ANATOMICAL PECULIARITIES OF *LEONOTIS NEPETIFOLIA* IN JHARIA COAL FIELD

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Abstract : Anatomy of a plant or phytotomy gives a better picture of the plant in terms of its adaptation and its physiology. The present study is aimed at studying the anatomy of a stress resistant plant *Leonotis nepetifolia* growing in harsh conditions of Jharia coal field where most of the plants failed to survive. Anatomical investigation of roots, stem and leaves of this plant growing in Fire area, subsidence area, O.B. Dump area was compared with that of the same plant growing in controlled condition.

IndexTerms - Leonotis nepetifolia, Anatomy, Trichome, Jharia coal field, Fire area, O.B. Dump area.

INTRODUCTION :

Leonotis nepetifolia L. is an annual medicinal herbaceous plant belonging to the family Lamiaceae. It is also called Granthiparni, Barchi buti, Knod grass, Lion's ear or Van tulsi (by local peoples of Jharia coal field). The ecology of this plant is very interesting. It grows in the areas where most of the plants failed to survive. So the present paper aims to find out the peculiarity of the plant in terms of its anatomical features. The anatomy of root, stem and leaves of *Leonotis nepetifolia* in all the study stations were studied and compared. Four study sites were choosen based on the difference in location and growth of *Leonotis nepetifolia* L. i.e. Fire area (barari colliery), O.B. Dump Area (In between North Tisra colliery and Jeenagora Colliery), Subsidence Area (In between Joyrampur and Jeenagora Colliery) and one controlled condition (Barari Basti) where land have not been disturbed at least for the last 10 years .

METHODOLOGY IMPLEMENTED :

Twenty different plants were taken from each study sites i.e.- Fire area , O.B. Dump Area, Subsidence Area and Control condition. Anatomical investigation was done by cutting Transverse section of stem, roots and leaves and They were stained with safranine and observed under microscope. Measurement of the thickness of each layer was done by calibrating ocular and stage micrometer. Photographs were taken and twenty readings each of T.S. of stem, roots and leaves of each area were taken. Mean of them were taken for concluding the result. Vascular bundle components were observed after maceration and staining.

RESULT AND DISCUSSION

Table 1. Mean Size (µm)of different regions of T.S. of Stem of *Leonotis nepetifolia* in different study sites.

Region	Control area	O.B. Dump area	Subsided area	Fire area
Trichomes	7.7	10.8	3.6	9.6
Cuticle	.1	.26	.35	.54
Epidermis	2.2	1.4	1.5	1.6
Cortex	9.6	11.4	6	12.5
Pericycle	2.45	3.8	1.8	1.6
Xylem	15.4	16.6	19.25	17.6
Phloem	3.7	4.2	3.75	5.4
No. of xylem vessels in 1 row	6	4	5	6
Xylem vessel size	1.5	1.88	1.66	1.6

Table 2. Mean Size (µm) of different regions of T.S. of roots of *Leonotis nepetifolia* in different study sites.

Region	Control area	O.B. dump area	Subsided area	Fire area
Epiblema	0.95	1	1.6	1.2
Cortex	7.4	6	2.7	5.6
Pericycle + Endodermis	2.2	3.2	0.9	1.8
Xylem	17.8	19.2	19.2	16
Phloem + Cambium	3.1	2.25	3.3	2.9

Table 3. Mean Size (µm)of different regions of T.S. of leaves of *Leonotis nepetifolia* in different study sites.

Regions	Control area	O.B. Dump area	Subsided area	Fire area
Lower epidermis	0.7	1.4	1.1	0.7
Collenchyma	2.5	3.6	3.4	3.4
Mesophyll + Parenchyma	10.4	13.6	13.2	16.4
Pericycle + Endodermis	1.8	0.9	1.8	2.7
Xylem	8.7	14.4	13.8	13
Phloem	1.9	2	2.2	3.4
Upper epidermis	0.7	1.3	1.1	1.7
Trichome size	7.1	16.1	9.8	15

Mean size of different regions of T.S. of stem of *Leonotis nepetifolia* L. in different study sites is given in Table 1. Size of trichomes were highest in fire area i.e. 9.6 µ and least in Subsided area i.e. 3.6 µ. Thickness of Cuticle was highest in fire area i.e. 0.54 µ and lowest in the controlled condition i.e. 0.1 µ. Epidermal layer was highest in Controlled condition and lowest in O.B. dump area. Thickness of cortical layer was highest in fire area and lowest in subsided area. The size of pericycle in controlled area was 2.45 µm , 3.8 µm in O.B. dump area, 1.8 µm in subsided area and 1.6 µm in Fire area. The thickness of Xylem in controlled area was 15.4 µm, 16.6 µm in O.B. dump area, 19.25 µm in subsided area and 17.6 µm in Fire area. The thickness of Phloem in controlled area was 3.7 µm, 4.2 µm in O.B. dump area, 3.75 µm in subsided area and 5.4 µm in Fire area. No. of xylem vessels in 1 row in controlled area was 6 µm, 4 µm in O.B. dump area, 5 µm in subsided area and 6 µm in Fire area. The thickness of Xylem vessel size in controlled area was 1.5 µm, 1.88 µm in O.B. dump area, 1.66 µm in subsided area and 1.6 µm in Fire area. Increase in seven different parameters of stem anatomy i.e. trichome size, cuticle thickness, cortex thickness, pericycle thickness, xylem and phloem and size of xylem vessels was reported in plants growing in O.B. dump area as compared to that of control area. This increase in various parameters may be because of some minerals in the O.B. dump. Analysis of O.B. dump has already shown the presence of Fe, Cu, Mn etc. in the soil over there (Maiti *et.al*, 2005 and Maiti, 2006 b). This increase may be attributed to the presence of these minerals. Five anatomical parameters decreased in plants growing in subsided area. These parameters are trichome size, thickness of epidermis, cortex, pericycle and no. of xylem vessels in one row. Cuticle thickness, size of xylem and phloem and size of xylem vessels increased. Ecological change created due to subsidence was found to be maximum harmful as is reported by the reduction in the value of these parameters. Minor increase in the size of conducting tissues might be a strategy adopted by the plants to sustain the adverse condition. Surprisingly, apart from only two parameters i.e. thickness of epidermis and pericycle, rest all parameters of *Leonotis nepetifolia* growing in fire area increased. This clearly indicates tolerance and adaptability of *Leonotis nepetifolia* in conditions of underground mine fire. Earlier workers like [5]Schlesinger, 1990; [6]Schoffl *et al.*, 1998; [7]Kotak *et al.*, 2007 have already reported presence of heat tolerant proteins in various plants. It is further increasing to note that only two anatomical components of stem- epidermis and pericycle reduced and both are parenchymatous.

