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Common Mycorrhizal Network as Facilitator of Bioirrigation

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Abstract

Food security for growing population and achieving the zero-hunger target by 2050 is a major challenge for mankind. Sustainable intensification of agriculture, i.e. increased food production without causing environmental damage has been foreseen as the way forward to address this challenge. In this study we tested a sustainable legume – millet intercropping model based on "bioirrigation" and biofertilisation to mitigate drought induced yield loss in rainfed areas of arid and semiarid tropics. We conducted several pot experiments under controlled conditions inside the greenhouse to test the hypothesis of common mycorrhizal network (CMN) mediated bioirrigation between pigeon pea and finger millet. The results of pot experiments clearly showed that pigeon pea does perform hydraulic lift (HL), and when roots of pigeon pea and finger millet are connected through CMN water relations of finger millet are supported by pigeon pea through bioirrigation. To test the efficacy of bioirrigation driven intercropping system, we conducted field trials at two experimental sites (GKVK, Bengaluru and Kolli Hills, Tamil Nadu) in southern India to optimise the spatial arrangement of pigeon pea and finger millet and tested its effect on yield and water-relations of finger millet. The field trial results demonstrated that, planting two rows of pigeon pea and flanking eight rows of finger millet showed improved yield of finger millet compared to pigeon pea plants planted in between eight rows of finger millet plants in a mosaic fashion. However, the effect of spatial arrangement varied with change in experimental site. At Kolli Hills site, within row plantation of pigeon pea and finger millet performed similarly to row wise (2 pigeon pea : 8 finger millet). However, the intercropping effect was not driven by the CMN facilitated bioirrigation because finger millet in intercropping treatments had lower leaf water potential than monoculture treatments due to interspecific competition between pigeon pea and finger millet. We envision that sustainable intercropping on the basis of our bioirrigation and biofertilisation model will help to design appropriate intercropping system especially in rain-fed areas that could provide sustainable food security, particularly for the marginal farmers in arid and semi-arid tropics.

Keywords: Bioirrigation, drought, intercropping, mycorrhiza, rainfed agriculture

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