Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

December 2021, Volume 34, Issue 2, Page 144-147

Standardization of propagation techniques of [*Populus gamblei* (Dode) Haines]: A difficult to root endemic species of Eastern Himalayas

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ARTICLE INFO

Article history:
Received: 14 September, 2021
Revision: 18 November, 2021
Accepted: 28 November, 2021

Key words: Populus gamblei, NAA, root surface area, juvenility, root shoot ratio.

ABSTRACT

Populus gamblei, commonly known as Himalayan aspen, is an indigenous important tree species of the North East Region of India. Like other aspens, it is a difficult to root species for which no standard rooting protocol is available. We evaluated the effect of dipping in water and the application of rooting hormone on rooting success to standardise the protocol for this important tree species. Cuttings planted in rooting media without any treatment failed to produce roots Hormonal treatment with 100ppm NAA without dipping treatment produced poor rooting (4.17 per cent). However, dipping the cuttings in water for 3 days without hormone treatment resulted in the maximum number of rooted cuttings (75.0 %). Cuttings dipped in water combined with NAA 100ppm treatment for 24 hours significantly affected root morphology and resulted in the maximum total root length and root surface area (408.85 cm; 443.04 cm^2 respectively).

1. Introduction

Populus gamblei is an indigenous poplar species naturally distributed in the Eastern Himalayan region of India (Naithani, 2001, Naithani 2005; Puran Chandra, 2015). The tree is fast-growing producing an annual output of 16.3 - 35.9 m^3 wood ha^{-1}. It is a suitable tree for agroforestry and other plantations having economically useful characteristics such as good stem form, deeply penetrating roots, good natural pruning ability, and resistance to drought and fire (Guhathakurta, 1973). Wood is suitable for plywood and match manufacture (FAO 2012). Considering the usefulness of the species, plantations were raised in Sukna, Rajabhat, Khawa, and Corubhatan beats of West Bengal using thousands of wildlings (seedlings collected from natural forest) in the 1970s (Guhathakurta 1973). However, after a few years of plantations, more than 95 per cent of plantations died. Natural regeneration of *P. gamblei* is by root sucker and seed is scanty and artificial propagation of the species is difficult due to asynchronous flowering, difficulty in seed collection from the taller crown, low seed germination per cent (22 per cent) and short seed viability (Beniwal and Singh 1989). Attempts were made to propagate the species using cuttings (Guhathakurta 1973; Gosh and Bhatnagar 1977; Lahari 1979), however, only limited success could be achieved. Thakur and Bisht (2009) attempted to propagate the species through the establishment of culture from axillary bud sprouting, however *in vitro* rooting and complete plant regeneration could not be achieved. In the present study, coppice shoots were used as vegetative propagules to standardize the propagation method for *P. gamblei.*

2. Material and methods

The present study was conducted at the Agroforestry farm of ICAR Research Complex for NEH Region Umiam Meghalaya during 2016-17. The experimental site is situated at 20° 40' 21" N, 90° 55' 16" E at an elevation of 950m. Young pole size tree was headed back in the month of Dec.-Jan to induce coppicing. About 15-20 cm long cuttings of

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pencil thickness size were prepared from coppice shoots in the last week of October. The experiment was laid in Factorial Completely Randomized Block Design with 2 levels viz. dip treatment and hormone treatment. We used 3 factors for dipping in water (no dip, 3 days dip and 5 days dip) and four factors for hormonal treatment (no hormones, 100ppm NAA for 24 hours, 1000 ppm NAA for 10 min, and 100ppmm NAA wettable powder). Treatments were replicated 4 times with 6 cuttings in each replicate (a total of 288 cuttings). During the dip treatment, water was replaced every day to remove leachates. All the cuttings were planted on the same day and accordingly dipping and hormone dipping was planned. The observation on rooting success was taken after 90 days of planting using the following formula

$$\text{Rooting per cent} = \frac{\text{total no of rooted cuttings}}{\text{Total number of cuttings planted}} \times 100$$

