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Effect of preplanting water dip treatments on sprouting and yield attributes of *Picrorhiza kurrooa* Royle ex Benth

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Picrorhiza kurrooa, rootstock yield, sprouting, survival and stolon cuttings.

ABSTRACT

Picrorhiza kurrooa Royle ex Benth is an endangered, high value, perennial medicinal plant which is generally propagated through stolon cuttings. However, rooting of cutting is affected by several factors like portion of cutting and pre-planting treatments etc. Studies were undertaken during 2005 to 2007 to standardize portion of stolon and pre-planting water dip treatments to achieve better sprouting, survival and yield. It was observed that top portion of stolon cuttings should be preferred over middle and basal potion for maximum sprouting and rootstock yield. Water dip for 36-60 hours to top portion of stolon cutting performed better and gave higher growth and yield.

INTRODUCTION

Picrorhiza kurrooa is native to western Himalayan three hill states viz. Jammu and Kashmir, Himachal Pradesh and Uttrakhand. In Kashmir Himalaya, it grows in high reaches of Gurez, Lolab, Karna, Sindh and Lidder Valleys. In Garhwal Himalayas, it has been reported to be indiscriminately collected from Badrinath, Kedarnath and Chamba areas. In Himachal Pradesh, it is common in Chamba, Pangi, Kullu, Shimla, Kinnaur and Lahaul valleys. It is 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, whereas rootstock of plant is a mainly consumed plant part as a 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, 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; and Joy and Kuttan 1999), and such rootstock is a major component of various formulations like Picroliv, Arogyavardhnivati, Laxminarayan Ras, Mahayograj Guggulu, Amritarista, Curminil Syrup, Livertone, Curminex, P K-300, Ayush-64 etc. (Yegnanarayan et al. 1982; Vaidya et al. 1996; Singh 1999; Gogte 2000 and Valecha et al.

2000)

Harvesting of stolons for drug/commercial purpose leads to destructive harvest with little regeneration activity being taken up at present. Moreover, the local people who were dependent on this commercially viable species for augmentation of their cash earnings are facing a lot of difficulty in meeting their day to day requirements in the lack of its natural regeneration process. If this situation is allowed to continue this important drug plant, which is categorized as endangered by the IUCN, will become extinct one day. Moreover high commercial demand of *P. kurrooa* coupled with good market price is attracting herbal traders with scanty attention being given to its conservation or cultivation. The resulting decline in its natural regeneration processes has not only put its status under threat but also adversely affected the trade and commerce of related industry.

Due to indiscriminate and non-systematic exploitation from wild, the species has become vulnerable and its populations are becoming scarce (Nayar and Sastry 1987). The plant populations have been reduced significantly in the easily accessible area and now it is restricted only to the inaccessible terrain (Kala 2004). Due to these reasons, the species is now classified as a critically endangered and also finds place in the negative list of export of Ministry of Commerce, GOI [Vide Notification No. 03 (RE-2003)/2002-2007 (Appendix II) dated 31st March, 2003 issued by Director General of Foreign Trade, Govt. of India].

In Himachal Pradesh, *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 technique on this endangered Himalayan plant species is insufficient and mostly limited to the closets. Keeping this in view, the present study was undertaken to develop standard propagation protocol for its successful cultivation.

MATERIALS AND METHODS

The present study was undertaken at Medicinal and Aromatic Plants Research Station, Rahla of Dr. Y.S. Parmar University of Horticulture and Forestry at Nauni, Solan (HP) during 2005 to 2007. The site is located an altitude of 2750 m at msl. The surface (0-15 cm depth) and sub-surface (15-30 cm 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^{-1}), medium to high in organic carbon (1.68-1.92 %) and available N (332.41- 407.68 kg ha^{-1}), P (40.32 - 44.80 kg ha^{-1}) and K (296.80- 333.40 kg ha^{-1}). 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 tempera te and alpine region.

The studies illuminates sprouting, survival and yield performance of *P. kurrooa* by deploying top, middle and basal portion of stolon cuttings pretreated with water for varying period of time intervals *viz.* 12, 24, 36, 48, 60 and 72 hours. Stolon cuttings of uniform size and length (6 cm) were subjected to water dip treatments for different periods and then planted in the field at a spacing of 25×25 cm during May, 2005. The experiment was laid out in RBD with nineteen treatments (including control) and three replications. The details of the treatment are given in Table 1.

