IJBPAS, September, 2012, 1(8): 1145-1152

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EFFECT OF GROWTH HORMONES ON ROOTING ATTRIBUTES OF STEM CUTTINGS OF ENDANGERED PLANT SPECIES, *Hildegardia populifolia (Roxb.) Schott* AND *Endl. (Sterculiaceae)*

SARADHA M AND PAULSAMY S*

Department of Botany, Kongunadu Arts and Science College, Coimbatore-641 029, India

***Corresponding Author: E Mail: paulsami@yahoo.com**

ABSTRACT

The present investigation deals with the clonal propagation of an endangered plant species, *Hildegardia populifolia* (Roxb.) Schott & Endl. of Sterculiaceae family. It is considered as one of the important traditional folklore medicinal plants in southern India. Semi-hard wood cuttings were collected from matured stock plants and treated with the auxins, IBA and NAA in different combinations and concentrations and kept in greenhouse condition for the observation on rooting attributes. The study reveals that the species is amenable for clonal propagation by mature stem cutting. The growth hormones, IBA and NAA at 3000ppm each induced highest amount of 70% of cuttings for rooting. In the same combination and concentration of IBA and NAA, other rooting attributes such as root number, root length, fresh weight and dry weight of adventitious roots were more pronounced in the stem cuttings. Therefore, clonal propagation through cuttings is proved to be an effective propagation method as the seed germination rate in this species is not at appreciable level.

Keywords: *Hildegardia populifolia,* Endangered Plant Species, Stem Cuttings, IBA, NAA, Vegetative Propagation.

INTRODUCTION

Hildegardia populifolia, native to India belongs to the family Sterculiaceae is a medium sized tree confined to few tropical deciduous forests of Viluppuram, Salem, Erode and Coimbatore districts of Tamil Nadu and Anantapur, Chitoor and Cuddapah districts of Andra Pradesh **[1]**. As per the information given in the Red Data Book of

Indian plants **[2]**, this narrow endemic species is under great threat due to factors not apparent at present. It is an enigmatic species in that its conservation status has been variously assessed as Critically Endangered **[3]**, Endangered **[4, 5, 6]**. **[7]** recognized five subpopulations of this endangered species in Rayalaseema District of Andhra Pradesh. **[8]** categorized it as Vulnerable. **[9]** assesses the conservation status of this species as Critically Endangered. It is assumed that anthropogenic interferences, habitat loss and other intrinsic and extrinsic factors might have accounted for their poor regeneration and low seed viability **[10]**.

The bark and leaves of this plant are used for the treatment of dogbite and malaria in the traditional medicinal practice of Tamil Nadu and Andra Pradesh **[11]**. Strong fibres are obtained from the bark, which is used for making ropes. As it is the species of conservation priority, employing modern propagation strategies for enhancing the population is most required. Hence in the present study an attempt has been made for macropropagation with respect to clonal multiplication by using stem cuttings as influenced by various combinations and concentrations of the growth promoters, IBA and NAA.

MATERIALS AND METHODS

Semi-hard wood shoot cuttings of 25-30cm length and 1.5-2.0cm diameter for the study species, *H. populifolia* were prepared after removing leaves and terminal buds from basal rounded portion of branches of one year growth from the individuals of Forest Genetics Division campus, Bhavanisagar, Erode District, Tamil Nadu. The cuttings were surface sterilized with 0.1% mercuric chloride solution for 5minutes followed by rinsing in water and arranged into groups of 50 cuttings. The basal cut ends (upto 2.0cm) of cuttings were provided dipping treatment for 10 seconds with Indole Butric Acid (IBA) and Naphthal Acetic Acid (NAA) in all possible combinations comprising 25 treatments **(Table 1)**. The talcum powder of 10g was used in all combinations to serve as binder for the growth hormones. The top cut ends were sealed with inert paraffin wax to avoid desiccation through surface loss of water. These cuttings were then planted in polythene bags (15 × 23cm) filled with formaldehyde fumigated garden soil and kept in mist chamber. Triplicates were maintained for all experiments. The planted cuttings were irrigated and weeded as and when required, until the termination of the experiment. Data were recorded for rooting percentage and number, length, fresh weight and dry weight

of adventitious roots at the end of the experiment. For recording fresh and dry weights, 5 rooted cuttings per replicate were randomly selected from each treatment.

