Effect of Combined Application of Subsurface Drainage and Mineral Fertilization on Iron-Reducing Bacterial Populations' Developments and Fe^{2+} Uptake by Two Rice Varieties in an Iron Toxic Paddy Soil of Burkina Faso (West Africa)

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INTRODUCTION

Iron toxicity is one of the main edaphic constraints that hamper rice production in West African (Becker and Asch, 2005).

In Burkina Faso, iron toxicity affects many agricultural plains like Moussodougou, Tiéfora and Kou Valley. For the latter, since 1986, 300 ha of fields were abandoned because of ferrous intoxication, and most among these intoxicated fields remained uncultivated up to date.

Iron reduction into the toxic form (ferrous iron) is largely controlled by microbial processes in anoxic conditions of flooded soils.

OBJECTIVES

To determine the effects of chemical fertilization and subsurface drainage on microbiological and chemical parameters sustaining iron toxicity in paddy fields and on rice yield in Burkina Faso.

METHODOLOGY

Experiments

The experiment was conducted in rainy season from (June to October 2014) on the site of the University Ouaga I Pr. Joseph KI-ZERBO (12°22'45.7" N and 1°29'52.5" W).

Seventy two plastics pots were filled with a sensitive soil from the site of Kou Valley, located at the West of Burkina Faso. At the bottom of each pot, an external tap was installed to sub-drain the soil and regulate the drained water flow.

BOUAKE-189 and ROK-5 rice varieties, respectively sensitive and tolerant to iron toxicity were used for study.

The soil was continuously flooded until rice harvest.

Three modes of fertilization: without fertilization, NPK+Urea and NPK+Urea+Zn+Ca+Mg.

Two modes of drainage: without drainage (D0) and drainage for 14 days (D2). Control pots, without drainage and fertilization (D0/NF) were prepared similarly.

Iron Reducing Bacterial (IRB) Populations Monitoring

The number of IRB in the soil were determined by the most-probable-number (MPN) method, using a culture medium adapted from Hammann and Ottow (1974).

Ferrous Iron Concentration in Soil

Vizier (1969) method was used to measure the content of ferrous iron in the soil solution, using 0.2% ortho-phenantroline and 10% acetic acid reagents.

Determination of Fe Content in Rice Plant

Using a colorimetric method described by Chapman and Pratt (1961) and Murphy and Riley (1962).

RESULTS

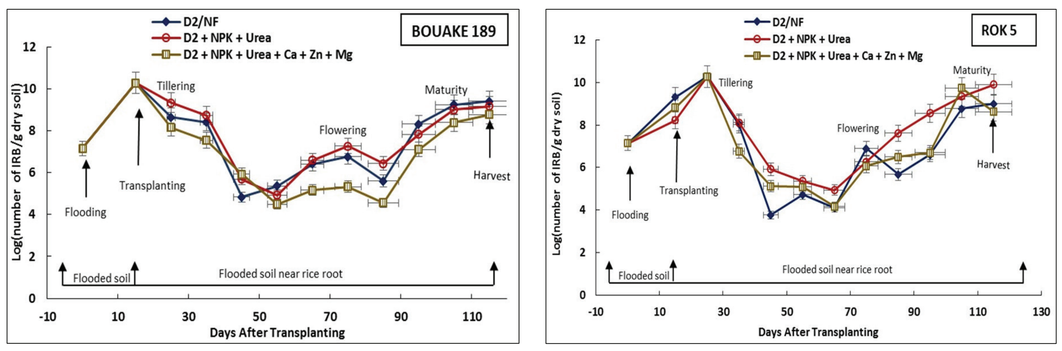

Fig. 1: Densities of IRB in soil near rice roots

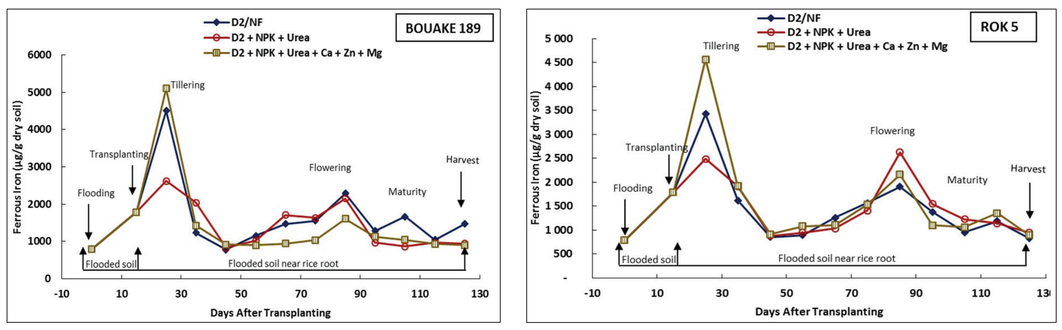

Fig. 2: Evolution of soil ferrous iron content

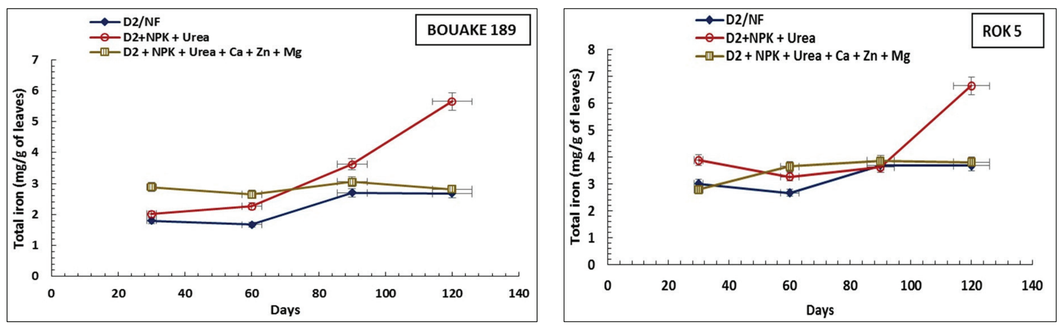

Fig. 3: Evolution of the aerial biomass total iron content

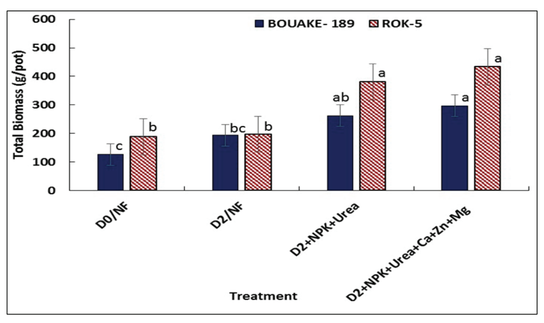

Fig. 4: Total biomass yield of rice varieties

CONCLUSION

The experiment showed that the rice plant remains the main factor which modulates the dynamic and activity of IRB during rice cultural cycle. Combined application of drainage and mineral fertilization seems also to decreases the number of IRB and have a synergic effect on improving rice yield in an iron toxic paddy soil.

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