NDSU NORTH DAKOTA STATE UNIVERSITY

IMPACTS OF FLOODING/WATERLOGGING ON CROP DEVELOPMENT

Waterlogging (flooded/ponded/saturated soils) affects a number of biological and chemical processes in plants and soils that can influence crop growth in both the short and long term. The primary cause of waterlogging in crop plants is oxygen deprivation or anoxia as excess water itself does not react chemically with the plant. Plants need oxygen for cell division, growth and the uptake and transport of nutrients. Since oxygen diffuses through undisturbed water much more slowly than a well-drained soil, oxygen requirements rapidly exceed that which is available when soils are saturated. The rate of oxygen depletion in a saturated soil is impacted by temperature and the rate of biological activity in the soil. Faster oxygen depletion occurs when temperatures are higher and when soils are actively metabolizing organic matter.

Generally, the oxygen level in a saturated soil reaches the point that is harmful to plant growth after about 48-96 hours. In an effort to survive, tissues growing under reduced oxygen levels use alternate metabolic pathways that produce by-products, some of which are toxic at elevated levels. Germinating seeds/emerging seedlings are very sensitive to waterlogging as their level of metabolism is high. Crops like small grains and corn tend to be more sensitive to waterlogging when their growing point is still below the surface of the soil (before the 5-6 leaf stage). Small plants can be killed if soils are saturated beyond 48 hours when soil temperatures exceed 65 degrees.

Crops can differ in their tolerance to waterlogging. Data from differing sources suggest a possible ranking of waterlogging tolerance as follows (most tolerant to most susceptible): rice, soybean, oats, wheat, corn, barley, canola, peas, dry beans and lentils. Growth stage and variety can influence this ranking. Waterlogged conditions also reduce root growth and can predispose the plant to root rots, so the ultimate effect of excess moisture may not be known until late in the season. It is common to observe plants that have experienced waterlogging to be especially sensitive to hot temperatures and to display nitrogen and phosphorus deficiencies later in the season due to restricted root development. Yield losses can occur even if these obvious visible symptoms are not observed.

Waterlogging can also indirectly impact cereal growth by affecting the availability of nitrogen in the soil. Excessive water can leach nitrate nitrogen beyond the rooting zone of the developing plant, particularly in well-drained lighter textured soils. In heavier soils, nitrate nitrogen can be lost through denitrification. The amount of loss depends on the amount of nitrate in the soil, soil temperature, and the length of time that the soil is saturated. Research conducted in other states found losses from denitrification between 1 and 5% for each day that the soil remains saturated.

Joel Ransom – Extension Agronomist
Joel.ransom@ndsu.edu

NDSU | EXTENSION