

*Project Title*

**Studies on the phenology of Pteridophytes common along the altitudinal and temperature gradient**

**(Final Technical Report)**

**Seed Grant RUSA 2.0**

**Submitted by**

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## Introduction:

Phenology is the time of development events in the life cycle of a plant species and temperature plays an important role in these events. It is observed that climatic variables particularly air temperature and relative humidity varies between altitudes and altitudes. Therefore, a comparison of the phenological events of a species in a unit time at two different altitudes and latitudes can determine the effect of temperature on the phenology of the plant species. Moreover, the behaviour of the plant species in the process of climate change can be assessed by taking the regular observations on the phenology of the species. It is understood that climate warming is disrupting natural phenological patterns in the species. The significance of these disruptions on population dynamics and inter-specific interactions are poorly understood in Himalayan Plants. Number of species are already conducted on the phenological events of plant species with response to current temperature. But the future predictions of the phenological events on the changing temperature regime is still a challenge.

During the present course of work pteridophytes growing on different altitudes were documents and the common among them were identified for further observations. Advantage of taking pteridophytes as the model organism are (a) absence of flowers, fruits and seeds, (ii) devoid of herbivory and (iii) non-deciduous nature. Four different sites at different altitudes and different mountain aspects along the Jammu Srinagar NH were identified and the species were regularly observed. The climatic conditions were related with the altitude and mountain aspect. The soil samples from also collected and worked out for physico-chemical parameters. The most significant edaphic parameters were identified with the help of a statistical tool Principal Component Analysis.

Although now a days predictive ecological nice modelling is an option for working on the future potential of the species and their habitat in the changing climate but while working on a small temporal scale the traditional visual observations are more beneficial.

## Study sites

Name of side	Geo-cordinates	Altitude	Aspect
Manthal	32 <sup>0</sup> 57'20'' -74 <sup>0</sup> 58'20''	770 meters amsl	Zero
Samroli	32 <sup>0</sup> 59'52'' -75 <sup>0</sup> 12'03''	822 meters amsl	Southern
Kud	33 <sup>0</sup> 02'57'' -75 <sup>0</sup> 17'38''	1536 meters amsl	Southern
Patnitop	33 <sup>0</sup> 05'31'' -75 <sup>0</sup> 19'41''	1930 meters amsl	Northern

### **Description of the sites:**

Manthal is a site on the Jammu-Srinagar NH about 40 km from Jammu. Characterized with Chir Pine forest, the study site was along a river-let in the shady area.

Samroli is also on the Jammu-Srinagar NH about 70 km from Jammu. Characterized with sub-tropical scrub forests, the study site was in an exposed area.

Kud is also on the Jammu-Srinagar NH about 100 km from Jammu. Characterized Chir Pine forest, the study site was in an exposed area.

Kud is also on the Jammu-Srinagar NH about 110 km from Jammu. Characterized Deodar forest, the study site was in an shady area.

### **Species subjected for long term observation**

1. *Adiantum incisum*
2. *Asplenium dalhousiae*



*Adiantum incisum*



*Asplenium dalhousiae*

### **Observations and discussion:**

Vegetation studies: A total of 05 pteridophytes (*Adiantum capillus-veneris*, *Adiantum incisum*, *Adiantum venustum*, *Asplenium dalhousiae* and *Equisetum arvense* ) were observed at all the 04 sites along the altitudinal gradient. Out of these 05 pteridophytes only 02 (*Adiantum incisum* and *Asplenium dalhousiae*) were common to all the 04 sites. Through detailed phenological observations taken in the study period revealed that:

1. The vegetative and reproductive period for both the pteridophytes operate in similar way at the extreme sites (i.e. 770 m and 1930).
2. Variation in the vegetative and reproductive phases of the life history of both the species is different on other two sites (i.e. 822m and 1536m).

