RESEARCH ARTICLE

STUDY OF PHENOLOGICAL EVENTS OF SOME MEMBERS OF ERICACEAE

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Abstract: Phenological events during the life cycle of plants in eight species of family Ericaceae e.g. *Enkianthus deflexus Schneider, Gaultheria hookeri Clarke, Lyonia villosa Hand- Mazz, Pieris Formosa Don, Agapetes serpens Sleumer, Vaccinium retusum Hook* and *Vaccinium vacciniaceum* Sleumer are recorded on the basis of field studies in their natural habitats. The various phenological events include bud initiation, period of flowering, anthesis time, pollination, fertilization, seed maturation and seed germination. Flower bud initiation takes place in the month of September and October. Buds are covered with scaly bracts and undergo dormancy for four to five months to overcome the severe winter. These buds after overcoming winters bloom in February to June accordingly. The pollen dehiscence takes place before anthesis. Fertilization follows in next 6-10 days and it is completed after pollination within 20 days. Seed and fruit mature from July to September. Seed dispersal takes place in September and October. It was concluded that various phenological events are affected by various climatic conditions.

Keywords: Phenological events, Ericaceae, Flower buds

INTRODUCTION

Ericaceae commonly known as "Heath family" are the largest among the families of Ericales comprising about 80 genera and over 1900 species which are cosmopolitan in nature, occurring in temperate ,sub-temperate or alpine in their distribution .The members have an assemblage of characters which are intermediate between the Polypetalae and Gamopetalae and many of the characters are primitive especially of reproductive organs The plants of Ericaceae can easily be identified on the basis of leaf characters, even in its vegetative phase ,by simple , alternate ,evergreen leaves with reflexed margins. The adaxial surface is shining dark green and smooth while the abaxial side has smooth tamontose dense trichomes . Both vegetative and reproductive buds are dormant and skip over severe winters by protected from thick compact scaly bracts. The shape and size of these vegetative and reproductive buds make a useful taxonomic character. Inflorescence may be terminal or axillary, with individual flowers bisexual, regular each with 4-5 lobed corolla, 5-10 stamens and a superior ovary. Fruit a capsule or berry. Family contains decorative and well known plants. Plants grow in acidic soil..Basal nectar girdling the base of the ovary is uniform in all the members of Ericaceae [Philipson (1985 and Palser 1989)]. Pollination takes place by different types of pollen vectors(Williams etal 1990) eg. honey bee, wasps, ants, flies, butterflies, beetles and birds etc (Govil, etal 1995).These visited the flower at sunny day, but in dark and rainy day no visitor were recorded. Flavon glocoside , tannins etc. are obtained from leaves of *Enkianthus & Agapetes.*

MATERIAL AND METHOD

Analysis of phenological characters of different species of family was done at the place of occurrence. During field study, observations were recorded of different phenological events viz. flower bud initiation, bud dormancy, flowering season, anther maturation and dehiscence, anthesis, pollination, fertilization and seed maturation. Seasonal timings of life cycle phases of the following plants were maintained during field study.(Fig 1-8)
Agapetes serpens sleumer, Cassiope fastigiata, Enkianthus deflexus, Gaultheria hookeri, Lyonia villosa, Pieris Formosa, Vaccinium vacciniaceum and V.retusum

Observation

(i) Flower bud initiation : - In *Agapetes serpens, Cassiope fastigiata, Enkianthus deflexus, Pieris formosa,* and *Vaccinium retusum* early bud initiation takes place during the during the month of September and October and remain dormant for 5-6 months covered by compactly closed scaly bracts which protect the flower buds from severe cold. In case of *Cassiope fastigiata* buds are solitary in the axil of much adpressed overlapping leaves and remain protected as they are covered by thick fleshy leaves, Scaly bracts are absent. In case of *Gaultheria hookeri, Lyonia villosa* and *vaccinium vacciniaceum* flower bud initiation takes place in the month of October.

(ii) Flowering Season : - The flowering season is prolonged from February to June in *Agapetes serpens*. Flower bloom into scarlet red bunches hanging downwards. Maximum flowering is during April-May. But it also depends upon the altitude and weather. At high altitude the flowering is late. In *Cassiope* and *Enkianthus deflexus* dormant flower buds show their

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appearance in May and June. In *C.fastigiata* flower buds bloom as white colour flowers in June to August. In *E.deflexus* dormant buds bloom into orange-red broadly bell shaped umbel flowers. At high altitude flowering is late. In *Gaultheria hookeri* and *Vaccinium retusum* dormant buds show their appearance in April and May. These buds bloom as white colour flower. In *Lyonia villosa* flowering season is from June to July. Flowers bloom into white or orange coloured racemes. In *Pieris formosa* flowering season is from March to May in which they bloom into bright white flowers arranged in panicled raceme in pendent. In *V.vacciniaceum* flowering occurs in dormant bud from April to June. They bloom into pink flowers arranged in raceme clusters.

