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ECOLOGY OF *LEONOTIS NEPETIFOLIA* L. IN LODNA AREA OF JHARIA COAL FIELD

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Abstract: *Leonotis nepetifolia* L., a plant of family lamiaceae grows extensively in coal fields and even in stressful conditions like fire area and O.B. dump area. So the present study was designed with the objective is To study the ecology of *Leonotis nepetifolia* L. growing in different locations like fire area, subsidence area, OB dump area, road side and control area of Lodna coal mines (Jharia coal field) of Dhanbad district, Jharkhand. Present study shows better adaptation of *Leonotis nepetifolia* in stressful conditions in terms of its morphological characters and biomass. An increase in fresh weight and decrease in dry weight in various disturbed locations clearly indicated that ultimate productivity of plants reduced in adverse conditions of coal mine areas. A high fresh weight of plants in disturbed locations may be because of strategy to overcome the adverse ecological condition by absorbing and accumulating more water. A low BGP may be because of the presence of various toxicological elements and other physical conditions of the soil. An increase in some of the morphometric parameters of *Leonotis nepetifolia* may be because of stress response of plants which has been reported in various other conditions as well. However possibilities of some evolutionary adaptation of this plant cannot be completely ruled out. A detailed investigation and extensive research work is required to properly infer the results obtained during this study.

Key words: *Leonotis nepetifolia* L.; fire area; control area; fresh weight; dry weight; productivity.

INTRODUCTION

India is the 3rd largest producer of coal in the world and is next to China and U.S.A. Coal mining in India plays a very important role in country's economy. More than 70% of the total power generated in the country is from coal, and considering the total energy requirement, coal contributes more than half. In India coal is produced by both underground and opencast mining but present thrust is being given to increase opencast mining where gestation period is much shorter. After nationalization of the coal mines in 1972-73, coal production grew at a very fast rate from 78 Mt in 1973- 74 to 431Mt in 2006-07 to 554 Mt in 2011-12 (Source: G.S.I) and it is estimated to be about 980 Mt at the end of 2017. But mining is essentially a destructive developmental activity where ecology suffers at the altar of economy. In almost every coal mine bearing region, mining and land degradation have been inseparably connected. Unscientific mining has caused degradation of land, accompanied by subsidence and consequential mine fires.

Apart from the impact of coal mining on local biodiversity, air, noise and water pollution, it temporarily degrades a large portion of land possessing a threat to the vegetation cover. These degraded land possess adverse physico chemical and physico mechanical properties thereby inhibiting soil forming process and plant growth. Other adverse effects are- removal of top fertile soil, elevated metal concentration, high stone content, lack of moisture, reduced nitrogen content ,decrease in water holding capacity, higher compaction, shortage of soil forming materials and organic matter etc. Degradation of land may take place by various impacts of coal mining like mine subsidence, O.B. dumping, mine fire, deforestation etc. On the other hand while studying vegetation of coal field, it was noticed that some of the species thrive relatively well in degraded land as well. *Leonotis nepetifolia* is one of them.

Keeping the above conditions in mind, the present study was designed with the following objective- To study the ecology of *Leonotis nepetifolia* L. growing in different locations like fire area, subsidence area, OB dump area, road side and control area of Lodna coal mines (Jharia coal field) of Dhanbad district, Jharkhand.

MATERIALS AND METHODS

Fire area, subsidence area, O.B. dump area, roadside area and one control area in Lodna coal mine and having good population of *Leonotis nepetifolia* L. was selected for present study. Field visit was done in the study area and its general vegetation survey was done. *Leonotis nepetifolia* L. was chosen because of its abundance in all the 5 study stations. Twenty plants of *Leonotis nepetifolia* from each area were randomly selected. They were washed and weighed. Weight of both underground parts and above ground parts were separately estimated. They were dried in hot air oven and weighed again and thus biomass of both above ground portion and below ground portion were found out. Leaf area was taken by randomly selecting 10 leaves from plants collected from each area. Morph metric records of *Leonotis nepetifolia* collected from different study sites were taken. Average of readings was taken for concluding the results.

RESULTS AND DISCUSSION

Results of morphometric parameters is presented in Table 1. Height of the plant was recorded 151.8 cm in controlled area whereas it was 199 cm in fire area as well as roadside. Plants collected from O.B. dump and subsidence was 172.5 cm and 182.2 cm high respectively. Length of the root was 30.2 cm in controlled condition. In fire, O.B. dump, subsidence and roadside areas average length of the root was 27.6 cm, 14 cm, 16.2 cm and 17 cm respectively. Number of branches was 8 in the plants of controlled condition whereas it was 16 in fire and road side area. It was 6 and 10 in O.B. dump area and subsidence area respectively. Leaf area was more in adverse conditions than the controlled ones. It was 24 cm^2 in fire area and 26.9 cm^2 in roadside area respectively, whereas it was 12.3cm^2, 16.1cm2 and 14.5 cm^2 in controlled area, O.B. dump area and subsidence area respectively. Number of nodes and number of inflorescence were also more in the plants of

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adverse conditions. They were 4 & 7 in controlled, 8 & 12 in fire area, 3 & 4 in O.B. dump area, 5 & 9 in subsidence and 8 & 12 in roadside areas respectively. Average distance between the two inflorescence was 7.5cm in controlled area, 11.3cm in subsided one, 15cm in O.B. dump area, 7.8cm in fire area and 9 cm in roadside area.