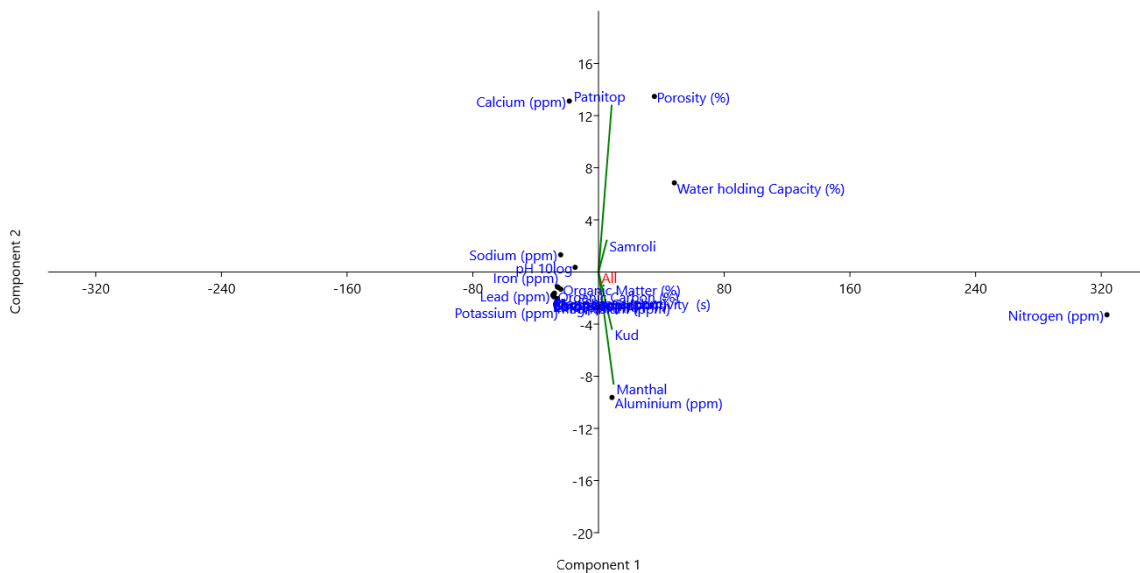
3. Plant individuals available at 770m and 1930m possesses well developed sori on both the species during winter. And in many cases immature sori along with the mature sori were observed in winter months, whereas the sori during summers were mature one.
4. Individual at 822 and 1536m possesses well developed sori during summer months indicating that high atmospheric temperature coupled with southern aspect effects are responsible for sori development in both the species, whereas during winters the dehisced sori were observed on both the species.



*Soil analysis:* Soil samples collected from all the sites were analysed for some physico-chemical analysis (Table-1):

<b>Parameters</b>	<b>Manthal</b>	<b>Samroli</b>	<b>Kud</b>	<b>Patnitop</b>
pH $10^{\log}$	6.9	6.8	6.5	8.3
Water holding Capacity (%)	44	34	32	45
Porosity (%)	31	25	28	45
Electrical Conductivity (s)	0.11	0.2	0.12	0.2
Organic Carbon (%)	1.1	1.7	2.1	1.9
Organic Matter (%)	2.6	2.3	2.3	2.7
Sodium (ppm)	1.986	1.011	0.91	5.4
Potassium (ppm)	1.597	1.5	0.15	0.01
Phosphorus (ppm)	0.023	0.013	0.23	0.2
Nitrogen (ppm)	208.4	112.2	188.1	181.2
Calcium (ppm)	0.198	0.901	0.201	18.91
Aluminium (ppm)	32.703	12.73	12.81	14.01
Magnesium (ppm)	2.197	1.17	0.72	1.198
Iron (ppm)	1.467	1.01	0.91	1.94
Zinc (ppm)	0.293	0.12	0.223	0.122
Copper (ppm)	0.016	0.076	0.022	0.012
Manganese (ppm)	0.715	0.015	0.0217	0.7

Boron (ppm)	0.025	0.015	0.005	0.011
Chromium (ppm)	0.0236	0.066	0.006	0.021
Lead (ppm)	0.0158	0.0102	0.010	0.01



Biplot of Principal Component Analysis

It is understood from the observation no. 1 that altitudinal variation is not a significant deciding factor for vegetative and reproductive phases of the species. However other factors need to be investigated. While studying another factor i.e. mountain aspect reveals that sun exposure period can be one of the significant factor for deciding the vegetative and reproductive phases in the life history of both the species. Mountain aspect has a direct relation with the moisture contents of the soil. Therefore, study reveals that southern aspect of the mountain play a significant role in setting the vegetative and reproductive phases in both the species. Principal Component Analysis reveals that Porosity and Water Holding Capacity are the two significant parameters at Samroli and Patnitop whereas nitrogen and aluminium are the two important parameters at Kud and Manthal. These parameters may have direct role in setting the phenological events in the two species.

**DEPARTMENT OF BOTANY**  
**University of Jammu, Jammu**

Utilization certificate

**Title of the Project:** Studies on the phenology of pteridophytes common along the altitudinal and temperature gradient

**Name of the faculty:** Harish Chander

**Department:** Botany

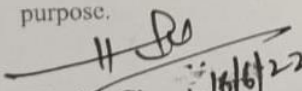
**Grant allocated:** 1.00 lakh (SEED GRANT RUSA 2.0)

**Reference no:** RUSAJU/2/2019-20/36/3428-3499 dated 05.11.2019

**Statement of expenditure**

S. No.	Items	Sanctioned Amount	Expenditure Incurred	Balance
1	Consumables	40,000/-	39,978/-	22/-
2	Travel	40,000/-	40,000/-	NIL
3	Contingency	20,000/-	16,277/-	3,723/-
Total		1,00,000/-	96,255/-	3,745/-

Certified that a total of Rs. 96,255/- (Ninety six thousand two hundred fifty five only) out of total sanctioned seed grant of Rs. 1,00,000/- (One Lakh only) has been utilized for the purpose.

  
(Harish Chander) 16/6/22

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