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WATER POLLUTION IN RELATION TO THE STOMATAL ANOMALIES IN THE LEAVES OF THE WILD FLORA OF MEERUT

MUKESH KUMAR

Department of Botany, Sahu Jain (P.G.) College, Najibabad - 246763, India.

With an idea to estimate the degree of damage caused to the wild flora of district Meerut, by water pollutants, several selected polluted sites at Kali Nadi were surveyed. All the species investigated did not response in similar fashion to the polluted water. However, certain species were tolerant, while others were sensitive to polluted water. This water could induce epidermal abnormalities as well as bring changes in the epidermal pattern of sensitive species. Kali nadi contains sugar and paper industry effluents.

Keywords : Epidermal abnormalities; Stomata; Water pollution.

The adverse effect of pollution on flora and fauna is more or less documented. However, the effect on the wild angiosperm flora is lacking to a great extent. With an idea to estimate the possible damage done by polluted water to the wild angiosperm flora, a highly water polluted site in the district Meerut was surveyed for the possible damage. Fifteen different wild species of angiosperm growing in very close contact with the polluted water were analysed morphologically. The analysis of the epidermis includes frequency of stomata, frequency of epidermal cells, stomatal index and frequency of anomalous stomata per milimeter area and the size of stomata.

The present investigation was carried out during November and December 1989, and January, 1990. The plants were identified with the help of different floras. The identifications were confirmed by compairing the herbarium specimen with the voucher specimen kept in the herbarium of Meerut University, Meerut.

Mature leaves of control and affected wild species were collected and fixed in F.A.A. The apidermal peels of the leaves were removed by scraping method or by making an oblique cut in them. In such taxa where peels could not be obtained by the above method the leaf bits were treated with 1:1 glacial acetic acid and H_2O_2. The peels were washed with water, stained in Delafield's haematoxylene, mounted in glycerine and sealed with DPX.

For the study of stomatal index Salisbury[1] gave the following formula -

$$SI = \frac{S}{E+S} \times 100 \quad \text{--------(i)}$$

Where, S = Number of Stomata/mm^2
E = Number of epidermal cells/mm^2

In the present work the stomatal index has been calculated by the following formula :

$$SI = \frac{S \times 2}{E + (Sx2)} \times 100 \quad \text{--------(ii)}$$

Where, S and E Symbolize same as in Formula (i)

Change in the formula (i) has been made due to the fact that the guard cells are also epidermal cells, so, for equating the stomata with normal epidermal cells, the number of stomata should be multiplied by 2 in general.

For the calculation of the stomatal index of abnormal stomata, formula (ii) can be modified as under :

$$\text{S.I. (Abnormal Stomata)} = \frac{\left[\text{Total No. of stomata} - \text{No. of stomata with both guard cell degenerated}\right] \text{No. of stomata x 2 - with one GC degenerated}}{\text{No. of guard cells + Total number of Epidermal cells}} \times 100 \quad \text{---------- (iii)}$$

A number of stomatal abnormalities have been encountered infrequently in the leaves of all the species (both surfaces) except those of *Cannabis sativa* and *Parthenium hysterophorus*. These include stomata with one guard cell degenerated (Fig. 3 : A, C), stomata with both guard cells degenerated (Fig. 3 : G, L), contiguous stomata (Fig. 3 : D, F), and stomatal clogging (Fig. 3 I, J). The graphical representation of the frequency distribution of stomata has been shown in Fig. 1. Our findings of one or both guard cells degeneration are confirmatory to the work of Rajachidambaram and

