

NUTRITIONAL EFFECTS OF CALCIUM, MAGNESIUM, SILICA  
AND SODIUM CHLORIDE ON CERTAIN ANATOMICAL  
CHARACTERS OF RICE PLANT RELATED TO LODGING\*

D. CHANDRAMONY and MARY K. GEORGE

*College of Agriculture, Vellayani, Kerala*

A serious problem which has to be faced in the cultivation of rice is the lodging in the case of heavily manured crop. The character of lodging is known to be related to certain anatomical features of the plant (Rarniah and Dharma. lingam 1934, Matsuo 1952, Bollich 1963, Russel 1958, Bhide and Bhalerao 1927). It is however not known whether Calcium, Magnesium, Silica and Sodium can produce any change in the lodging types through induced anatomical variations in the cell structure.

Materials and Methods

An indica variety of rice namely Ptb - 31 was used for the studies. Pot cultures of this variety were raised using red loam mixed with sand in the proportion of 3 : 1 and farm yard manure at the rate of 80 lbs./acre. The various treatments included, Control, Calcium oxide, Magnesium oxide, Sodium silicate, Calcium oxide + Magnesium oxide, Calcium oxide + Sodium Silicate, Magnesium oxide + Sodium silicate, Calcium oxide + Magnesium oxide + Sodium silicate. Sodium chloride, Calcium oxide and Magnium oxide were used at the rate of 500 lbs./acre and Sodium silicate at 100 lbs /acre. Sodium chloride equivalent to Sodium silicate on Sodium basis was used. Each pot was filled with 40 lbs. of soil and an unreplicated pot culture experiment was conducted for studying the induced anatomical variations. To make the anatomical studies, samples of stem and leaves of the plants were collected at the time of flowering and fixed in Formalin - aceto-alcohol mixture. Hand sections of these were stained with 0.5% aqueous solution of safranin, haematoxylin and fast green. The characters studied were the cell size of parenchyma and sclerenchyma of the bundle sheath at the cortex region, length and breadth of vascular bundle in the cortex including the bundle sheath, thickness of sclerenchyma band at the periphery of the stem thickness of culm, total number of vascular bundles in the cortex region of stem and the total number of vascular bundles in the leaf including those at the midrib region. The data on these characters were statistically analysed.

\* From M. Sc. (Ag.) thesis submitted to the University of Kerala in 1966.

Table 1

Characters studied	Treatments									
	Q	Ca.	Mg.	Ca + Mg.	Si.	Ca + Si	Mg + Si	Ca + Mg + Si	NaCl.	
Mean diameters of parenchyma cells (in microns)	82.2	95.7	69.3	81.8	81.2	95.0	80.9	77.2	80.9	
Mean diameters of sclerenchyma cells (in microns)	10.8	9.8	8.5	10.6	8.6	10.9	8.9	9.8	9.4	
Mean thickness of culm (in microns)	654.7	789.0	639.2	737.2	613.8	791	573.2	646.1	712.5	
Mean thickness of sclerenchyma band (in microns)	24.7	28.7	36.3	26.7	25.7	27.4	26.1	28.1	27.4	
Mean length of vascular bundle (in microns)	194.4	199.3	187.8	206.9	200.6	203.9	172.6	180.2	197.3	
Mean breadth of vascular bundle (in microns)	92.4	119.5	116.5	111.2	94.7	120.8	84.8	95.4	115.2	
Mean number of vascular bundle in the stem	56.5	56.5	57.0	56.0	55.5	54.5	55.5	57.0	55.5	
Mean number of vascular bundle in the leaf	58.0	65.5	67.5	66.0	66.5	63.0	60.5	57.5	60.5	

### Results and Discussion

The results are presented in the Table 1. It is seen that calcium significantly increases the parenchyma and sclerenchyma cell size while magnesium significantly reduce the parenchyma and sclerenchyma cell size. But sodium chloride has a significant influence in reducing only the sclerenchyma cell size. The effect of silica is not significant in reducing cell size. The present study indicates that Calcium favours lodging by producing larger thin walled cells while magnesium resist lodging by producing smaller and compact cells. Russel (1958) from his observations concluded that increase in cell diameter and decrease in cell wall thickness increased the tendency of the plants to lodge.

The thickness of culm is significantly increased by Calcium and Sodium chloride treatments while it is reduced by magnesium and Silica treatments. The increase in culm thickness by Calcium treatment can be attributed to the positive effect of Calcium in increasing the parenchyma cell size and the reduction of culm thickness by Magnesium treatment may be attributed to the negative effect of Magnesium in changing the parenchyma cell size.

