14.2	59.3
T2S3	48.1	5.2	9.9	14.6	38.3
T3S3	40.7	5.2	8.1	11.4	25.9
T4S3	25.9	4.2	7.2	10.1	16.0
T5S3	22.2	3.9	4.5	4.9	13.6
CD (P=0.05)	9.27	0.28	0.30	0.32	8.5

Literature reveals that Indolebutyric acid (IBA) has been used for rooting of cuttings derived from a variety of tree species. In the present study, lower concentrations (250 ppm) of IBA significantly enhanced the sprout and root lengths of *Celtis australis*. Our results are contrary to Bhatt and Todaria (1990) who reported no rooting after exogenous application of auxins in *C. australis* although some cuttings sprouted but failed to root. The results however in line with findings of Shamet *et al.* (2005) also reported that, exogenous application of 10000 ppm concentration of IBA enhanced rooting in *Celtis australis* under mist conditions. Auxins influences polysaccharide hydrolysis resulting in increased content of physiologically active sugar, which is required to provide energy for meristematic tissues and later for root primodia and formation of root (Nanda 1975; Husen and Pal 2007). Husen and Pal (2006) found IBA and NAA to enhance rooting and sprouting responses of bamboo species. The difference in interactive effects may be attributed to the endogenous auxin balance and the amount of carbohydrates in the cuttings (Smart *et al.* 2003; Zalesny *et al.* 2003).

Conclusion

Sprouting and rooting in *Celtis australis* responds well to the application of IBA. Concentrations of 250 ppm of IBA in rainy season gave the highest success rates in shoot and root growth and is recommended for vegetative propagation of the species. These results of the study are useful in breeding programmes for making improvement in the species and developing suitable clones which will further be helpful in enhancing productivity of the species.

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