NITROGEN FIXATION THROUGHOUT GROWTH, AND VARIETAL DIFFERENCES IN NITROGEN FIXATION BY THE RHIZOSPHERE OF RICE PLANTED IN POTS

by KUK-KI LEE, TERESITA CASTRO and TOMIO YOSHIDA*

The International Rice Research Institute, Los Baños, Laguna, Philippines

SUMMARY

The nitrogen-fixing activity in the rhizospheres of various rices was measured by the acetylene-reduction method throughout plant growth in greenhouse pots. The activity began to increase 4 weeks after transplanting, increased until heading stage, then decreased. The concentrations of exchangeable ammonium and sugars in the soil were not related to the variation of nitrogen-fixing activity during rice growth.

The nitrogen-fixing activities in the rhizospheres of 41 rice varieties in pots were measured to discover varietal differences. Levels of nitrogen fixation were highly correlated with the rices' dry root weight at heading stage.

INTRODUCTION

The maintenance of nitrogen fertility in tropical paddy fields has been thought to be due mainly to autotrophic nitrogen fixers, particularly to the well-known blue-green algae. However, Yoshida and Ancajas recently found that the rice rhizosphere could also fix a considerable amount of atmospheric nitrogen under flooding, and attributed the nitrogen-fixing activity to heterotrophic bacteria around the roots.

It is important to investigate the variation in nitrogen-fixing activity throughout growth in order to clarify the relationship between rice and bacteria. Although reports on nitrogen fixation at different growth stages are available, no attempt has been made to

* Present address: National Institute for Environmental Studies, P.O Yatabe, Ibaraki 300-21, Japan
measure nitrogen-fixing activity using the entire plant and soil system. In this study, nitrogenase activity in the rhizosphere of one rice variety (IR26) was measured in the plant-soil system at different growth stages. The relations between nitrogenase activity and exchangeable ammonium in the soil, and between nitrogenase activity and sugars in the soil were also examined.

Yoshida and Ancajas showed that nitrogen-fixing activity in the root zone of one variety, IRS, differed from that in another variety, Peta. The finding led to an extensive investigation of differences in nitrogen fixation in the rhizospheres of various rice varieties. The present paper deals with an experiment in which the nitrogen-fixing activities in the rhizospheres of 41 rice varieties planted in pots were measured by the acetylene reduction method.

**MATERIALS AND METHODS**

Nitrogen-fixing activity in the rhizosphere of the rice variety IR26 was measured at different growth stages. The seed was germinated on net floating on tap water. One week after germination, three seedlings were transplanted into a pot containing 500 g of Maahas soil. The pot surface was covered with black cloth to prevent algal growth, and the pot was watered two or three times each day to maintain flooding until harvest.

To examine varietal differences, 41 rice varieties were given the treatment described above. Each variety occupied 10 pots in the greenhouse. Five pots were collected from each variety 4 weeks after transplanting, the other five at heading stage.

Since the detachment of the aerial part immediately before acetylene reduction assay did not affect acetylene-reducing activity, the top of the plant was detached. The pot containing the root and soil was placed in a plastic bag, and 3 liters of a gas mixture (20% acetylene, 80% air) was introduced into the bag. After 24 hours of incubation, 1 ml of the gas was analyzed for ethylene by gas chromatography (Varian Aerograph Model 2700; column, aluminum 1.85 m long and 0.32 cm in diameter packed with Porapak R; column temperature, 50°C; detector temperature, 70°C; injector temperature, 35°C).

Soil cores were taken from each pot and extracted with 2N KCL solution. The extract was analyzed for ammonium and for anthrone sugars.

**RESULTS**

Nitrogen-fixing activity and concentrations of exchangeable ammonium and of anthrone-reactive sugars at different stages of growth are shown in Fig. 1.