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ALTERNATIVE WATER MANAGEMENT IN TEMPERATE RICE: YIELDS AND ENVIRONMENTAL IMPLICATIONS

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Purpose:
Alternative water management practices adopted in temperate rice paddies may strongly influence redox-driven changes in rice paddies with important implications on nutrient availability and nitrogen use efficiency (NUE), greenhouse gas (GHG) emissions and water quality, water balance, as well as crop yields. We evaluated three water management practices for all these aspects through a two-year (2012-13) field experiment carried out in Castello d'Agogna (Pavia, NW Italy).

Approach and methods used:
Three water management practices were compared: (i) water seeding and submerged conditions (FLD); (ii) dry seeding and flooding delayed by about 40 days (DRY); (iii) dry seeding and rotational irrigation (IRR). During the cropping seasons, water balance terms were monitored, surface and subsurface water samples were collected and analyzed for inorganic N, while methane and nitrous oxide emissions were measured *in situ* by the closed-chamber technique. For each treatment we also evaluated grain yield, yield components and NUE of 4 rice varieties.

Key results:
Higher grain yields were obtained for FLD and DRY treatments, while IRR showed lower production for all 4 varieties evaluated (15-25% less). Although we did not observe any significant difference between treatments in 2012, NUE decreased in the order FLD>DRY>IRR in 2013. Soil water analyses evidenced an increase in ammonium-N in correspondence with pre-seeding and tillering stage N fertilization events, particularly for DRY and IRR. Moreover, whereas limited nitrification in FLD resulted in lowest nitrate concentrations, DRY and IRR showed important nitrate concentrations and leaching along the soil profile. Differences in soil redox conditions between treatments influenced GHG emissions, in the order IRR≤<DRYDRY≤FLD for methane and FLD≤DRY≤IRR for nitrous oxide.<DRY<DRY<DRY<DRY<DRY< <DRY<FLD<DRY<DRYConsidering the total GHG emissions, DRY and IRR respectively resulted in a 31 and 68% decrease in the total Global Warming Potential with respect to FLD.</DRY</DRY<FLD<DRY</DRY<</DRY</DRY</DRY</DRY</DRY

Synthesis and Applications:
Whereas grain yields are not significantly influenced by dry seeding, rotational irrigation still showed a 20% reduction in grain yield. Both dry seeding and rotational irrigation offer a potential for reducing the GWP of rice cropping systems. However, appropriate fertilizer management strategies must be adopted in irrigated systems to mitigate N_2O emissions and nitrate leaching to ground waters.