Responses of Electromagnetic Radiations from cell tower on Micromorphological leaf apparatus complexes

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Abstract: The over increasing technological development and a need of faster communicating system, our living environment has turned to be a network of electromagnetic frequencies . This is an entirely different kind of pollution the world is facing with and which affects the whole of biological systems.

An effort has been made to assess the effect of Electromagnetic frequency radiation on the immobile living system – Plants growing for a long period around the source of such range of radiations. Plants are having minute micromorphological complexes on their leaf surface which are critical to the survival of terrestrial plants. These structures get chronically exposed to the radiation doses from cell towers and may get induced positively or negatively.

When *Tridax procumbens* was studies on this assumption , the stomatal complex in plants grown at various distances from cell tower were found to have significantly induced in comparison with those which were out of range and taken as control. The closer the plants were, the positive stimulation was observed and there was a range supposed to be critical for that plant at which it got reduced in its micromorphological stomatal complex in terms of frequency and density. Simultaneously, the stomatal pore surface also behaved and thus the gaseous exchange pattern was altered due to alteration in Stomatal conductance.

Key words:- Electromagnetic Frequencies, Stomata ,Stomatal Conductance etc .

Introduction:-

Rapid developments in various fields of science and technology in recent years have intensified the human interference into the natural environment and associated physical, biological and ecological systems resulting in various unintended and undesirable negative impacts on environment. With economic, social and scientific development fresh avenues for environmental pollution are being thrown open in recent times .Pharmaceutical , genetic , nano-particulate and electromagnetic pollution are the prominent ones among them in the limelight for all the negative reasons.

The intensity of electromagnetic radiation has become so ubiquitous and it is now increasingly being recognized as a form of unseen and insidious pollution that might perniciously be affecting the life forms in multiple ways.[1,2,3].

The magneto and electrobiology are disciplines which are specialized in investigating the influence of electromagnetic fields (EMF) on biological systems. It is well known that magnetic field produce biochemical physical and physiological changes in cell structures. [4]

It has become necessary to explore the influence of electromagnetic radiation (EMR) , affecting human beings and plants as well.the observation the plants growing close to the cell towers suggested that electric field did not affect the normal vegetative patterens.[5]

A survey of plant life near high –voltage transmission lines showed that EMF fields, caused a slight influence on plant growth.[6]

Assessment of the RF-EMF impact on plant is of great importance because plants are primary producers of organic compounds and oxygen. Plants are continuously exposed to various environmental stresses and display a wide spectrum of developmental and biochemical responses contributing to stress adaptation .Their physiological responses can be evoked by a great variety of external stimuli including mobile phone radiation.Many studies have reported that stomatal are affected the most under moderate stresses, but biochemical limitations are quantitatively important during leaf ageing or during serve drought. [7]

Plant stomata , the vital gate between plant and atmosphere may play a central role in plant /vegetation responses to environmental conditions, which have been and are being investigated from molecular and whole plant perspective as well as at ecosystem and global levels.[8]

An attempt has been made to evaluate the influence of electromagnetic radiation on the stomatal behavior . This plant is an important medicinal weed growing along the road side drain usually.

Material and Methods:-

The experimental design has been conceptualized on the basic principal of radiations . The field of Intensity is inversely proportional the square of distance from the source. The cell towers continuously emit Electromagnetic radiation which may affect the plant growing around. That is why at fix radial distances (Table-1) the *Tridax procumbens* was collected . These plants were subjected continuously under exposure while a control area was regarded where no tower was found at a radius around 500m, Since such electromagnetic radiations reach upto 300m with its full intensity and then fades away. Barodha ghat and Jublee park area were chosen as treated and control respectively.

Table 1 – Symbolizing radial distances from cell tower

SL.No	DISTANCES	PARAMETER
1	CONTROL	No tower at a place upto 500m
2	D1	50 m distances from cell tower
3	D2	100m distances from cell tower
4	D3	150m distances from cell tower
5	D4	200m distance from cell tower
6	D5	250m distance from cell tower

Fresh leaves were collected in clean and dry plastic bags and taken to lab. These material were washed ,blotted and peeled out for study the stomata .From the data raised with the help of RLM-Microscope (magnification- 100X-2400X),frequency , Index and Density were calculated and stomatal pore surface area was measured using image-J software.

Stomatal index was calculated using the equation of Salisbury (1927)[9] as follows -

Stomatal index = number of stomata × 100 / (number of stomata + no of epidermal cells)

Stomatal density was determined by counting the number of stomata per square millimeter of leaf surface (at magnification 100 x – 2400 x) with help of 3D- RLM microscope .

Sd= No. of Stomata/Leaf Area (Mm^2)

For every data five samples were taken and their mean values were tabulated.

