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Morphological, phenological and seed germination studies in *Rheum australe* D Don: An endangered medicinal plant

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Abstract
The experiment on *Rheum australe* an endangered medicinal plant was conducted at Dr. Y.S. Parmar U.H.F, Nauni, Solan Himachal Pradesh. The present study was conducted to determine the seed germination behavior of *Rheum australe* an endangered medicinal plant of high altitude Himalayas under different field conditions *viz.* open, glass house and shade net house and different time of sowings at lower altitude of 1250 m of mid hill conditions of Himachal Pradesh. Seeds were harvested during October month from different natural ecological zones of Himachal Pradesh. Seed germinability was tested in the mixture of soil+ sand+ vermicompost+ cocopeat (2:1:1:1). The results showed that maximum seed germination (83.00 per cent) was recorded under shade net house conditions in soil +sand+ vermicompost+ cocopeat (2:1:1:1) media, when the seeds were sown during November month. Morphological and phenological studies were conducted both in natural habitat and under laboratory conditions. Qualitative and quantitative data was recorded for plant habit, root, stem and leaf, floral characteristics, flowering duration and fruit and seed type.

Keywords: Endangered, seed germinability, medicinal plants, phenology

Introduction
The demand for medicinal plants has increased globally due to the resurgence of interest in and acceptance of herbal medicine. Most of the demand is being met through collection of large quantity of medicinal plants and plant part from wild populations. The methods of extraction employed are almost invariably crude and unsystematic. As a consequence, the rates of exploitation may exceed those of local natural regeneration. Also the natural habitat are fast depleting. The Indian Himalayan region is a rich reservoir of biological diversity. This region have many high value medicinal herbs, has a rich local tribal tradition of herbal medicine.
Rheum australe is a high altitude endangered medicinal plant commonly known as Revandchini belongs to family Polygonaceae. The root of the plant contains number of anthraquinones derivatives based on emodin, emodin3- monoethylether, chrysophanol and rhein. Roots are purgative, astringent, tonic, stomachic and aperients. The petioles are pickled; powdered roots are used for cleaning the teeth and sprinkled over ulcers for quick healing. (Anonymous. 1972; Chopra 1958; Nautiyal *et al.* 2003) [1, 3]. It is of special use for infant's stomach problems. It has been found as potent anti-inflammatory drug (Nautiyal and Nautiyal 2004; Chauhan 1999) [4]. Due to these properties, the species has excessive demand, which leads to illegal exploitation from natural habitat, resulting in habitat destruction. There is an urgent need to develop and implement regeneration/conservation strategies for exploited medicinal plant species. A simultaneous development of easy to employ means of ex-situ propagation of the species concerned would encourage its cultivation, there by considerably easing the pressure on natural habitats. The common means of regeneration and propagation of medicinal plants include seed based, clonal and micro-propagation methods. Seed based multiplication is the most effective, and convenient method of propagation and has been employed here.

Materials and Methods
The experiment on *Rheum australe* was conducted at experimental farm, Nauni, Solan, Himachal Pradesh having altitude of 1250 m, Morphologial and phenological studies were conducted both in natural habitat and under laboratory conditions. Climate of the experimental area is hot during summer with maximum temperature sometimes rising up to 36 ^{0} C. On the other hand winters are cold (with minimum temperature touching zero) accompanied by frost for few weeks. The area gets on an average1000-1300 mm rainfall and most of the rainfall is received during monsoon and spring season. Soil analysis was done for the site soil.

Table 1: Soil analysis of the experimental area at Nauni

Sr. No.	Soil analysis parameter	Test value
1.	pH	6.55
2.	Organic carbon (%)	0.60
3.	Available nitrogen (kg/ha)	213
4.	Available phosphorus (kg/ha)	17
5.	Available potash (kg/ha)	235

The soil of the experimental area at Nauni was found to be neutral, medium in organic carbon, available phosphorus and potash and low in available nitrogen.

