International Journal of Farm Sciences **4(4)** : 128-135, 2014

Effect of growth regulators on sprouting and yield attributes of *Picrorhiza kurrooa* Royle ex Benth

MK THAKUR

Department of Silviculture and Agroforestry
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan 173230 HP
Email for correspondence: drmanojthakur@gmail.com

ABSTRACT

Picrorhiza kurrooa commonly known as Kutki/Karru is native to western Himalayan region. This high valued medicinal plant categorized as endangered by the IUCN finds use both in traditional as well as modern system of medicine. Its rootstock (roots and stolon) constitutes the drug and is considered as hepatoprotective, laxative,appetizer, diuretic, anti-diabetic and anti-cancerous. It is used to cure leucoderma, jaundice, viral hepatitis and other ailments. Increasing national and international demand with good market price has led to its indiscriminate and unscientific exploitation from the wild coupled with negligible cultivation has put its existence under threat. In order to find out the best propagation technique so as to encourage its cultivation field trials were conducted to study the effect of IAA, IBA and NAA growth regulators comprising 100, 200 400 and 600 ppm concentrations on sprouting, growth and yield attributes. It was concluded that in order to get higher rootstock yield stolon cuttings should be pretreated with IBA 200 ppm > IBA 600 ppm > NAA 200 ppm in the increasing order of their preference.

Keywords: *Picrorhiza kurrooa*; growth regulators; sprouting; survival; leaf; rootstock; rootstock/shoot ratio

INTRODUCTION

Picrorhiza kurrooa is native to western Himalayan region distributed along stream borders and moist rocks of temperate and alpine zone between 3000-5000 m elevations. It is a creeping, glabrous perennial herb and is often found gregarious in its natural habitat. It is commonly known as Kutki/Karru and belongs to the family Scrophulariaceae. It is an important species considering its demand and use vis-à-vis threat status. It is a high value medicinal plant used in both traditional as well as modern systems of medicine the rootstock of which constitutes the drug.

The rhizomes and roots of *P kurrooa* are medicinally important as hepatoprotective, stomachic, anti-periodic, anthelmintic, laxative, cardiotonic, anti-diabetic, anti-cancerous, cholagogue, diuretic, cooling, appetizer and anti-asthamatic and also used to cure vitiligo,

leucoderma, jaundice and viral hepatitis (Chopra et al 1956, Shah 1969, Mehta 1982, Bedi et al 1989, Kaul and Kaul 1996, Sinha 1996, Singh 1999, Jeena et al 1999, Joy and Kuttan 1999) and its rootstock is a major component of various formulations like Picroliv, Arogyavardhni Vati, Laxminarayan Ras, Mahayograj Guggulu, Amritarista, Curminil syrup, Livertone, Curminex, PK-300, Ayush-64 etc. (Yegnanarayan et al 1982, Vaidya et al 1996, Singh 1999, Gogte 2000, Valecha et al 2000).

Despite increasing national and international demand *P kurrooa* is largely extracted from its wild habitat and with very limited cultivation. The only way this species can be saved from extinction and also for its sustainable utilization large-scale cultivation is necessary. However for any large scale cultivation there is need of efficient propagation technique. The available propagation techniques on this endangered Himalayan plant species are insufficient and mostly limited to the closets. Keeping this in view the present studies were undertaken to develop/standardize/ improve its propagation technique.

MATERIAL and METHODS

The present investigation was undertaken at Medicinal and Aromatic Plants Research Station, Rahla of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2005 to 2007. The station is located an altitude of 2750 m amsl. The surface (0-15 cm depth) and sub-surface (15-30cm depth) soil of the experimental site was acidic in reaction (pH 5.5 to 5.7) with safer EC value (0.091 to 0.115 ds/m), medium to high in organic carbon (1.92 to 1.68%) and available N (407.68 to 332.41 kg/ha), P (44.80 to 40.32 kg/ha) and K (333.40 to 296.80 kg/ ha). The area with deep fertile soil and nice undulating topography receives heavy snowfall and is highly conducive for cultivation of medicinal and aromatic plants of temperate and alpine region.