Standard error was calculated as

SExm = S/√n

Where: SExm = Standard Error of Mean
S = Standard deviation of mean
n = number of observations of sample

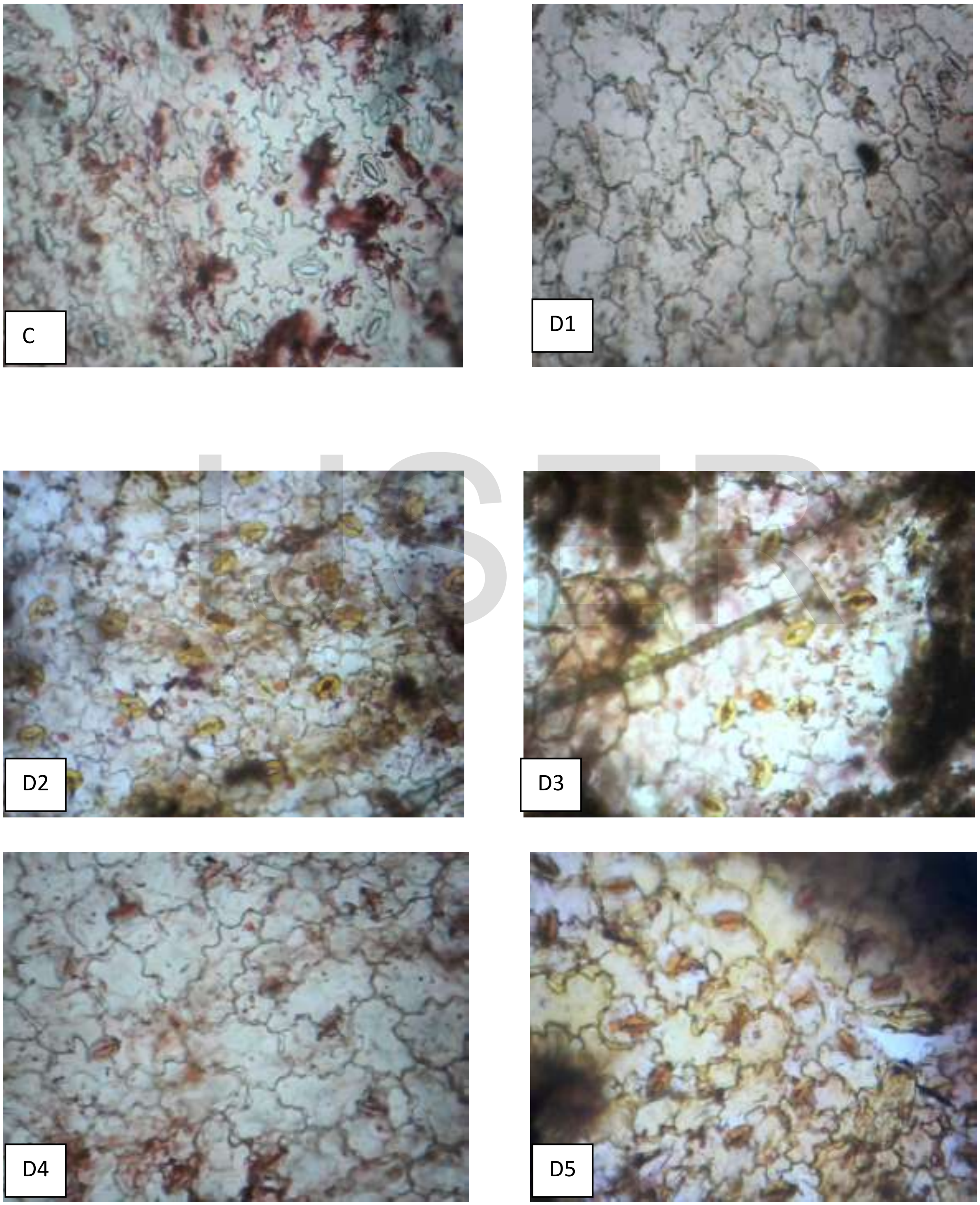
<u>Observation:-</u>

Stomatal frequency, stomatal density , stomtal index and area of stomata were measured and arranged in tabular form (Table -2). On the basis of these data graphical representation (figure: 1-5) were also assembled.

Table: 2 Stomatal patterning in *Tridax procumbens* in varying distances from cell tower

Distances	Stomatal Frequency		Stomatal Index %		Stomatal Density mm^2		Stomatal Length µm		Stomatal Width µm		Stomatal Area µm^2	
	Dorsal	Ventral	Dorsal	ventral	Dorsal	ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral
Control	20.2	30.6	26.994	32.735	103.061	156.122	36.569	38.905	27.567	27.283	1.008.097	1,061.445
50 m	19	43.2	28.247	37.226	96.939	220.408	44.303	44.562	38.838	35.113	1,720.639	1,564.705
100 m	20	25.8	26.313	33.215	102.041	131.633	43.497	50.593	31.024	33.351	1,349.450	1,687.327
150 m	12	36.8	22.181	36.362	61.224	187.755	46.032	44.082	32.632	32.690	1,502.116	1,441.040
200 m	11.2	23.2	18.734	30.318	57.143	118.367	36.918	38.456	24.574	25.496	907.222	980.474
250 m	16.2	29	24.256	31.393	82.653	147.959	37.835	37.635	23.536	25.923	890.484	975.612

