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Ecology of *Ranunculus laetus*

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With 2 Figures

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1. Introduction

The present communication on the ecology of *Ranunculus laetus* is a further contribution to the series of investigations carried out by the author (AHMED 1968) on various species of genus *Ranunculus* growing in Kashmir.

Ranunculus laetus WALL. is a species of Himalayan origin. It is an erect, perennial herb which usually grows to a height of 25—115 cm. The species covers extensive areas and forms pure stands. The stem is covered with long whitish hairs and is usually much branched. The root system penetrates to a maximum depth of 7.3—16.2 cm and has a lateral spread of 6.7—19.3 cm. The stem leaves are smaller and sessile. The radical leaves being 6—12 cm in diameter, deeply three lobed and long stalked. Flowers are bright yellow, long stalked and 2.0 cm. in diameter. The plants start vegetative growth in March immediately after the snow melts. The vegetative growth being quite vigorous. In May the flowering starts and the plant dies down in August. In the following autumn some seeds do germinate but seedlings fail to get established because of the low temperature prevailing

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during that period. The plant is distributed in Afghanistan, Temperate Himalayas, Western Tibet and inner ranges of Sikkim (HOOKER 1872). In Jammu and Kashmir State the plant grows in and around Kishtawar, Hirpur, Sannasar, Patni top, Islam-abad, Baramullah, Sopore, Badgam and Srinagar. It ascends up to an altitude of 2200 m. In Srinagar it grows gregariously round Nursing Home, Burn Hall, Chashmashahi and Harwan. Ocassional plants were also observed to grow at Nishat, Shalimar and Naseem gardens and in some meadows in the vicinity of Chatabal.

2. Methods and Procedures

Germination studies were carried out in well sterilized dishes over moist cotton under controlled conditions with and without treatment. The replicates of 50 seeds were used in each case. The frequency of the species in different stands was determined by random sampling. The performance of the plant at various sites was estimated by taking a mean value of 50 observations for fresh weight of the shoot and height of the plant respectively. The mineral requirements of the plant were assessed by analysing the soil samples (PIPER 1944) obtained from the rooting region (12 cm depth). Moisture content, expressed as a percentage of the dry weight of the soil and pH, using Photovolt Beckmann pH meter, were determined with fresh soil samples.

3. Results and their interpretation

3.1. Seed and its Germination

3.1.1. Size, shape and weight: The fruit is a globose head of many smooth and flattened achenes, weighing 0.059 mgs. Length of the achene varies from 0.2 to 0.3 cm. The breadth varies from 0.05 cm to 0.2 cm. A single achene weighs about 0.001 mgs.

3.1.2. Seed output: Average seed output as calculated in various localities is 2515 per plant (Maximum 3987, Minimum 817).

3.1.3. Germination: Seeds when ripe enough were harvested from the field in August 1966. These were not able to germinate successfully whereas, those kept for germination on 1-10-1966 gave 43% germination. Hence it could be suggested that the seeds have an initial period of dormancy which lasts for about one month and is completed by storing them dry. These seeds, when subjected to treatments with concentrated H_2SO_4, hot water, pea seedling extract and burrial under mud behaved differently in their germination.

3.1.3.1. Treatment with conc. H_2SO_4: The percentage germination increases with the increase in duration of treatment. The maximum, i. e. 68%, was obtained at one minute duration beyond which there is a decrease in germination percentage (Fig. 1).

3.1.3.2. Treatment with hot water: The seeds treated with hot water at 75° C for various durations showed an increase in the germination %. The % was highest i. e. 60% in case of seeds treated for 15 minutes whereafter there is an abrupt fall in the germination percentage (Fig. 1).

3.1.3.3. Treatment with pea seedling extract: It has been seen that the extract obtained from pea seedlings activates germination due to the presence of active materials like purines, adenine and hypoxanthine (cf. KAUL 1965). The seeds after treatment with this extract in the present investigation resulted in 72% germination.

3.1.3.4. Treatment with mud: The seeds burried under mud for 8, 15 and 30 days respectively; when taken out and placed for germination, showed that the percentage germination was highest i. e. 58% in seeds

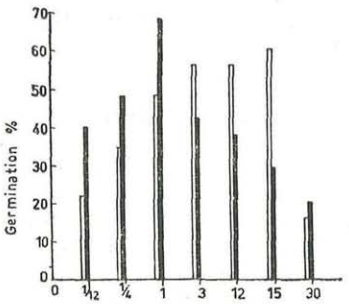

Fig.1:- Effect of conc. H_2SO_4 (═) and hot water(▭)on the germination of Ranunculus laetus.