The studies elucidate sprouting, survival and yield performance of *Picrorhiza kurrooa* employing different growth regulator treatments to stolon cuttings prior to planting. In order to find out the best hormonal treatments to the stolon cuttings six cm long stolon cuttings of uniform size were subjected to twelve different types/concentrations of growth regulators along with a control (no treatment). The treatments consisted of three types of growth regulators viz IAA, IBA and NAA with four concentrations of 100, 200, 400 and 600 ppm. The treated cuttings were planted at a spacing of 25 x 25 cm in May 2005. The experiment was laid out in a randomized block design with three replications.

The observations were recorded on sprouting by counting the number of cuttings sprouted after four months of planting and

expressed as percentage of the total cuttings planted. Field survival of rooted cuttings was recorded in the second and third year of plant growth by counting the number of survived plants at the end of the respective growing season out of the total cuttings planted and is expressed in percentage. For observing the rootstock yield randomly selected five plants per replication were dug out at the end of growing season in the month of October when the plants were in their second and third year of growth. They were washed thoroughly to remove all adhering soil particles, sundried for two days followed by shade drying for ten to fifteen days and oven drying at 50°C till no further weight loss was observed. These oven dried plant samples were separated into leaves and rootstock (stolons plus roots), weighed and expressed in g/plant and kg/ha. Rootstock/shoot ratio was calculated by dividing rootstock weight by leaf weight.

RESULTS and DISCUSSION

Treatment to uniform sized (6 cm in length) stolon cuttings with different concentrations (100, 200, 400 and 600 ppm) of growth regulators (IAA, IBA and NAA) was given and were tested for sprouting, field survival, leaf and rootstock yield and rootstock/shoot ratio.

Sprouting percentage: A perusal of data (Table 1) recorded in October 2005 reveals that treatment T_{12} (400 ppm NAA) induced highest sprouting (90.12%) followed by T_7 (90.00%) and T_{13} (87.18%) whereas lowest (68.06%) sprouting was noticed in T_2 following T_1 (control) (70.04 %).

Field survival: Plant survival (Table 1) in the field was recorded highest (85.00%) by treating the cuttings with 200 ppm IBA (T_7) followed by treating either with 400 ppm NAA (T_{12}) or 600 ppm NAA (T_{13}) showing value of 82.40 per cent. However treatments T_7, T_{12} and T_{13} behaved statistically alike. Control of the experiment (T_1) exhibited lowest survival (62.10%) following treating the cuttings with T_4 (400 ppm IAA) (64.24%).

Leaf yield: It is evident from the data presented in Table 1 that treating the cuttings with 400 ppm NAA (T_{12}) resulted in highest leaf yield in the second (0.84 g/plant) as well as third year (2.16 g/plant) of plant growth followed by 600 ppm IBA (T_9) showing values of 0.67 g/plant and 1.99 g/plant in the second and third year respectively. IAA 400 ppm (T_4) registered lowest leaf yield (0.38 g/plant and 1.70 g/plant in the second and third year respectively).

Rootstock yield: A perusal of data (Table 1) reveals that highest rootstock yield of 1.76 g/plant as well as 281.60 kg/ha was recorded with 400 ppm NAA (T_{12}) in the second year of plant growth which subsequently showed its values of 5.08 g/plant and 812.80 kg/ha in the third year of plant growth. This was followed by treating

with 600 ppm IBA (T_9) 260.80 kg/ha and 808.00 kg/ha in the second and third year respectively. On the other hand lowest rootstock yield of 0.73 g/plant and 4.15 g/plant was observed with 400 ppm IAA (T_4) in the second and third year of observation thereby depicting 116.80 kg/ha and 664.00 kg/ha rootstock yield in the second and third year respectively. The lowest root stock yield (116.80 kg/ha and 664.00 kg/ha) was obtained in T_4 which was even lower than the control (T_1) depicting values of 121.60 kg/ha and 668.80 kg/ha in the second and third year of plant growth respectively.

