Objective

To examine root growth, AM fungal colonization and AM fungal community structure in a durum wheat trap crop over time grown in soils with different preceding crops (flax or canola) and weed seedbank densities (Low, Medium, High) collected from a long-term experiment.

Background

In 1990, a study investigating the effects of reduced in-crop herbicide use (Paraquat Free Production) was initiated at the University of Manitoba. This experiment contains an annual crop rotation (Wheat-Wheat-Wheat-Canola) under mild production that is replicated three times in each block. Each repetition of the experiment is a subplot, which has different weed species densities. The experiment continues to this day, allowing for the study of the effects of weed species on AM fungal communities.

Methods

Analysis of variance (ANOVA) was used to determine differences among means. The experiment was conducted in a randomized complete block design with four replicates. The significance level was set at 0.05. The effects of weed species, weed density, and the interaction of weed species and density were analyzed. The number of AM fungi that colonized the roots of durum wheat was determined using a soil-serial dilution technique. Fungal biomass was measured using a phosphorus-32 incorporation technique.

Summary

AM fungal colonization and community structure in durum wheat grown in soils retrieved from this long-term study showed that subtle changes in weed management had significant effects on durum root growth and the dynamics of the AM fungal community. Increased weed seedbank densities contributed to greater root exploration of the soil through increased root length and root colonization by AM fungi, while the effect of durum wheat on the AM fungal communities was not significant. Differences were also observed in the AM fungal communities present in soils with different weed species densities. AM fungal colonization and community structure were affected by the presence of a weed species, and the effect of the weed species depended on the soil environment.

Results & Discussion

The relative subtle differences in weed management, in specific, reduced in-crop weed management that over a period of ten years resulted in stable differences in weed seedbank densities among the treatments (Gulden et al., 2011), were associated with altered root exploration of the soil and different colonization of the AM fungal communities by durum wheat root crop. In this study, effects of weeds were related to weed seedbank densities and to above-ground weed populations. Above-ground weed populations were substantially different in canola compared to flax. In fact, the above-ground weed populations reflected weed densities, however, in canola, effective in-crop herbicides in addition to the competitive capabilities of canola resulted in virtually complete control of weeds in all treatments, irrespective of initial weed density.

Differences were found in the physiologically active AM fungal community structure and dynamics in canola and flax, irrespective of the above-ground weed density. Two factors were found to be the most significant: the initial soil seed bank and the presence of weeds. The effects of weeds were more pronounced if the dominant weed species were more mycorrhizal. Weed seedbank density and preceding crop both resulted in different AM fungal community trajectories throughout the development of durum wheat.

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Mycorrhizal fungus colonization and community dynamics in a long-term rotation as influenced by preceding crop and weed management intensity

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References:


Table 1. Percent total variation and provinces for preceding crop (Crp), weed seedbank density (WdCh), durum development stage (Stage) main-effects and their interactions for ICPC 1 through 5 as PC1 through PC5.

Table 2. Percent total variation and provinces for preceding crop (Crp), weed seedbank density (WdCh), durum development stage (Stage), AM fungal community composition (AMF), and their interactions for ICPC 1 through 5 as PC1 through PC5.

Table 3. Percent total variation and provinces for preceding crop (Crp), weed seedbank density (WdCh), durum development stage (Stage), AM fungal community composition (AMF), and their interactions for ICPC 1 through 5 as PC1 through PC5.