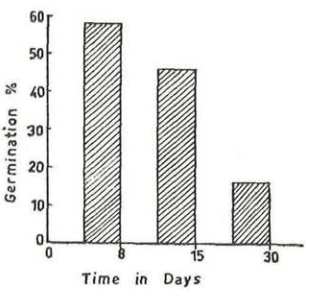

Fig.2:- Effect of burrial under mud on the germination of Ranunculus laetus

kept for 8 days under mud whereas, those kept for 30 days resulted in the least percentage germination i. e. 16%. The majority of seeds in latter case had decayed, probably due to the fungal attacks (Fig. 2).

3.1.3.5. Effect of light: Seeds were put for germination on 1-10-1966 in continuous light under a 60 Watt electric bulb, in continuous darkness in a dark room and in diffused light by the side of a window. The seeds exposed to continuous light resulted in 85%, those in continuous dark showed 2% and the set placed in diffused light showed 48% germination.

3.2. Reproductive capacity

According to SALISBURY 1942 reproductive capacity is a characteristic feature of great ecological significance. He defined it as the product of the average seed output and the fraction represented by the average % germination. It can be formulated as:

$$\frac{\text{Seed output} \times \%\ \text{Germination}}{100} = \text{Reproductive capacity.}$$

In case of *Ranunculus laetus* it works out to be 1082. A comparison of seed output, % germination and reproductive capacity of some species is given in table I.

According to the data presented in table I it is seen that the species shows high reproductive capacity.

3.3. Dispersal

The fruits of *Ranunculus laetus* being heavy are not effectively dispersed by wind, but fall near their own abode. The animals also do not help in their dispersal. Water, however, may carry the fruits to some distance and theirby help in its dispersal to some extent.

Table I

A comparison of seed output, % germination and reproductive capacity of some species

Species	Reproductive capacity	Seed output	% Germination	Author
Verbascum thapsus	108.800	136.000	70	Salisbury 1942
Lindenbergia polyantha	70.266	71.731	98	Misra & Rao 1948
Ranunculus muricatus	1.281	2.082	62	Ahmed 1968b
Ranunculus laetus	1.082	2.515	43	Author
Ranunculus arvensis	813	1.982	41	Ahmed 1968a
Chrozophora rottleri	424	552	70	Mall 1956
Themeda quadrivalvis	373	1.332	28	Pandeya 1967
Orthosiphon pallidus	304	845	36	Ramakrishnan 1964
Anagallis arvensis	67	150	45	Salisbury 1942
Mercurialis perennis	15	300	5	Salisbury 1942

3.4 Environmental factors

3.4.1. Climatic: *Ranunculus laetus* thrives in areas having salubrious climate. The climate of a typical area — Srinagar, Kashmir — is subtemperate. Temperature fluctuates seasonally between —8° C and 32° C. Rains are frequent during March and April. Summers which cover the months of June, July and August are dry and humid. During winter i. e., December, January and February, precipitation is mainly in the form of snow.

3.4.2. Edaphic: Much has been said about the role of the edaphic factor in governing the growth and distribution of plants. Hewetson 1951 and Pearsall 1932 laid emphasis on single factors like pH, NO_3, exch. Ca etc. Daubenmire 1947, Oosting 1948, Gorham 1954 and others have laid great stress on the relations between soil characters such as moisture,

configuration of surface, mechanical and chemical properties of adjacent rocks. According to SHREVE 1951 depth, structure and mineralogical origin of soils are very important factors for the growth of perennials. In view of this an analysis of soils underlying *Ranunculus laetus* was carried out. The results along with the performance of the plant in these localities are presented in table II. It is seen from the table that the species grows in soils which are moist and rich in different chemical constituents like Nitrogen and Phosphorus. The species can even tolerate water-logged conditions. A correlation is discernable between the fresh weight, height of the plants and seed output and % moisture content in soils. The plants growing in localities with higher % moisture show high seed output and better performance in terms of fresh weight and height of the plants.

Table II

Soil analysis and performance of plant in different localities

Localities	1	2	3	4	5	6
% Moisture	14,2	25,7	9,5	43,7	29,1	7,8
pH	7,4	8,0	7,4	7,6	7,4	7,2
% Available K_2O	0,043	0,025	0,037	0,025	0,026	0,040
% Available P_2O_5	0,039	0,030	0,031	0,025	0,041	0,053
% Available Nitrogen	0,102	0,356	0,110	0,320	0,255	0,278
Average height of plant (cm)	103,1	115,4	14,3	133,7	121,3	17,5
Average fresh weight (gms)	253,2	731,3	31,5	933,6	453,5	43,3
Average seed output	2244	3760	817	3987	3169	1121

Localities: 1. Chashmashahi, 2. Nursing Home, 3. Panth Chok, 4. Burn Hall, 5. Harwan, 6. University Campus.