Rootstock/shoot ratio: As is clear from the Table 1 that T_{11} (NAA 200 ppm) gave highest (2.60) rootstock/shoot ratio followed by T_3 (200 ppm IAA) with value of 2.57 whereas T_4 (400 ppm IAA) as well as T_{13} (600 ppm NAA) recorded lowest (1.92) value in the second year of growth. In the third year of plant growth T_8 (400 ppm IBA) exhibited highest (2.63) rootstock/shoot ratio followed by value of 2.59 exhibited by T_3 (200 ppm IAA)/T_{11} (200 ppm NAA). However lowest (2.35) ratio was shown by 400 ppm NAA (T_{12}) following 600 ppm NAA (T_{13}) with value of 2.37.

Alpine plants are generally multiplied asexually by using stem cuttings (Hills 1959).There are two periods when divisions of alpine plants can be carried out either when the plant is still growing but main season of seed production is over or in the early part of growing season when young plants are actively growing. March and early September are therefore suitable months for the division (Hills1959). *P kurrooa* can be vegetatively propagated through stolon cuttings (Anon 1969). It is evident from the results obtained during present investigation that *P kurrooa* can be successfully multiplied through stolon cuttings within a short period of time which is also supported by the earlier studies (Nautiyal et al 2001, Mehra 2006).

Several organic compounds including growth promoters as well as inhibitors have been found to be effective in promoting rooting (Chin and Beevers 1969). Synthetic rooting hormones are perhaps the most important contribution of modern science to the art of propagation. Went (1929) for the first time reported that the application of a diffusate from leaves to apical end of cuttings caused rooting at cutting base and this root promoting agent was later on termed as indole-3-acetic acid (Thimann and Went 1934). Further it was confirmed that synthetic IAA was as effective as natural IAA (Thimann and Koepfli 1935). At the same time it was also reported that indole-3-butyric acid was effective in promoting rooting of the cuttings in species where IAA was not effective (Zimmerman and Wilcoxon 1935). Amongst the auxins IBA and NAA are most widely used for promotion of rooting (Couvillon 1988). Auxins increase mobilization of reserve food materials by

Table1. Effect of hormonal treatments on the performance of *Picrorhiza kurrooa*

Treatment	Sprouting (%)	Survival (%)	Leaf yield (g/plant)		Rootstock yield (g/plant)		Rootstock yield (kg/ha)		Rootstock/shoot ratio	
			2nd year	3rd year	2nd year	3rd year	2nd year	3rd year	2nd year	3rd year
T_1 (control)	70.04	62.10	0.39	1.71	0.76	4.18	121.60	668.80	1.94	2.44
T_2 (IAA 100 ppm)	68.06	67.20	0.41	1.73	0.80	4.22	128.00	675.20	1.9	2.44
T_3 (IAA 200 ppm)	85.10	80.12	0.42	1.74	1.08	4.50	172.80	720.00	2.5	2.59
T_4 (IAA 400 ppm)	70.14	64.24	0.38	1.70	0.73	4.15	116.80	664.00	1.9	2.44
T_5 (IAA 600 ppm)	78.92	67.10	0.57	1.89	1.38	4.80	220.80	768.00	2.4	2.54
T_6 (IBA 100 ppm)	70.14	68.00	0.63	1.93	1.43	4.85	228.80	776.00	2.2	2.51
T_7 (IBA 200 ppm)	90.00	85.00	0.63	1.96	1.50	4.92	240.00	787.20	2.3	2.51
T_8 (IBA 400 ppm)	80.12	72.00	0.54	1.86	1.48	4.90	236.80	784.00	2.7	2.63
T_9 (IBA 600 ppm)	83.90	70.00	0.67	1.99	1.63	5.05	260.80	808.00	2.4	2.54
T_{10} (NAA 100 ppm)	78.12	66.12	0.51	1.83	1.28	4.70	204.80	752.00	2.5	2.57
T_{11} (NAA 200 ppm)	75.08	70.14	0.53	1.85	1.38	4.80	220.80	768.00	2.6	2.59
T_{12} (NAA 400 ppm)	90.12	82.40	0.84	2.16	1.76	5.08	281.60	812.80	2.1	2.35
T_{13} (NAA 600 ppm)	87.18	82.40	0.57	1.91	1.10	4.52	176.00	723.20	1.9	2.37
$CD_{0.05}$	3.17	5.17	0.03	0.11	0.07	0.16	8.41	12.31	0.06	0.09

increasing the activity of hydrolytic enzymes which as a consequence stimulate rooting of stem cuttings (Nanda et al 1968). In this backdrop the role of auxins namely IAA, IBA and NAA was studied in the present investigation to understand their effect in promoting higher sprouting, survival, leaf and rootstock yield in *P kurrooa*. The results of the studies revealed that the sprouting, survival and yield parameters viz leaf, rootstock yield and rootstock/shoot ratio in *P kurrooa* have been significantly influenced by different types and concentrations of growth hormones applied to the stolon cuttings prior to planting (Table 1).