Plates : 1 Dorsal Stomata in *T. procumbens* (L.) at various distances from cell tower (800x)



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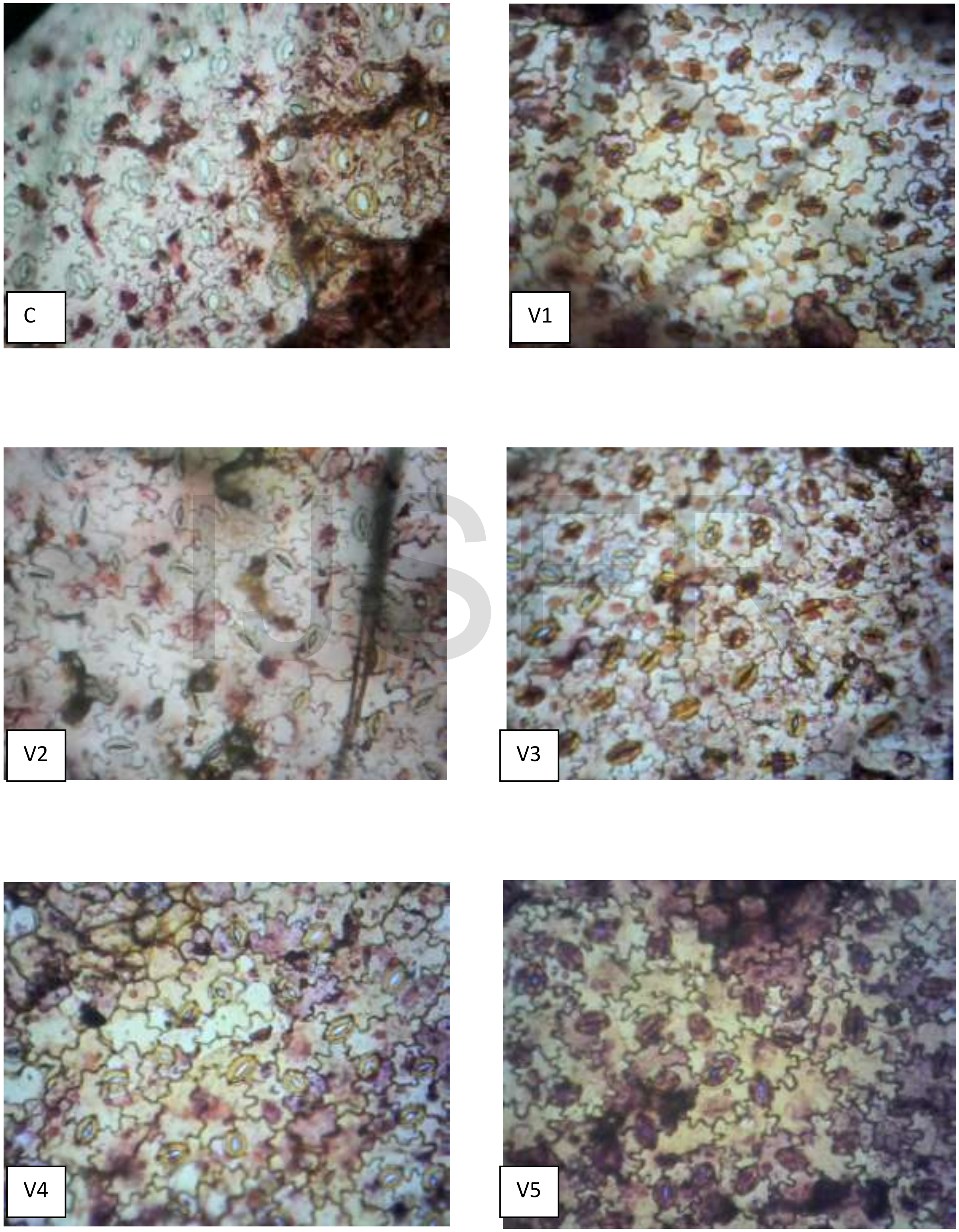
