

Effect of crop rotation on mycorrhizae formation, WUE and wheat yield under different fertiliser treatments

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Crop rotation and fertiliser application are essential management practices for improving soil quality. Preceding crops can affect the growth and yield of subsequent crops not only by changing the nutrient status of the soil but also by changing the soil microbial community including mycorrhizal fungi. Two wheat genotypes (249 and a CIMMYT line) were planted after crop rotation with canola or chickpea with different nitrogen and phosphorus fertiliser treatment (0 and 100 kg N ha⁻¹ and 0 or 20 kg P ha⁻¹) in the field. Crop rotation and fertiliser treatment effects on yield and leaf $\delta^{13}C$ (a proxy for water use efficiency) were examined. The percentage of roots colonized by arbuscular mycorrhizae fungi was determined and related to soil available N and P, proportion of fine diameter roots, yield and leaf $\delta^{13}C$. Crop rotation had no effect on soil available N and soil available P. However, mycorrhizal infection in wheat was substantially higher after chickpea than after the canola rotation (on average 60% higher). Wheat yield after the chickpea rotation also increased, particularly for the CIMMYT line. While soil available N and P were not related to yield, we observed significant relationships between mycorrhizal infection and yield for both genotypes. In contrast, both N and P fertiliser application reduced mycorrhizal infection and yield, but increased plant biomass and leaf tissue N and P concentrations. Possibly, mycorrhizal infection reduced water stress in wheat as suggested by the observed negative relationship with leaf $\delta^{13}C$, particularly in the 249 line. Mycorrhizal infection was further related to the proportion of fine roots, suggesting that fine roots are conducive to mycorrhizal infection. We conclude that cultivation of crops (e.g., chickpea) in the previous season that can enhance mycorrhizal infection of wheat roots may reduce water stress and increase grain yield.