



Phenological Study of a Medicinally Important Plant *Leonotis nepetifolia* in Jharia Coal Field

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Authors' contributions

This work was carried out in collaboration between both authors. Author SKK designed the study, done the field visit and noted the key points. Author PKM done the literature survey and analysed the data. Both the authors read the manuscript and finally approved it.

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ABSTRACT

Leonotis nepetifolia (L.) R. Br. is a herbaceous plant belonging to the family Lamiaceae and grows across India by the roadsides or on the barren land field. This plant is medicinally very important. Various parts of the plant are used as depurative, febrifuge, antihelminthic, in relieving cough, in skin problems etc. But the ecology of this plant is also quite interesting. It can even survive the harsh conditions of Jharia coal field where the atmospheric conditions and edaphic factors are not favourable for the growth of various plants. But the plant, *Leonotis nepetifolia* grows luxuriantly in those stressful conditions as well. Keeping in view this ecological adaptability of this plant the present study was conducted with an objective to study the phenology of this particular plant in various conditions of Jharia coal field of Dhanbad district of Jharkhand so as to know how germination and flowering time of *Leonotis nepetifolia* changes with adversity so as to understand the ecological aspects quite better. For this, three stressful conditions were chosen where this plant was growing and their phenology was compared with that of the plant growing in controlled conditions. The phenology of this annual plant was found to be quite distinct in different places especially their germination time and death/dormancy.

Keywords: *Leonotis nepetifolia*; phenology; Jharia coal field; fire area; O. B. dump area.

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1. INTRODUCTION

Phenology is the scientific study of seasonal change i.e. the periodic phenomena of organisms in relation to their climate change. Different species have different germination time, fruiting, flowering etc. So, phenology is the calendar of events in the life history of the plants and how these events influence development, reproduction, dormancy, hibernation, migration and flowering. Diagrammatic representation of these events is called Phenograms or Phylophaes. The events are germination, vegetative growth, flowering, fruit formation and seed maturation. Phenology of a plant helps us to understand the ecological interactions in the nature in relation to that particular plant. This paper deals with the phenology of an annual plant *Leonotis nepetifolia* (L.) R. Br. in various conditions of Jharia coal field. Medicinal properties of this plant have been extensively studied by various scientists [1]. It is used for heart conditions associated with anxiety and tension and will calm palpitations, tachycardia and irregular heartbeats and also used as depurative and febrifuge and the infusion is used as antihelminthic [2]. The paste of leaf when fried with ghee is used to relieve cough [3,4]. The flowers of this plant are used in case of healing wounds, scars and burns [5]. The seeds are used for healing the burns [6]. Some workers have reported the use of the plant ash, paste and leaf steam bath for the cure of paralysis, skin diseases, rheumatism and post natal swelling. But very few work have been done regarding the ecology and especially on its phenology [7]. Aluri, R.J.S. and Reddi, C.S. 1994 worked extensively on the pollination and mating system of this plant. So an attempt has been made to fulfil this gap by studying its phenology in Jharia coal field. The plant is annual and grows from the month of August in some areas to January. Height of the plant varies from 162.5 cm to 220 cm at different places. The stem of the plant is squaremous and have sulcations ranging from narrow to deep groove. These sulcations lengthwise down the centre of each side. The body of stem also contains hair like projections called trichomes. These trichomes are found in leaves as well. The inflorescence is verticillaster with velvet orange coloured flower and bilipped corolla. Phenological records of the dates on which seasonal phenomena occur can provide important information on how climate affects ecosystem over the time (Meifang Zhao et al.

2012) [8]. Phenology of a plant also differs according to different conditions (Forest et al. 2010) [9].

1.1 Study Area

The study area chosen for the research work was Jharia coal field which is located in Dhanbad District of Jharkhand. It is located at an elevation of about 77 m above mean sea level. Topography of the study area is undulating. The area is having very few water reservoirs and underground water level is also very poor. The Jharia is located at the bank of river Damodar. It lies about 250 Km west of Kolkata. Four study sites of Jharia coal field were selected. They were Fire area, O.B. dump area, subsidence area and one control area.

1.2 Objective

To study the phenology of *Leonotis nepetifolia* (L.) R. Br. growing in different study sites of Jharia coal field.