Observations on per cent sprouting were made in October, 2005 whereas, plant survival was noticed in October, 2006. Yield attributes viz. leaf yield, rootstock yield and rootstock: shoot ratio were recorded in October, 2006 and October, 2007 in the second and third year of plant growth respectively.Randomly selected five plants per replication were dug out after first and second growing season in the month of October and washed thoroughly to remove all adhering soil particles. These plants were shade dried for 10 days followed by oven drying at 50°C till no further weight loss was observed. These oven

dried plants were separated into leaves and rootstock (stolon plus roots), weighed (g) and the data were reported as mean. Rootstock-shoot ratio was calculated by dividing the rootstock weight by leaf weight and was reported as mean.

RESULTS AND DISCUSSION

Results revealed that maximum sprouting (88.14 %) and survival (85.23 %) was observed in T_4 i.e. by using top portion of cutting and dipping for 36 hours in water (Table 1). Whereas, minimum (38.11 %) sprouting was noticed in T_8 i.e. cuttings taken from middle portion of stolon and dipped for 12 hours. However, minimum (33.02 %) survival was recorded in T_9 i.e. middle portion cuttings dipped for 24 hours in water.

Leaf yield during second year of growth ranged from 1.18 g plant^{-1} (T_1) to 1.65 g plant^{-1} (T_{18}). Whereas, during third year of growth it was recorded the minimum value (1.75 g plant^{-1}) in T_8 and maximum (2.85 g plant^{-1}) in T_{18}. Rootstock yield (g plant^{-1}) depicted maximum (2.85) value in T_5 and minimum (2.14) in T_1 in the second year of growth whereas, its respective maximum (4.85) and minimum (3.25) values in third year of growth was observed in T_4 and T_8 respectively. Rootstock yield (kg ha^{-1}) was observed maximum in T_5 (456.00 kg ha^{-1}) which was statistically at par with T_{18} (448 kg ha^{-1}) and T_4 (444.80 kg ha^{-1}) during 2nd year of its growth. In the third year of growth, the yield was observed maximum in T_4 (776.00 kg ha^{-1}) which was statistically at par with T_5 (764.80 kg ha^{-1}). However the minimum rootstock yield of 320 kg ha^{-1} and 520 kg ha^{-1} was observed for T_8 during 2nd and 3rd year of growth respectively. During second year of growth, minimum (1.51) rootstock: shoot ratio was obtained in T_7 whereas, maximum (2.05) in T_6. On the other hand during third of growth, rootstock : shoot ratio depicted minimum value (1.53) in T_{18} and maximum (2.20) in T_6 (Table 1).

Alpine plants are generally multiplied asexually by using stem cuttings (Hills 1959). *P. kurrooa* commonly propagated through stolon cuttings (Anonymous 1969). It is well known that rooting of cutting is affected by several factors like cutting size, portion of cutting, pre-planting treatments and age etc. However, there is little information available with respect to the portion of the cutting (top, middle and basal) used for planting to get better field survival and rootstock yield. 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). They have reported that stolons dipped in water for 48 hours before planting, resulted in more than 90 per cent rooting in top segments of stolons. Further they (Nautiyal et al. 2001) observed that during third year of growth, total rootstock production was 6-7 times higher as compared to first year and maximum production of 1092 kg ha^{-1} was recorded with the application of leaf litter @ 60 kg ha^{-1}.