To study root morphology, the images of the root system were acquired using Epson perfection V-700 Photo scanner at 200 dots/inch (dpi) and analysed with the WinRHIZO professional software. Parameters such as total root length (cm) and root surface area (cm) were estimated using WhinRHIZO software. The root and new shoot were separated and oven-dried to constant weight and the root shoot ratio was calculated using the following formula.

$$\text{Root shoot ratio} = \frac{\text{Oven-dried weight of root}}{\text{Oven-dried weight of shoot}} \times 100$$

Recorded data were subjected to analysis of variance and the critical difference was calculated for comparison of means. The differences between means were considered statistically significant at $P=0.05$

3. Results and Discussion

Rooting success:

The cuttings planted without any treatment (control: no dip and no hormone) failed to root. Very poor rooting per cent (< 5 %) was observed in cuttings planted without dip treatment. Dipping in water before planting was found to be very effective in inducing rooting, and rooting success increased considerably with dipping in water. Rooting was recorded maximum (75 %) in 3 days dip without hormone application (Fig 1). Poor rooting (4.17%) was recorded both in cuttings planted after application of NAA 100ppm for 24 hours (without dipping in water) and 100ppm NAA applied as a wettable powder (without dipping in water). In many other species, it has been reported that soaking of hardwood cuttings before planting promotes rooting and subsequent survival and growth (Hartmann et al. 1990; Puri and Thomson; 2003). Soaking leaches compounds that inhibit rooting and stimulate ethylene production in the cuttings (Blake et al. 1982). Water extracts from *P. nigra* 'Italica' were found to inhibit root production on cuttings of other plants due to the presence of leaches in water that inhibits rooting (Leclerc and Chong 1983). Soaking in water removes inhibitors, and daily water replacement is an effective way of removing inhibitors. Soaking for 2-14 days has been recommended for various *P. deltoides*, and *P. nigra* clones (Krinard and Randall 1979, Hansen et al. 1993; Desrohers and Thomas, 2003).

Root morphology:

Results indicated that pre-planting treatments significantly improved root morphological parameters such as total root length, root surface area, and root shoot ratio (Table 1). In cuttings without dip treatment, only a few cuttings rooted and enough rooted cuttings were not available for analysing root morphology. Therefore, we are reporting data for only those treatments that had sufficient cuttings available for studying root morphology using a root scanner. The effect of dipping duration (3 days and 5 days) was found to be non-significant, however, the effect of hormones on root morphology was found to be significant. Total root length was recorded maximum (408.85 cm) in 5 days dipping treatment with 24 hours treatment with 100ppm NAA, which was significantly higher than other treatments. Similarly, root surface area was recorded maximum (443.04 cm^2) in 5 days dip treatment with 24 hours treatment with 100ppm NAA. Root shoot ratio was recorded maximum (0.58) in 3 days dip treatment with 24 hours 100ppm NAA treatment. The treatment was found to be statistically at par with 3 days dip with 1000ppm NAA for 10 min (0.57), 5 days dip with 100ppm NAA (0.51), and 5 days dip with 1000ppm NAA for 10 min (0.48).

A perusal of the table reveals that dip treatment and hormonal application significantly improved the rooting behaviour of *Populus gamblei*. In *Populus* spp., NAA is effective in inducing rooting. Bojarczuk and Jankiwiz (1975) reported that NAA applied as 24 hours dip produced maximum root length and number of roots in *P. alba* and *P. canadensis* as compared to the application of NAA in talc powder.

All the efforts made in the past to propagate *P. gamblei*, either through cuttings or mass propagation through tissue culture, had not considered the influence of maturity of apical meristem on rooting and efforts were not directed towards capturing juvenility either by using seedling explants or by using juvenile parts in the older tree. Coppicing and pruning provide a simple way to delay maturation (Bolstad and Libby, 1982; Bonga,