2. METHODOLOGY

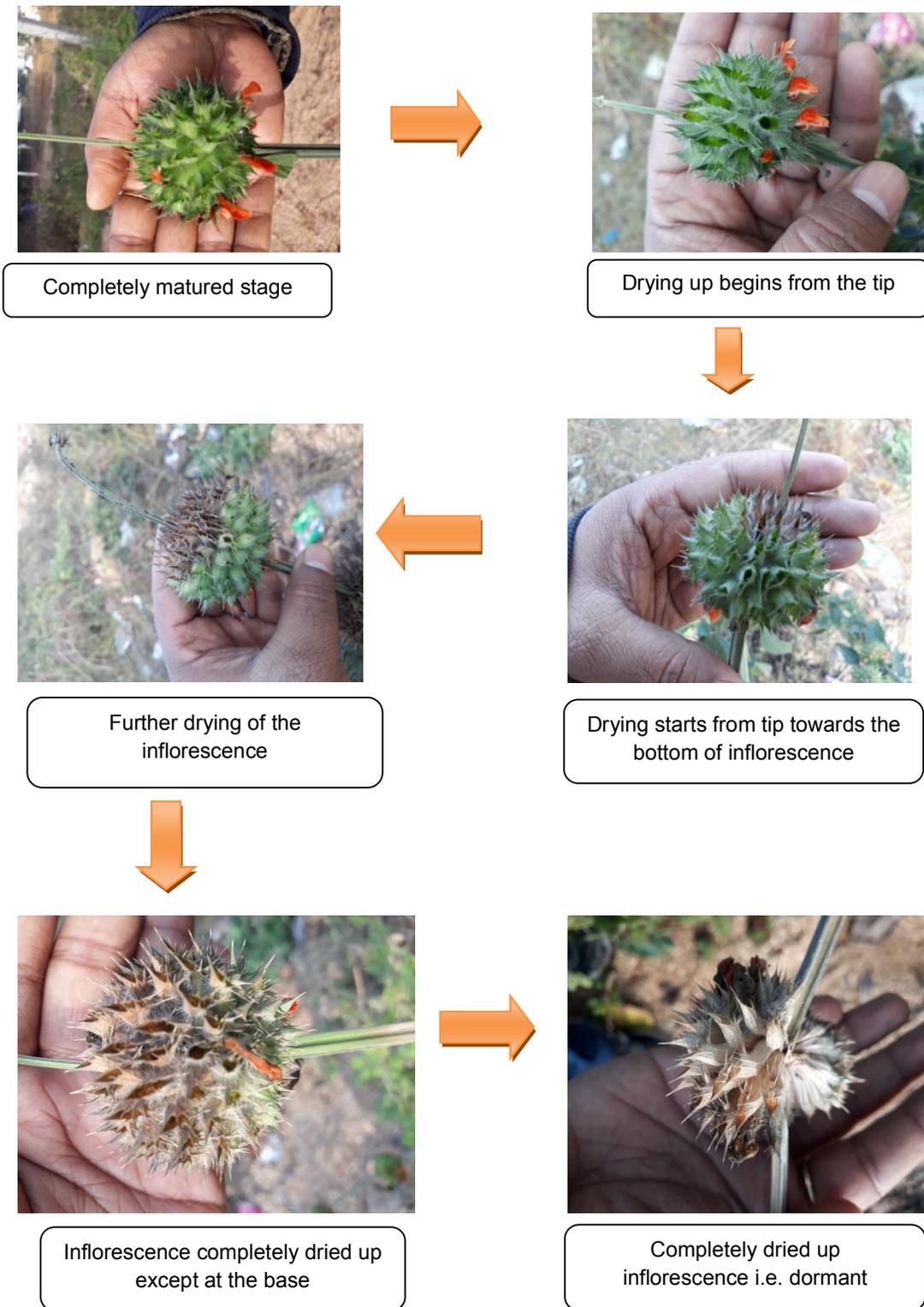
First of all four study stations were chosen on the basis of the availability of the plant *Leonotis nepetifolia*. Out of the four study sites, three were chosen as areas where the land degradation was taking place enormously. They were Fire area, O.B. dump area and Subsidence area. One Control condition was chosen from Jharia coal field where mining has not taken place for the last 20 years. Fire area was located at Barari colliery of Jharia coal field having latitude 23°42'01" N and longitude 86°25'58" E. Coal fire, redness of coal and fumes were seen here and there in that area. The region was vegetationally very poor. In spite that, the plant *Leonotis nepetifolia* L. was growing luxuriantly in that site. O.B. Dump area was located between North Tisra and Jeenagora colliery of Jharia coal field located between 23°42'46" N and 86°26'23" E. The O.B. Dump area was full of burden rocks with poor vegetation. However, *Leonotis* was growing there also. Third Study station was subsidence area (23°43'01" N and 86°26'45" E) where the land was subsided due to mining and there was moderate vegetation throughout. *Leonotis* was growing there also. The controlled condition was taken where there was hardly any mining activity took place for the last 20 years. Barari basti (23°42'16" N and 86°25'40" E) was taken as area for the control condition where good amount of vegetation was there including

Leonotis. From all these areas, the plant *Leonotis nepetifolia* was studied from time to time for a period of two years (2018-19). About 50 plants from each study station were studied. Since this plant is an annual plant growing from the month of August till January, so the readings were noted accordingly. Various stages of life cycle of the plant which includes plant growth, vegetative phase, flowering, seed maturation and death/ dormancy were noted for these two consecutive years.

