Nitrogen makes winter wheat big– and thirsty

Research at Akron shows too much N can stress plants if water is in short supply

A three-study at the USDA's Akron Station has focused on how water stress and nitrogen fertilization interact. Here a technician uses an infrared sensor gun to measure water stress on winter wheat.

What are the two major limiting factors for winter wheat in the Central Great Plains? You guessed it: 1) The amount of water that is available: 2) and nitrogen fertility.

Now, scientists at the USDA-ARS Central Great Plains Research Station at Akron, Colorado have determined how those two factors interact to determine the final wheat yield.

Dr. David Nielsen and Dr. Ardell Halvorson have found that increased levels of nitrogen fertilizer can increase yield potential, but it also increases the amount of water needed by the plant.

It goes like this. When adequate water is available so that water stress is low, high levels of nitrogen increase yields. But when water supplies (precipitation and stored soil water) are limited, the bigger plant produced by the increased nitrogen is under greater water stress and yields are lower than of plants fertilized at lower rates.

They say that matching nitrogen fertilizer application rates to estimated available water supplies is important to obtaining profitable yields.

Their conclusion comes at the end of a three-year study. Nielsen and Halvorson studied winter wheat growing on a Platner loam soil in a wheat-corn-fallow rotation.

In the experiment, five levels of nitrogen fertilizer ranging from 0 to 100 lbs N/acre were applied prior to wheat planting. During the growing season, water use was measured by monitoring of the soil water content each week. Water stress was measured using an infrared thermometer to monitor wheat canopy temperatures daily in the early afternoon.

The wheat plants yielded well with the high rates of nitrogen fertility as long as their was plenty of water. But under the more typical conditions of dryland winter wheat production in the Central Great Plains, where water stress generally occurs in the moderate to severe range, high rates of nitrogen application (greater than 75 lb N/a) reduced yields.

The scientists say the reduced yields are associated with leaf area and availability of water. Higher levels of nitrogen grew bigger plants, providing more leaf area to intercept solar radiation and produce carbohydrates. Those carbohydrates eventually go into the grain yield.

But, the larger plant size was only good for increased grain production up to a point, because bigger plants with more leaf area require more water for transpiration. That increased water requirement is partially met in the larger plants by an increase in rooting depth. But that advantage is soon used up in the Central Great Plains under the area's typical, water-deficit conditions.

Nielsen and Halvorson report that a conservative rate of nitrogen fertilizer application that consistently maximized yields in their study without promoting excessive water stress was 50 lbs. of N per acre. They also determined that about 6 bushels an acre of grain were produced per inch of water used. They advise that 2 to 2.4 lbs. of N per bushel is needed to meet the total N requirements (soil N plus fertilizer N) of a winter wheat crop that is not subjected to severe water stress conditions. ❑

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COVER

This month's cover is the work of Stephen Collector, a critically-acclaimed photographer in Boulder. His new book, The Law of the Range, *features portraits he shot over an 11-year period of brand inspectors in Colorado, Wyoming and Montana. The work captures the lifestyle and landscape of those who guard the Western livestock industry.*

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