

# Effect of soil variables on the size and shape of stomata of *Plantago* species.

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**Abstract**— An experiment was set up to study the effect of different soil variables on the size and shape of stomata of *Plantago* species. In order to determine the effect of soil variables on the size and shape of stomata of *Plantago ovata*, *P. lanceolata* and *P. coronopus*, the length and width of definite number of stomata of each species was recorded with the help of stage micrometer and ocular from each soil type. After that, the mean of the length and width of stomata from each species was obtained in each soil condition. The data was then subjected to statistical analysis. On the basis of the above results, it can be concluded that the organic soil is the best one for the growth of *Plantago* species. The wideness of stomata in organic soil might have a definite and positive role in altering the rate of photosynthesis, respiration, transpiration etc. giving a signal for the increase in productivity of the plants.

**Indexed Terms**— *P. ovata* (*Plantago ovata*), *P. lanceolata* (*Plantago lanceolata*), *P. coronopus*, (*Plantago coronopus*) etc.

## I. INTRODUCTION

The genus *Plantago* belongs to the family Plantaginaceae which includes three Genera viz. *Bougueria* (1 species), *Litorella* (1 species) and *Plantago* (over 200 species). About 10-14 species of *Plantago* are native of India. But for *Plantago ovata* which is cultivated for its seed husk, all other species are wild. The *Plantago lanceolata* and *Plantago coronopus* are B-chromosome carrier species. During our investigation it has been planned to study the effect of soil variables on the size and shape of stomata of *Plantago* species. In order to study the effect of soil variables on the stomata of *Plantago* species, four different types of soils were used, i.e., Control soil (pure garden soil only), Organic soil (pure cow dung), sandy soil (pure sand only) and usar soil (the mixture of garden soil and usar soil in the ratio 10:1).

## II. MATERIAL AND METHODS

The three species of the Genus *Plantago* were selected for the study viz. *P. ovata*, *p. coronopus* and *P. lanceolata*. The selected species are diploid with normal mitosis and meiosis. The seeds of different species of *Plantago* were procured through courtesy of Central Institute of Medical and Aromatic Plants (CIMAP), Lucknow, Jardin Botanique de L. Universite, Louis Pasteur de Strasburg, France and Narendra Deo Agriculture University, Kumarganj, Faizabad.

To determine the effect of different soils on stomata of *P. ovata*, *P. coronopus* and *P. lanceolata*, the length of with definite number of stomata of each species was recorded with the help of stage micrometer and ocular from every soil type. After that the mean of the length and width of stomata from each species was obtained in each soil condition. The data was then subjected statistical analysis.

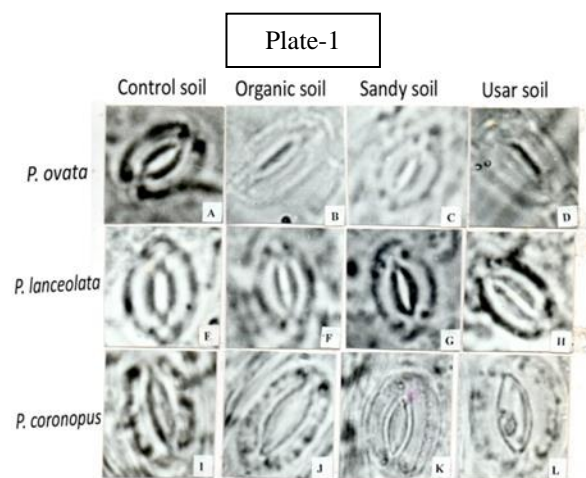
## III. RESULTS AND DISCUSSION

In the case of *Plantago ovata* it was observed that the average mean value of length in control, organic, sand and usar soil were 24.949  $\mu\text{m}$ , 26.176  $\mu\text{m}$ , 23.51  $\mu\text{m}$  and 25.153  $\mu\text{m}$  respectively and the average mean value of width was observed as 19.632  $\mu\text{m}$ , 21.47  $\mu\text{m}$ , 19.63  $\mu\text{m}$  and 20.24  $\mu\text{m}$  respectively. The maximum length was observed in organic soil while the minimum length was observed in sand. The maximum width was also observed in organic soil and the minimum width was recorded in control and sandy soil. (Table-1) (Plate-1).

