How the plant's microbiome affects its health

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Introduction

Plant's health is greatly impacted by it's microbiome. A plant's microbiome consists of three sections. These sections are called the phyllosphere, the endosphere, and the rhizosphere. However the most important section is the rhizosphere as it's the area around a plant root that is inhabited by a unique population of microorganisms that can either positively or negatively impact a plant's growth.

Hypothesis

We predict that the type of rhizosphere microorganism found in a plant's rhizosphere will determine whether the plant will survive and grow.

Discussion

We found that there are many types of Rhizosphere organisms. These rhizosphere organisms can either be beneficial or damaging to a plant's growth. Rhizosphere organisms that are damaging to a plant's growth include pathogenic fungi(eg: parasites)and oomycetes. Pathogenic fungi, oomycetes, and nematodes can result in major stresses in plants. The reason for this is these types of harmful bacteria lead to malabsorption among plants which does not allow plants to effectively absorb nutrients, water, and carbohydrates. As a result, plants can become deficient in important minerals such as magnesium. A deficiency of magnesium in plants results in a disease called chlorosis. Chlorosis refers to a plant being unable to produce an adequate amount of chlorophyll. The main symptom of chlorosis is plants developing yellow leaves instead of green leaves. A lack of chlorophy impedes plants from partaking in the process of photosynthesis.

Just as there is harmful rhizosphere microorganism, there are also friendly rhizosphere microorganisms. Examples of friendly rhizosphere microorganisms that promote plant growth include pseudomonas, bacillus, as well as fungi from the deuteromycetes(Trichoderma and Gliodclaidum) . Pseudomonas promotes plant growth in various ways. For example, Pseudomonas suppress pathogenic micro-organisms by producing cell wall degrading enzymes. Cell wall degrading enzymes impede pathogenic fungi from invading the plant. In addition , pseudomonas help with regulating plant hormones. Plant hormones include ethylene, gibberellins, cytokinins, abscisic acid, and auxins. It's essential that these hormones are synthesized as they help with promoting increased plant disease resistance.

Similarly to pseudomonas Bacillus also promotes plant growth. However, Bacillus does this differently. Bacillus promotes plant growth by producing stress-tolerant spores. Bacillus spores combat abiotic stress. Examples of abiotic stresses that plants may experience include excessive drought and parasite infestations. Additionally, abiotic spores maintain the ionic balance of plants. Plant ionic balance refers to plants receiving an adequate amount of crucial minerals such as nitrogen, phosphorus, potassium and magnesium, and sulfur. Combined, these plant nutrients are key to healthy plant growth. Nitrogen boosts photosynthesis. Phosphorus facilitates root growth. Potassium helps plants form enzymes which are necessary for several metabolic functions such as photosynthesis and respiration. Magnesium results in the production of chlorophyll which allows plants to absorb sunlight and convert it to energy. Sulfur ensures that plants are forming amino acids such as phenylalanine, tyrosine, and tryptophan which are vital for chlorophyll formations. Moreover, Bacillus spores ensure that water moves effectively through a plant. This is essential as water carries nutrients back and forth between roots and leaves resulting in healthy plant growth and development.

As mentioned, pathogenic fungi are the type of fungi that are detrimental to the health of all organisms including plants. However, there are beneficial fungi. Examples of beneficial fungi include mycorrhizal fungi. They form a symbiotic relationship with plants. This symbiotic relationship is known as Mycorrhizal fungi. The study called "Effect of arbuscular mycorrhizal fungi on the physiological functioning of maize under zinc-deficient soils" proves mycorrhizal fungi effectiveness among maize inoculants. According to the study, an increase in chlorophyll uptake was seen in inoculated maize with Mycorrhizal fungi. On the other hand, non-inoculated maize experienced a decrease in chlorophyll uptake (Saboor et al., 2021). This further proves how mycorrhizal fungi positively impact the growth of plants by acting like a sponge for important nutrients.

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