The Effects of Mycorrhizal Inoculation on the Drought Stress Tolerance of Corn

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Background

Mycorrhizal fungi alter plant-water relations in several ways, but the potential role of the fungal hyphae as regulators of plant water uptake remains a controversial issue. Many mycorrhizal inoculants have been introduced into the market that claim the ability to improve water uptake, thereby reducing drought stress. Since irrigation water is becoming increasingly scarce and global climate changes are creating weather pattern fluctuations, these products are receiving considerable attention; however, the effect of soil type, specific crop, and weather patterns on the ability of the mycorrhizae to affect plant-water relations is largely unknown.

Objectives

• Determine the soil water content percentage at the time of plant death for both mycorrhizal inoculated and un-inoculated corn plants.

• Determine whether mycorrhizal inoculation is a viable agronomic tool for growers.

Methods

Conventional corn was planted into 2-gallon pots and grown in a greenhouse setting. Two treatments were replicated ten times. The pots were filled with a 1:1 mix of pasteurized field soil and a peat moss/composted bark mix. One trial had two grams of MycoApply® Micronized Endo Powder incorporated in the soil at the time of seeding. The experimental design was completely randomized.

The plants were allowed to grow in a regulated climate of 21°C during the day and 18°C at night, with a sustained relative humidity of 60 percent. All plants were watered regularly for five weeks. On the 36th day a drought was initiated.

Methods continued

The plants were allowed to wilt and die. When the sixth foliar leaf wilted below a 45° angle in relation to the stalk or the stalk lodged, the plant was considered dead, and an approximately 300 g soil sample was collected. Soil was collected 5 cm below the soil surface near the root mass using a small spade.

The soil sample was added to a beaker, weighed, and placed in an oven at 105°C until its mass stabilized. The moisture content (MC) of the soil as a percentage was calculated using the following equation:

$$MC = \frac{B - C}{C - A} \text{x } 100$$

A – Mass of beaker
B – Weight of moist soil and beaker
C – Weight of dried soil and beaker

Figure 1: The corn plants 8 days into a drought.

Results

A slight average MC difference appeared between inoculated and un-inoculated plants at the time of death. On average, inoculated corn plants died with 0.526% less water in the soil, but after running one-way ANOVA data analyses, it was determined that there was no statistical difference between treatments. Inoculated plants did, however, survive 5.6 days, or 28%, longer during a drought than un-inoculated plants, on average, at the 95% level of significance.

Data and Tables

Soil MC% at Death	
Inoculated	Un-inoculated
1.211	2.196
1.624	2.847
1.914	2.303
1.691	2.622
3.990	2.621
1.714	2.414
1.552	3.652
2.219	4.037
2.567	1.715
3.106	2.442

Drought Days Until Death	
Inoculated	Un-inoculated
17	16
23	17
23	17
23	18
24	19
25	20
25	23
32	23
33	24
33	25

Average MC% at Death	
Inoculated	Un-inoculated
2.159	2.685

Average Drought Days Until Death	
Inoculated	Un-inoculated
25.8	20.2

Conclusion

While there was no statistical difference in soil moisture content percentages between treatments, there was a statistical difference between treatments in number of days a plant survived a drought. The research suggests that utilizing a mycorrhizal inoculant as a means of improving drought stress tolerance in corn plants may be a viable agronomic tool.

Further Research

There are two methods that could be applied to this particular study to enhance the results: first, the soil could be taken from much deeper in the soil profile to get a more realistic representation of the moisture content. Secondly, the roots could be dyed and the mycorrhizal hyphae counted in order to ensure the effectiveness of the inoculation.

There is plenty of research that could be conducted to improve the current understanding of mycorrhizal inoculation's ability to improve drought stress tolerance. It would be interesting to learn if soil type and soil fertility affect the effectiveness of mycorrhizal inoculation in improving drought stress tolerance.