The average mean value of length of stomata of *Plantago lanceolata* were observed in control, organic, sand and usar soil as 24.54  $\mu\text{m}$ , 24.33  $\mu\text{m}$ ,

26.99  $\mu\text{m}$  and 23.92  $\mu\text{m}$  respectively and the average mean value of width was recorded as 19.42  $\mu\text{m}$ , 22.69  $\mu\text{m}$ , 18.20  $\mu\text{m}$  and 19.01  $\mu\text{m}$  respectively. The maximum length was observed in sand the minimum length was observed in usar soil likewise, the maximum width was observed in organic soil and the minimum width was recorded in sand (Table-1) (Plate-1)

The average mean value of length of stomata in *Plantago coronopus* were recorded in control, organic, sand and usar soil as 27.60  $\mu\text{m}$ , 28.01  $\mu\text{m}$ , 27.19  $\mu\text{m}$  and 23.72  $\mu\text{m}$  respectively and the average mean value of width of stomata was recorded as 22.29  $\mu\text{m}$ , 24.94  $\mu\text{m}$ , 21.67  $\mu\text{m}$  and 21.26  $\mu\text{m}$  respectively. In *P. coronopus* the maximum length was recorded in organic soil while the minimum was observed in usar soil and the maximum width was observed in organic soil and the minimum in usar soil (Table-1), (Plate-1).



In *Plantago ovata* the coefficient variation in length were recorded as 11.47%, 10.36%, 9.32% and 12.87% in control, organic, sand and usar soil respectively. The maximum variation in length was observed in usar soil while the minimum was recorded in sandy soil. Likewise, the coefficient variation of width were recorded as 15.59%, 11.85%, 11.17% and 13.51% in control, organic, sand and usar soil respectively. The maximum variation was observed in control soil while the minimum was recorded as in sandy soil (Table-1) (Plate-1).

In *P. lanceolata* the coefficient variation in length were recorded as 11.78%, 13.52%, 7.42% and 12.41% in

control, organic, sand and usar soil respectively. The maximum variation in length was observed in organic soil while the minimum was observed in sandy soil. Likewise, the coefficient variation of width were recorded as 11.2%, 8.96%, 11.17% and 12.30% in control, organic, sand and usar soil, respectively. The maximum variation in width was observed in usar soil while the minimum was recorded in organic soil (Table-1) (Plate-1)

In *P. coronopus* the coefficient variation in length was observed in control, organic, sand and usar soil as 9.22%, 10.60%, 7.17% and 6.89%, respectively. The maximum variation in length was observed in organic soil while the minimum was observed in usar soil. Likewise, the coefficient variation in width were recorded as 10.18%, 7.14%, 8.64%, and 11.53% in control, organic sand and usar soil respectively. The maximum coefficient variation was observed in usar soil while the minimum was recorded in organic soil (Table-1) (Plate-1).

The t-test value of length of *P. ovata* was recorded significant in control, sand and usar soil while it was non-significant in organic soil at 40% probability and also at 60% probability. Likewise, the t-test value of width was recorded significant in control, sand and usar soil while it was again non-significant in organic soil at 40% as well as 60% probability (Table-2).

The t-test value of length and width of *P. lanceolata* was significant in all the four types at 40% as well as at 60% probability. (Table-2)

Likewise, the t-test value of length of *P. coronopus* was significant in all the four soil type at 40% as well as 60% while the width was recorded significant in control soil and non-significant in organic, sand and usar soil at 40% probability while at 60% probability the value of t-test was significant in control and sandy soil while it was non-significant in organic as well as in usar soil (Table-2)

The effect of different soil type on the size and shape of stomata, was more or less like that of the size and shape of leaves.

