EFFECTS OF SILICA AND NITROGEN SUPPLY ON SOME LEAF CHARACTERS OF THE RICE PLANT

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INTRODUCTION

Leaf erectness is known to be one of the important factors that affect light conditions in a plant population. Rice breeders have been using leaf erectness as one of the criteria for selecting nitrogen responsive varieties. While the degree of leaf erectness is a varietal characteristic, it is also affected by nutritional conditions. For instance, a nitrogen or phosphorus deficient plant has more erect leaves than the normal plant.

Previous studies have indicated that silica supply can affect leaf erectness of the rice plant to a great extent. In view of the relationship between dry-matter production of a rice population and the utilization of solar energy, one of the important roles of silica may be related to its function of maintaining more erect leaves. Iwata and Baba reported that, with a japonica variety, silica nutrition affected characters such as leaf-angle to different degrees, and they related these characters to the photosynthetic ability of a rice population. Tanaka and Kawano showed that the leaf openness of the second leaf from the top is well correlated with the light extinction coefficient of a rice population.

In the tropics, rice growth tends to become excessive, and mutual shading is often the cause of low grain yield. In such an environment leaf erectness may assume greater importance than it does under temperate conditions.

This paper describes the modifying effects of silica and nitrogen on some leaf characters of rice varieties.
MATERIALS AND METHODS

Five varieties with different leaf characters were selected. Seeds were germinated on a plastic mesh and grown for 2 weeks. Selected seedlings were transferred to four-liter pots at a rate of 3 seedlings per pot. The basal composition of the nutrient solution was: 40 ppm of K (as K$_2$SO$_4$), Ca (as CaCl$_2$), Mg (as MgSO$_4$•7H$_2$O); 10 ppm of P (as NaH$_2$PO$_4$•2H$_2$O); 2 ppm of Fe (as Fe-citrate); 0.5 ppm of Mn (as MnCl$_2$•4H$_2$O); 0.2 ppm of B (as H$_3$BO$_3$); 0.01 ppm of Zn (as ZnSO$_4$•7H$_2$O), Cu (as CuSO$_4$•5H$_2$O) and Mo (as (NH$_4$)$_6$Mo$_7$O$_{24}$•4H$_2$O). Deionized water was used. The culture solution was adjusted to pH 5.2 with 1 N NaOH or 1 N HCl. Three levels of nitrogen, 5, 20, and 200 ppm as NH$_4$NO$_3$, were superimposed on three levels of silica, 0, 40, and 200 ppm. Silica was added to the culture solution in the form of dilute sodium silicate. The silica in the culture solution was confirmed by a colorimetric method to be in soluble form. Each treatment was replicated five times. The culture solution was renewed once a week in the first three weeks, twice a week from the third week to flowering, and once a week from flowering to harvest. Standard procedures were followed for pest and disease control. Leaf openness was used to describe leaf erectness and was measured as follows: Immediately after severing the main tiller from the hill, it was placed against a vertical board on which a paper of suitable size was secured at its four corners. The culm itself was the vertical axis. With the leaves drooping normally from the axis, the positions of the tip and collar of each leaf were marked on the paper. A line was drawn between the two points and the angle between this line and the vertical axis was measured with a protractor. Mean leaf openness is the mean value of leaf openness of all leaves except the top one on the main culm. Leaf area was measured by blue print. Leaf thickness was expressed in mg per cm$^2$. In order to obtain the relationship between light extinction coefficient of a population and leaf openness, the necessary data were collected from the field where the same five varieties were grown at 0, 50 and 100 kg N per ha. The light extinction coefficient (K) of a rice population was calculated by Monsi and Saeki’s formula: $I = I_0 \exp (-K \cdot \text{LAI})$.

Total silica content of straw was determined by a standard procedure.

EXPERIMENTAL RESULTS

(a) Leaf openness

Table 1 summarizes the effect of silica and nitrogen supply on mean leaf openness of each variety at flowering. In general, increased nitrogen resulted in higher leaf openness values, and increased silica decreased leaf openness markedly. There were also big varietal differences with different combinations of silica and nitrogen supply.