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Electromagnetic Radiation Influencing Stomatal Patterning in Oxalis Corniculata L

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Abstract- ***This paper attempts for assessing the effect of Electromagnetic field and low intensity radiations from haphazardly erected network of cell towers on some plants which are being exposed continuously in their natural habitat. Although the electrosmog being unsmelt and unfelt, its potential harm over long periods of exposure could be realized on plants in the manifestation of morphological and biochemical disorders. Such kind of manifestations when aimed at Oxalis corniculata at various distances from cell tower positively indicated in its stomatal patterning. Increased stomatal density and stomatal index at certain distances followed by a sharp fall in values compels to think that this invisible threat has become a new environmental challenge.***

Key words; EMF, Exposure, Radiation,Stomatal patterning

I. INTRODUCTION

The mushrooming mobile Industry in every corner of the globe with radiating antennae erected on cell towers has forced life- forms to the continuous exposure of Electromagnetic frequencies leading to alarming undesirable effects on them .The perils of overuse of radiofrequencies from various sources and, especially from cell towers are looming large on human and plant lives mainly by its non-ionizing radiations. Some peculiar metabolic changes in certain plants led to work on weeds getting continuous exposure in their natural environment. Such weeds are well adapted to highly unstable and unpredictable environments as they can compete with plants for nutrients, water, light, space and harbors crop pests or diseases through different survival tactics [1]. *Oxalis corniculata* is a weed of cosmopolitan distribution growing throughout the year. It is growing in its natural habitat at the selected site which is being continuously showered upon by mobile tower radiation, therefore it was taken to be the most suitable experimental material to study its stomata and stomatal traits in response to environmental and physiological cues. Since such structures manifest variability in relation to microclimatic condition [2].

II. MATERIAL AND METHODS

The radiation power from antenna of a micro-cellular base station is directed towards the horizon with a slight downward tilt which tend to reach the ground level at distances in the range of 50-300 m.

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The RF field intensity increases away from the base stations and then decreases at greater distances (>250 m) from the antenna because the power intensity is inversely proportional to the square of distance from antenna. The planning for this study is based on changes in the stomatal patterning in oxalis getting electromagnetic radiations at various radial distances from multiple cell towers at a place in comparison to no tower for at least a kilometer (control). Plants of Oxalis were collected from Sakchi (Bagmati road) area of Jamshedpur where four towers have been erected nearby. The radial distances were 50, 100,150,200 and 250 in meters. The area of control was Jubilee Park where minimum radiation was supposed due to lack of any tower. Leaves collected from the mid portion of the fully grown plants and studied under RLM Scope (magnification 100 x-2400 x) after taking epidermal imprint. Measurements were taken from mid region epidermal impressions of adaxial and abaxial surfaces of mature fully expanded leaves. This region has been shown to contain the mean stomatal features of entire leaf (Poole at.al; 2000). Five repeats of stomatal indices, densities and length and width were taken in random field of view. Photographs were saved in the computer system. Data were tabulated in table 1 and 2 and graphs were prepared.

III. OBSERVATION

Stomatal density, stomatal index and stomatal size were measured and arranged in tabular form (Table 1, 2). On the basis of these data graphical representation (Figure: 1, 2, 3) were also assembled.

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Table 1: Stomatal Patterning of Oxalis Corniculata with Varying Distances from Cell Tower