The experiment was conducted to compare the effect of different field conditions i.e. open, glass house and shade net house and nine treatments of time of sowing varied from November to July. Seed germinability was tested in the mixture of soil+ sand+ vermicompost+ cocopeat (2:1:1:1).The experiment was conducted for two consecutive years with three replications.

For conducting morphological and phenological studies qualitative and quantitative data was recorded on following parameters:

Plant Habit

The plant habit of *Rheum australe* was studied by observing the general growth features such as height, number of leaves per plant and flowering duration etc. The plant height was measured from base to the top of longest shoot. The data was recorded in centimeters and reported as mean. The flowering period was determined by recording the date of first and last flower opening.

Root, stem and leaf

The length of root was measured from the point of emergence to the terminal point of the longest root. The observations were recorded in centimeters and have been reported as mean. The length of stem was determined as the length of the longest flowering shoot and has been recorded as mean. Leaves were studied for their qualitative and quantitative characters *viz*. leaf length and width in centimeters and recorded as mean.

Floral characteristics

The studies were undertaken on qualitative and quantitative characters like number of flowers, colour of flowers and duration of flowering. The floral studies were made at full bloom stage.

Flowering duration

The flowering duration was determined by recording the date of first flower formation to the last flower opening.

Fruit and seed type

The type and dimension of fruit and seeds were determined at mature stage.

Seed weight

The weight of 1000 seeds was recorded and taken as mean.

Results and Discussion

The experiment was conducted under different field conditions i.e., Glass house, shade net house and open conditions.

Germination percentage

Data presented in table 2 revealed that among different time of seed sowing maximum mean germination percentage (63.91) was observed in T_1 which was followed by T_2 (61.15) and it was statistically superior to all other treatments. Minimum mean germination percentage (6.25) was observed in T9. Among different field conditions maximum mean germination percentage was recorded in shade net house (51.99) followed by glass house (37.50) and minimum was recorded in open conditions (24.74) and treatment F_3 was found statistically superior to all other treatments. However among interaction effect between field conditions and time of sowing, maximum germination percentage was observed in treatment combination T_1F_3 (83.32) which was followed by T_2F_3 (81.28) and minimum germination percentage was recorded in T_9F_1 (3.40). Treatment combination T_1F_3 was significantly superior to all other treatments.

Table 2: Effect of field conditions and time of sowing on germination percentage

Field conditions Time of sowing	Open conditions (F_1)	Glass house (F_2)	Shade net house (F_3)	Mean
November T_1	45.10 (42.17)	63.30 (52.69)	83.32 (65.86)	63.91 (53.57)
December T_2	40.82 (39.69)	61.34 (51.53)	81.29 (64.3)	61.15 (51.86)
January T_3	13.38 (21.44)	27.22 (31.43)	32.18 (34.55)	24.26 (29.14)
February T_4	19.28 (26.03)	33.41 (35.30)	46.19 (42.79)	32.96 (34.71)
March T_5	38.40 (38.27)	52.11 (46.19)	79.39 (62.79)	56.63 (49.14)
April T_6	35.1 (36.35)	47.38 (43.48)	75.46 (60.28)	52.67 (46.70)
May T_7	18.45 (25.43)	32.29 (34.61)	43.50 (41.25)	31.41 (33.76)
June T_8	8.69 (17.13)	13.37 (21.44)	18.24 (25.27)	13.43 (21.28)
July T_9	3.40 (10.60)	7.05 (15.39)	8.32 (16.75)	6.25 (14.25)
Mean	24.74 (28.57)	37.50 (36.90)	51.99 (46.01)	
	CD $_{0.05}$	SE±		
Field conditions	0.18	0.09		
Time of sowing (S)	0.32	0.15		
Field conditions x Time of sowing	0.55	0.27		

*Values within parenthesis are arcsine transformed values.

Morphological and Phenological studies

Habit: *Rheum australe* is a robust perennial herb with thick, long roots and was growing on rocky lands. Roots were stout and the stem was hollow. Flowering occured during May-June and fruiting in the month of October-November.

