

## Study of Phenology of A Medicinal Plant Centella Asiatica of Family Apiaceae

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### **Abstract**

*This paper deals with the investigation of phenological events in the fields . Phenological studies were conducted on Centella asiatica (L.) Urban belonging to family Apiaceae in the field . Flowering period was found throughout the year. Although maximum flowering seems to occur during March to June . During field and laboratory study flower colour , number of anthers , presence of bract , ovary, style, stigma, fruit, seeds, pollination were observed and recorded.*

### **Keywords**

*Centella asiatica, Flowering, colour, Field study, phenology*

### **Introduction**

*Centella asiatica* (L.) Urban has been used as a medicinal herb for thousands of years in India, China, Srilanka, Nepal and Madagascar. This plant belongs to family Apiaceae. There are various names given to this plant in various literature. Name Mandookparni and Gotu Kola is given in Hindi and Bhekaparni in Sanskrit. It is a creeping, low growing (4-18 inches), perennial herb with fan shaped, tasteless, odourless green leaves on their stems and small white to purplish-pink flowers. Mainly these are grown in damp, swampy areas of India, Srilanka, South America. The study of the timing of natural events is called phenology. The timings of the annual cycles of plants, is extremely sensitive to changes in climate. It may adjust the timing of certain phenological events according to climate. As the seeds are sown in the field they start germination. There are many events that are undergone by the plant after germination. This is a type of natural calendar. After germination the seed undergoes root and shoot elongation. Further there is increase in length of plant. Emergence of leaves and there further development takes place after root – shoot elongation. Buds arise either at nodes or at base. Later on the bud enlarges until the stamens protrude outwards. That represents the complete flower. Leaf unfolding, flowering of plants in spring, fruit ripening, color changing are recorded during the study of phenological events. This also includes the abundance and distribution of organisms, ecosystem services, food webs and global cycles of water and carbon. In turn, phenology may be altered by changes in temperature and precipitation. The study of the timings of recurring biological events are associated to biotic and abiotic factors. There are three main factors that affect phenology:

1. Sunlight
2. Temperature
3. Precipitation.

### **Materials and Methods**

*Centella asiatica* (L.) Urban plantlets were brought from Patanjali Haridwar in the year 2017. The plants were grown in the kitchen garden. The phenological investigations were recorded in the field. Ten individuals of each species were observed on daily basis. Photographs were captured and slides were prepared. Floral visitors and pollinators were recorded during the entire flowering period by capturing picture.

### **Phenology**

Phenological observations were recorded daily after initiation of buds for two consecutive years. Tagging is done. All the events from flowering (bud initiation to fertilization) to fruiting (period between fruit maturation until seed dispersal) were recorded by observing tagged plants. During peak periods of flowerings and fruiting observations were recorded daily.

### **Floral Visitors**

Observations were made on daily basis. As during full blooming period the insects visit the flower to collect the nectar and pollen. Common pollinators observed during study were termites, ants, bugs, snails etc. There are two types of pollinators:

1. Effective pollinators
2. Occasional pollinators: Which collected nectar or pollen during their rare visits or failed to contact with the reproductive parts.

## Results and Discussions

*Centella asiatica* (L.) Urban (Family Apiaceae) is a vigorous scrambling herb with trailing branches (Fig-). There is a single stem arising from the ground but branches are often very low on the stem and are slender. The entire plant is covered with hairs. (Fig-1). There are three sessile flowers in an umbel inflorescence. One central flower and one lateral flower. An involucre of 2 ovate, membranous, persistent bracts is present. Pedicels are slender or obsolete (less developed), petals dark crimson to greenish-white, orbicular with a slender inflexed point. Calyx teeth and stylopodium depressed, styles are short and divergent.

### Phenology

Phenological events are recorded in two reproductive cycles of plants in at least 10 plants. Tagging was done. Phenological events studied were bud initiation, bud opening, flowering season, anthesis, anther maturation and dehiscence, pollination, fertilization, fruit formation and maturation and seed germination.

1. Bud initiation: Bud initiation takes place during the month of April. It takes within 20 days. Buds show no dormancy. They are pointed towards apex. Buds are green in color.

2. Bud Opening: Buds open after 5-10 days. That time is noted by tagging. Buds have two membranous bracts. Bracts are green in colour. Buds are hairy. Three buds in an umbel inflorescence are present. Central bud matures first. Lateral flowers remain in bud condition.

3. Flowering season: Flowering occurs in a robust way during summer season. Flowers are very small and pink in colour. The petals are pinkish and have white lines. They spread outward. Flowering takes place throughout the year. Flowers are borne at nodes and at basal portions. The number of flower ranges from 5-6. Three flowers in an inflorescence, in which one central flower is surrounded by two lateral flowers. When flower opens stamens and petals unfold. Stylopodium is depressed.

4. Anthesis: Unfolding of stamens proceeds anther dehiscence. Anther dehiscence takes whole day and anthesis is finished after next day of flower opening. Anthesis is observed during morning. Time is 4.00-8.00 am early morning. After the bud emerges, anthesis takes place within 7 days. Stamens are inflexed and anthers are introse. On the stylopodium nectar secretion starts now. Maximum secretion of nectar is seen when all the anthers are dehiscing. It starts on 5th day of petal falling. Stigma receptivity is marked divergence of two lobes away from each other. After increasing in length, the two lobes become V shaped at the time of peak stigma receptivity. It happens at the first day of anthesis when dehiscence starts in third and fourth anther in the noon time. Stigma receptivity increases as the anther dehiscence approaches towards completion.