Table 1: Scheme of Stem Cutting Treatment of *Hildegardia populifolia*

S.No.	IBA concentration (ppm)	NAA concentration (ppm)				
		0 (N_0)	1000(N_1)	2000(N_2)	3000(N_3)	4000(N_4)
1	0(I_0)	I_0N_0	I_0N_1	I_0N_2	I_0N_3	I_0N_4
2	1000(I_1)	I_1N_0	I_1N_1	I_1N_2	I_1N_3	I_1N_4
3	2000(I_2)	I_2N_0	I_2N_1	I_2N_2	I_2N_3	I_2N_4
4	3000(I_3)	I_3N_0	I_3N_1	I_3N_2	I_3N_3	I_3N_4
5	4000(I_4)	I_4N_0	I_4N_1	I_4N_2	I_4N_3	I_4N_4

RESULTS AND DISCUSSIONS

The results on response of rooting attributes to plant growth regulators were recorded 60 days after planting. The combined treatments of stem cuttings of the study species, of *H. populifolia* with the auxins, IBA and NAA generally increased the induction and growth of adventitious roots significantly **(Table 2)**. It indicates that for rhizogenesis, the growth regulator, auxin played much important functional role. The differential effects of various auxins on rooting of stem cuttings of various plant species have been ascribed to the chemical nature of auxin, the mode of treatment and the morpho-physiological status of the cuttings **[12 - 15]**. **[16]** explained that exogenous application of various auxins generally stimulates adventitious rhizogenesis in shoot cuttings of many woody species.

When applying exogenous auxin on cuttings, the endogenous auxin concentration reaches a peak after wounding **[17 - 19]** and coinciding with the initiation of the rooting process. Role of these auxins has also been extensively investigated for root induction in semi-hard wood shoot cuttings of many species **[20 - 23]**. Generally, it is reported that application of the auxin, IBA with another auxin, NAA results in increased rooting in many plants as the physiological stages of rooting are correlated with the changes more effectively in these auxin concentrations **[21, 24 - 26]**.

Results of the present study revealed that shoot cuttings of *H. populifolia* treated with the combination of the two auxins, IBA and NAA at 3000 ppm each exhibited optimum adventitious rhizogenesis from 3 to 9 times greater than that of the talcum powder treated control. The possible explanation for this fact is that auxins are more essential for the

induction of adventitious roots and the quantity required is found to be species specific **[27, 28]**. **[29]** reported that the rooting response to auxin includes a rapid initial cell growth response that may involve auxins induced changes in pH, calcium and gene expression which are more effective in IBA and NAA combinations rather than the combinations of any other auxins as the inter conversion of these two auxins is more possible and successful, a process required for effective rooting. Further, **[30]** stated that the local application of these two auxin levels generates regional concentration gradients and local maxima that are crucial for establishing and maintaining a root primordia. The root growth in terms of increase in fresh and dry weights is varies significantly with the influence of various combinations and concentrations of the growth hormones, IBA and NAA **(Table 2)**. The optimum dosages of these two auxins, IBA and NAA for better root growth on basis of weight for *H. populifolia* is determined to be 3000 ppm each as shown for other rooting attributes. The synergetic effect of these two hormones during rhizogenesis and subsequent rooting stages rapidly added cells by division which naturally increases the biomass of roots **[31].** In addition, the cell elongation in the basal meristem of growing root is reported to be influenced very much positively by the auxins, IBA and NAA which can also be one of the possible factors for the enhancement of root biomass **[32].** Similar results of increase in root biomass after the stem cutting treatment with various auxins is already well documented for many species **[22, 33 - 38].**

Present results indicate that acquisition of sensitivity by cells towards phytohormones for the growth of roots of the species, *H. populifolia* is more essential in addition to dosages provided.

COCLUSION

The prescribed protocol developed in this study for clonal propagation of this species may be followed for mass propagation. Further, it is suggested that the clones of this species to be developed by this method can be introduced into tropical deciduous forests of southern India after identifying the suitable micro-sites for the enhancement of its population and hence to conservation.

REFERENCES

[1] Pullaiah T, Medicinal plants in India, Regency Publications, New Delhi, 2000.

