ORIGINAL ARTICLE

Macroproliferation of *Gentiana kurroo* Royle

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Gentiana kurroo is a small perennial herb, with a stout rhizome bearing decumbent flowering stems, commonly found in North –Western Himalayas, at altitudes of 5,000–11,000 ft. Due to multiple uses, species is being over exploited in its natural habitats at the Garhwal Himalaya. The propagation by rhizome has emerged as an effective method of multiplication and conservation of plant species. In the present study, an attempt was made to evaluate the impact of different hormones, i.e., Indole -3 butyric acid (IBA) and Indole-3 acetic acid (IAA) for the root induction in *G. kurroo*. For this, the growing tip of rhizome was split into 2, 3 and 4 longitudinal parts. Each split contained ½, ⅓ or ¼ of longitudinal section of mother rhizome and above ground part with growing buds. Two piece rhizome exhibited significantly higher survival percentage (97.5%) under control conditions followed by three piece (90%) and four pieces (22.5%) cuttings. Two and three pieces IBA-treated cuttings showed better results than IAA treatments and enhanced the emergence percentage. Therefore, macroproliferation of *G. kurroo* rhizome is an easy and effective technique for multiplication and conservation of this endangered herb.

Key words: Conservation, hormones, multiplication, rhizome and herb

INTRODUCTION

Gentiana kurroo [family: Gentianaceae] is a small perennial herb, with a stout rhizome bearing decumbent flowering stems, commonly found in North–Western Himalayas, at altitudes of 5,000–11,000 ft. The dried rhizome and roots of *G. kurroo*, described under the name Indian Gentian are exported from the hills. The plant does not seem to have been cultivated on a large scale anywhere in India. The flowers are hermaphrodite and are pollinated by bumblebees and butterflies. It takes some years to produce flowers and considerable time elapses before the roots reach marketable size.[1] Flowering starts from the third week of August and continues till the first week of November, with the peak between 15 September and 20 October and on an average, a plant produces 20 flowers.[2]

The flowers close during night and under low light, and re-open when the sun shines brightly. The first fortnight of November is the ideal time for seed harvest after which the capsules open up, scattering the seeds. About 70–75 % of seeds germinate and June is the ideal month for seed sowing. The seeds have to be stored at low temperature (below 5°C) after harvesting. Otherwise, there is considerable reduction in germination percentage. Seeds more than one-year old lose viability and do not germinate.[2] *Gentiana* requires a stony soil with perfect drainage.[3]

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Importance and Ethnobotany of *Gentiana kurroo*

It is valued as a bitter tonic, antiperiodic, expectorant, antibilious, astringent, stomachic, anthelmintic, blood purifier and carminative.[4,5] This species is one of several that are the source of the medicinal gentian root. *Gentiana* root has a long history of use as herbal bitter in the treatment of digestive disorders and is an ingredient of many proprietary medicines.[6,7] It contains some of the most bitter compounds known and is used as a scientific basis for measuring bitterness.[8] It is especially useful in treating exhaustion from chronic disease and in all cases of weakness of the digestive system and lack of appetite.[9]

It is one of the best strengtheners of the human system, stimulating the liver, gall bladder and digestive system.[8] It is an excellent tonic to combine with a purgative in order to prevent tonic, cholagogue, emmenagogue, febrifuge, refrigerant and stomachic.[8-13] The root is harvested in the autumn and dried for later use. It is quite likely that the roots of plant that have not flowered are the richest in medicinal properties.[9] It is also called as *"Ram Vaan"* because of its effective healing properties.[14]

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Status of *Gentiana kurroo*

The drug plant, heavily extracted from its natural habitat is an endangered medicinal plant. Hence, the Ministry of Commerce, Government of India has included it in the negative list of exports vide Notification no. 2 (RE-98) 1997-2002 dated 13th April 1998.[2]

According to IUCN, this species is declared endangered (nationally) and its cultivation is not yet known.[15] At the study site (Chakrata), this species was rediscovered after 65 years. Last time it was collected in 1942.[16]

MATERIALS AND METHODS

In the present study, we analysed various methods for the macroproliferation of *G. kurroo*, so that the most appropriate procedure or hormone is selected for its propagation, which will help the *in situ* and *ex situ* conservation of this species.

The plants of *G. kurroo* were collected during March 2009 from Chakrata forest division at an altitude 2,100 m above mean sea level. The site is situated between the latitude 30°26' N and 31°02' N and longitude 77°38' E and 78°04' E, at an elevation range of 1800–2750 m above mean sea level.