Results obtained during present investigation revealed that the sprouting and yield parameters viz. leaf, rootstock yield and rootstock shoot ratio in *P. kurrooa* has been significantly influenced by the pre-planting treatments of water dip to the stolon cuttings. The present studies reveals that top portion of cutting with water dip treatment for 36 hours results in maximum sprouting (88.14 %) and survival (85.23 %) and give maximum rootstock yield. Thus cuttings should be given water dip treatment for 36 hours before planting in the field to achieve as high as 444.80 kg ha^{-1} and 776.00 kg ha^{-1} yield in 2nd and 3rd year of growth respectively (Table 1). This observation confirms earlier reports of significant re-sprouting in damaged stolons of *P. kurrooa* through water culture (Sharma and Raj, 2001). This effect of water dipping was further noticed to affect the survival of the rooted cuttings after one year of growth. Cuttings dipped in water for 36 hours gave maximum survival percentage of 85.23 % whereas, direct planting of stolon cuttings (without any water dipping treatment) gave only 34.20 % survival. Considering the overall sprouting and survival percentage and rootstock yield per plant, it appears that stolon cuttings

Table 1. Effect of cutting portion and water dip treatment on performance of *Picrorhiza kurrooa*

Treatments	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
Top Portion										
T_1(No dip)	45.68	34.20	1.18	1.98	2.14	3.98	342.40	636.80	1.81	2.01
T_2(12 hrs)	47.40	42.36	1.26	2.08	2.46	4.10	393.60	656.00	1.95	1.97
T_3(24 hrs)	82.64	78.40	1.20	2.04	2.10	4.28	336.00	684.80	1.75	2.10
T_4(36 hrs)	88.14	85.23	1.48	2.38	2.78	4.85	444.80	776.00	1.61	2.04
T_5(48 hrs)	76.81	68.34	1.55	2.62	2.85	4.78	456.00	764.80	1.84	1.82
T_6(60 hrs)	79.19	72.15	1.63	2.14	2.66	4.70	425.60	752.00	2.05	2.20
T_7(72 hrs)	62.33	55.05	1.36	2.16	2.05	4.36	328.00	697.60	1.51	2.02
Middle Portion										
T8(12 hrs)	38.11	35.36	1.21	1.75	2.00	3.25	320.00	520.00	1.65	1.86
T_9 (24 hrs)	39.11	33.02	1.28	2.36	2.10	3.68	336.00	588.80	1.64	1.56
T10(36 hrs)	64.68	52.16	1.42	2.33	2.48	3.94	396.80	630.40	1.75	1.69
T_{11}(48 hrs)	66.71	51.23	1.44	2.48	2.62	4.38	419.20	700.80	1.82	1.77
T_{12}(60 hrs)	57.75	49.08	1.63	2.46	2.61	4.56	417.60	729.60	1.60	1.85
T_{13}(72 hrs)	44.32	38.28	1.38	2.10	2.46	3.95	393.60	632.00	1.78	1.88
Basal Portion										
T_{14}(12 hrs)	44.40	30.81	1.26	2.04	2.22	3.38	355.20	540.80	1.76	1.66
T_{15} (24 hrs)	50.42	46.08	1.25	2.36	2.48	3.75	396.80	600.00	1.98	1.59
T_{16}(36 hrs)	72.09	62.00	1.50	2.14	2.34	3.68	374.40	588.80	1.56	1.72
T_{17} (48 hrs)	68.08	60.72	1.48	2.15	2.72	4.25	435.20	680.00	1.84	1.98
T_{18}(60 hrs)	68.10	65.33	1.65	2.85	2.80	4.36	448.00	697.60	1.70	1.53
T_{19}(72 hrs)	64.80	58.32	1.56	1.96	2.62	3.60	419.20	576.00	1.68	1.84
CD $_{0.05}$	**20.76**	**12.08**	**0.22**	**0.38**	**0.22**	**0.78**	**14.10**	**18.15**	**0.16**	**0.24**

dipped in water for 36 – 60 hours before planting gave the best results. Pre planting water dipping of stolon cuttings for 24 hours gave 60 % survival after one year of growth. However, water dipping for 60 hours (50 % survival) gave maximum rootstock biomass yield after one year (1.14 gm plant^{-1}) and two year growth((1.60 gm plant^{-1}), (Mehra 2006).

CONCLUSIONS

Water is essential for the structural integrity of biological molecules, cells, tissues and the organism as a whole besides performing vital role in translocation of nutrients in the plant. Use of water as a rooting media is definitely going to be beneficial as a cheap source of production of nursery stock is always the inherent objective of any propagation experimentation**.** Top portion of stolon cutting dipped in water for 36-60 hours gave better sprouting, survival and rootstock yield

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