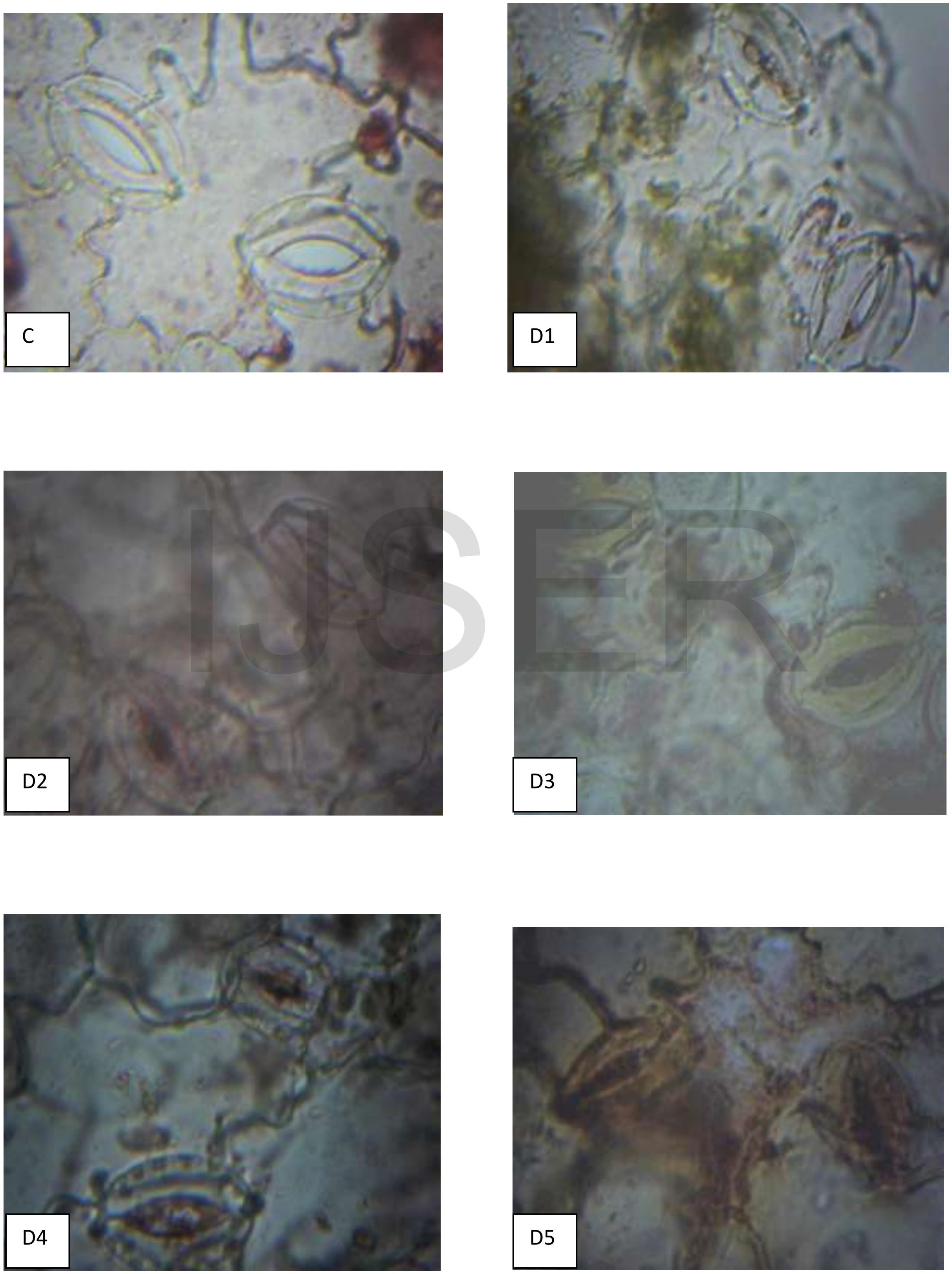
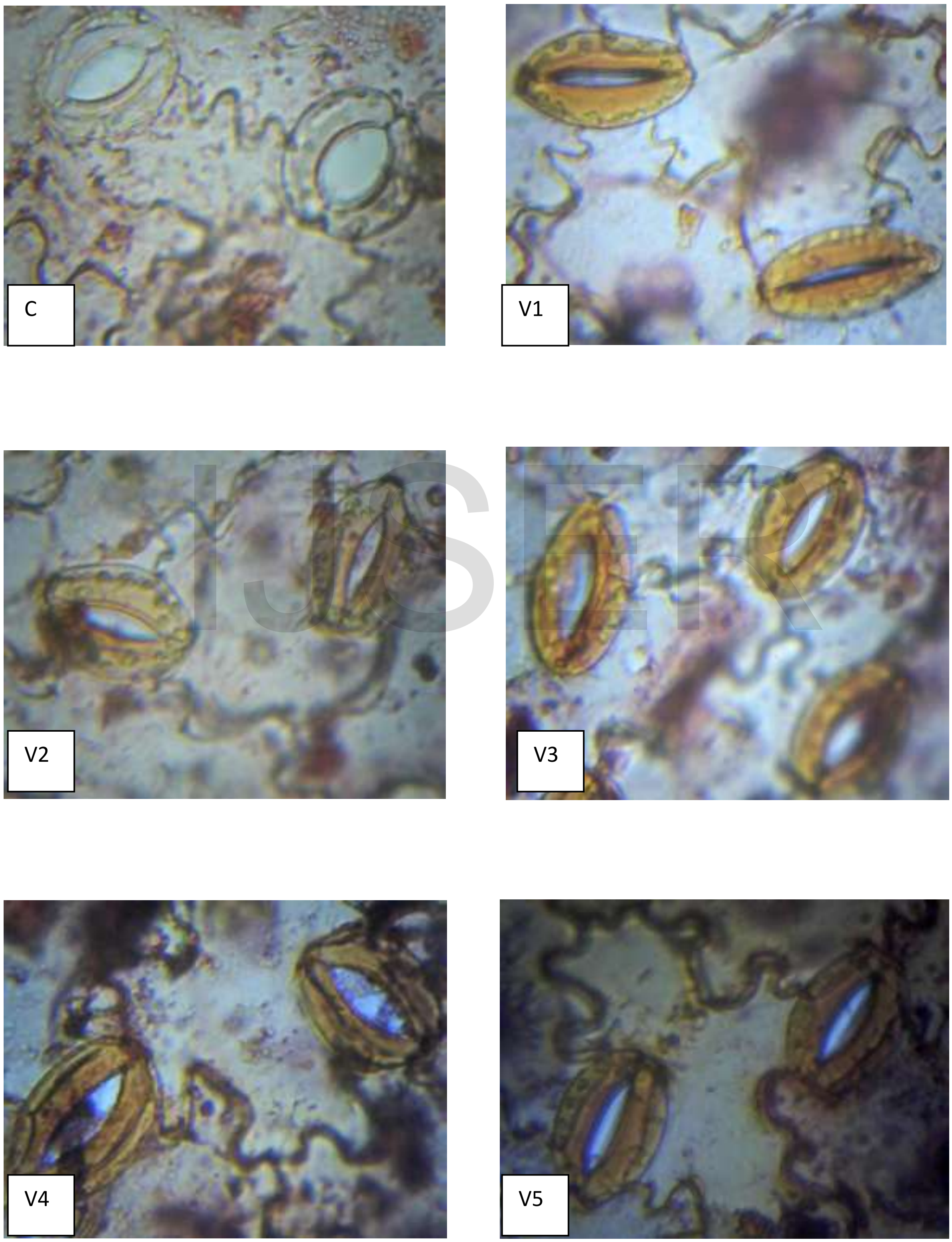
Plates: 2 Ventral Stomata in *T. procumbens* (L.) at various distances from cell tower (800x)