Rhizome study was undertaken for *G. kurroo*. The ball of earth was removed carefully and soil loosened, so as to expose the rhizome. The entire plant, along with rhizome, was washed in a bucket of water. Rhizomes of *G. kurroo*, about 5–8 cm in diameter, were then divided into 2, 3 and 4 equal longitudinal pieces. Each split contained ½, ⅓ or ¼ of longitudinal section of mother rhizome and above ground part with growing buds. These cuttings were dipped in different hormone solutions for 12 hours at room temperature. The hormonal treatments include Indole -3 butyric acid (IBA) (100 ppm, 200 ppm and 300 ppm), Indole -3 acetic acid (IAA) (100, 200, and 300 ppm) and control prepared for comparison. Ten plantlets per replicate were planted in raised nursery beds at temperate forest nursery under natural conditions. The plantlets were watered regularly, and planted at equal distance of about 15 cm. The experiment was laid in a randomized block design with four replicates for each treatment. Survival per cent at the end of three months was calculated as (number of plantlets survived/total number of plantlets planted) ×100.

Statistical tools used in the study were analysis of variance (ANOVA) and Fisher's LSD. Fisher's LSD was applied to test the best treatment when ANOVA was significant at $P<0.05$. All the per cent values were transformed as described by Gomez and Gomez.[17] Data was analysed using computer programs SPSS (1997) and Microsoft Excel.

RESULTS AND DISCUSSION

When comparision between three longitudinal pieces, two pieces cuttings exhibited significantly (ANOVA, $P<0.01$) higher (97.5%) survival under control conditions followed by three pieces (90%) and four pieces (22.5%) cuttings [Table 1]. Other then this, two piece cuttings also had the maximum survival percentage under T_2 to T_7. Two and three pieces IBA-treated cuttings showed better results than IAA treatments and enhanced the emergence percentage.

Among the seven treatments, both two and three piece cuttings recorded significantly higher survival percentage under controlled conditions (T_1). While two piece cuttings recorded least survival percentage under T_6 (70.0%) treatment, three piece cutting recorded least survival under T_7 (55.0 %) treatments. Four piece cutting showed lowest under T_7 (12.5%) treatment [Table 1].

Chopra[18] observed that the plants at higher altitudes of Himalayas are generally propagated by rhizomes and seeds. Tomar and Srivastava[19] reported that two to three rhizomes bulge with leaves gives better result in *Cyrtomium caryotideum*. Similarly, Badhwar and Sharma[20] found that larger the rhizome or clump taken, the better the chances of a successful division in *Podophyllum hexandrum*.

Thus, it can be convincingly stated that the propagation of *G. kurroo* can be successfully done by splitting a rhizome into two pieces. Due to its beautiful flower and peculiar appearance it can be multiplied for botanical as well as ornamental purposes, which can be a good choice for containers, rock gardens or to cover rocky patches. Moreover, its medicinal value needs much more study to find out its commercial exploitation by local people. Considering the medicinal value of this species, *in situ* as well as *ex situ* conservation is needed at this juncture.

Table 1: Propagation through rhizome cuttings of *Gentiana kurroo*

Treatments	Survival (%)		
	2 piece	3 piece	4 piece
T_1 Control	$97.5^{a,a}$ (0.50)	$90.0^{a,b}$ (0.82)	$22.5^{c,c}$ (0.50)
T_2 IBA 100 ppm	$80.0^{c,a}$ (0.82)	$75.0^{b,a}$ (1.00)	$35.0^{b,b}$ (0.48)
T_3 IBA 200 ppm	$85.0^{b,a}$ (0.58)	$70.0^{c,b}$ (0.82)	$45.0^{a,c}$ (0.52)
T_4 IBA 300 ppm	$80.0^{c,a}$ (0.82)	$75.0^{b,b}$ (0.58)	$35.0^{b,c}$ (0.58)
T_5 IAA 100 ppm	$77.5^{c,a}$ (0.50)	$62.5^{d,b}$ (0.50)	$32.5^{b,c}$ (0.50)
T_6 IAA 200 ppm	$70.0^{d,a}$ (0.82)	$57.5^{e,b}$ (0.96)	$35.0^{b,c}$ (0.43)
T_7 IAA 300 ppm	$72.5^{d,a}$ (0.50)	$55.0^{e,b}$ (1.00)	$12.5^{d,c}$ (0.50)

IBA - Indole -3 butyric acid; IAA - Indole -3 acetic acid; The values refer to mean and S.D. (n=25×4). Mean followed by the different superscripted letter are significantly different at $P<0.01$ (Fisher's LSD). First letter (a,b,c,d,e (top to bottom)) represents variation among treatments (T_1-T_7) and second letter (a,b,c (left to right)) represents variation between rhizome cuttings (2,3 and 4 pieces).

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