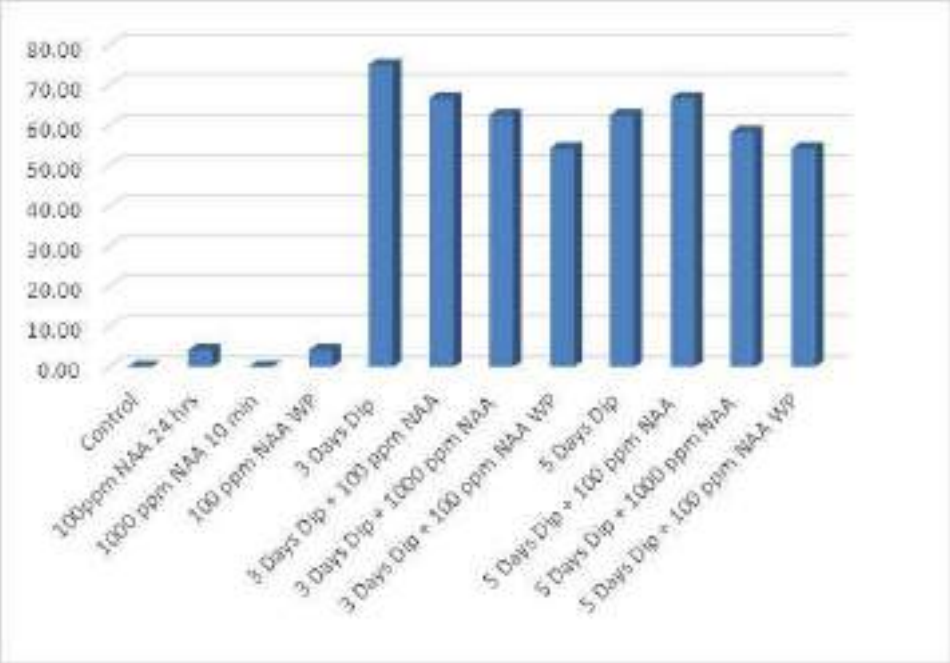

Fig 1. Effect of pre-treatments on rooting success of cuttings of *P. gamblei* Dode

Table 1. Effect of duration of the dip in water and hormonal treatment on root morphological traits of *P. gamblei*

Parameters	TRL (cm)			SA (cm^2)			RSR		
Hormone concentration/ Dipping duration	3 Days dip	5 Days dip	Mean	3 Days dip	5 Days dip	Mean	3 Days dip	5 days dip	Mean
No Hormone	206.51	162.63	184.57	275.16	247.99	261.58	0.15	0.19	0.17
100ppm NAA 24 hrs	311.08	408.85	359.97	333.19	443.04	388.12	0.58	0.51	0.55
1000ppm NAA 10 min	213.17	93.34	153.26	227.39	84.65	156.02	0.57	0.48	0.53
100ppm NAA WP	166.98	154.24	160.61	161.26	241.31	201.29	0.28	0.19	0.24
Mean	224.44	204.77		249.25	254.25		0.40	0.34	
Dip treatment	NS			NS			NS		
SEm± Hormone treatment	35.04			36.60			0.06		
$CD_{0.05}$	59.95			62.62			0.11		
Water Dip × Hormone	NS			NS			NS		

TRL: Total root length; SA: Total root surface; RSR: Root shoot ratio; CD: Critical difference; SEm±: Standard error of the mean;

NS: Non-Significant

1982; Wendling, et al., 2014). New Juvenile shoots near the base of the tree possess a higher adventitious rooting capacity and root vigour (Wendling, et al., 2014).

4. Conclusion

Cuttings planted in the rooting media without any treatment failed to produce roots. Ddipping in water for 3 days without NAA application produced the maximum number of rooted cuttings (75.0 %). Cuttings dipped in water and treated with NAA 100ppm for 24 hours significantly affected root morphology and the treatment resulted in maximum total root length and root surface area (408.85 cm; 443.04 cm^2 respectively).

5. Acknowledgements

The authors are thankful to the Director, ICAR Research Complex for NEH Region, Umiam, Meghalaya for providing all the facilities for conducting the research. Help received from the Forest Department, West Bengal Forest Division and Division of Horticulture, ICAR RC Umiam, Meghalaya is duly acknowledged.

