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SHORT COMMUNICATION

SEED GERMINATION STUDIES ON *SAUSSUREA COSTUS* (FALC.) LIPSCH – A THREATENED MEDICINAL PLANT OF N.W. HIMALAYA

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Germinability and seedling survival studies of the *Saussurea costus* (Asteraceae) were carried out under *ex situ* conditions at 1495m. Among various treatments given to the seeds to enhance germinability, scarification/complete removal of the seed coat were found to be most effective and showed 90.0 ± 4.08% germination against the control of 21.66 ± 2.35%. This was primarily due to the presence of inhibitors in the seed coat. Treatment with GA_3 20, 50, and 100ppm showed the percentage germination 41.66 ± 6.23, 70.0 ± 12.24 and 70.0 ± 16.32% respectively and that with kinetin 20, 50 and 100ppm showed 31.66 ± 6.23, 60.0 ± 4.08 and 40.0 ± 4.08% germination respectively as against the control of 21.66 ± 2.35%.

Key words: **Alpine medicinal plant, *Saussurea*, seed germination.**

Saussurea costus (Falc.) Lipsch. propagates by both vegetative and sexual means. The vegetative propagation is through the development of underground rhizome, while the sexual reproduction occurs through the production of seeds. As and when the seeds disperse from the capitula, they germinate immediately on a suitable habitat from the last week of September to first week of October. The seedlings, however, fall prey to the unfavourable climatic conditions at the alpine and sub-alpine regions and the young seedlings die due to winter frost in November when they are only at "first leaf" stage. Such a habitat condition along with extraction and uncontrolled exploitation of the crude drug in the form of rhizomes are responsible for the critically endangered status of the species.

Seed reproduction includes seed development, seed dispersal and seedling establishment. These three aspects constitute an important phase between the parent and the offspring generation. Any deviation from the normal mode of the seed reproduction results in its failure. If the adverse conditions continue for a period of time, the species survival will be threatened and ultimately become extinct. *Saussurea costus* is also facing the above conditions wherein the seedlings of the species neither can resist the unfavourable climatic conditions nor the extraction and exploitation of the rhizomatous portion by illegal plant collectors. Plants and populations escaping collection by collectors and exploiters fall a victim to grazing animals. All these factors have brought the species to the brink of extinction and is categorized as critically endangered (CE) (Anonymous 1997). The species decline, in addition to the economic fallout also has a bearing on other functional aspects of the ecosystem in particular and environment in general (Wafai and Nawchoo 2001).

Saussurea costus (Falc.) Lipsch. belongs to family Asteraceae and is commonly known as "*Kuth*"(Singh and Kachroo 1976). It is distributed in N.W. Himalayas from Kashmir to Kumaon (Dhar and Kachroo 1983). The roots of the plant are used as an insect repellant, smoked as the substitute for opium and is also used in treatment of cough, asthma and joint pains (Kaul

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1997,Dar *et. al.* 1984). Because of the economic potential of the herb, there is a need to conserve and protect it from becoming extinct. Being an alpine herb (2500-3200m), the *in situ* conservation of the species is cost prohibitive and impossible (Wafai and Nawchoo 2001). Therefore, the only other way left is *ex situ* conservation, which can be achieved through seed banks, domestication, botanical gardens, tissue culture etc.

Saussurea costus is a root perennial which reproduces vegetatively as well as sexually through seeds. It was generally observed that by the end of each growing season the underground rhizome produces the vegetative buds, which remain dormant during the winter. In the next growing season these buds develop into leafy shoots. The single rhizome produces 3-7 vegetative buds, which mostly form the leafy shoots, with only one or two entering reproductive phase after one year. Usually, of the several vegetative shoots developing from a rhizome, only one enters sexual phase and bears flowers. Vegetative means of propagation is the principle and predominant mode of propagation of the species. The seeds generally are dispersed in the vicinity of the mother plant due to the lack of adequate dispersal mechanisms and the larger size. As and when the seeds fall on the suitable substrate they germinate without exhibiting any dormancy and the seedlings reach upto the first leaf stage. However, the sub-zero temperature at higher altitudes during October-November makes seedling survival impossible. Only the seeds that escape immediate germination till the following spring actually contribute to the new recruitment.