[2] Nayar MP and Sastry ARK, Red Data Book of Indian Plants-Volume 3, Botanical Survey of India, Calcutta, 1990, 251-253.

[3] [4] Ahmedullah M, *Hildegardia populifolia*, In: Nayar, MP and Sastry ARK,

(eds.), Red Data Book of Indian Plants-Volume 3, Botanical Survey of India, Calcutta. 1990, 251-253.

[5] Walter KS and Gillet HJ, 1997, IUCN Red List of Threatened Plants, IUCN Publishing service, Cambridge, 1998, www.unep-wcmc.org.

[6] Rao, BRP, Suresh Babu MV, Reddy AM, Sunitha S, Narayanasamy A, Lakshminarayana G, and Ahmedullah M, Conservation status of *Hildegardia populifolia* (Roxb.) Schott & Endl. (Malvaceae: Sterculioideae: Sterculieae), an endemic of southern peninsular India, Journal of Threatened Taxa., 3(8), 2011, 2018-2022.

[7] Rao BRP, Sunitha S, and Reddy AM, Notes on *Hildegardia populifolia* (Roxb.) Schott & Endl. (Sterculiaceae), an endemic and endangered species, Eighth Annual conference of IAAT and national Seminar on Biodiversity, conservation and Taxonomy of tropical flowering plants, Calicut, 1998, 47.

[8] Jadhav SN, Ved DK, Ghate U, Reddy KN and Reddy S, Proceedings of the Workshop in Conservation Assessment and management planning for Medicinal plants of Andhra Pradesh (CAMP) MPCC, Hyderabad, 2001.

[9] World Conservation Monitoring Centre, *Hildegardia populifolia.* In: IUCN, 2011, IUCN Red List of Threatened Species, Version 2011, 1, 1998, <www.iucnredlist.org>.

[10] Anuradha T and Pullaiah T, Effect of hormones on the organogenesis and the somatic embryogenesis of an endangered tropical forest tree *Hildegardia populifolia* (Roxb.) Schott. & Endl. Taiwania, 46(1), 2001, 62-74.

[11] Varaprasad B, Katikala PK, Naidu KC and Penumajji S, Antifungal activity of selected plant extracts against pytopathogenic fungi *Aspergillus niger*, Indian Jounal of Science and Technology, 2(4), 2009, 87-90.

[12] Nanda KK, Investigation on the use of auxins in vegetative reproduction of forest plants, Final Report PL- 480 Res., Proj., A7-Fs-11, 1970.

[13] Hartmann HT, and Kester, Plant propagation: Principles and propagation: Principles and Practices, Prentice – hallm Englewood Cliffs. N.J., 1983.

[14] Pal M, Clonal Forestry: A feasible approach for yield improvement in forest plantations. Ann. Conf. Silvic. And Res. of N-W Region held at Nainital, 6-7 November, 1998.

[15] Das N, Propagation prospects of dye yielding plant *Rhinacanthus nausutus* Kurz, Natural Product Radiance, 5, 2006, 42-43.

[16] Blakesley D, Weston GD and Hall JF, The role of endigenous auxin in root initiation. Part 1: Evidence from studies on auxin application and analysis of endogenous levels, Plant Growth Regulation, 10, 1991, 341-353.

[17] Gaspar T, Kevers C, Penel C, Greppin H, Reid D, Thorpe T, Plant hormones and plant growth regulators in plant tissue culture, *In vitro* cell develop Biol Plant, 32(4), 1996, 272-289.

[18] Gatineau F, Fouche JG, Kevers C, Hausman JF, Gaspar T, Quantitative variations of indolyl compounds including IAA, IAA asparatate and serotonin in walnut microcuttings during root induction. Biol plant, 39, 1997, 131-137.

[19] Tiberia IP, Pamfil D, and Bellini C, Auxin control in the formation of adventitious roots, Not Bot Hort Agrobot Cluj., 39(1), 2011, 307-316.

[20] Nautiyal S, Uma Singh, Gurumurthi K, Rooting response of branch cuttings of Teak (*Tectona grandis*) as influenced by growth hormones and position of the cutting in the crown, Indian Forester, 118, 1992, 112–121.

[21] Singh S, Kumar P, and Ansari SA, Clonal propagation of Teak (*Tectona grandis*) by composite treatment of auxin with thiamine, Indian Journal of Forestry, 28(2), 2005, 108-111.