STOMATAL PATTERNING OF *Oxalis Corniculata*										
DISTANCE	STOMATAL DENSITY				STOMATAL INDEX				AREA OF STOMATA/ cm^2	
	D S		V S		D S		V S		D S	V S
	H M	L M	H M	L M	H M	L M	H M	L M	H M	H M
CONTROL	0.01 ±0.38	0.11 ±5.94	0.01 ±0.38	0.15 ±1.44	40.79 ±3.28	22.70 ±3.78	43.60 ±4.37	31.77 ±1.06	6.10	5.49
50 m	0.01 ±0.20	0.07 ±1.75	0.02 ±0.60	0.19 ±1.33	39.17 ±2.83	18.49 ±0.74	47.32 ±3.23	35.70 ±1.15	7.03	6.06
100 m	0.01 ±0.38	0.08 ±2.21	0.02 ±0.49	0.18 ±5.15	39.72 ±3.28	20.68 ±0.83	47.66 ±1.49	34.43 ±1.22	6.27	5.34
150 m	0.02 ±0.25	0.15 ±3.97	0.02 ±0.20	0.21 ±2.60	47.46 ±1.58	27.73 ±1.75	49.43 ±3.26	35.83 ±0.53	5.91	6.18
200 m	0.01 ±0.45	0.12 ±4.10	0.02 ±0.25	0.19 ±1.42	35.82 ±3.16	22.69 ±2.53	47.98 ±1.25	35.07 ±1.17	5.38	5.86
250 m	0.01 ±0.38	0.07 ±3.13	0.01 ±0.38	0.13 ±3.12	29.52 ±4.45	18.18 ±3.52	45.78 ±1.91	32.66 ±1.57	5.65	7.20

*D S- Dorsal surface, *V S- Ventral surface, *H M –High Magnification,*L M- Low Magnification

Table 2: Variations in Total Stomatal Densities and Stomatal Index

Distances	Total stomatal index at high magnification	Total stomatal density at low magnificattion
Control	84.39	0.26
50 m	86.49	0.26
100 m	87.38	0.26
150 m	96.89	0.36
200 m	83.80	0.31
250 m	75.30	0.20