The present study was carried out with the objective of developing a protocol for seed based cultivation of the species at low and easily approachable altitudes. This will help in conservation and multiplication of this endangered taxon and in making its mass multiplication possible.

Mature seeds of *Saussurea costus* of the same age (seed cohort) were collected from a selected natural population at Khillanmarg (2590m), Kashmir Himalaya. The seeds were treated with 0.1% Mercuric Chloride for 5 – 7 minutes and then with 70% ethanol for 1 minute and afterwards washed thoroughly with distilled water. The treatments given to these seeds include:

a) GA_3 20ppm., b) GA_3 50ppm.

c) GA_3 100ppm., d) Kinetin 20ppm.

e) Kinetin 50ppm., f) Kinetin 100ppm.

g) Conc. H_2SO_4 treatment.

h) Scarification.

For each treatment there were three replicates kept in light and in dark, each with a set of control, to compare germination efficiency. Percentage germination was calculated.

The present study conducted on seed germination revealed that the seeds did not germinate in darkness and there is a need of light energy which points to photoblastic nature of the seeds. Similar results were reported earlier by Ganai and Nawchoo, (2002) on *Arnebia benthamii* - highly endangered N.W.Himalayan herb restricted to similar extremely specific ecological habitats as those endured by *Saussurea costus.*

Freshly collected seeds germinate but the percentage of germination is low. Scarification results in 90% germination as against the control (21.66% germination) where the seed coat was not removed. Prasad (1999) obtained almost similar results in the seeds of the *Podophyllum hexandrum* enhancing germination to 70% as against 30% in the control and Ganai and Nawchoo (2002) on the seeds of *Arnebia benthamii* enhancing the germination to 90% as against 25-30% in the control.

From these observations, it becomes evident that there are some inhibitors present in the seed coat which impair the germination process as argued and experimentally demonstrated earlier by Ganai and Nawchoo (2002).

Besides scarification, GA_3 (100ppm) treatment resulted in 70% germination as also reported by Prasad (1999) in *Podophyllum hexandrum*. Similarly kinetin (100ppm) treatment resulted in 40% and kinetin (50ppm) treatment resulted in 60% germination. The sulphuric acid treatment enhanced the seed germination up to 33% as against 21.66% in the control. The seedlings thus raised

Table 1. Effect of different treatments on seed germination of *Saussurea costus*

Treatment	No. of seeds germinated in light under room conditions	No. of days taken for first seed to germinate	Total no. of days taken for completion of germination	Percentage germination
Control	4.33 ± 0.45	5.33±0.45	14.66±0.46	21.66±2.35
Scarification	18.0±0.81	1.33±0.46	3.33±0.45	90.0±4.08
GA_3-20ppm	8.33±1.24	2.33±0.47	12.33±0.46	41.66±6.23
GA_3-50ppm	14.0±2.44	3.0±1.41	11.0±1.41	70.0±12.24
GA_3-100ppm	14.0±2.30	9.33±0.94	13.33±0.94	70.0±16.32
Kinetin-20ppm	6.33±1.24	9.33±1.24	16.33±1.24	31.66±6.23
Kinetin-50ppm	12.0±0.81	1.33±1.59	12.0±0.81	60.0±4.08
Kinetin – 100ppm	8.0±0.81	9.0±0.81	16.0±0.81	40.0±4.08
Conc. H_2SO_4 dip. for 10 sec.	6.66±1.69	4.0±1.63	18.0±1.63	33.3±8.49

Number of seeds taken for each treatment is 20; Under dark conditions seeds do not germinate.

show little or no mortality on nutrient rich soils and exhibit satisfactory plant recruitment quite similar to that reported in *Arnebia benthamii* by Ganai and Nawchoo, (2002).

From the observation it is clear that the proper management and the maintenance of the bioresources will help in developing conservation strategies. The basic requirements are to collect the vegetative as well as sexual propagules at proper stage, store them properly and start propagation protocol at specific time and under specific conditions. The studies also reveal that protection of natural habitats (*in situ* conservation) will preserve and conserve the bio-resources especially economically important plants in general and medicinal plants in particular.

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