5. Anther maturation and dehiscence: Anther can be seen by naked eyes. They turn black on maturation. Mature anther is red in color. There are 4 lobes and four corners that are swollen. These bears the pollens. There is a dehiscence line from which anther dehisce. It releases the pollen grains. Pollen grains are released in monad stage. Mature anther is easily dehisced. Its dehiscence usually takes place during noon.

6. Pollination: Pollination is cross and entomophilous. Cross pollination occurs when the pollens are released and deposited on stigma. Various agents that act as

pollinators eg. bugs, ants, snails, and earthworm. The maximum activity of pollinators are seen during noon and morning time. Pollination is usually seen after 14 days of flower opening.

7. Fertilization: Fertilization occurs when the pollen grains reaches the stigma and pollen germination starts. It takes place after 16 days of pollination. There are several changes in the ovary and also the whole flower. Swollen ovary is the sign of fertilization. Fruit formation is the result of fertilization.

8. Fruit formation and maturation: Fruits are formed after fertilization. Fruits are formed after 16 days. Fruits are green in color. They have red lines on it. Fruits consists of stylopodium at top. There are at least 5-6 fruits in bunch. The whole flowers get converted into fruits.

9. Seed germination: Seed germination occurs within 10-12 days. Seeds show no dormancy. Seed are divided into two mericarps.

#### **Floral Visitors**

Floral visitors observed during field study were honey bees, bugs, ants, termites and snails. They visit the flower when it opens in the early morning. There activity was found at 6 am. They carry pollen on their hind legs and when they visit other plant they left the pollen on that flower for pollination. Fruit formation occurs after fertilization. Fruit of *Centella asiatica* (L.) Urban was found to be achene, circular to ellipsoid in shape, yellowish brown colored and slightly lobed. Fruits are green in colour. The skin of seed was shiny, hard, and smooth and grey in color (Fig.). Seeds were pear shaped and average diameter was found to be 3-5 im. (Fig. 52)

#### **Conclusion**

Phenological events are recorded in two reproductive cycles of plants in at least 10 plants. Tagging was done. Phenological events including flowering, fruits, seeds etc. Flowering season was reported from December to June and it remained throughout whole year. It is a deviation from normal flowering period. Small buds project from the base of stem. Inflorescence is compound umbel. Bud is pink in color and covered by 2-3 bracts. Flowers are arranged in terminal umbels. Flower show blooming during early morning from 4-6 a.m. Mainly there were three to five flowers in an inflorescence. There is one central flower and two lateral flowers in an inflorescence. The time of their opening and closing was recorded by tagging. First central flower opened and then lateral flowers. Flowering is reported throughout the year. Maximum flowering is seen during summers from March to June. Unfolding of petals and stamens are seen during opening of flowers. When unfolding is completed then anther dehiscence takes place. Anther dehiscence is reported throughout the day. When all the anthers are exploding the pollen, it is the peak period showing secretion on stylopodium. Stylopodium is a glandular disc and exudates nectar during this process. Stamens and petals fall down on 3<sup>rd</sup> day. On 3<sup>rd</sup> day pollen can be seen on stigma. Lateral flowers open on 4<sup>th</sup> and 5<sup>th</sup> day consecutively. Self pollination is seen but due to insect visitors like honey bees, ants, snails etc cross pollination can also take place. Bees are effective pollinators and ants and snails are occasional pollinators. On 5<sup>th</sup> day swelling of ovary is seen after fertilization. When central flower is in pistillate stage at that time lateral flowers are in staminate stage without any overlapping. Fruits are green in colour and have red colour striations on outer wall. Fruit after

10 days converted into seeds. Seeds are brown in colour and they are kidney shaped. The seeds are bifurcated into two mericarps. At least 3-5 seeds are present on a single inflorescence. They showed vigorous flowering and numerous seeds were obtained. The flowering period is a little bit shifted from normal April- June to December –June. *Centella asiatica* has been listed by International Union for Conservation of Nature and Natural Resources (IUCN).

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#### Plate 1: Showing Various Stages of Flower Phenology



Fig:1. FlowerBud Initiation



Fig:2.Bud opens(after 5-6days)



Fig:3. Central bud matures first(6-8days)



Fig:4. First Lateral flower open (7days)



Fig:5. Second Lateral flower open(9 days)



Fig:6. Lateral flower Full bloom



Fig:6. Anther dehiscence and nectar on stylopodium(11,14 days)



Fig:7. V Shaped Lobes(13 days)

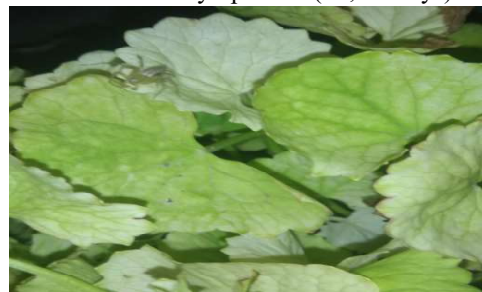


Fig:9. Pollinators(14 days)



Fig:10. Pollinators(14 day)



Fig:11.Pollinators(14 days)



Fig:12.Fruits(15 days)



Fig:15.Seeds(18 days)



Fig:14.Seed germination(10 days)