3. RESULTS AND DISCUSSION

Phenology of *Leonotis nepetifolia* growing in different areas of Jharia coalfield have been depicted in Table 1. The plant is annual and grows from August to January. *Leonotis* growing in control area shows earliest germination i.e. from 15th to 20th August. It depends upon rain for seed germination. Plants growing in Fire area and O.B. dump area start germinating from mid-September and that growing in subsidence area starts from first week of September. So they start germinating a bit later than the control area where the plant starts germinating from mid-August. The plant growing in controlled condition and fire area is at the peak of its full-fledged vegetative growth in the month of September and October. One special feature of the plants growing in Fire area is that they have white froth like structure [10] formed by the secretion of foamy spittle masses during feeding of xylem sap by the spittle nymphs in order to protect them from enemies and from drying out, which starts from the early growth phase and remains till pre seed maturation. This may be due to infestation by the insect. But the plant didn't showed any degenerative loss for that. [11] Khawas and Mishra, 2015 also stated that the plant *Leonotis nepetifolia* growing in fire area were better adapted as compared to other stressful conditions. The vegetative growth of the plants growing in subsidence area is at its full peak in the month of September and remains till mid October, whereas that of O.B dump is in the month of October. The plant attains a height of upto 220 cm (fire area) and have vigorous stems. The leaves of the plants growing in control area were comparatively greener than as compared to that of other stressful conditions. The inflorescence appears in the month of October. The seed formation generally takes place in the month of October (last week) to November. Seeds of *Leonotis* growing in O.B. dump area matures earliest (November). In rest other areas the seed matures in the month of December.

This may be due to the fact that the O.B dump area having stressful condition and infertile soil, the plants undergo a strategy for early maturation to avoid complete loss of the plant and early regeneration. The plants growing in controlled condition became dormant in mid-January, whereas that in subsided area and fire area *Leonotis* became dormant in the last week of December to first week of January whereas that growing in O.B dump area became dormant very early i.e. from last week of November to first week of December. The dormancy i.e. drying up of the plant also follows a specific pattern. Drying up of leaves takes place early on followed by inflorescence and then the stem and roots. The inflorescence starts drying up from the tip and for the drying of entire inflorescence it takes a month or 40 days. It has been clearly depicted in Fig. 1. They die after setting seed and their dried stem and flowering stalk remains erect. The results are in accordance with previous workers like [12] Cleland et al, 2007; [13] Chambers and Keatley, 2010; [14] Ault et al., 2011; [15] Liang et al., 2012. After attaining favourable environmental conditions the pollination takes place and the seed germinates to produce a new plant. So the total life period of an individual plant from its seed germination to dormancy is about 5 months which is one month more than as reported by [5] Aluri R.J.S and Reddi C.S., 1994. Pollination generally takes place by aerophily and with the help of sunbirds (xenogamy) [16]. Salim Ali (1932) has compiled a list of plant species pollinated by sunbirds and by others in which he mentioned this plant also. In his work he also mentioned that the sunbirds pollinate the flower of *Leonotis* by puncturing the corollas. The phenological results of this plant are in line with various workers like [17] Solomon Raju and Subba Reddi (1988) in which they stated that the vegetative growth of *Leonotis nepetifolia* along roadsides of Prakasam district of Andhra Pradesh appears in September, flowering commences from mid October upto December and then dry up. Therefore it is likely that the plant *Leonotis* is still in its competition phase (of Clements' succession phase) in O.B. dump area where it is facing competition by other species, so it discharges its seeds quickly and goes to dormant phase quite early and thus trying to adapt itself according to the adverse conditions. Whereas it seems to be in reaction phase in Fire area where the humus content was also good and the plant has already replaced various plants growing in that area and established itself successfully in terms of vegetative growth and flowering.



Photograph 1. Photographs of inflorescence showing how plant (inflorescence) reaches dormancy stage

Table 1. Phenogram of *Leonotis nepetifolia* L. in different study sites of Jharia coal field

| | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------------|--------------------|---------------------------------|---------|----------|----------|---|
| Control area | 15th-20th August | September and October | October | November | December | January |
| Fire area | Mid September | September and October | October | November | December | Last week of December - 1st week of January |
| Subsidence area | September 1st week | September and up to mid October | October | November | December | Mid January |
| O.B. Dump area | Mid September | October | October | October | November | Last week of November- 1st week of December |

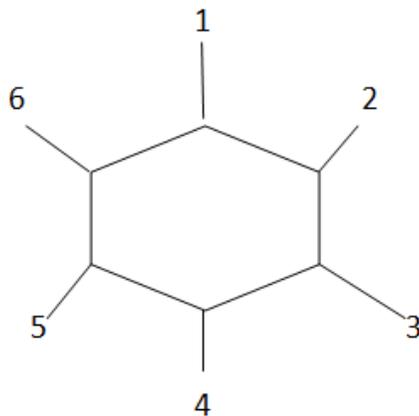


Fig. 1. Germination 2. Vegetative growth 3. Flowering 4. Fruit formation 5. Seed maturation 6. Dormancy/ Death

4. CONCLUSION

Phenology of *Leonotis nepetifolia* growing in various conditions of Jharia coal field vary. In O.B dump area having stressful condition and infertile soil, the plants undergo a strategy for early maturation to avoid complete loss of the plant and early regeneration. Early dormancy is also found in that of plants growing in stressful conditions of O.B. dump and subsidence. The plants growing in fire area and subsidence area have established itself

successfully in that area. This is a clear indication that the plant *Leonotis nepetifolia* growing in adverse condition tends to mature early, so that the seeds may remain intact in the closed inflorescence. This is a significant adaptive mechanism of plant.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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