The thickness of sclerenchyma band is increased by Magnesium treatment although the sclerenchyma cell size is reduced. This may be due to the increase in the number of small and compact cells thus providing a stronger band of sclerenchyma cells at the periphery of the stem. Sodium chloride significantly reduces the sclerenchyma band thickness which may be due to the reduction in cell size.

Calcium treatment significantly increases the length and breadth of vascular bundles in the stem while they are significantly reduced by Magnesium and Silica treatments. The increase in the size of vascular bundles by Calcium application can also be correlated to the increase in the size of sclerenchyma cells in the bundle sheath and the reduction in the vascular bundle size by Magnesium and Silica treatments may be due to the reduction of sclerenchyma cell size.

There is no significant change in the number of vascular bundles in the stem or leaf as a result of any of the treatments.

### Summary

The anatomical changes induced by the application of elements like Calcium Magnesium, Silica and Sodium chloride and their relationship with lodging resistance were studied in one lodging variety.

The study indicates the differential effects of Calcium and Magnesium on the anatomical characters of rice. Calcium weakens the straw strength and favours lodging by producing large thin walled cells while Magnesium resist the lodging tendency by producing small but thick and compact cells. Silica and Sodium chloride also, to some extent induce anatomical changes favourable for lodging resistance.

### Acknowledgement

Grateful acknowledgements are due to Dr. C. K. N. Nair (former) Principal and Additionnl Director of Agriculture Research and to Professor P. Kumara Pillai, (former) Head of the Division of Botany for their constant help during the course of this investigation and also to Professor E. J. Thomas, Professor of Statistics, for his help in the Statistical analysis of the data.

### സംഗ്രഹം

കാത്സ്യം, മഗ്നീഷ്യം, സിലിക്കോൺ, സോഡിയം ക്ലോറൈഡ് മുതലായ പോഷക മൂല്യങ്ങൾ ഉപയോഗിക്കുമ്പോൾ *fflnDoJQ^slajCoasrs0AonD rawjowcolaj* വ്യത്യാസങ്ങൾ, പ്രത്യേകിച്ച് നെൽച്ചെടികളുടെ വീഴ്ച സ്വഭാവത്തെ ചെറുക്കുന്നവ, ഇൻഡിക്കാ വർഗ്ഗത്തിൽപ്പെടുന്ന ചായുന്ന സ്വഭാവമുള്ള ഒരു ജാതിയിൽ പരീക്ഷിച്ചു നോക്കിയതിൽ താഴെപ്പറയുന്ന വസ്തുതകൾ തെളിഞ്ഞു. 'കാത്സ്യം' കോശങ്ങളുടെ വലിപ്പം വർദ്ധിപ്പിച്ചു തണ്ടിന്റെ ബലം കുറയ്ക്കുകയും തൽഫലമായി നെല്ലിന്റെ വീഴ്ചയെ സഹായിക്കുകയും ചെയ്യുന്നു. എന്നാൽ മഗ്നീഷ്യം കോശങ്ങളുടെ വലിപ്പം കുറയ്ക്കുകയും എണ്ണം വർദ്ധിപ്പിക്കുകയും തൽഫലമായി വീഴ്ചയെ ചെറുക്കുന്നതിനുള്ള കെല്പ് തണ്ടിന് പ്രദാനം ചെയ്യുകയും ചെയ്യുന്നു. സിലിക്കോൺ, സോഡിയം ക്ലോറൈഡും ഏറിയ കൂറും മഗ്നീഷ്യത്തെപ്പോലെ വീഴ്ചയെ ചെറുക്കുന്നതിന് സഹായകമായ മാറ്റങ്ങളാണ് വരുത്തുന്നതു്.

### REFERENCES

- Bhide, R. K. and Bhalerao, G. G. 1927. Rice. Longmans, Green and Co. London, New York, Toronto.
- Bollich, C. N. 1963. Inter-relation of rice characteristics of possible importance in lodging. *Proc. Rice Tech. Working Group*, (10th Meeting) Houston, Tex: 14-15
- Kawata, Shin-Ichiro, Etaukamata and Koou Yamazaki 1962. Studies on vessel elements of rice shoot grown on border and in the inner part of paddy fields. *Proc. Crop. Sci. Soc. Japan* **31**, 195-200
- Matsuo, T. 1952. Genecological studies on the cultivated rice. *B. Natl. Inst. Agri. Sc. (Japan) Ser. D.* **3**, 1-111
- Ramiah, K. and Dharmalingam 1934. Lodging of straw and its inheritance in rice (*Oryza sativa*) *Indian. J. Agric. Sci.* **4** : 880-894
- Russel, W. 1958. Soil Conditions and Plant growth. Longman, Green and Co. London,

(M. S. received 31-1-1975)