Plates : 3.2.1 Dorsal Stomata in *T. procumbens* (L.) at various distances from cell tower (2400x)



Plates : 3.2.1 Ventral Stomata in *T. procumbens* (L.) at various distances from cell tower (2400x)



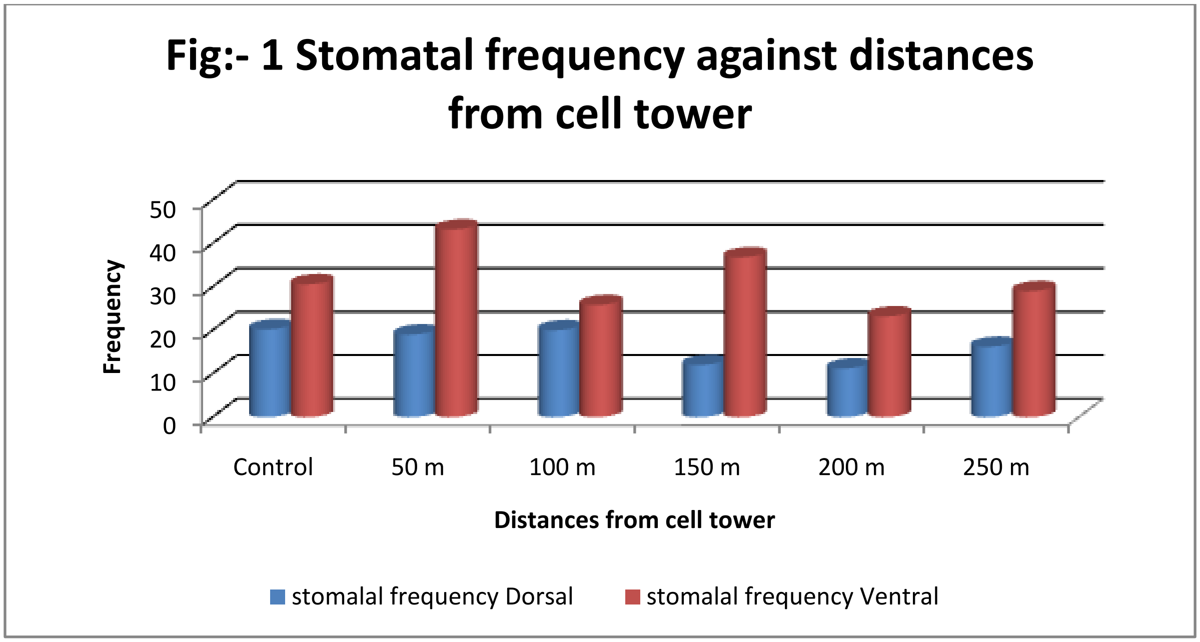


Fig:- 1 Stomatal frequency against distances from cell tower
Frequency
50
40
30
20
10
0
Control
50 m
100 m
150 m
200 m
250 m
Distances from cell tower
stomalal frequency Dorsal
stomalal frequency Ventral

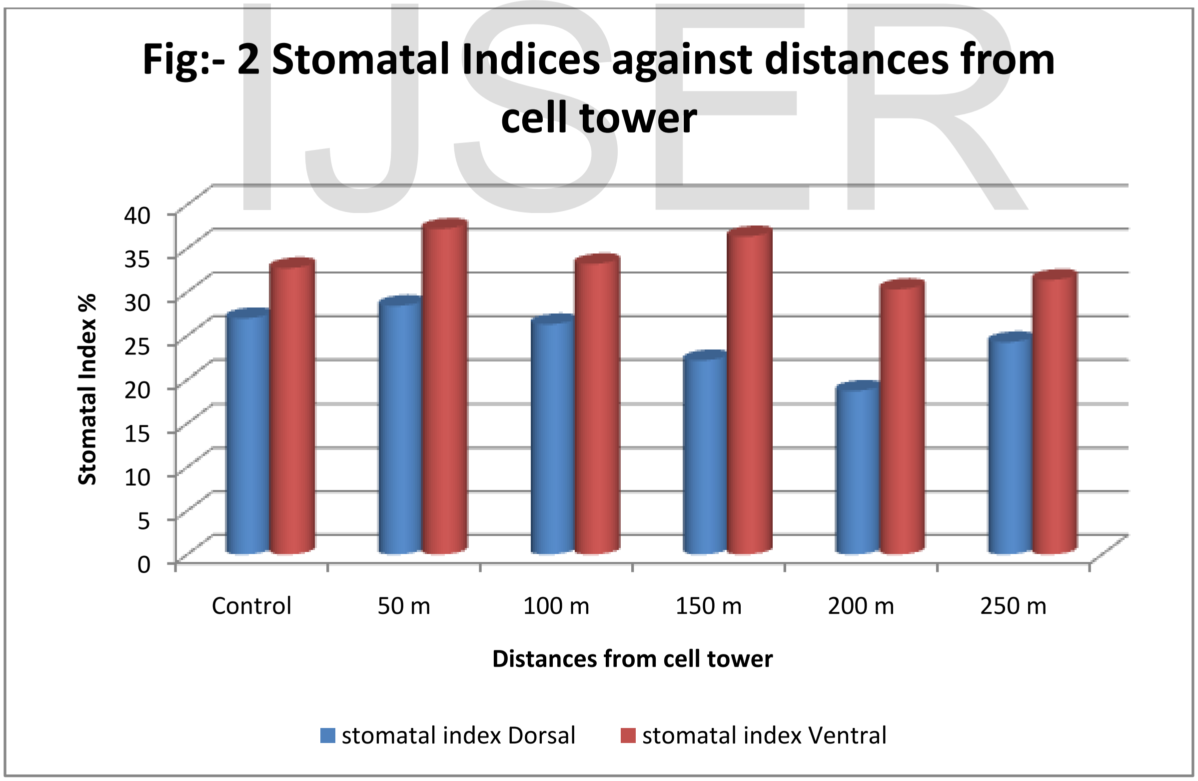


Fig:- 2 Stomatal Indices against distances from cell tower
Stomatal Index %
40
35
30
25
20
15
10
5
0
Control
50 m
100 m
150 m
200 m
250 m
Distances from cell tower
stomatal index Dorsal
stomatal index Ventral