Mean size of different regions of T.S. of roots of *Leonotis nepetifolia* L. in different study sites is given in Table 2. The thickness of epiblema in controlled area was 0.95 µm, 1 µm in O.B. dump area, 1.6 µm in subsided area and 1.2 µm in Fire area. The thickness of Cortex in controlled area was 7.4 µm, 6 µm in O.B. dump area, 2.7 µm in subsided area and 5.6 µm in Fire area. The thickness of Pericycle Endodermis in controlled area was 2.2 µm, 3.2 µm in O.B. dump area, 0.9 µm in subsided area and 1.8 µm in Fire area. The thickness of Xylem in controlled area was 17.8 µm, 19.2 µm in O.B. dump area, 19.2 µm in subsided area and 16 µm in Fire area. The thickness of phloem and cambium in controlled area was 3.1 µm, 2.25 µm in O.B. dump area, 3.3 µm in subsided area and 2.9 µm in Fire area. In roots of this plant the epiblema, pericycle, endodermis, and xylem exhibited increase in value as compared to the plants growing in controlled condition. Cortex and phloem shows decrease as compared to the control ones. It was noticed that the variation in different parameters of root anatomy was not as significant as in stem anatomy so far plants growing in O.B. dump is concerned. Epiblema, xylem & phloem components exhibited increase in plants growing in outsided area when compared to control area. Out of the three parameters, increase in parameter of conducting tissue was not much significant. The epiblema however showed significant increase which might be because of change in physical properties of soil. Almost all parameters of root anatomy of plants growing in fire area decreased considerably when compared to the same parameters of plants growing in controlled areas

Mean size of different regions of T.S. of leaves of *Leonotis nepetifolia* L. in different study sites is given in Table 3. The thickness of Lower epidermis in controlled area was 0.7 µm, 1.4 µm in O.B. dump area, 1.1 µm in subsided area and 0.7 µm in Fire area. The thickness of collenchyma in controlled area was 2.5 µm, 3.6 µm in O.B. dump area, 3.4µm in subsided area and 3.4 µm in Fire area. The thickness of mesophyll + parenchymatous layer in controlled area was 10.4µm, 13.6 µm in O.B. dump area, 13.2 µm in subsided area and 16.4 µm in Fire area. The thickness of pericycle + endodermis in controlled area was 1.8 µm, 0.9 µm in O.B. dump area, 1.8 µm in subsided area and 2.7 µm in Fire area. The thickness of Xylem in controlled area was 8.7 µm, 14.4 µm in O.B. dump area, 13.8 µm in subsided area and 13 µm in Fire area. The thickness of Phloem in controlled area was 1.9µm, 2 µm in O.B. dump area, 2.2 µm in subsided area and 3.4 µm in Fire area. The thickness of Upper epidermis in controlled area was 0.7 µm, 1.3 µm in O.B. dump area, 1.1 µm in subsided area and 1.7 µm in Fire area. Trichome size in controlled area was 7.1 µm, 16.1 µm in O.B. dump area, 9.8µm in subsided area and 15 µm in fire area. .

Looking at different anatomical parameters of leaf anatomy, it was remarkably noticed that almost all parameters of leaf anatomy in all the three areas i.e. O.B. dump area, subsided area and fire area exhibited marked increase as compared to the control area. [3]Wahid *et al,* 2007 has reported that heat stress drastically affects the metabolism of the plants such as photosynthesis, respiration and water relation. Another remarkable affect is the change in membrane structure. On the molecular level, Michaelis- Menten Constant (Km) is also affected as reported by [8]Mitra and Bhatia, 2008. But as the plant *Leonotis nepetifolia* possess adequate defense mechanism in the form of heat shock protein, the cell membrane stability is maintained. *Leonotis* have specialized trichomes on its stem and leaves which helps it to survive in the adverse conditions. Four types of Trichomes are found- Capitate stalked, Capitate sessile, Non glandular and bulbous trichomes. The density of trichomes (of leaves) in stressful conditions like O.B. dump area and subsidence area is highest. The trichome size of stem in O.B. Dump area and fire area is highest. Vascular bundles are also well developed in adverse conditions of O.B. dump and Fire area. As survival strategy, the synthesis of antioxidants and accumulation of osmoregulators is also expressed ([3]Wahid *et al.*, 2007). This all is reflected in the anatomy of leaves in plants growing in adverse conditions. Decrease in the parameters of stem and root and also in the dry weight ([4]Khawas and Mishra, 2015) is a clear indication that a good quantity of metabolites are consumed in coping with the stress condition rather than using them for increase in biomass.

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