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NITROGEN FIXATION BY HETEROCYSTOUS CYANOBACTERIA IN URUGUAYAN RICE FIELDS

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Cyanobacteria play a vital role in the maintenance of flooded rice field fertility. They can contribute, as other nitrogen fixing organisms, to build up the soil nitrogen pool.
Biological nitrogen fixation in rice cultivation has been studied mostly in Asia and Europe where crop management is quite different from Uruguayan rice fields.
Among the many factors affecting cyanobacterial growth and nitrogenase activity, herbicides are important ones.
To evaluate the abundance, diversity and nitrogen fixing ability of heterocystous cyanobacteria in Uruguayan ricefields, studies in Paso de la Laguna (INIA-Treinta y Tres) were carried out during three consecutive crop seasons.
About 90% of the heterocystous cianobacteria found in the soil belonged to the genus *Nostoc* and *Anabaena*. The highest number of heterocystous cyanobacteria, 1.6 x 10^4 CFU, was found 8 weeks after flooding.
The nitrogen fixing ability was evaluated in rice fields as nitrogenase activity *in situ* which reached maximal values 12 weeks after flooding. The lack of significance of nitrogen treatment suggests that nitrogen fixation is governed by other factors and not only by nitrogen fertilizer.
Two of the most abundant heterocystous cyanobacterial isolates were tested for tolerance to propanil and quinclorac, herbicides commonly used in Uruguay.
Propanil and quinclorac at field recommended doses affected oxygen photoevolution but nitrogenase activity was only inhibited by propanil.
Inoculation with native cyanobacterial propagules may shorten the time necessary for their multiplication and soil colonization.
Keywords: cyanobacteria, nitrogen fixation

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THE PERSISTENCE OF RICE PESTICIDES IN FLOODWATERS: INFLUENCE OF WATER MANAGEMENT

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The sustainability of the Australian rice industry depends on maintaining its 'clean and green' image to retain and extend overseas markets. Information is required on the persistence of rice pesticides so as off-site impacts can be assessed and minimised. Local irrigation authority guidelines recommend that rice water should be with-held on-farm for 21-28 days of pesticide application. Usually on-farm storage is adequate but during severe storms and at critical growing periods excess drainage is sometimes inevitable. Chemical persistence was studied by taking water and soil samples at regular intervals from field trials in the Murrumbidgee Irrigation Area (MIA), eastern Australia. The chemicals investogated were molinate, chlorpyrifos, benzofenap and clomazone. Field plots were automatically monitored for water temperature, electrical conductivity, pH and water depth and circular flumes were installed to measure water supply flows. Maximum concentrations of molinate applied at 3.36kg a.i. /ha was 1264 ìg l^{-1}, clomazone applied at 0.24kg a.i./ha was 252 ìg l^{-1}, chlorpyrifos at 0.075kga.i/ha was 30 ìg l^{-1} and benzofenap at 0.6 kg a.i./ha was 14.4 ìg l^{-1}. Over a 5 day period molinate concentrations had dissipated by 67%, clomazone by 8%, chlorpyrifos by 83% and benzofenap by 77%. $T_{1/2}$ were 4 days, 40 days and < 1 day for molinate, clomazone and both chlorpyrifos and benzofenap respectively. Ongoing research will determine how soil/water partitioning behavior of different chemicals is affected by water depth and dilution and the significance of environmental variables for with-holding periods.
Palabras Claves / Key Words pesticides, rice, sustainability

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EFFECT OF NITROGEN FERTILIZATION AND INOCULATION WITH CYANOBACTERIA ON NITRIGEN STATUS OF RICE

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heterocystous cyanobacteria, ^{15}N-labeled fertilizer
As the average heterocystous cyanobacterial density in Uruguayan rice fields was lower than the reported for other rice fields, inoculation with native cyanobacterial strains appeared as a possibility of a supplementary nitrogen input to this ecosystem.
Field experiments were conducted during two crop seasons in which heterocystous cyanobacterial density and nitrogen incorporation to the plant were evaluated from ^{15}N-labeled fertilizer and inoculated with cyanobacteria assays.
The aim of this study was to quantify how much nitrogen from fertilizer was incorporated to rice and to establish if cyanobacterial inoculation contributed to nitrogen nutrition and yield of rice.
Heterocystous cyanobacteria number was not different in inoculated plots and grain yield was unaffected by cyanobacteria inoculation.
A significant fraction of cyanobacterial fixed nitrogen was neither available to the rice plant during the growth period of the crop nor to the following crop (ryegrass), when nitrogen fertilizer was applied at sowing.
The use efficiency of N from fertilizer was of 16% when applied at sowing.
An assay applying ^{15}N-labeled fertilizer at three different moments of the crop cycle was established.

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MICROBIAL PROCESSES AND POPULATIONS AS INDICATORS OF SUSTAINABLE RICE PRODUCTION

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To evaluate sustainability of agricultural practices (irrigated rice production), an ecological microbial approach can be used to reflect quality and fertility of soils. Microorganisms are central to many processes in the environment regulating nutrient cycling in soil-water ecosystems and supplying many of the plant nutrients. It has been reported that a decrease in microbial diversity can lead to flooded rice soils to be resilient to intensification pressures. Our previous work on rice floodwater suggested that the bacteria involved in the nitrogen cycle were the most influenced by cultivation. This work aimed to combine a molecular and process approach to assess microbial diversity in the floodwater-sediment interface, focusing on bacteria of the nitrogen cycle. Microbial community composition and metabolic activity (characterization of culturable microorganisms, maximum denitrifying activity, genetic fingerprints using the technique known as T-RFLP (terminal restriction fragment length polymorphism) and cloning methods were used. Heterotrophs, ammonium-oxidizers, denitrifiers, methanotrophs, nitrogen-fixers (aerobic, anaerobic and microaerophilic), ammonifiers and anaerobic phototrophs were enumerated. Community structure data obtained via the different approaches were analyzed and compared. Sequencing data revealed the presence of an important variety of known cultured and uncultured bacteria as well as non-described bacteria. Overall, the results indicate that the soil-water interface harbors a diverse bacterial community potentially important in the interaction with rice plants.
Keywords: sustainability; microbial diversity; soil-water interface