6. References

Beniwal, B. S. and Singh, N.B. 1989. Observations on flowering, fruiting and germination behaviour of some useful forest plants on Arunachal Pradesh. *Indian Forester*. 115(4): 216-227

Blake T.J., Cain N.P., Gadziola R., Hills C.I. and Zitnak T. 1982. Ethylene and auxin improve the rooting of difficult-to-root poplar cuttings Proc. North American Poplar Council Annual Meeting. Rhinelan-der, WI, pp. 20–28

Bojarczuk T and Jankiwiz LS (1975). Influence of phenolic substances on rooting of softwood cuttings of Populus alba L. and P. Canadensis. *Acta agrobotanica*, 28(1):121-129

Bolstad, P.V. and Libby, W. J. 1982. Comparison of radiata pine cuttings of hedge and tree form origin after seven growing seasons. *Silvae Genetica*. 31:9-13.

Bonga, J.M. 1982. Vegetative propagation about juvenility, maturity, and rejuvenation. In: Tissue Culture in Forestry. J. M. Bonga and D. J. Durzan (eds.). Martinus Nijhoff/Dr. W. Junk Publishers, The Hague: 387-412

Desrochers, A and Thomas, BR 2003. A comparison of pre-planting treatments on hardwood cuttings of four hybrid poplar clones. *New Forests* 26:17–32

Desrochers, A. and Thomas, B. R. 2003. A Comparison of pre-planting treatments on hardwood cuttings of four hybrid poplar clones. *New Forest*. 26: 17-32

FAO. 2012. Improving life with poplars and willows: synthesis of country progress reports - activities related to poplar and willow cultivation and utilization-2008 through 2011. Forest Assessment Management and Conservation Division. FAO. Rome Italy. 93 p.

Gosh, R. C. and Bhatnagar, H.P. 1977. Rooting response of branch cutting of *P. gamblei* Dode. *Indian Forester*. 103(6): 382-386

Guhathakurta.; P. 1973. *Populus gamblei* Dode- a little known poplar of eastern Himalayas. Proceeding of First Forestry Conference. December, 6; 1973. Dehradun. pp. 244-247

Hansen, E.A., Netzer, D.A. and Tolsted, D.N. 1993. Guidelines for establishing poplar plantations in the north-central U.S. USDA Forest Serv. North Central Forest Exp. Sta. Res. Note NC-363

Hartman, H. T., Kester, D. E., Davis, F.T. and Geneve, R. L. 1997. Plant propagation: principles and practices. 6th Edition, Prentice-Hall Inc. Upper Saddle River, N. J. 770p.

Krinard R.M. and Randall W.K. 1979. Soaking aids the survival of long, unrooted cottonwood cuttings. Tree Planter's Notes 30: 16–1

Lahari, A. K. 1979. Vegetative propagation of forest trees. *Indian Forester*. 105 (2):101-105

Leclerc C.R. and Chong C. 1983. Influence of willow and poplar extracts on rooting cuttings. Combined Proc. Inter. Plant Propag. Soc. 33: 528–5

Naithani, H. B., Chandra, S. and Pal, M. 2001. Indian poplar with special reference to indigenous poplar. *Indian Forester*. 127(2):230-237

Naithani, H.B., Deorani, S.C. and Yaden, T. A. 2005. *Populus gamblei* Dode A tree new to Nagaland, India. *Indian Forester*. 131(9):1212-1216

Puran Chandra, Thakur A, Chaturvedi OP, Mehra TS and Leptcha B. 2015. *Populus gamblei* Dode: an Eastern Himalayan poplar reported from new sites. *Indian Forester*. 141(6):205-206.

Puri, S. and Thomson, F.B. 2003. Relationship water to adventitious rooting in stem cuttings of Populus species. Agroforestry Systems. 59:1-9

Thakur, A. and Bisht. P. 2009. Surface disinfection and cultural establishment of nodal explants of *Populus gamblei* Dode. Proc. of IV Forestry Conference, FRI Dehradun. 156-159

Wendling, I., Trueman S. J., Xavier, A. 2014. Maturation and related aspects in clonal forestry ± part I: concepts, regulation and consequences of phase change. *New Forests*. 45: 449-471