

\[ ^{15}\text{N}_2 \text{ INCORPORATION BY RHIZOSPHERE SOIL} \]
\[ \text{INFLUENCE OF RICE VARIETY, ORGANIC MATTER AND} \]
\[ \text{COMBINED NITROGEN} \]

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KEY WORDS

Combined nitrogen \[ ^{15}\text{N}_2 \text{ incorporation} \]
Rhizosphere soil \[ \text{Rice straw amendment} \]
Variety

SUMMARY

Heterotrophic nitrogen fixation by rhizosphere soil samples from 20 rice cultivars grown under uniform field conditions was estimated employing \[ ^{15}\text{N} \text{-tracer technique}. \]

Rhizosphere soil samples from different rice cultivars showed striking differences with regard to their ability to incorporate \[ ^{15}\text{N}_2 \]. \]

Rhizosphere samples from rice straw-amended (3 and 6 tons/ha) soil exhibited more pronounced nitrogen-fixing activity than the samples from unamended soil; while the activity of the rhizosphere samples from soils receiving combined nitrogen (40 and 80 kg N/ha) was relatively low.

However, the inhibitory effect of combined nitrogen was not expressed in the presence of rice straw at 6 tons/ha. Results suggest that plant variety, application of combined nitrogen and organic matter influence the rhizosphere nitrogen fixation.

INTRODUCTION

The exceptional ability of the paddy soils in meeting the greater part of the nitrogen demand of the crop even after several years of continuous cultivation without fertilizer nitrogen has been partly attributed to the activities of free-living microorganisms\[ ^{1,8,13,14,15} \]. Moreover, the submerged soil appears to provide ideal conditions for both aerobic and anaerobic nitrogen fixation particularly in the presence of the rice plants\[ ^{12,14,16,19} \]. Employing field in situ acetylene reduction assay technique the rhizosphere nitrogen fixation was evaluated by several workers\[ ^{1,3,7,8,9} \]. Although such studies indicated the rate of the nitrogen fixation by the indirect acetylene reduction assay technique, information on the potential and magnitude of nitrogen fixation in the rhizosphere soil employing more direct tracer \[ ^{15}\text{N}_2 \text{ incorporation technique} \] is less numerous.

The influence of plant genotype on the association of nitrogen-fixing bacteria
has been observed\(^4\). The existence of varietal variation with respect to nitrogen fixation in the rhizosphere \textit{in situ} assays\(^8\) as well as in pure microbial cultures isolated from the roots\(^1\) has been established. Application of combined nitrogen to paddy soil ecosystem at levels beyond 40 ppm N suppressed nitrogen fixation under both upland and lowland conditions\(^2,6,13\). However this suppression could be alleviated by the organic matter application\(^5,13\). Little information is available on the influence of combined nitrogen and organic matter on nitrogen fixation in the rhizosphere soil. The present study deals with the evaluation of the influence of plant genotype, rice straw and combined nitrogen on heterotrophic nitrogen fixation in the rhizosphere soil employing the isotopic \(^15\)N tracer technique.

**MATERIALS AND METHODS**

**Soil**

The alluvial soil used in the present study had the following properties: pH 6.2, organic matter 1.6\%, total N 0.09\%, electrical conductivity 0.6 mmhos/cm, CEC 18.6 meq/100 g, exchangeable NH\(_4^+\) 10 ppm, clay 15.6\%, silt 4.8\%, sand 79.6\%.

**Field experiment**

Twenty high yielding, semi-dwarf rice (\textit{Oryza sativa} L.) cultivars, used in the study, are listed in Table 1. Fifteen-20-day old seedlings were transplanted and were grown under uniform field conditions in three replicate microplots under submerged conditions without fertilizer application. After 60 days of transplanting, the rhizosphere soil was collected by uprooting four plants from each replicate plot for each variety. The percentage moisture was determined immediately. To determine nitrogen fixation by rhizosphere soil samples, 5-g portions (dry weight basis) of the rhizosphere soil from each variety (in triplicate) were placed in glass vials and amended with 0.5\% cellulose. Then the samples were flooded (1.5 cm standing water) and incubated in \(^15\)N\(_2\) atmosphere.

**Greenhouse experiment**

In pot experiments, 20-day old seedlings (cv. Supriya) were transplanted to 3 kg alluvial soil in pots and maintained under submerged conditions till maturity. Three levels of combined nitrogen as ammonium sulphate at 0, 40 and 80 kg N per ha were applied in two splits at transplanting and maximum tillering (30 days after transplanting) stages. Another set of pots received two levels of rice straw at 3 and 6 tons per ha level. Rice straw was applied to the flooded soil 30 days before transplantation and allowed to decompose. In the third set the rice straw-amended (3 and 6 tons/ha) pots received combined nitrogen at 0, 40 and 80 kg N per ha. Unplanted pots served as non-rhizosphere controls. All treatments were replicated thrice.

After 60 days the rhizosphere soil was collected from all the treatments (in triplicate) and 5-g (dry weight basis) portions of the soil samples were transferred to glass vials for \(^15\)N\(_2\) incorporation studies.