Kaul and Kaul (1996) have attempted clonal propagation with hormonal treatment in *P kurrooa* with varying success. They reported that in pot culture IBA showed encouraging rooting response (60% stolon splits rooted). Nautiyal et al (2001) while studying the effect of 100 ppm and 200 ppm solutions of IAA, IBA, NAA and GA_3 for 48 hours on stolon cuttings of *P kurrooa* observed that GA_3 and IAA treated top segments showed more than 90 per cent rooting.

It is evident from the results that treating stolon cuttings with 400 ppm NAA (T_{12}) before planting gave highest (90.12%) sprouting, 2.16 g/plant leaf yield and 812.80 kg/ha rootstock yield in the third year of plant growth. Treating the cuttings with 200 ppm IBA (T_7) gave highest (85.00%) survival. However 600 ppm IBA (T_9) registered second place with values of leaf yield 1.99 g/plant and rootstock yield of 808.00 kg/ha in the third year of plant growth. This was better than other growth regulators tested as well as control.

Better results obtained in IBA treatments have also been reported in several other species viz *Rauwolfia serpentina* (Pal et al 1995), *Andrographis elongata* (Alagesaboopathi and Balu 2000), *Eclipta prostorta* (Ghate and Pansare 2000). In *Asparagus racemosus*, application of IBA has resulted in more root length (Vijay and Kumar 2005). Even in *P kurrooa* it has been reported that IBA increased the survival percentage of tissue culture raised plants (Wawrosch et al 2003).

It is evident from Table 1 that different concentrations of growth regulators tested did not give corresponding linear results with the increasing concentration but followed random order. It appears that response of the cuttings to these applied growth regulators is also partly influenced by other unexplainable factors.

CONCLUSION

Under present investigation 12 different combinations of 3 types of growth hormones (IAA, IBA and NAA) and 4 types of concentrations (100, 200, 400 and 600 ppm) were tested to find out the best

one to get higher rootstock yield. It was concluded from the studies that different growth and yield attributes viz sprouting, survival, leaf and rootstock yield of *Picrorhiza kurrooa* showed higher values by pretreating the stolon cuttings with 400 ppm NAA followed by 600 ppm IBA and 200 ppm IBA and therefore should be pretreated with these growth hormones.

REFERENCES

Alagesaboopathi C and Balu S 2000.Vegetative propagation of *Andrographis elongata* T by stem cuttings. Journal of Economic and Taxonomic Botany **24(2):** 409-412.

Anonymous 1969. The wealth of India: a dictionary of Indian raw materials and industrial products. Council of Scientific and Industrial Research, New Delhi, India **3:** 49-50.

Bedi KL, Zutshi U, Chopra CL and Amla V 1989. *Picrorhiza kurroa*, aayurvedic herb may potential phytochenotherapy in Vitiligo. Journal of Ethnopharmacology **27:** 347-352.

Chin TY and Beevers L 1969. The stimulation of rooting by abscisic acid. Plant Physiology Supplement **44:** 33.

Chopra RN, Nayar SL and Chopra IC 1956.Glossary of Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi, India, 192p.

Couvillon GA 1988. Rooting responses to different treatments. Acta Horticulture **227:** 187-196.

Ghate VS and Pansare S 2000. Nursery propagation techniques and sustainable biomass harvest in Bhringraj (*Eclipta prostorta* L). MFP News **2:** 7-8.

Gogte VVM 2000. Ayurvedic pharmacology and therapeutic use of medicinal plants (Dravyagunavigyan), Surendra Shringi, Mumbai, pp 325-327.

Hills LD 1959. The propagation of alpines. Faber and Faber Ltd, London, 484p.

