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STUDIES ON LEAF CHARACTERS IN *MALACHRA CAPITATA* L.

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ABSTRACT

Studies made on different leaf characters in *Malachra capitata* showed that the leaf angle is negatively correlated with the length and width of leaves but positively correlated with the area of leaves. The leaf angles are differentiated into three forms according to the position of leaves on the stem.

INTRODUCTION

In the present investigation, an attempt has been made to study the different leaf characters such as leaf angle, total length, width, area of the lamina and length of only the petiole in *Malachra capitata* L. This study was conducted at the Jute Agricultural Research Institute, Barrackpore, West Bengal during 1967.

MATERIALS AND METHODS

Ten plants were selected for recording (a) the angle of the petiole with the shoot, (b) the length of the petiole, (c) the length of the whole leaf, (d) width of the leaf and (e) the area of the lamina. These characters were scored in the first week in August, when the plants completed their vegetative phase. In choosing the plants for scoring, care was taken to see that they had equal numbers of leaves and the characters were recorded from successive leaves from the base. Leaf angle was measured by drawing the actual angle formed by the petiole with the stem axis, on a white paper clamped on a hard board, from the standing plant. The other characters were, however, recorded after the plants were harvested. In determining the area of the leaves, only three regions on the stem were considered and the same was determined by means of a planimeter. Average value for each character was determined and the data were analysed by using ideograph technique. Statistical difference in the measures of any character at different positions of a plant and the correlations between different characters were also worked out by using analysis of variance and covariance technique. The correlation coefficients between different pairs of characters were obtained from the error line of the analysis of variance table. For this study, data from three regions of the plant namely, base, middle and top were taken into consideration.

OBSERVATION

The leaves of *Malachra* are simple, alternate, stipulate, stipules free-lateral, 1 to 4 on each side of the leaf base, linear, pubescent and 0.6 cm to 1.0 cm long. Stipules remain in a cluster at the base of the petiole, when the internodes are short and sometimes these formed a ridge on each side of the long internodes. The petiole is finely pubescent with reddish tinge on the upper surface and greenish on the lower surface. Lamina is inlobed, cordate, orbicular, broad, 7-nerved, palmately reticulate and purplish on the veins of the lower surface of older leaves. The surface of the lamina is hairy and the margin superficially dentate and purplish, and the apex is hardly distinguishable. In some cases, the leaves at the top portion at the flowering period turn white and crumple.

Measurements of different characters associated with the successive leaves on the stem showed a fall according to their insertion on the stem towards the apex (Table 2). The angle of the leaves with the stem is wider in the case of the basal leaves and narrower in the upper leaves. The angle formed by the petiole of the lowermost leaves exceed even one right angle, and upto 6th leaf starting from the lowermost one, the angle follow more or less an irregular pattern, *i.e.*, some are