Root

Thick, long, very stout roots were observed. The length of roots ranged from 14-30.50 cm (with an average of 24.50 cm ±1.74).The rhizome surface was dark brown in colour.

Stem
Stem was tall, leafy, hollow, green to brownish in colour. The length of the stem ranged from 90 -135 cm (with an average of 123.20 ±2.36cm).

Leaves
The radical leaves are long petioled, very large orbicular or broadly ovate. Length ranges from 22-35cm with an average of 30.20 ±1.70 cm and width 15.20-26.0 cm with an average of 19.90 ±0.86cm.

Flowers
Flowers were actinomorphic, hermaphrodite, small, dark purple in tall axillary panicles. Flower with six perianth segment free, white coloured having average perianth length 2.11mm ± 0.0032 and width 1.03 mm ± 0.0051, androecium; 9 anthers, bilobed, dorsifixed, yellow coloured with average anther length 0.66 mm ± 0.0068 and width 0.63 mm ± 0.0081 and filament length 0.57 mm ± 0.0039 and width 0.19 mm ± 0.0025. Gynoecium; Tricarpellary, hypogynous, syncarpous, three style bearing capitate stigma, ovary three angled, one ovule in basal placentation, length of ovary 0.53 mm ± 0.0049, length of stigma 0.44 mm ± 0.0062, width 0.39 mm ± 0.0036. Flowering started from 3rd week of May to last week of June.

Fruit and seed
Fruit nutlet type, purple with narrow wings, rounded heart shaped base and angled. Seeds dark brown in colour, Average weight of 1000 seeds were observed as 14.67g ± 0.0036. Fruiting occurred from last week of August to last week of September. The qualitative and quantitative morphological and floral features /parameters are given in tables 3 and 4.

Table 3: Qualitative morphological features of *Rheum australe* D. Don

Plant Part	Character
Habit	Perennial stout herb.
Root	Thick, long, very stout
Stem	Tall, leafy, hollow, green to brownish.
Leaves	Radical leaves long petioled, very large, orbicular or broadly ovate.
Flower	Actinomorphic, hermaphrodite, small, dark purple or pale red in tall axillary panicles.
Flowering duration	May - June.
Perianth	Six perianth segments free, white coloured.
Androecium	Anthers nine, bilobed, dorsifixed, yellow coloured.
Gynoecium	Tricarpellary, syncarpous, hypogynous, three style bearing capitate stigma, ovary three angled, one ovule in basal placentation.
Fruit and seed type	Fruit nutlet, purple with narrow wings, rounded heart shaped base and angled.
Seed	Dark brown

Table 4: Quantitative morphological features of *Rheum australe* D. Don

Sr. No.	Parameter	Dimension / Number /Range
1.	Plant height	123.2 cm ± 2.36 (90-135 cm)
2.	Root /Rhizome Length	24.50 cm ± 1.74 (14-30.50 cm)
3.	Leaves Length width	30.20 cm ± 1.70 (22-35 cm) 19.90 cm ± 0.86 (15.20 -26.0 cm)
4.	Perianth Number Length Width	6 2.11mm ± 0.0032 1.03mm ± 0.0051
5.	Androecium Number of anthers Anther size Length width filament length width	9 0.66mm ± 0.0068 0.63mm ± 0.0081 0.57mm ± 0.0039 0.19mm ± 0.0025
6.	Gynoecium Number of carpel Length of ovary Length of stigma Width of stigma	3 0.53mm ± 0.0049 0.44mm ± 0.0062 0.39mm ± 0.0036
7.	Fruit Length Width	0.7cm ± 0.041 0.4cm ± 0.048
8.	Seed 1000 seed weight	14.67g ± 0.0036

Discussion
Conditions needed for seed germination of a particular species are the results of interaction between its genetic makeup and environmental complex. The environmental conditions include availability of water, optimum temperature, season and light intensity. Collectively such environmental

conditions determine the time of sowing and success of germination percentage, but also determine the growth cycle of species.