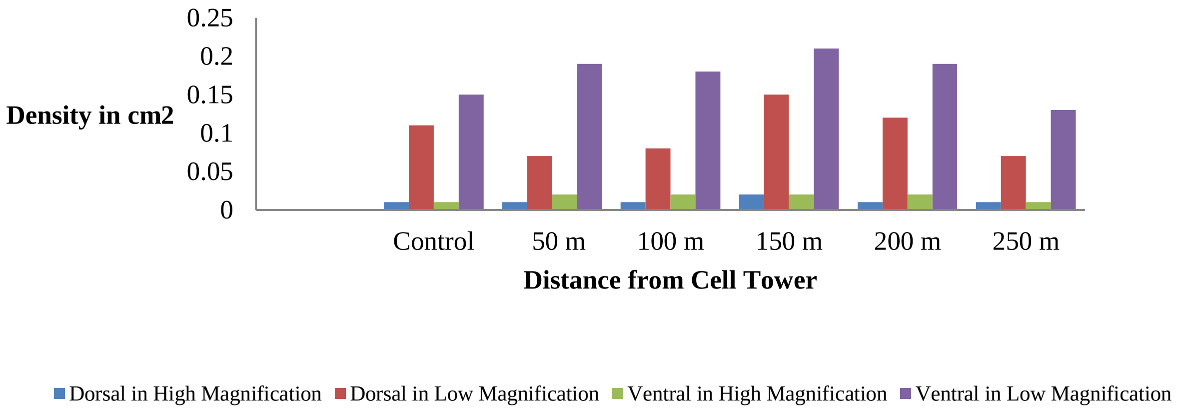

Fig: 1 Stomatal Density Against the Distances from the Cell Tower

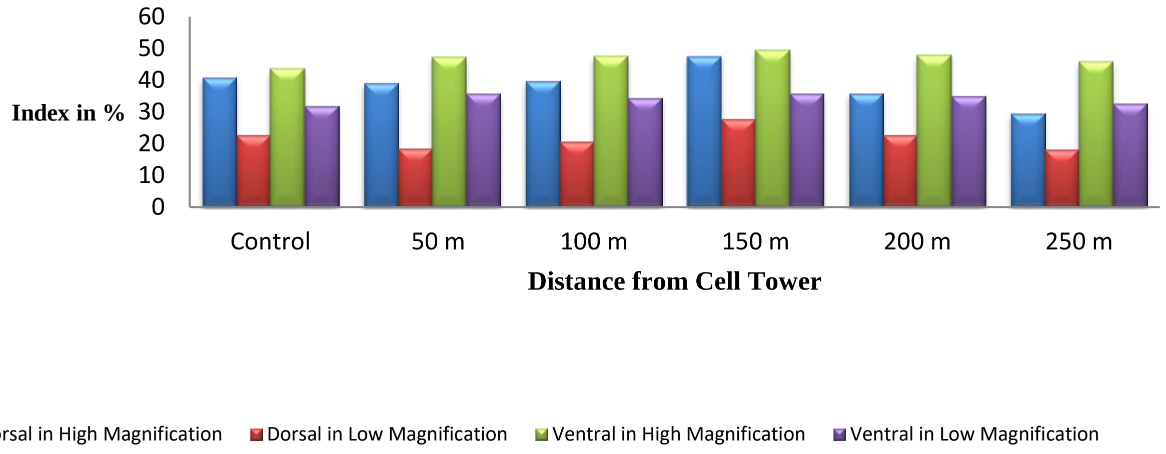

Fig: 2 Stomatal Indexes Against the Distances from the Cell Tower

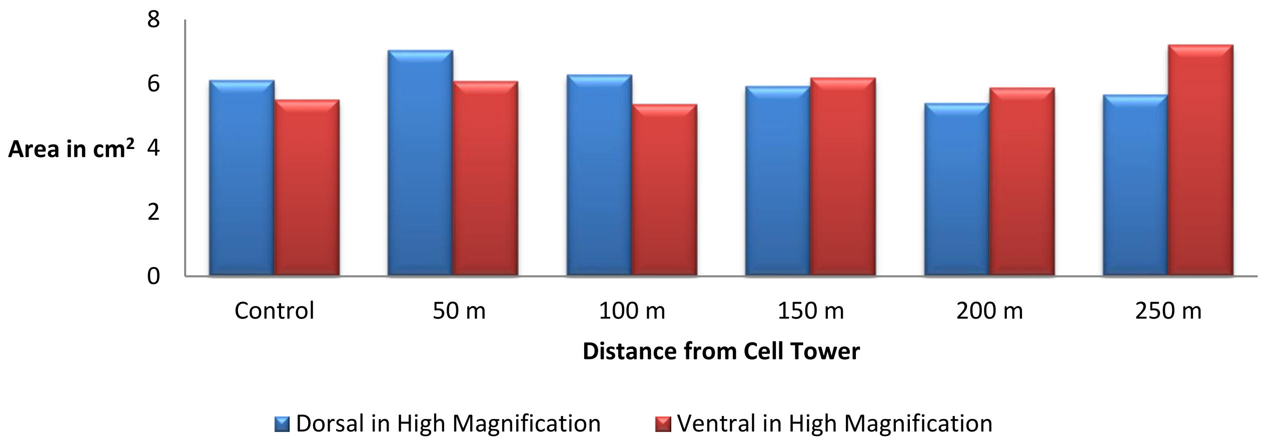

Fig: 3 Area of Stomata Against the Distances from the Cell Tower

IV. RESULT AND DISCUSSIONS

From the observation table 1, it has been revealed that micro-morphological parameters like stomatal density and indices increased significantly from control to 150 m distance while decreased as measured at 200 and 250 m. Stomatal size at various distances were noticed to have decreasing dimensions although at 100m, it was having a highest area on the dorsal surface of leaves .The area of stomata at all other distances got reduced. The increasing stomatal indices and densities may be in response to increasing thermal effect due to non-ionizing electromagnetic radiations. The thermal effects produced by absorption of Electromagnetic energy are the direct result of water molecules acted upon by the oscillating electric field, rubbing against each other to produce electric heat creating thermal effect [3]. Scientists are attributing this effect as also causing global warming and more emphatically on radiofrequency radiation [4].The high density of stomata at 150 m is probably indicative of higher stomatal conductance which allows higher rate of transpiration along with gaseous exchange maintaining normal temperature within the plant body. Otherwise, the higher temperature might have caused injury and death of leaf tissues (Sharma & Butler, 1975) .Increased stomatal density allowed the plant to adapt optimally in the environment of raised temperature. The rise in temperature may also lead to reduction in water content in plant body leading to reduced photosynthetic rate and loss of turgidity in guard cells resulting in the closure of stomata even at mid morning times. This has been actually observed at certain distances. Jones in 1987[5] has stated the similar effect and mentioned that the dimension and specially frequency of stomata can change more than two fold in response to water status or change in developmental stages. The data in relation to mean stomatal number per unit area on adaxial and abaxial surfaces indicated significant variations (Table 1). Stomatal indices are in positive correlations with those of densities. These variations could be explained by the differences in radiations received by the plants at increasing distances from cell towers as the other environmental conditions being similar. The combined mean values of stomatal indices and densities of both dorsal and ventral surfaces (Table 2) shows its climax at 150 m and lowest at 250 m showing thereby that as the doses of radiation becomes effective in terms of intensities, there is increase in stomatal area, and once the plant comes out of range, it again records a significant decrease in such values.