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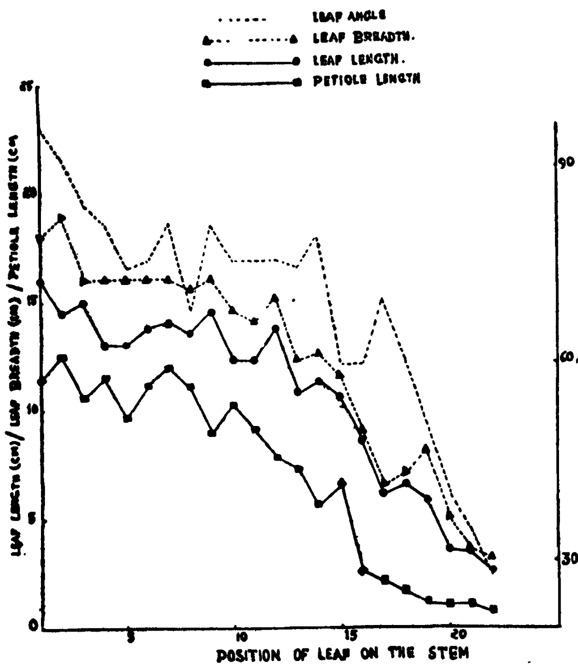
wider while the others narrower, and from the 18th to the measured topmost one, angles are regular, but they become narrower gradually. The leaf angle ot the successive leaves, [as it is observed in ideographs (Fig. 1)] could be differentiated into 3 forms. In form I, there was a more or less consistent decrease (basal region), form II showed irregular angles (intermediary region) and form III showed gradually narrowed angles (subterminal and terminal). Petiole length did not, however, follow the same course of development as the angle. The length of the petiole is irregular upto 10th leaf on the stem from the base, where the successive petioles upto this point are one long alternating with a shorter one, the 2nd one being the longest and the 9th the shortest. Starting from the 11th one, the petiole becomes shorter in length gradually upto 14th leaf and the next one is slightly longer, while the rest towards the top exhibit a sharp fall in length of their petioles. At the extreme tip, the petioles can hardly be distinguishable. The same course was traced in the case of width of leaves also, with the exception that the 2nd leaf from the base is broader than the 1st leaf. In all the leaves width is more than the length, however, the differences gradually lower towards the top (Table 2). It can be seen from Fig. 2 how the leaf shape changes gradually on the stem, where the widtns of the consecutive leaves and their petiole length are plotted against their lengths on a logarithmic scale. It could be seen that the graph representing most of the foliage leaves, is a straight line. Basal foliage leaves, however, do not bear any relation between the length and width or the length of petiole and the length of the leaf.

The analysis of variance (Table 4) revealed that the mean values for leaf angle, length of petiole, length and width of leaf and the area of the leaf at three positions, e.g., base, middle and top of the plant were highly significant. With the gradual reduction in length, width and area of the leaves, the petiole became gradually shorter resulting in narrowed leaf angle (Table 3). Correlation of leaf angle with the petiole length and the length and width of the leaves were found to be negative, whereas, it was positively correlated with the area of the leaves. Though the petiole was negatively correlated with the length and area of a leaf, its correlation with the width of leaf was positive. Leaf area and leaf width were found to be positively correlated and among the different r values, only



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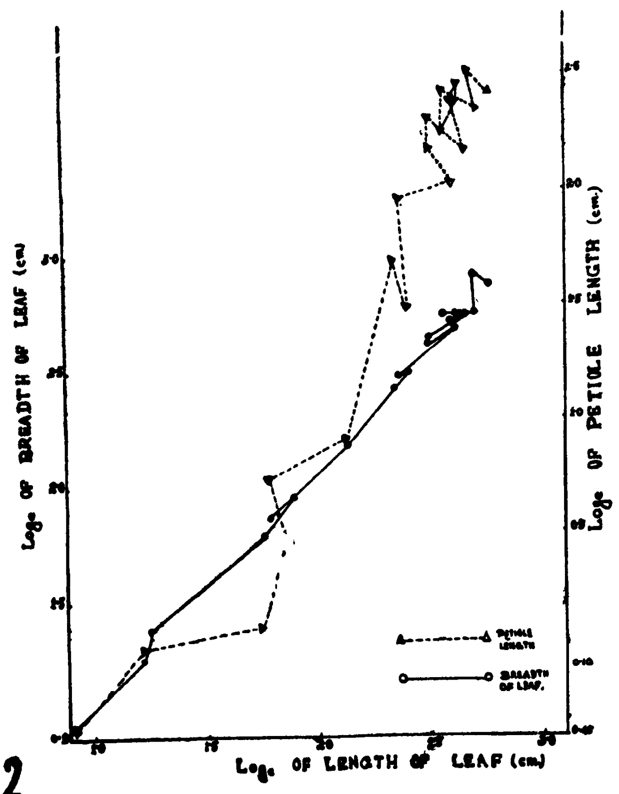

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Fig. 1. Graph showing the relation among different leaf characters. Fig. 2. Graph showing the pattern of leaf shape.

one value of r, *i.e.*, for the pair length and width of leaf was statistically significant (Table 4).

TABLE 1: *Measurements of leaf angle, petiole length, length and width of successive leaves in Malachra capitata* L.