[22] Paulsamy S, Senthilkumar P, and Shivashanmugam M, Clonal multiplication Strategies for medicinal plants inhabiting Nilgiri Biosphere Reserve, the Western Ghats, India, Journal of Theoretical and Experimentl Biology, 4(3), 2008, 115-119.

[23] Alagesaboopathi C, Use of auxin in vegetative propagation of *Andrographis lineate* Nees – An endemic medicinal plant from Southern India, Middle – East Journal of Scientific Research, 10(4), 2011, 450-454.

[24] Anantha Padmanabha HS and Vijayalakshmi G, Vegetative propagations of Teak through branch cuttings and sprouts, Tree breeding and propagation, 3, 1994, 8-9.

[25] Torres AI, Rooting experiments with *Euphorbia lagascae* cuttings, Anales de Biologica, 26, 2004, 101-104.

[26] Dhillon RS, Hooda MS, Pundeer JS, Ahlawat KS, and Kumari S, Development of efficient techniques for clonal multiplication of *Jatropha curcus* L., a potential biodiesel plant, Current Science, 96(6), 2009, 823-827.

[27] Ansari SA, Sharma S, Pant PC and Mandal AK, Synergism between IBA and thiamine for induction and growth of adventitious roots in *Tectona grandis.* J. Sust. For., 15, 2002, 99-112.

[28] Tatematsu K, Kumagai S, Muto H, Sato A, Watahiki MK, Harper RM, Liscum E and Yamamoto KT, MASSUGU2 encodes *AUX/IAA*19, an auxin-regulated protein that functions together with the transcriptional activator NPH4/ARF7 to regulate differential growth responses of hypocotyl and formation of lateral roots in *Arabidopsis thaliana.* Plant Cell, 16(2), 2004, 1497-1504.

[29] Quint M, Barkawi LS, Fan KT, Cohen JD and Gray WM, Arabidopsis IAR4 modulates auxin response by regulating auxin homeostasis, Plant Physiol 150(2), 2009, 748-758.

[30] Benjamins R and Scheres B, Auxin: the looping star in plant development, Annu Rev Plant Biol., 59, 2008, 443-465.

[31] Ludwig-Muller J, Vertocnik A and Town CD, Analysis of indole-3-butyric acid-induced adventitious root formation on Arabidopsis stem segments, J Exp Bot,56(418), 2005, 2095-2105.

[32] Overvoorde P, Fukaki H and Beeckman T, Auxin control of root development, http://cshperspectives.cshlp.org Cold Spring Harbor Laboratory Press, 2010, 1-16.

[33] De Andres EF, Alegre J, Tenorio JL, Manzanares M, Sanchez FJ, and Ayerbe L, Vegetative propagation of *Colutea arborescens* L, A multipupose leguminous shrub of semiarid climates, Agrofer. Syst, 46, 1999, 113-121.

[34] Lewu FB, Grierson DS and Afolayan AJ, Clonal propagation of *Pelargonium sidoides:* A threatened medicinal plant of South Africa., Afr.J. Biotechnol., 5, 2006, 123-125.

[35] Ehiagbonare JE, Vegetative propagation on some key malaria medicinal plants in Nigeria, Sci. Res. and Essay, 2, 2007, 37-39.

[36] Husen A and Pal M, Effect of branch position and auxin treatment on clonal propagation of *Tectona grandis* Linn. F, New Forest, 34, ,2007, 223-233.

[37] Senthilkumar P, Paulsamy S and Vijayakumar KK, Rooting ability of *Rubia cordifolia* L.- A potential therapeutic plant species in the western ghats, Nilgiri biosphere reserve, India, Scientific Transactions in Environment and Technovation, 2(4), 2009, 187-190.

[38] Jeeshna MV, Manorama S, Senthilkumar P, and Paulsamy S, Clonal multiplication strategeis for the medicinal shrub, *Glcosmis pentaphylla* Correa, Plant Archives, 9(1), 2009, 331-333.

