RESEARCH NOTES

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Structural Variations in the Stem of R[illegible] za *Sativa* L.) Under the Influence of Salinity and Drought

There are considerable salt and drought affected areas in India. Further, the problems of salt and drought resistance in rice are of special importance in India, where the severity of the occurrence of these environmental stresses are variable in nature. Soil moisture stress and salinity either singly or together, can be considered as a drought condition. The first one is recognised as physical drought while the latter one as physiological drought. When rice plants are subjected to these environmental stresses, they react to them, and some important structural changes result. The response to these environmental stresses can be profitably utilised to select promising rice varieties for drought and/or salt tolerance. Very little information is available on the structural variation of the rice plant grown under these conditions of environmental stresses. In the present investigation the structural changes in the stem of rice plants under the influence of salinity (15.5 millimhos/cm at 25°C) and drought (25-30 per cent soil moisture) have been studied, with a view to determining the adaptive significance of such changes with a minimum of adverse effect.

A recommended photoperiod sensitive rice variety with wide adaptability, OC 1393, was used in the present study. Plants were raised in porcelain pots (33 cm × 26 cm) under controlled, salinity and drought conditions in the glass house. Clay loam soil from a rice field was used after it was well pulverised. The soil was mixed with $\frac{1}{4}$ kg of well-rotted compost. The salinity level was maintained by addition of sodium chloride in the soil and it was adjusted at weekly intervals. The electrical conductivity in millimhos/cm at 25°C of the leaches on solubridge served as a measure of salinity. The procedure of Pearson's Drum Technique (1961) was followed with partial modification (Datta, 1972). The pots were irrigated with fresh water and adjusted to desired salinity level (15.5 mmhos) by adding the requisite amount of salt. The water (saline) level was maintained at 3 cm above the surface of the soil; the pH value was 7.8 (Datta, 1972). Under drought condition the pots were watered regularly to avoid permanent wilting (Parija, 1960 and Sen & Datta, 1967). On an average, 25-30 per cent soil moisture was maintained under drought condition. The control pots were irrigated regularly with fresh water. The water (normal) level was maintained 3 cm above the surface of the soil. Sowing was done on the 8th of July and there were three plants per pot. Two pots were provided for each treatment. Samples of first internode (basal portion) of the main shoot were collected at post flowering stage and were preserved in 70% alcohol. Free-hand sections were cut, stained in safranin-heamatoxylin and mounted in Canadabalsam. Anatomical data (Table I) were collected from transverse sections.

From the previous studies made on the tolerance to salinity and drought of rice under varying levels, the variety, OC 1393 (selection from 'Harimai'), was developed as suitable for growing under moderate saline and drought conditions with a reasonably good yield (Sen and Datta, 1967 and Datta, 1972). Variety, OC 1393 in this respect is better than the other varieties tested. Here, the effects of high level of drought as well as of salinity adversely affected the rice variety. Growth and yield per plant was reduced markedly under these two treatments. The reason for these detrimental effects is explained by the fact that the formation of productive tillers per plant was severely inhibited due to very high levels of salinity and drought. Accordingly, these high levels of stress conditions seem to have some further unfavourable effects on the structural behaviour.

Relative to the control, almost all the characteristics tested exhibited greater values except cortical cells per unit area, no. of air sacs, total no. of vascular bundle and thickness of phloem. On the other hand, it has been found that the number of cortical cells per unit area, no. of air sacs and total no of vascular bundles increased under stress conditions whereas their sizes were noticed to have decreased (Table 1). Regarding overall characteristics of vascular bundle, the number in general, was least under control and maximum under drought condition and intermediate under salinity; in contrast, its size was maximum under control and intermediate under salinity and minimum under drought.

Under saline conditions no. of peripheral vascular bundle, thickness of peripheral phloem, diameter of metaxylem of internal vascular bundle and thickness of phloem of internal vascular bundle increased more than under control and drought conditions.

A large number of characters viz. length of internode, diameter of internode, thickness of internode, diameter of lumen, thickness of cortex, diameter of air sac, diametér of peripheral and internal vascular bundle showed a remarkable reduction in drought, intermediate in salinity and least in control (Table I) Under drought condition cortical cells per unit area, no. of air sac, total no. of vascular bundle. diameter of peripheral metaxylem, no. of internal vascular bundle increased appreciably more than under control and salinity conditions.

In general, xylem vessels were more developed under drought conditions than control and salinity but in the case of salinity, phloem was found more developed than control and drought Regarding diameter of peripheral metaxylem its value was intermediate under control but maximum under drought and minimum under salinity. It is similar with the thickness of peripheral phloem, where the value was intermediate under control but maximum under salinty and minimum under drought. These data indicate a clear difference between physical or edaphic and physiological drought. From the data (Table I) it appears that there exists an opposite relationship between these two characters viz. xylem and phloem under salinity and drought conditions. For the former character its expression was maximum under drought and minimum under salinity; whereas the later exhibited higher values under salinity and minimal ones under drought. From the above, it may be suggested in conclusion that the anatomical knowledge about salt resistant plants has helped considerably in providing some basic information along which drought resistance phenomenon may be analysed. Anatomical studies are therefore, likely to prove to be of great value in assessing the basis of salt or drought resistance in rice plants.

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TABLE-1 Effect of salinity and drought on anatomical changes in the first internode of rice (Variety : OC 1393)

Character	Control	Salinity	Drought
Length of internode (cm)	5.4	4.0	3.8
Diameter of internode (mm)	5.0	4.8	3.5
Thickness of internode (μ)	1048.7	886.0	616.0
Diameter of lumen (mm)	3.0	3.0	2.5
Thickness of cortex (μ)	1038.9	847.0	612.0
Diameter of cortical cell (μ)	72.6	50 0	42.4
Cortical cells per unit area	6 6	13 0	17.3
No. of air sac	18 0	25 0	29.3
Diameter of air sac (μ)	484.0	314.0	198.0
Total no. of vascular bundle	37.9	43.5	53.3
No. of peripheral vascular bundle	17.9	27.0	25.0
Diameter of peripheral vascular bundle (μ)	120.6	104·0	95.0
Diameter of peripheral metaxylem (μ)	27.7	24.0	29.0
Thickness of peripheral phloem (μ)	26.7	28.0	24.1
No. of internal vascular bundle	20.0	22.5	28.3
Diameter of internal vascular Bundle (μ)	164.7	168.0	154.5
Diameter of metaxylem of internal vascular bundle (μ)	41.4	42.0	41.8
Thickness of phloem of internal vascular bundle (μ)	65.6	75.0	58.5