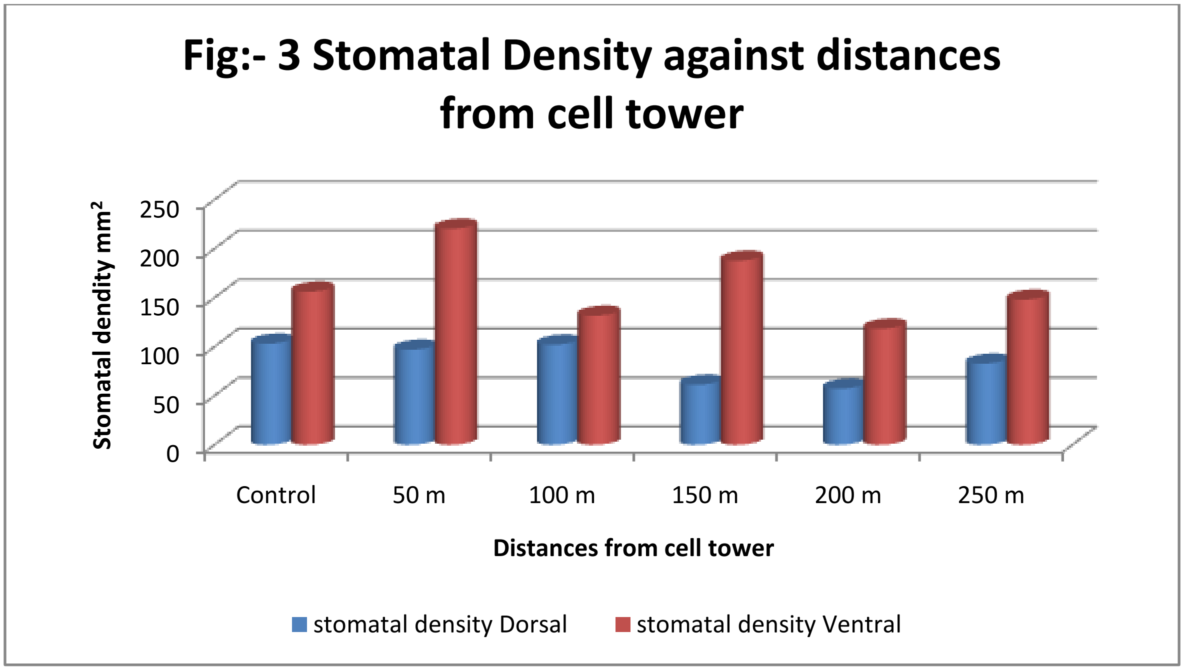


Fig:- 3 Stomatal Density against distances from cell tower
Stomatal dendity mm²
250
200
150
100
50
0
Control
50 m
100 m
150 m