Jeena KJ, Joy KL and Kuttan R 1999. Effect of *Emblica officinalis, Phyllanthus amarus* and *Picrorhiza kurroa* an N-nitrosodiethylamine induced hepatocarcinogenesis. Cancer Letters **136(1):** 11-16.

Joy KL and Kuttan R 1999. Anti-diabetic activity of *Picrorhiza kurroa* extract. Journal of Ethnopharmacology **67(2):** 143-148.

Kaul MK and Kaul K 1996. Studies on medico-ethnobotany, diversity, domestication and utilization of *Picrorhiza kurroa*. In: Supplement to cultivation and utilization of medicinal plants (SS Handa and MK Kaul eds). Regional Research Laboratory, Council of Scientific and Industrial Research, Jammu, J&K, India pp 333-348.

Mehra TS 2006. Studies on reproductive biology, propagation and bitter principle content in *Picrorhiza kurroa* Royle ex Benth. PhD thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP, India.

Mehta RC 1982. Indian herbal drugs in the treatment of diabetes. Current Medical Practices **26(16):** 289-305.

Nanda KK, Purohit AN, Tandon R and Bala A 1968. Mechanism of auxin action in rooting of cutting. Proceeding of the International Symposium on Plant Growth Substances (SM Sircar), Eka Press, Calcutta, West Bengal, India, pp 201-209.

Nautiyal BP, Vinay Prakash, Chauhan PS, Purohit H and Nautiyal MC 2001. Assessment of germinability, productivity and cost benefit analysis of *Picrorhiza kurroa* cultivated at lower altitudes. Current Science **81(5):** 579-585.

Nayer MP and Sastry ARK 1987. Red data book of Indian plants. Botanical Survey of India, Calcutta, West Bengal, pp 350-351.

Pal M, Badola KC and Bhandari HCS 1995. Vegetative propagation of *Rauwolfia serpentina* by rooting of branch cuttings. Indian Journal of Forestry **18(1):** 18-20.

Shah NC 1969. Rhizomes of *Picrorhiza kurroa*. Science and Culture **35:** 687-688.

Singh PB 1999. Illustrated field guide to commercially important medicinal and aromatic plants of H P (with special reference to Mandi district). Society for herbal medicine and Himalayan biodiversity, Mandi, HP, India, pp 67-68.

Sinha RK 1996. Ethnobotany (The renaissance of traditional herbal medicine). INA Shree Publishers, Jaipur, Rajsthan, India, pp 111-112.

Thimann KV and Koepfli JB 1935. Identity of growth promoting and root forming substances of plants. Nature **135:** 101.

Thimann KV and Went FW 1934. On the chemical nature of the root forming hormone. Proceedings of National Academic Wetench **37:** 456-459.

Vaidya AB, Anantkar DS and Doshi JC 1996. *Picrorhiza kurroa* (Kutki) Royle ex Benth as a hepatoprotective agent – experimental and clinical studies. Journal of Postgraduate Medicine **42:** 105-108.

Valecha ND, Joshi H, Shani VK, Sharma VP and Shivlal 2000. Comparative efficacy of Ayush-64 v/s chloroquine in *Vivax* malaria. Current Science **78(9):** 1120-1122.

Vijay N and Kumar A 2005. Improving growth and productivity of *Asparagus racemosus:*effect of NPK and growth regulators. Phytomorphology **55(1&2):** 1-7.

Wawrosch C, Zeitlhofer P, Grauwald B and Kopp B 2003.Effects of rooting chemicals on the establishment of micro-propagated *Picrorhiza kurroa* plantlets in the greenhouse. Acta Horticulture **616:** 271-274.

Went FW 1929. On a substance causing root formation. Proceedings of Kon Academic Wetensch **32:** 35-39.

Yegnanarayan R, Dange SV, Vaidya SD and Balwani JH 1982. Study of *Picrorhiza kurroa* (PK300) in case of bronchial asthma. Bombay Hospital Journal **24(2):** 15-18.

Zimmerman PW and Wilcoxon F 1935. Several chemical growth substances which cause initiation of roots and other responses in plants. Contributions from Boyce Thompson Institute, Ithaca, New York, USA **7:** 209-229.

Received: 3.7.2014 ***Accepted: 22.10.2014***