Leaf No. from base	Angle of the petiole with the stem (0° degrees)	Length of the petiole (cm)	Length of the whole leaf (cm)	Width of the leaf (cm)	Log of length (cm)	Log of width (cm)	Log of petiole length (cm)
1	96.7	11.4	16.0	18.0	2.7726	2.8904	2.4336
2	92.3	12.5	14.5	19.0	2.6742	2.9445	2.5257
3	85.1	10.6	15.0	16.0	2.7081	2.7726	2.3609
4	81.6	11.5	13.0	16·0	2.5650	2.7726	2.4424
5	75.3	9.6	13.0	16.0	2.5650	2.7726	2.2618
6	75.9	11.1	13.8	16.0	2.6247	2.7726	2.4070
7	82.1	11.9	14.0	16.0	2.6391	2.7726	2.4766
8	65.0	11.0	13.5	15.5	2.6027	2.7409	2.3979
9	82.4	8.9	14.5	16.0	2.6742	2.7726	2.1861
10	75.8	10.2	12.2	14.5	2.5015	2.6742	2.3224
11	75.5	9.0	12.2	14.0	2.5015	2.6391	2.1972
12	76.4	7.7	13.7	15.1	2.6175	2.7143	2.0412
13	74.8	7.2	10.7	12.2	2.3703	2.5015	1.9741
14	59.8	4.5	11.2	12.5	2.4159	2.5257	1.5041
15	60.2	5.5	10.5	11.5	2.3514	2.4424	1.7047
16	60.1	2.5	8.5	9.0	2.1401	2.1972	0.9163
17	69.9	2.1	6.0	6.5	1.7918	1.8918	0.7419
18	59.4	1.6	6.5	7.0	1.8718	1.9459	0.4700
19	40.3	1.1	5.8	6.0	1.7579	1.7918	0.0953
20	39.7	1.0	3.1	4.0	1.2528	1.3863	0.0000
21	35.2	1.0	3.4	3.5	1.2238	1.2528	0.0000
22	28.0	0.7	2.5	2.6	0.9163	0.9555	1.6433

TABLE 2: *Mean leaf angle, length, width, area of the leaf and the length of the petiole in M. capitata* L. *at three positions on the stem.*

Position	Leaf angle (degrees)	Length of petiole (cm)	Length of leaf (cm)	Width of leaf (cm)	Leaf area (sq. cm)
Base	87.79	11.81	14.45	16.75	247.20
Middle	74.44	8.42	12.32	14.09	160.30
Top	30.38	0.82	2.46	2.55	72.50
S. E.	0.73	0.16	0.27	0.25	5.47
C. D. 5%	2.16	0.47	0.80	0.74	16.19
C. D. 1%	2.96	0.65	1.10	1.02	22.20

TABLE 3: *Total correlations among different characters of the leaf in M. capitata* L.

Characters	Leaf angle	Petiole length	Length of leaf	Width of leaf	Leaf area
Leaf angle		—0.0743	—0.1425	—0.3351	0.1552
Petiole length			—0.1223	0.0481	—0.0537
Length of leaf				0.8112**	0.0720
Width of leaf					0.1627
Leaf area					

** Significant at 1% P.

TABLE 4: *Analysis of variance of leaf angle, length, width, area and the petiole length at three positions on the shoot in M. capitata* L.

Variation due to	DF	Mean sum of squares				
		Leaf angle	Length of petiole	Length of leaf	Width of leaf	Leaf area
Plants	9	26.15**	0.52	1.91*	1.99*	308.66
Position	2	9025.69**	316.72**	209.19**	569.81**	76300.90**
Error	18	5.41	0.26	0.71	0.62	295.34

* Significant at 5% P.
** Significant at 1% P.

DISCUSSION

The finding that the broad leaves of *Malachra capitata* are arranged in such a way that the shedding of consecutive leaves is prevented and leaves thereon could carry out assimilation efficiently is interesting. Observations on the leaf arrangement in *Malachra* is in confirmity with the findings of Troll (1949), who analysed the relation between shape and length of petiole and lamina in the genera, *Prunus, Pyrus,* etc., and found that broader the lamina, longer was the petiole. He further pointed out that this relation might not hold good always as heterophyly often combined with foliar reduction in the vicinity of the reproductive region of a plant. In the present case also the broader lamina is not always accompanied by a longer petiole like some of the leaves at the subterminal and terminal portion of the plant.