200 m
250 m
Distances from cell tower
stomatal density Dorsal
stomatal density Ventral

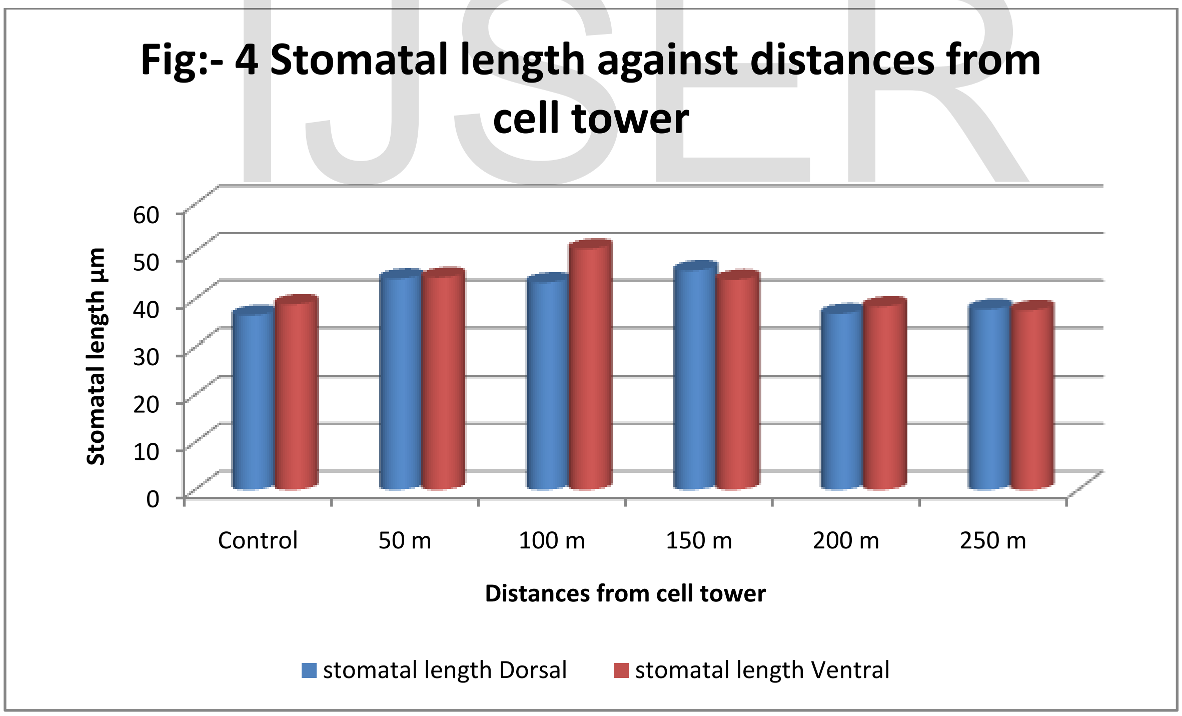
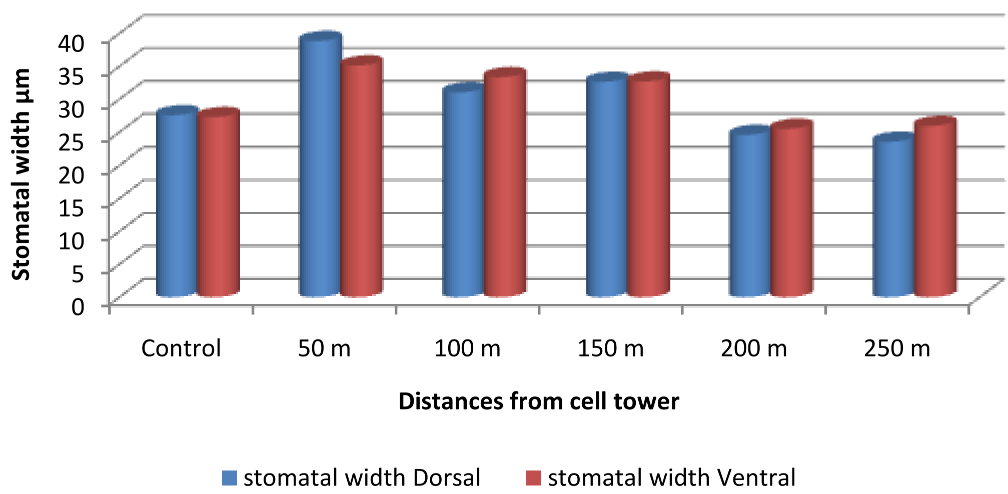


