ISPAMed 2024 International Conference

Strategies to support crop productions and reduce GHG emissions in the Mediterranean area

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Keyword(s): Nitrous oxide; Methane; fertilization; irrigation

Abstract

In the Mediterranean, the time gap between peak irradiance and temperature (summer) and higher water availability (winter), along with the low organic matter (OM) content in most cropped soils, contributes to the low productivity of rain-fed crops. On the other hand, irrigated systems leverages solar radiation and prolonged frost-free periods to achieve high yields. The distinct soil conditions between irrigated and rain-fed crops influence soil microbial processes, which regulate the fluxes of carbon (CO_2, CH_4) and nitrogen (N_2O, NO_3^-, NH_3) in soil [1]. Soil water content and nutrient availability are the most influential factors affecting N_2O emissions in the Mediterranean area. Therefore, mitigation strategies targeting these emissions play a crucial role in reducing greenhouse gas (GHG) emissions in the Mediterranean [2]. Paddy soils contribute to approximately 6% of the total CH_4 emissions from Mediterranean agriculture [3]. These substantial CH_4 emissions result from methanogenesis under strictly anaerobic conditions and low redox potentials [4]. Conversely, aerobic agricultural soils, whether rain-fed or irrigated, promote CH_4 oxidation, which is highly dependent on management practices i.e. nitrogen fertilization. Agricultural management strategies aimed at reducing methanogenesis in paddy soils or enhancing CH_4 oxidation in aerated soils are often overlooked in Mediterranean agriculture, despite their potential to significantly reduce total GHG emissions from these systems. In recent decades, GHG emissions from the agricultural sector have shown a continuous increase. However, the trends observed in the Mediterranean indicate a relatively stable pattern, accounting for about 5% of global emissions. At the European level, GHG emissions amount to approximately 40% of the total emissions, highlighting the importance of regional mitigation actions [5]. The rationalization of nitrogen use, the selection of fertilizer types (synthetic, organic, nitrification inhibitors), the optimization of irrigation, and the increase of soil carbon stock are the most promising strategies for reducing GHG emissions in the Mediterranean. However, there are still open questions about the best choices to adopt in order to achieve the maximum mitigation potential of emissions in the Mediterranean.

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