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Thus at 150 m stomata occupied larger proportion of leaf surface and smaller proportion at 250 m. The radiation power from antenna of micro-cellular base station is directed towards the horizon with a slight downward tilt reaching the ground level at distances in the range of 50-300 m as stated in the News letter of central Pollution Control Board, MOEF in 2010[6]. This clearly justifies the significance of maximum variations in the stomata at 150 m and least at 250 m. Again higher temperature might have caused loss in enzymatic functions. The increased stomatal density might be due to the formation of 45-amino acid peptide called "Stomagen" which is released by mesophyll cells and induces the formation of stomata in the epidermis [7].

Usually stomatal density varies with temperature humidity and light intensity around the plant. In this experimental condition except temperature, all the other factors remained the same. This definitely indicates the pronounced and significant effect of electromagnetic radiation effect on plants. Levit (2010) [8], also opined that trees and other vegetation may also be affected by Radio frequency Electromagnetic radiations by growth stimulation and die back. In similar studies it was found that the output of most fruit bearing trees got drastically reduced from 100 % to less than 5 % after a few years of cell tower installation in a form facing four -towers in Gurgaon–Delhi Toll Naka [9]. The radiofrequency radiation creates electromagnetic pollution in plants also along with other living forms and the plants should be categorized in terms of sensitivity to this form of energy [10]. It needs to be investigated properly .It opens a new vista for future research.

V. CONCLUSION

Although numerous studies have documented various biological effects of Radio frequency Radiations on human brain and DNA, only a few investigated effects have been documented on plants. Oxalis plants have manifested significant impacts of Electromagnetic radiation from cell towers. The gradually increasing densities and frequencies at 150 m and decreasing values at distances farther away (250m) from cell tower might be due to innocuous sensation of warmth to serious physiological implications.

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REFERENCES

[1] Rodenburg, J., C.R. Riches and J. M. Kayeke.2010.Addressing current and fiture problems of parasitic weeds in rice. Crop prot., 29: 210-221.

[2] Barber, J. L., Thomas, G. O., Kerstiens, G., and K. C. Jones(2004). Current issues and uncertainties in the measurement and modelling of air-vegetation exchange and within-plant processing of POPs. Environmental Pollution. **128**, 99-138.

[3] Kasevich RS, 2000. Cell Towers, Wireless Convenience or Environmental Hazards? Proceedings of the "Cell Towers Forum" State of the Science/State of the Law. Chapter 11, Levitt BB (Ed.), Canada: New Century Publishing, pp. 170–175.

[4] Chatterjee, A., and Kar, S.S., Radio Frequency – A blessing or a curse. Every man's Science , vol .XLVIII No. 5, Dec'13- Jan'14, 370-374.

[5] Jones, H.G. (1987). Breeding for stomatal characters. In: *Stomatal Function*, Zieger, E.,Farquhar, G.D. and Cowan, I.R. (eds). Stanford University Press, Stanford (CA), pp. 431-443.

[6] PARIVESH newsletter ,2010. Mobile tower installations in INDIA & its impact on environment.Central pollution control board.

[7] **Lake** et.al , Nature , 411 : 154, 10th May 2001.

[8] Levitt BB, Lai H, 2010. Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. Canada: NRC Research Press, 369–395.

[9] Kumar N, Kumar G, 2009. Biological effects of cell tower radiation on human body. Electrical engineering department, IIT Bombay. December 16–19, ISMOT, 2009, New Delhi, India.

[10] Havas M, 2006. Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis. Electromagnetic Biology and Medicine, 25: 259–268.

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