(iii) Anthesis : - In case of all eight species anthesis period is morning between 8 am to 12 noon. In cloudy rainy day anthesis does not take place and flower buds remain unopen.

(iv) Anther maturation and dehiscence : - In *Agapetes serpens*, anther reach to maturity before anthesis. Sometimes anther dehiscence takes place 2-3 days before anthesis as it was observed that in many cases when the buds are still closed pollen are attached to the style. Dehiscence of anther takes place through pores which are morphologically basal in position but acquired apical position due to inversion of anthers (plate). Anther dehiscence takes place early in the morning before 2-3 days of anthesis. Dehiscence of anther continue upto afternoon. However, the peak hours of anthesis are during noon hours.(fig. 9-12).

(v) Pollination : - In *A. serpens* pollination occurs after 6-7 days of anthesis as observed during the field studies. Both cross and self pollination occur in this species. In *c. fastigiata* pollination takes place only after 4-5 days of anthesis. In rest of the species it is observed that pollination occurs after 1-7 days of anthesis. Cross pollination takes place with the help of different types of vectors or insect pollinators, like honey bee, termites, flies, which are attracted by basal nectary and bright coloured flowers. These vectors visit flower for their forage and carry pollen from one place to another.

(vi) Fertilization: - In all the species of the family studied interval between pollination and fertilization is 6-10 days. The marker for fertilization is the change in colour and fall of petals. The receptivity of stigma remains for 2-3 days and it depends upon the climate.

(vii) Seed maturation: - Between fertilization and seed maturation a long time takes place in all the species observed. It may be from 3-4 months. It is observed that seed mature in July to September in case of *A.serpens*. In *Cassiope fastigiata* seeds mature in August-September. During field visits June-July months is observed for seed maturation in *Enkianthus*. In case of *G.hookeri, V.villosa* and *P.fomosa* seeds maturation takes place in July to august. In both the species of *Vacciunum*May-June and June-July months are observed for seed maturation. After maturation fruit dehisce and liberate the seeds.

(viii) Seed dispersal: - Seed dispersal takes place between September to October in *A.serpens, C.fastigiata, G.hookeri, L.villosa, P.formosa And V.retusum. In E. Deflexus* seed dispersal is found in August to October and in *V.vacciniaceum* it is found only in the month of October.

(ix) Seed germination: - The seeds remain buried in humus soil in dormant stage after dispersal. The germination takes place in next spring when the weather is warm. In *A.serpens, P.formosa and V.retusum* seed germination period is March-April. In *C.fastigiata, E.deflexus & L.villosa* germination takes place in the month of April. In April and May germination is seen in *G.hookeri* and *V.vaccinaceum.*

Table 1. Showing distribution, place of collection, time and altitude of eight members of Indian Ericaceae

S.No.	Name of the speciec	Place of collection	Altitude(Mts)	Period of Collection
1.	*Agapetes serpens*	Sikkim (Lachung)	1500-2700	March-May
2.	*Cassiope fastigiata*	Sikkim (Lachung)	2800-4500	March-May
3.	*Enkianthus deflexus*	Sikkim (Lachung)	2500-3300	March-May
4.	*Gautheria hookeri*	Sikkim (Lachung)	2700-3000	March-May
5.	*Lyonia villosa*	Sikkim (Lachung)	2100-3800	March-May
6.	*Pieris Formosa*	Sikkim (Lachung)	2100-3300	March-May
7.	*Vaccinium retusum*	Sikkim (Lachung)	1400-3600	March-May
8.	*V.vacciniaceum*	Sikkim (Lachung)	1500-2800	March-May

Table 2. Phenological events of members of family Ericaceae.

Name of the species	Period of bud initiation	Period of flowering	Anther maturation (days before anthesis)	Anthe-sis a.m.-noon	Pollination (days after anthesis)	Fertiliza-tion days after pollination	Seed maturation	Seed dispersal	Seed germination
Agapetes serpens	Sept-Oct	Feb-June	2-3	8-12	6-7	6-10	July-Sept	Sept-Oct	Mar-April

Cassiope fastigiata	Sept-Oct	May-June	2-3	8-12	4-5	6-10	Aug-Sept	Sept-Oct	April
Enkianthus deflexus	Sept-Oct	May-June	2-3	8-12	1-7	6-10	Jun-July	Aug-Oct	April
Gaultheria hookeri	October	April-May	2-3	8-12	1-7	6-10	July-Aug	Sept-Oct	April-May
Lyonia villosa	October	June-July	2-3	8-12	1-7	6-10	July-Aug	Sept-Oct	April
Pieris formosa	Sept-Oct	Mar-May	2-3	8-12	1-7	6-10	July-Aug	Sept-Oct	Mar-April
Vaccinium retudum	Sept-Oct	April-May	2-3	8-12	1-7	6-10	May-Jun	Sept-Oct	Mar-April
V.vacciniaceum	October	April-June	2-3	8-12	1-7	6-10	Jun-July	October	April-May

