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Bioirrigation and Biofertilisation for Sustainable Intercropping of Pigeon Pea and Finger Millet

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Abstract

Food security for the growing population and achieving the zero hunger target by 2050 is a major challenge for humanity. Sustainable intensification of agriculture, i.e. increasing food production while at the same time reducing the environmental impacts, has been proposed as the way forward to address this challenge. In this study we propose a sustainable cereal - legume intercropping agroecosystem model employing the concept of bioirrigation and biofertilisation. "Bioirrigation" is based on the principle of hydraulic lift (HL), where transfer of water occurs through roots from wet soil layers to dry soil layers as a consequence of a soil water potential gradient. Specifically, the process of bioirrigation describes the water supply of a deep-rooted plant to a neighbouring shallow-rooted plant. In our study, we designed an experiment to test the effects of bioirrigation and biofertilisation in the growth and yield of a intercropping system that included pigeon pea (*Cajanus cajan*) as a deep-rooting plant to bioirrigate the neighbouring shallow rooted finger millet (*Eleusine coracana*). In order to increase efficacy of water transfer from pigeon pea to finger millet, AMF (arbuscular mycorrihzal fungi) and PGPR (plant growth promoting rhizobacteria) were applied as biofertilisers. The results that we will present were generated testing the following hypotheses: (i) hydraulic lift performed by pigeon pea has the potential to bioirrigate the neighbouring finger millet; (ii) the presence of AMF and PGPR increases the efficacy of transfer of hydraulically lifted water and (iii) only in the presence of pigeon pea, finger millet can access the deep water. We envision that sustainable intercropping using bioirrigation, as tested in our experiment, will help maintaining the stability of agriculture and food security, especially in rain-fed areas, when applied to real-world agroecosystems.

Keywords: Biofertilisation, hydraulic lift, intercropping, sustainable agriculture

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