The results of the soil test is presented in the Table 2. Three parameters of soil composition was tested – Electrical conductivity, organic carbon content (gm/kg) and pH. All the three contents were same in subsidence and controlled area. Electrical conductivity was 6.9 in fire area, 7.9 in O.B. dump and 6.4 in subsidence and controlled area. Organic carbon content was very low (3.7gm/kg) in fire area, it was 10.1gm/kg in O.B. dump area and 28.5gm/kg in subsidence and controlled area. The soil was acidic in nature. It was 5.8 in fire area, 4.6 in O.B. dump area and 5.1 in controlled and subsided area.

The results of the biomass is presented in Table 3. Average fresh weight of the plant was more in disturbed areas than the controlled areas. It was 99 gm in control area, 240.4 gm in fire area, 103gm in O.B. dump area, 105 gm in subsidence area and 232 along the roadside. Dry weight was 24.2gm in control area, 19.8gm in fire area, 15gm in O.B. dump area, 16 gm in subsidence and 18.8 gm in roadside plants. Above ground weight and below ground weight of the total dry weight of the plant were 10 gm & 14.2gm in control area, 9.8 gm and 10gm in fire area, 11.2 gm and 3.8gm in O.B dump area, 11.4gm and 4.6gm in subsidence area and 11 gm and 7.6gm in roadside area respectively.

Table 1: Morphometric study of *Leonotis nepetifolia* L. in different locations.

Parameters \ Area	Control	Fire	O.B. dump	Subsidence	Roadside
Height of the Plant (cm)	151.8	199	172.5	182.2	199
Length of the root (cm)	30.2	27.6	14	16.2	17
No. of branches	8	16	6	10	16
Leaf area (cm^2)	12.3	24	16.1	14.5	26.9
No. of nodes	4	8	3	5	8
No. of Inflorescences	7	12	4	9	12
Distance between two inflorescence (cm)	7.5	7.8	15	11.3	9

Table 2: Soil test- The results of the soil test are as follows

Parameters \ Area	Fire area	O.B. dump area	Control& Subsidence area
Electrical conductivity	6.9	7.9	6.4
Organic carbon (gm/kg)	3.7	10.1	28.5
pH	5.8	4.6	5.1

Table 3: Biomass of *Leonotis nepetifolia* growing in different locations (Control area, Fire area, O.B. dump, Subsidence and Roadside area).

S. No.	Parameters \ Area	Fresh weight (gm)	Dry weight (gm)	A.G.P. (gm)	B.G.P. (gm)
1.	Control	99	24.2	10	14.2
2.	Fire	240.4	19.8	9.8	10
3.	O.B. dump	103	15	11.2	3.8
4.	Subsidence	105	16	11.4	4.6
5.	Roadside	232	18.8	11	7.8

Results obtained during this study reveal some astonishing facts regarding the ecology of *Leonotis nepetifolia* L. Growth parameters exhibited better condition of this plant in disturbed areas as compared to the control ones. In almost all disturbed areas, height of the plant was significantly more than the controlled condition. Roots of the plant however growing in disturbed areas were smaller than the roots of the plant growing in controlled condition. Number of branches, leaf area and number of inflorescences was also more in fire area and road side plants as compared to the controlled condition. No uniformity was recorded as far as the distance between the two inflorescence is considered. The results clearly indicate better adaptability of *Leonotis nepetifolia* in fire area and other disturbed locations.

Fresh weight of the test plant was also high in all disturbed location as compared to the plants growing in controlled areas. Dry weight however exhibited a reverse trend. Dry weight of *Leonotis nepetifolia* was more in controlled condition and it reduced significantly in all disturbed location. Maximum reduction in dry weight was observed in plants growing on O.B. dump area. Above ground productivity was increased in disturbed habitat. On the other hand, the below ground productivity was highest in controlled condition and it reduced in all other degraded condition. An increase in fresh weight and decrease in dry weight in various disturbed locations clearly indicated that ultimate productivity of plants reduced in adverse conditions of coal mine areas. A high fresh weight of plants in disturbed locations may be because of strategy to overcome the adverse ecological condition by absorbing and accumulating more water. A low BGP may be because of the presence of various toxicological elements and other physical conditions of the soil. An increase in some of the morphometric parameters of *Leonotis nepetifolia* may be because of stress response of plants which has been reported in various other conditions as well. However possibilities of some evolutionary adaptation of this plant cannot be completely ruled out. A detailed investigation and extensive research work is required to properly infer the results obtained during this study. One point is however clear that a highly complicated interrelationship of different ecological parameters and plant response is further authenticated. Latifovic *et al.,* 2005, studied the change in vegetation pattern and clearly indicated that apart from disturbing the vegetation, coal mines also significantly changes the vegetation spactra. Sarma 2005, Sama and Baraik 2011, and Sarma *et al* 2010 have studied change in vegetation pattern in mining area of Meghalaya. He reported that new species fully or partially replaced coal resistant species. The present study also proves that *Leonotis nepetifolia* L. has established itself in areas degraded because of coal mining. Worth performance of *Leonotis nepetifolia* indicates that some heat resistant protein might be there to enhance metabolic activities. Exact nature of the protein is still to be investigated.

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