Table 2: Effect of IBA and NAA Interaction on Characteristics of Adventitious Rooting in the Species, *Hildegardia populifolia*

S.No.	Interaction concentration	Rooting (%)	Root number	Root length (cm)	Fresh weight (mg)	Dry weight (mg)
1.	I_0N_0	8.2±0.03[a]	8.35±0.01[a]	3.60±0.01[a]	0.75±0.02[a]	0.31±0.01[a]
2	I_0N_1	10.1±0.06[ab]	10.62±0.03[b]	5.54±0.01[b]	1.95±0.01[bc]	0.65±0.01[b]
3	I_0N_2	12.6±0.02[b]	15.71±0.04[c]	8.72±0.02[c]	1.72±0.01[bc]	0.62±0.01[b]
4	I_0N_3	18.6±0.05[c]	12.60±0.03[bd]	6.41±0.01[b]	0.95±0.02[ac]	0.31±0.02[a]
5	I_0N_4	14.3±0.04[bh]	14.58±0.02[c]	8.53±0.02[cd]	1.53±0.01[c]	0.57±0.01[ab]
6	I_1N_0	22.2±0.02 [d]	9.32±0.04[ab]	6.47±0.02[b]	0.87±0.02[ac]	0.30±0.02[a]
7.	I_1N_1	14.08±0.07 [bh]	16.91 ±0.05[c]	7.00±0.01[bd]	0.92±0.01[ac]	0.28±0.01[a]
8	I_1N_2	28.1±0.05[e]	18.73±0.04[eh]	7.35±0.02 [bd]	0.99±0.02[ac]	0.47±0.02[ab]
9	I_1N_3	60.5±0.01[f]	41.07±0.03[f]	12.01±0.01[e]	3.50±0.03[d]	0.92±0.01[c]
10	I_1N_4	34.7±0.04[gj]	26.15±0.04[g]	8.98±0.03[cd]	1.80±0.02[bc]	0.61±0.02[ab]
11	I_2N_0	14.1±0.03[bh]	7.63±0.02[a]	3.37±0.02[a]	0.69±0.01[a]	0.21±0.01[a]
12	I_2N_1	22.1±0.05[dc]	19.22±0.03[h]	9.31±0.06[c]	1.21±0.01[c]	0.45±0.02[ab]
13	I_2N_2	16.3±0.06[h]	21.71±0.04[h]	8.20±0.04[a]	2.00±0.03[bc]	0.73±0.01[b]
14	I_2N_3	36.9±0.02[g]	33.40±0.03[i]	11.47±0.02[e]	3.71±0.04[d]	0.93±0.03[c]
15	I_2N_4	50.5±0.06[i]	12.37±0.01[bd]	6.77±0.03[b]	1.02±0.01[ac]	0.35±0.02a
16	I_3N_0	32.6±0.03[j]	37.42±0.04[j]	12.65±0.05[e]	3.07±0.03[d]	0.91±0.02[c]
17	I_3N_1	28.8±0.05[ge]	27.23±0.02[g]	9.75±0.02[c]	2.91±0.04[d]	0.87±0.03[c]
18	I_3N_2	54.9±0.03[i]	44.03±0.01[f]	13.76±0.03[e]	3.74±0.03[de]	0.93±0.02[c]
19	I_3N_3	70.1±0.02[k]	52.80±0.02[k]	15.32±0.01[f]	4.38±0.02[e]	1.05±0.03[c]
20	I_3N_4	46.2±0.06[i]	24.62±0.01[g]	9.54±0.02[c]	2.67±0.01d	0.93±0.01[c]
21	I_4N_0	18.4±0.01[c]	32.56±0.03[i]	12.21±0.03[e]	2.93±0.02d	0.92±0.02[c]
22	I_4N_1	20.4±0.04[dc]	20.92±0.02[h]	10.11±0.04[c]	1.62±0.04[c]	0.81±0.01[c]
23	I_4N_2	16.3±0.02[h]	16.44±0.04[c]	8.03±0.06[c]	1.00±0.02[ac]	0.43±0.04[ab]
24	I_4N_3	28.6±0.03[e]	28.73±0.03[g]	10.68±0.05[c]	1.79±0.03[bc]	0.68±0.03[b]
25	I_4N_4	12.4±0.01[b]	13.47±0.05[bd]	9.43±0.04[c]	1.58±0.02[c]	0.59±0.01[ab]

***Means in the Columns Followed by Different Letter(s) are Significant to Each Other at 5% Level According to DMR**