During the present studies among different time of seed sowing maximum mean germination percentage (63.91) was observed during November month which was followed by sowing during December (61.15). However among interaction effect between field conditions and time of sowing, maximum germination percentage (83.32) was observed when seeds were sown during November month under shade net house.

The higher values may be due to the fact that controlled conditions are provided in shade net house condition. The effect of moisture and optimum light intensity which facilitates the seeds to germinate and grow early. Also seed viability is more during November month as seeds were harvested in October which decreased gradually with sowing during December up to July. These findings are in line with those of Nautiyal and Chauhan (2007) [6] in *Nardostachys jatamansi* where they have reported poor seed germination under field conditions compared to that under controlled conditions. Similar results were also reported by Nautiyal *et al*. (2001) [7] in *Picrorhiza kurrooa* and Vashishta *et al*. (2007) [8] in *Angelica archangelica*.

During the present study thick long very stout roots were observed. The length of roots ranged from 14-30.5cm (with an average of 24.5cm ±1.74).The rhizome surface was dark brown in colour. Stem is tall, leafy, hollow, green to brownish in colour. The length of the stem ranged from 90 -135 cm (with an average of 123.20 ±2.36cm).Stem is tall, leafy, hollow, green to brownish in colour. The length of the stem ranged from 90 -135 cm (with an average of 123.20 ±2.36cm). Flowers actinomorphic, hermaphrodite, small, dark purple or pale red in tall axillary panicles. Flower with six perianth segment free white coloured having average perianth length 2.11mm ±0.0032 and width 1.03mm ±0.0051, Androecium; 9 anthers, bilobed, dorsifixed, yellow coloured with average anther length 0.66 mm ±0.0068 and width 0.63mm ±0.0081 and filament length 0.57mm ±0.0039 and width 0.19mm ±0.0025. Gynoecium; Tricarpellary, hypogynous, syncarpous, three style bearing capitate stigma, ovary three angled, one ovule in basal placentation, length of ovary 0.53mm ±0.0049,length of stigma 0.44mm ±0.0062, width 0.39mm ±0.0036.Flowering started from 3rd week of May to last week of June. Fruit nutlet type purple and angled. Seeds dark brown in colour, Average weight of 1000 seeds were observed as 14.67g.

References

1. Anonymous. Wealth of India: (Raw Material) CSIR Publication, New Delhi. 1972; 9:3-4.
2. Chauhan NS. Medicinal and Aromatic Plants of Himachal Pradesh, Indus Publishing Company, New Delhi, 1999.
3. Chopra RN. Indigenous drugs of India. Dhar and Sons, Pvt. Ltd. Calcutta Nautiyal BP, Prakash V, Maithani UC, Chauhan RS, Purohit H, Nautiyal MC, 2003, 158.
4. Germinability, productivity and economic viability of *Rheum emodi* Wall. ex Meissn. cultivated at lower altitude. Current Science. 1958; 84(2):143-148.
5. Nautiyal MC, Nautiyal BP. Agrotechnique for High Altitude Medicinal and Aromatic plants. Bishen Singh and Mahender Pal Singh, Dehradun, 2004, 158-161.
6. Nautiyal BP, Prakash V, Chauhan RS, Purohit H, Nautiyal MC. Assessment of germinability, productivity and cost benefit analysis of *Picrorhiza kurrooa* cultivated at lower altitudes. Current Science. 2001; 81(5):579-585.
7. Nautiyal MC, Chauhan RS. Seed germination and seed storage behaviour of *Nardostachys jatamansi* D C, an endangered medicinal herb of high-altitude Himalaya. Current Science. 2007; 92(11):1620-1624.
8. Vashistha RK, Nautiyal BP, Nautiyal M C. Economic viability of cultivation of the Himalayan herb Angelica glauca Edgew at two different agro climatic zones. Current science. 2007; 93(8):1141-1145.