3.4.3. Biotic: The species is avoided by cattle, sheep and horses during grazing period owing to its unpalatability, however, the plants get trampled under their feet due to their habit. The plants are also eradicated from the field by man as a useless plant. A great number of insects were seen to flock around the plants which are thus subjected to their predatory effects. As regards the interspecific competition it has been observed that the species fails to dominate when growing in association with other species. As far as intraspecific relationships are concerned plants do not suffer due to this. It was observed that in denser stands plants become less branched and taller whereas in less dense stands branching is profuse. BUTLER & BISBY 1934 record the occurrence of *Erysiphe polygoni* on this species.

3.5. Density and distribution

A close observation of the plants at various localities revealed that *Ranunculus laetus* occurs with a frequency of 85% at Burn Hall, Nursing Home and Harwan in the Srinagar district. The most common associates at these localities were *Polygonum amphibium*, *Potentilla reptans*, *Rumex dentatus* and *Ranunculus sceleratus*. At Chashmashahi, University Campus and Panth Chok it shows about 22% frequency and had *Euphorbia helioscopia*, *Sonchus oleraceus*, *Geranium nepalense*, *Medicago sativa*, *Ranunculus muricatus*, *Lolium multiflorum*, *Cynodon dactylon*, *Trifolium repens*, *Plantago lanceolata*, *Veronica agrestis*, *Veronica biloba*, *Lotus corniculatus* etc. as its associates.

4. Discussion

Ecological success of a plant species depends on its capacity to cope with the physical environment with associated plants and animals. Viewing the behaviour of *Ranunculus laetus* in this context the following points emerge from the present study.

The range of distribution, both geographical and ecological of this species is quite narrow. It may be ascribed to the factors like migration, ecesis, ecological amplitude and climate which play a dominant role at every stage of its development and establishment.

Migration appears to be a weak factor in the present species because of the inefficient mobility (via poorly developed dispersal mechanism). Ecesis follows migration. The first crucial phase in ecesis is germination. The seeds of *Ranunculus laetus* show a dormancy period which lasts for only one month. The treatment of these seeds by hot water, conc. H_2SO_4 and burrial under mud shows a significant increase in % germination. This improvement in germination mainly influences the increased permeability of water to the parts enclosing the embryo and also to the removal of chemical inhibitors which retard germination. The effect of light on germination shows that germination is higher in continuous light and is inhibited in continuous dark. The fact that highest germination is obtained in continuous light suggests that fruits must not get burried deep in nature which would otherwise be a detrimental factor in its establishment. Light acts as a stimulant by releasing the latent powers of growth.

The fate of seedlings is the next crucial point for the colonization of a plant. In case of *Ranunculus laetus* the seedlings formed in spring do not show any mortality and result in the formation of pure stands in specialized habitats. Those of the seedlings formed in autumn show a mortality to some extent. There is every possibility that the absence of moisture in the soil and severe biotic interference in this season are the causes for this.

As far as the ecological amplitude is concerned, it is very important in determining the presence of a species in various habitats (Hanson 1958).

Ranunculus laetus shows a narrow range of tolerance with respect to the soil factors and in particular the moisture content. As is apparent from the observations considerable plasticity is shown in height, fresh weight and seed output of the plants. The % moisture content seems to have a paramount impact in this direction (cf. table II). *Ranunculus laetus* being a perennial plant, it is greatly effected by the whole complex of the physical and biotic conditions that make up the habitat and theirby result in its restricted distribution.

The geographical distribution of a species with a high reproductive capacity is also limited by the climate of an area in which it grows. In case of *Ranunculus laetus* it seems that the periodic climate with warm humid rainy season followed by longer dry season prevalent in tropics restricts the distribution of this species to warm temperate zones.

5. Acknowledgements

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6. Summary

The paper deals with some observations on the ecology of *Ranunculus laetus* WALL. The species shows a restricted distribution. It possesses high reproductive capacity. It is poorly adapted to different types of fruit dispersal. The investigations carried out reveal that low migration capacity and low ecological amplitude are the reasons for its restricted distribution. The species thrives well on habitats rich in bases and moisture content. The germination is inhibited in continuous dark.

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