Fig 1. *Agapetes serpens* **Fig 2.** *Cassiope fastigiata*

Fig 3. *Enkianthus deflexus* **Fig 4.** *Gaultheria hookeri*

Fig 5. *Lyonia villosa* **Fig 6.** *Pieris Formosa*

Fig 7. *Vaccinium retusum* **Fig 8.** *V.vaccineacum*

Fig 9. **Fig 10.**

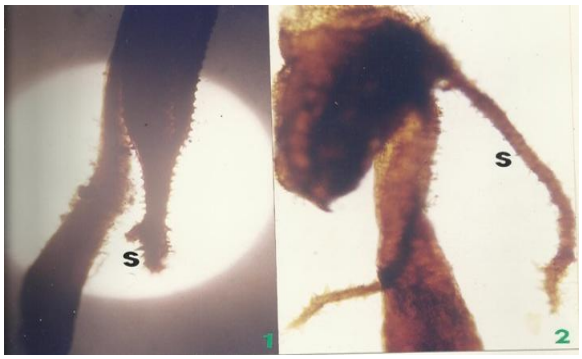

Fig 11. **Fig 12.**

(Fig 9-12): Shows spurs on anthers

RESULT AND DISCUSSION

Phenological events in the biology of reproduction of plants are the regulating factors for the production of progeny. Different aspects of floral biology, mainly flower initiation, blooming period, anthesis, dehiscence of anthesis, pollination after anthesis, fertilization, seed maturation, seed dispersal and seed germination are important events in the life-cycle of a plant. Among the herbaceous plants the life-cycle is complete within a short span of time and not much effect of climatic factors and nutritive factors are visible but in tree species and perennial plants physical factors, hormonal factors and nutritional factors influence various events of phases in growth that are taking place in life-cycle. Ericaceaen plants which are temperate or subalpine have shown adaptability so as to complete efficiently their life cycle. Among all the members studied it is observed that the initiation of flower bud takes place much earlier before the onset of winters. Flower buds which initiate in the month of September-October remain dormant for almost five to six months during the severe winter climate. The dormant buds are protected by hard scales which keep the buds in a compact structure. Flower bud dormancy appears to be an adaptive feature of Ericaceae as a whole. Schneider (1964) concluded that the resting period of flower buds in Ericaceae (Rhododendron) is related with bud scale. He observed that when the scales are removed after onset of rest it causes the termination of rest period. Further the rest period of each flower is independent to rest period of adjacent flower. Philipson (1985) and Stevens (1985), concluded that there is relationship of flower buds with weather. During the present studies it is noticed that temperature highly influences the flower bud differentiation. Our observations are in conformity with the observations of these workers. Period of flowering vary in different members of Ericaceae and it is highly controlled by temperature and altitude. Species growing at low altitude flower early while those which are growing at higher altitude flower late in month of July- August. The same species growing at different altitudes show difference in period of blooming. At a higher altitude where the temperature is low the flowering is delayed. In the members studied longest time for flowering is reported in *Agapetes serpens* from February to June which is not reported in any other member of Ericaceae. *A. serpens* is found at low altitude. A good account of flower and flowering time is given by a number of workers namely Stevenson (1947), Bowers (1960), Leach (1962), Kruaaman (1970), Cox (1973), and Feng (1988) etc. The anthesis of flowers usually takes place early in the morning between 8 a.m.-12 noon. After the anthesis, pollination takes place between 1-7 days and stigma remains receptive during this period. Anther dehiscence takes place two to three days before anthesis. This may lead to high chance of self compatibility. Ericaceae members are self as well as cross pollinated. Various pollinators or pollen vectors visit flowers and they off load pollen on the stigma. It is observed that the pollinators visiting the flowers come either for forage or nectar.

Fertilization occurs after 6-10 days of pollination. The completion of process of fertilization can be marked with specific markers i.e. either there is a change in colour of petals or fall off petals after fertilization. Fruits and seed setting takes a longer period. Seed mature from May to September. Seed dispersal takes place in the month of September-October. A reproductive time table for different species of *Rhododendron* (Ericaceae) has been prepared by a number of workers as falser etal., (1989) for *R. nuttalti,* Rouse etal., (1991) for *R. maogregoriae* etc. Which are similar in most of the members of Ericaceae studied.

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