Deep-rooted pigeon pea promotes the water relations and survival of shallow-rooted finger millet during drought-Despite strong competitive interactions at ambient water availability

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Bioirrigation has been defined as the transfer of hydraulically lifted water by a deep-rooted plant to a neighbouring shallow-rooted plant which cannot access deep soil moisture. In this study, we tested if facilitative effects of bioirrigation or the competition for water dominate the interaction of two intercropped plants-deep-rooted pigeon pea (PP) and shallow-rooted finger millet (FM) before and during a drought. Additionally, we tested how the presence of a common mycorrhizal network (CMN) affects the balance between facilitative (i.e. bioirrigation) and competitive interactions between two intercropping species. Our results show that PP can indeed promote the water relations of FM during a drought event. Specifically, stomatal conductance in FM controls dropped to low values of 27.1 to 33.6 mmol m(-2)s(-1), while FM in intercropping treatments were able to maintain its stomatal conductance at 60 mmol m(-2)s(-1). In addition, the presence of PP reduced the drought-induced foliar damage and mortality of FM. The observed facilitative effects of PP on FM were partially enhanced by the presence of a CMN. In contrast to the facilitative effects under drought, PP exerted strong competitive effects on FM before the onset of drought. This hindered growth and biomass production of FM when intercropped with PP, an effect that was even enhanced in the presence of a CMN. The results from our study thus indicate that in intercropping, deep-rooted plants may act as ”bioirrigators” for shallow-rooted crops and that a CMN can promote these facilitative effects. However, the interspecific competition between the intercropped plants under conditions of abundant moisture supply can be strong and are enhanced by the presence of a CMN. In more general terms, our study shows that the extent by which the antagonistic effects of facilitation and competition are expressed in an intercropping system strongly depends on the availability of resources, which in the case of the present study was water and the presence of biotic interactions (i.e. the presence of a CMN).
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