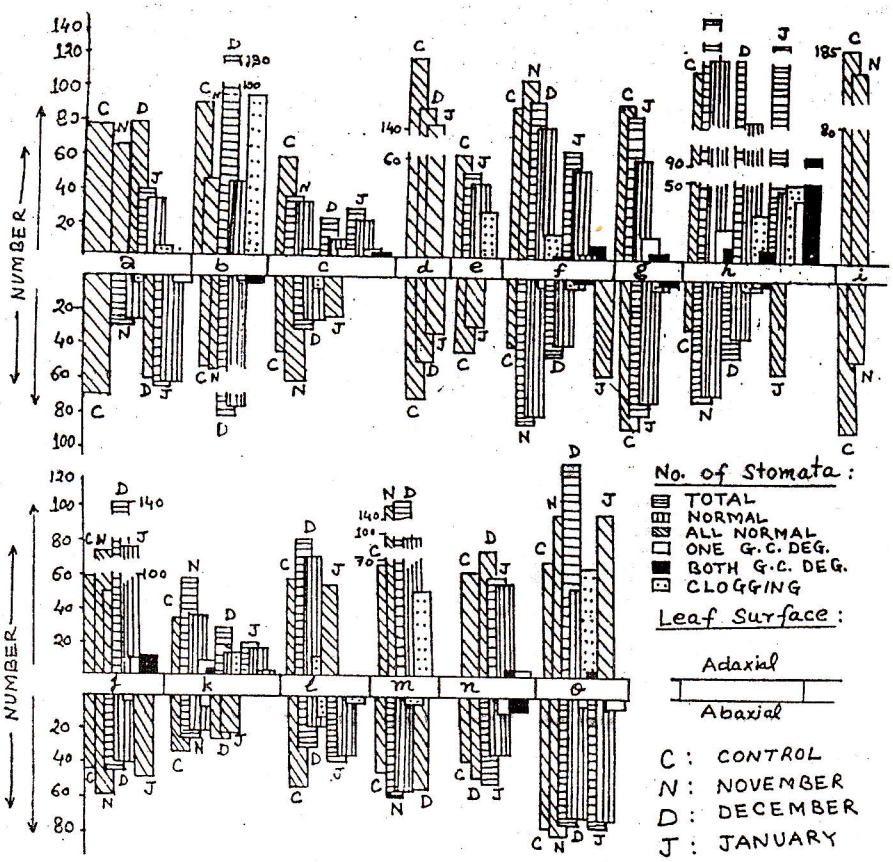

Fig. 1. Frequency Distribution of Stomata / mm² area, in the plants collected from river Kali (Meerut).

(a) *Alternanthera sessilis* (b) *Amaranthus spinosus* (c) *Blumea lacerata* (d) *Cannabis sativus* (e) *Chenopodium album* (f) *Chenopodium ambrossoides* (g) *Croton bomplandianum* (h) *Eclipta alba* (i) *Parthenium hysterophorus* (j) *Polygonum glabrum* (k) *Ranunculas sclerotes* (l) *Rumax dentatus* (m) *Solanum nigrum* (n) *Veronica anagalis* (o) *Xanthium strumarium.*