It is well known that the plants within a row compete with each other besides leaves within a plant competing among themselves for sunlight and the problem of competition for sunlight would be solved in two ways—(1) by increasing the space between plants and rows, and (2) by the use of genotypes with better efficiency of intercepting sunlight. Basak (1968) observed that in jute, the features associated with the plants which contributed to the better efficiency of intercepting sunlight were leaf area, leaf angle, petiole length, leaf arrangement and morphology of leaf surface. In *Malachra,* it has been observed that within a plant, the basal leaves are broader and longer having long petioles forming wider angles than the upper ones and could utilise sunlight efficiently for a longer period avoiding early leaf fall. Length and width of leaf are positively correlated with leaf area. The finding of positive correlation between leaf area and leaf angle in the present study indicate that bigger leaves with their wider angles could utilise light more efficiently which might result in higher net assimilation. The contribution of leaf area to net assimilation rate in many crops has been proved (Watson, 1956; Wallace and Munger, 1965). As regards petiole length, Black (1960) observed that in clover, a variety having greater petiole length, had better competing ability as it helped in receiving greater amount of sunlight. Basak and Chaudhuri (1968) have shown the presence of phenotypic plasticity of petiole of the two species of jute and they have also shown the presence of genotypic variation in leaf angle. In *Malachra,* distinct genotypes are at present almost absent. A wide collection of types may be necessary in order to evolve a variety capable of utilising sunlight with greater efficiency.

The reduction in sizes of leaves on a plant is due to the response to the position on the shoot and is symptomatic of some processes of ageing in the apical meristem as has been emphasized by Ashby and Elisabeth (1950) in a study on the morphogenesis of leaves in *Ipomoea* who observed that leaf shape was controlled by internal as well as external factors. Change of leaf shape from node could be taken as a measure of the physiological ageing of the plant. In the present observation, when the length of consecutive leaves are plotted against their width on a logarithmic scale, it is observed that part of the graph representing most of the foliage leaves becomes a straight line. This is in agreement with the observations of Melville (1953) which signified that the rate of growth in length and width bore constant relation to one another which was also confirmed by the value of 'r' obtained for this pair of characters in the present investigation. In the straight line region, the growth is allometric and in the graph, the slope of line is a measure of relative rate of length and width of leaves in *Malachra.*

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REFERENCES

Ashby, E. and W. Elisabeth. Studies in the morphogenesis of leaves. IV. Further observations on area, cell size and cell number of leaves of *Ipomoea* in relation to their position on the shoot. *New Phytol.* 49 : 23-35. 1950.

Basak, S. L. Suggestions for genetic improvement of jute for fibre yield. *Indian J. Genet.* 28 : 26-265. 1968.

—— and B. B. Chaudhuri. Interspecific differentiation in plasticity of petiole orientation of jute in response to sun light. *Indian J. Agric. Sci.* 38 : 497-503, 1968.

Black, J. N. The significance of petiole length, leaf area and light interception in competition between strains of subterranean clover (*Trifolium subterraneum* L.) grown in swards. *Aust. J. Agric. Res.* 11 : 277-291. 1960.

Melville, R. Growth and plant systematics. *Proc. Linn. Soc. Lond.* 164 : 173-181. 1953.

Troll, W. Die stiplspreiten—Relation as ausdruck des prinzips der variablen proportionen (The relation of petiole and lamina, an example for the principle of variable proportions). *Naturwiss.* 36 : 333-338. 1949.

Wallace, D. H. and H. M. Munger. Studies of the physiological bases for yield differences. I. Growth analysis of six dry bean varieties. *Crop. Sci.* 5 : 343-348. 1965.

Watson, D. J. *Leaf growth in relation to crop yield. In the growth of leaves.* Edited by F. L. Milthorpe. Butterworth Sci. Publ. Lond. 178-191. 1956.