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# IRON TOXICITY TO RICE IN AN ACID SULFATE SOIL AS INFLUENCED BY WATER REGIMES

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*Key words*

Active iron Continuous flooding Iron in solution Rice growth Soil drying

*Summary*

The effects of two water regimes: Continuous flooding and flooding with soil drying on iron toxicity to rice in an acid sulfate soil was studied by continuously growing 7 crops of IR-32 rice in pots under the two water treatments. There was no plant growth upto the second crop under both water treatments due to iron toxicity. But there was good growth of rice under the continuous water regime from third cropping onwards, however, there was no growth of rice in the flooding with soil drying treatment even upto the seventh crop due to iron toxicity.

The results of the study bring out that keeping an acid sulfate soil flooded for a few weeks and then planting rice when iron in soil solution has dropped below toxicity level may be a possible management practice for lowland rice culture on such soils. Drying and reflooding an acid sulfate soil on the other hand aggravates soil acidity and keeps iron in solution in high amounts to be toxic to rice plant.

Iron toxicity in acid sulfate soils on submergence is the major growth limiting factor for rice on such soils[2, 3]. During the course of a greenhouse study in pots on the nitrogen supplying capacity of some rice soils from the Philippines, it was observed that water regime was very critical for iron toxicity and growth of rice in an acid sulfate soil. This report describes the effects of two water regimes on the growth of rice as affected by iron toxicity in an acid sulfate soil.

## Materials and methods

The acid sulfate soil used in the study was calalahan sandy loam from Bicol, Philippines. The soil sample was ground and screened through a 5 mm sieve before use. The soil had a pH (1:1) of 3.4, an organic matter content of 2.7% and active iron and manganese contents of 1.44% and 0.002% respectively as extracted and determined by the method of Asami and Kumada[1].

The ground soil samples (10 kg) were filled in 16 l glazed pots. The soil was supplied with 50 ppm of P and K but no N was applied. The soil was puddled and saturated with water and seeded with the pregerminated of IR-32 rice. The flood water level in the pots was increased as the seedlings grew. Six

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plants per pot were grown upto 6 weeks after which the plants were cut about 5 cm above the soil surface and drymatter weight recorded after drying. Before seeding the second crop, one set of pots were kept flooded and in the other soil was allowed to dry for 2 weeks. This sequence was followed and 7 successive crops of rice were grown under two water regimes of continuous flooding and flooding with soil drying between two successive crops.

## *Results and discussion*

It was observed that there was no plant growth under both the water treatments upto the second crop due to iron toxicity. The iron in soil solution ranged from 3450 to 1090 ppm upto 10 weeks in a continuously flooded soil. However, in the continuously flooded treatment there was good growth of rice from the third cropping onwards and the drymatter weights for third, fourth, fifth, sixth and seventh croppings were 3, 36, 12, 17 and 6 g/pot respectively. But there was no growth of plants in the soil drying treatment even upto the seventh crop.

Soil analyses during the growing period of the fourth crop after about 28 weeks of the start of the experiment revealed that the amount of water soluble iron in the soil with drying treatment was more than ten times (585 ppm) higher than that in the continuously flooded water treatment (50 ppm). The pH of the surface water as well as of the soil was lower in the soil drying treatment (respectively 3.4 and 5.4) than in the continuously flooded pots (3.9 and 6.2 respectively). Thus soil drying and reflooding increased the amount of iron in solution and also aggravated acidity by production of sulfuric acid, which hindered the growth of rice. Because when an acid sulfate soil is dried there is oxidation of $Fe^{2+}$ to $Fe^{3+}$ which is hydrolyzed to $Fe_2O_3.xH_2O$ and $H_2SO_4$ during reflooding, accentuating soil acidity and increasing the amount of iron in soil solution due to solubilization of iron oxides under low pH conditions.

The observations from this study bring out that keeping an acid sulfate soil flooded for about 10–12 weeks or more and then planting rice when soil acidity and iron in solution have dropped below toxic levels may be a possible management practice for lowland rice culture. Drying and reflooding an acid sulfate soil on the other hand aggravates soil acidity and increases iron in soil solution to toxic limits for growth of rice.

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