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Microbial consortia increase nutrient use efficiency on irrigated and rainfed corn over 5-year monocropping

by Francesco Ferrero | Ernesto Tabacco | Gabriele Rolando | Giorgio Borreani | University of Turin - Department of Agricultural, Forest and Food Sciences (DISAFA) | University of Turin - Department of Agricultural, Forest and Food Sciences (DISAFA) | University of Turin - Department of Agricultural, Forest and Food Sciences (DISAFA) | University of Turin - Department of Agricultural, Forest and Food Sciences (DISAFA)

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Inoculating crops with microbial consortia (MC) is increasingly gaining attention in agriculture as possible way for sustainable arable crop growth and efficiency. Some studies have stressed the positive effect of MC crop inoculation on growth, nutrient uptake under laboratory condition (Hett et al., 2023), however, field applications of MC over a long experiment period have been less investigated. Microbial consortia usually consist of two or more plant growth-promoting microorganisms, and, among these, the rhizobacteria and beneficial fungi are the most frequently used in cereal. The aim of the study was to assess the nutrient contents and uptakes of irrigated and rainfed mono-cropped corn inoculated with MC under field conditions over a long-term experiment. The study was conducted over a 5-year period at the University of Turin. A split-plot design with four replicates was used, with irrigation treatment assigned as the whole plot, inoculation with MC as split plots, and replicates as blocks. Corn was inoculated at sowing by row distribution with a MC containing mycorrhizae, beneficial bacteria of rhizosphere, and saprophytic fungi. Experimental field received 161, 48, and 61 kg ha^{-1} of N, P_2O_5, and K_2O, respectively. Irrigation treatment was managed following the crop needs and resulted in 2 to 4 irrigation per growing season. The dry matter (DM) yield, corn grain nutrient contents, nutrient balance, and nutrient use efficiency were assessed following Tabacco et al. (2018). On average the irrigation improved the yield of +7% (P<0.001) with a stronger effect showed in one year out of five (+18% and +21%, for control and MC, respectively). Inoculation with MC showed an increase in the yield of +3% (P=0.033) with higher value in irrigated than in rainfed plots. Inoculation with MC increased the nutrient use efficiency which compared with untreated corn increased from 0.88 to 0.92 (P=0.007), from 1.38 to 1.44 (P=0.011), and from 0.96 to 1.00 (P=0.042) for N, P_2O_5, and K_2O, respectively. This resulted in a reduction of surplus per hectare that was from 93 to 64 (P=0.001), from -90 to -105 (P=0.001) and from 12 to 1 (P<0.001) for N, P_2O_5, and K_2O, respectively. Due to high availability of soil P, the amount of P_2O_5 delivered to crop was lower than actual uptake and this resulted in very high nutrient efficiency. The N content of grain linearly decreased over the 5-year period (R^2 = 0.93), indicating the ability of plant to use a lower amount of nutrient without reducing the dry matter yield. Results of the present work indicates that MC can represent a way to improve corn nutrition efficiency and yield, however, evaluation

of difference in incomes or value-added between the two treatments are needed. Acknowledgments**.** This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This abstract reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.