In *P. ovata*, the length of stomata was almost alike in different type of soil but breadth was maximum in

organic soil, however the coefficient of variation was lowest in organic soil and sandy soil and it was maximum in usar soil. In *P.lanceolata* again the length of stomata did not vary under changed soil conditions but the width was maximum in organic soil. Coefficient of variation was again maximum in usar soil. In *Plantago coronopus*, the length of the stomata did not have much response under changed soil conditions but the width was maximum in organic soil. Coefficient of variation was again maximum in usar soil.

The result clearly indicated that the size and shape of stomata remain unaffected under changed soil conditions but there was some indication that the width of stomata was maximum in organic soil.

On the basis of the above results it can be concluded that the organic soil is the best one for the growth of *Plantago* species. The wideness of the stomata in organic soil might have a definite and positive role in altering the rate of photosynthesis, respiration, transpiration etc. Giving a signal for the increase in the productivity of the plant.

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TABLE-1  
Effect of different soil type on the size and shape of stomata.

TYPE OF SOIL	<i>P. ovata</i>						<i>P. lanceolata</i>						<i>P. coronopus</i>					
	Length			Width			Length			Width			Length			Width		
	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %	$\bar{x}$ $\mu\text{m}$	S.D $\mu\text{m}$	C V %
CONTROL SOIL	24.9	2.863	11.47	19.2	3.060	15.59	24.4	2.86	11.78	19.2	2.16	11.2	27.0	2.53	9.22	22.9	2.37	10.81
ORGANIC SOIL	26.176	2.69	10.36	21.47	2.54	11.85	24.33	3.272	13.52	22.69	2.00	8.96	28.01	2.94	10.60	24.94	1.75	7.14
SAND SOIL	23.51	2.16	9.32	19.63	2.16	11.17	26.9	1.96	7.42	18.20	2.00	11.17	27.1	1.92	7.17	21.67	1.86	8.64
USAR SOIL	25.153	3.23	12.87	20.24	2.69	13.51	23.94	2.94	12.41	19.03	2.33	12.30	23.72	1.63	6.89	21.26	2.45	11.53

 $\bar{x} \mu\text{m}$  = Mean Size

CV% = Coefficient variation.

S.D. $\mu\text{m}$  = Standard Deviation

TABLE-2  
Plant To Plant Variation of size and shape of stomata in *Plantago* species under changed soil conditions.

Plant species	Source of variation	B Total size of stomata/Total no. of Plants		$\bar{x}$ Mean Stomata size		SD Standard Deviation		S.E. Standard Error		$t = \frac{B - \bar{x}}{S.E.}$	
		L	W	L	W	L	W	L	W	L	W
<i>Plantago ovata</i>	Control	6.1	4.8	5.0	4.0	0.71	0.76	0.70	0.74	1.5714*	1.08108*
	Organic	6.4	5.25	6.00	5.00	0.68	0.63	0.66	0.60	0.6060**	0.4166
	Sand	5.75	4.75	5.0	5.00	0.55	0.55	0.54	0.54	1.38*	1.38*
	Usar	6.1	4.95	5.0	4.0	0.78	0.68	0.76	0.66	1.44736*	1.43939*
<i>Plantago lanceolata</i>	Control	6.0	4.75	5.0	4.0	0.72	0.55	0.7	0.5	1.428*	1.5*
	Organic	5.95	5.55	5.0	5.0	0.82	0.51	0.8	0.4	1.1875*	1.375*
	Sand	6.6	4.45	6.0	4.0	0.50	0.51	0.4	0.49	1.5*	1.125*
	Usar	5.85	4.65	5.0	4	0.74	0.58	0.7	0.5	1.214*	1.3
<i>Plantago Coronopus</i>	Control	6.75	5.45	6.0	5.0	0.63	0.60	0.6	0.5	1.25*	0.9*
	Organic	6.85	6.1	6.0	6.0	0.74	0.44	0.7	0.4	1.21*	0.25
	Sand	6.65	5.3	6.0	5.0	0.48	0.47	0.4	0.4	1.625*	0.75**
	Usar	5.85	5.2	5.0	5.0	0.366	0.61	0.3	0.6	2.833*	0.33

L=Length  
40% = \*Significant at  
40% = 0.861W=Width  
60% = \*\*Significant at  
60% = 0.533