The Water Relationship between Plants and Soils

The amount of water that the soil can use for plants to use is defined as the difference between the amounts of water in the soil at field capacity of a soil and the permanent wilting point of that same soil. The amount of plant available water in the soil is related to both soil texture and structure. Soil texture and structure define the surface area and available pore space for holding water.

Water moves to the plant roots and through the xylem in the plants to the leaf surfaces via a concentration gradient. The atmospheric water potential is less than the water at the leaf surface, thus water moves from the plant into the atmosphere. This loss of water from the leaf surfaces causes more water to move to the leaf surfaces from inside the plant. This gradient continues down to the root surface. At the root surface the water potential causes water to move into the roots. As the soil dries at the root surfaces, the water potential gradient draws more water closer to the roots.

When a field is saturated, plant growth is limited and potential of plant death is high due to lack of oxygen in the soil. Plant growth is at maximum near field capacity due to adequate water and oxygen levels in the soil. As the soil water decreases past field capacity, there is a potential for temporary wilting of the plant. Wilting plants have decreased photosynthetic rate due to limit available water and the plants inability to harvest sunlight. During periods of reduced photosynthesis, the plant relies heavily on stored reserves. The effect this has on final yield of agronomic crops depends on the time frame in which it happens. For instance, the critical time for corn is two weeks before to two weeks after pollination. The soil-plant water relationship also effects nutrient uptake. Higher soil water contents increase the nutrient flow to the plant roots. As soil water content lessen, the nutrient flow to the plant decreases.

Root growth and development is critical for obtaining adequate moisture in periods of stress. Root systems that are shallow and developed poorly cannot harvest the water needed to carry a crop. Warm, dry conditions early in the season encourage deeper rooting and help to weather-proof the crop. Limiting root problems like compaction, insect feeding, or other problems that limit root growth, add another layer of weather-proofing to our crops.