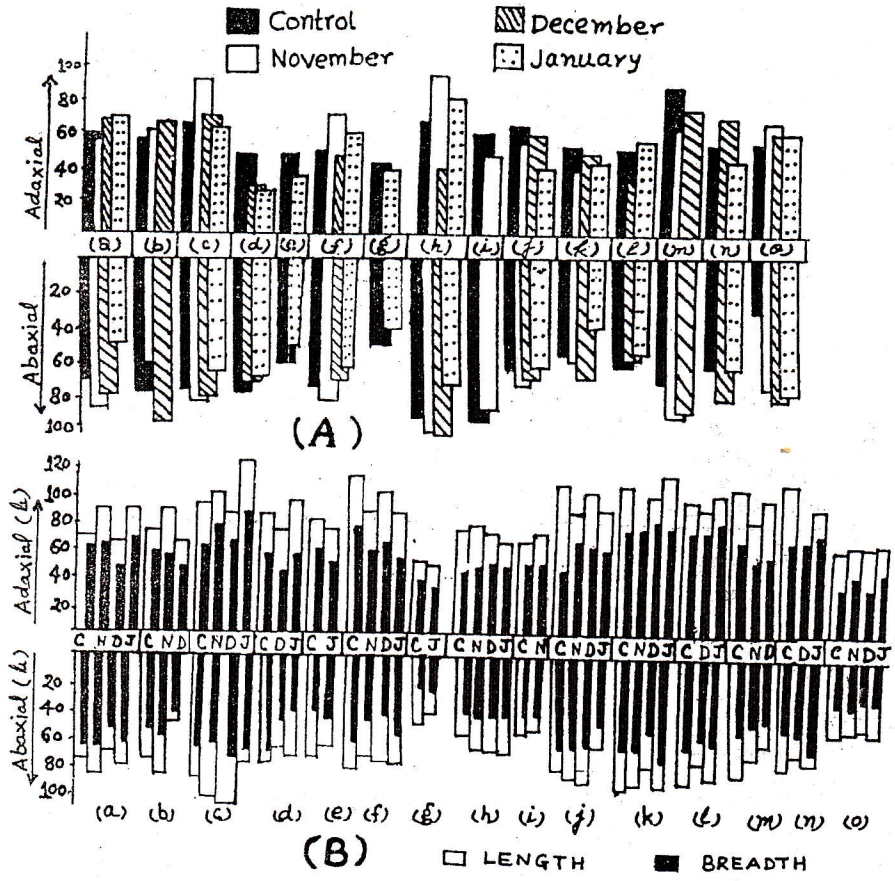

Fig. 2. (A) Stomatal Index/mm^2 (B) Size of the stomata (μ)
(a) *Alternanthera sessilis* (b) *Amaranthus spinosus* (c) *Blumea lacerata* (d) *Cannabis sativus* (e) *Chenopodium album* (f) *Chempodium ambrossoides* (g) *Croton bomplandianum* (h) *Eclipta alba* (i) *Parthenium hysterophorus* (j) *Polygonum glabrum* (k) *Ranunculas sclerotes* (l) *Rumax dentatus* (m) *Solanum nigrum* (n) *Veronica anagalis* (o) *Xanthium strumarium.*

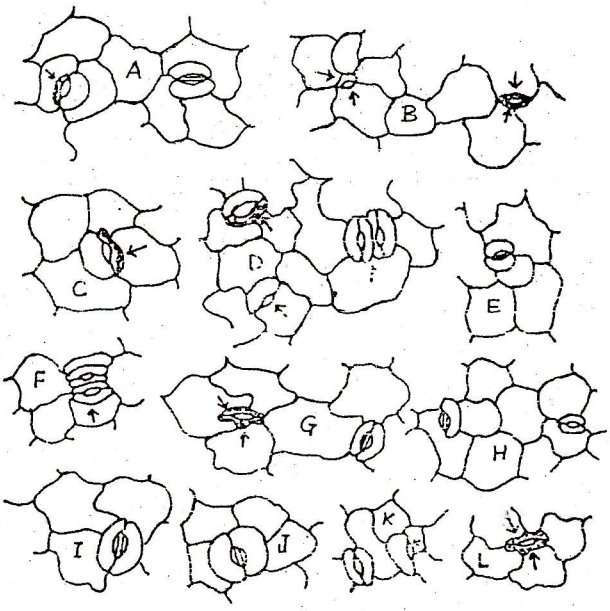

Fig. 3. Stomatal Abnormalities
A : *Alternanthera sassilis*; B : *Amaranthus spinosus;* C : *Blumea lacerata*; D : *Chenopodium ambrossoides*; E : *Chenopodium album*; F : *Croton bomplandianum;* G : *Eclipta alba*; H : *Jussea sufroticosa*; I : *Ranunculas sclerotes*; J : *Rumax dentatus*; K : *Solanum nigrum*; L : *Veronica anagalis.*

Krishnamurty[2]. The polluted water altered the stomatal index and size of stomata in relation to the control. Data have been summerised in Fig. 2 A and Fig. 2 B, respectively. A decrease in the stomatal index caused by the pollutents was also observed by Bhirvamurty and Kumar[3]. Different plants exhibited different degree of response to the pollution in relation to the control which may be due to the change in the quality of the effluent in respective months. Some species are more sensitive while others are tolerant. The size of stomata is increased in some taxa while it decreased in others. The increase in the size of stomata is supported by the reports of Sharma and Butler[4], a reduction on the other hand was observed by Garg and Varshney[5]. Most of the species show a deviation over control with respect to the parameters studied. Due to some natural causes such as heavy rain some plants could not be observed during a few months. The frequency of abnormal stomata is directly proportional to the concentration of the effluent. These anomalies may be due to the developmental errors caused by the toxicity of the polluted water in which the plants were growing. The degeneration of the guard cells may be due to the accumulation of some chemicals in them[6].

It is established from the above investigations that the epidermal parameters of plants can be used for monitoring the level of water pollution and the magnitude of changes induced. Eqidermal characteristics can be used to assess the extent of damage caused to the flora of a particular place.

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