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07d. Production systems and crop management/protection

ARSENIC AND RICE IN TEMPERATE CLIMATES. ITALY: STATE OF THE ART AND PERSPECTIVES FOR MITIGATION

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Purpose:

In 2012-2013, Ente Nazionale Risi in collaboration with the Universities of Turin, Piacenza, Milan and the Istituto Superiore di Sanità carried out experimental trials to identify critical factors affecting arsenic uptake in rice plants and provide management practices limiting arsenic phytoavailability.

Approach and methods used:

In 2012, 168 grain samples were collected from Italian paddy fields, taking care in selecting representative fields and farms of the different paddy regions.

The effect of water management was evaluated by both field and lysimeter trials. Water and dry seeding methods and different drying periods during the crop cycle were compared in split plot design.

In 2012-2013, 21 rice cultivars were compared in order to evaluate the genotypic effects on As accumulation in the grain.

In all the experiments total As and As species was analyzed by ICP-MS and HPLC-ICP-MS, respectively.

Key results:

The range of total As concentrations in white rice from the field survey was 49-523 µg/kg, while inorganic As ranged between 40-184 µg/kg.

Water management results showed higher inorganic As concentrations in grain from the treatment involving dry seeding and delayed flooding with respect to water seeding. Aerobic rice resulted in the lowest arsenic content, but yield performance was quite lower with respect to the other treatments. Total arsenic content in grain varied between 201 and 352 µg/kg, for inorganic As between 99 and 188 µg/kg. A drying period before the booting stage resulted in a 3 times and a half reduction compared to continuous flooding for total and inorganic As, respectively. The different varietal behavior could be attributed to genetic effects determining a greater or lesser ability of rice plant to translocate the different forms of arsenic from the soil solution.

Synthesis and Applications:

Our studies showed that water management is important to reduce As concentration in rice grain. Seeding methods and drying periods are effective to reduce As bioavailability in the soil resulting in a low As content in the grain.

The variety trials indicate the significant potential for lowering rice-grain As concentration through genotype selection and plant breeding. Specific national guidelines must be defined in order to combine yield and quality need.