Fig:- 4 Stomatal length against distances from cell tower
Stomatal length µm
60
50
40
30
20
10
0
Control
50 m
100 m
150 m
200 m
250 m
Distances from cell tower
stomatal length Dorsal
stomatal length Ventral

Fig:- 5 Stomatal width against distances from cell tower



Result and Discussion:-

The success and stability of plant species in its environment depends on its ability to manipulate its responses and find a balance between photosynthetic uptake of CO2 and water conservation. The experimental results in case of *Tridax procumbens* justifies this behavior by varying the total leaf area allocated to stomatal pores and by altering the number and size of the stomata to have a control on stomatal conductance. Stomatal features have been recorded to have a large number of smaller stomata or a small number of larger stomata thereby altering and regulating its water relation by changing frequency index and density of stomata at varying distances from cell tower.

As obvious from Table and graph, plants nearer to cell tower (50 m) might have got stimulated and showing increased stomatal frequency and density in comparison to control plants. From 100 meters onwards, fluctuations in all the stomatal parameters were observed which might be an attempt of attaining normalcy in response to stress due to Electromagnetic radiations.

The havoc created in plant leaves at physiological level definitely would have been expressed in micromorphological numbers and sizes of stomata. At 50 m therefore, total no of epidermal cells increased with highest frequency and density of stomata although the total area of leaf allocated to stomata was reduced as revealed by decreased Index from 32.7% to 31.2%.

The stomatal area increased at 150m with highest Index of 36.36% but with stomatal pore surface a bit reduced. At 100 meters the total number of epidermal cells although reduced considerably the stomatal pore surface increased at its peak (1687.33 $m\mu^2$).

At 200 meters and 250 meters when the plants were out of drastic influence, the stomatal values returned to normal (as observed in Table-2)

From all these manipulations in stomatal features by the plant the evidence of electromagnetic influence certainly appears to be there. The higher doses of EMF must have been received by the plants growing in mid-range of distance i.e. between 100 meters and 150 meters .At this distance there must have been decreases in chlorophyll molecules in guard cells which might have caused a change in the balance of stomatal density and index.

The stomatal characteristics have tendency to alter to make the plants adapt in changing level of Environmental stress.

The reduction in stomatal size should be associated with more efficient stomata and with faster movement response. Small stomata with higher density would actually result in shorter path length for diffusion of gases and maximum efficiency in stomatal conductance .Thus it seems that physically the plant is not at loss but physiologically and biochemically there must be great loss to plants.

The increased stomatal density and stomtal pore surface also point towards the efficient thermoregulations mechanism. Due to the thermal effect of electromagnetic radiations the plants might experience internal thermal stress and it gets regulated by increasing the number of stomata changing the frequency and index . By changing the pore area the increased conductance of gases result in autocooling which is required for survival of plants.

Lake et.al , 2001 [10] conceptulazied about 'stomagen' which is a small polypeptide released by chlorophyll and induce the formation of stomata in the epidermis of leaf .This could be thought of as an adaptive stimulatory measure by the plant.

Tridax is an amphistomous plant in which the leaves have stomata at both the surfaces. The stomatal behavior altered both the surfaces proving thereby the major role played by EMF radiations.

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