WHEAT TECHNOLOGY CONFERENCE Proceedings

Water and Winter Wheat

Monday, February 28, 2005
Holiday Inn: I-80, Exit 59
Sidney, Nebraska (50)
9 a.m. - 4 p.m.

Tuesday, March 1, 2005 (30)
Eagles Club: W. 3rd St.
Alliance, Nebraska
9 a.m. - 4 p.m.

Thursday, March 3, 2005
Perkins County Fairgrounds
2nd & Garfield (20)
Grant, Nebraska
9 a.m. - 4 p.m.

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The University of Nebraska-Lincoln
Institute of Agriculture and Natural Resources
Cooperative Extension Division and the
Nebraska Wheat Board

University of Nebraska Lincoln

How Wheat Responds to Water

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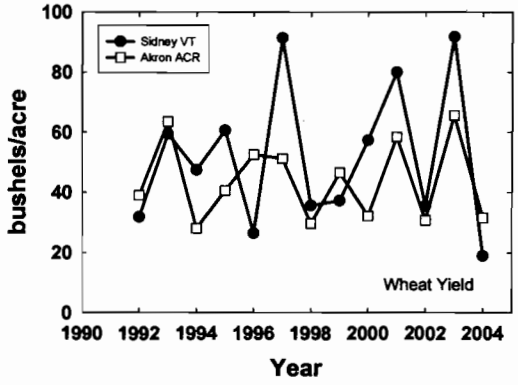
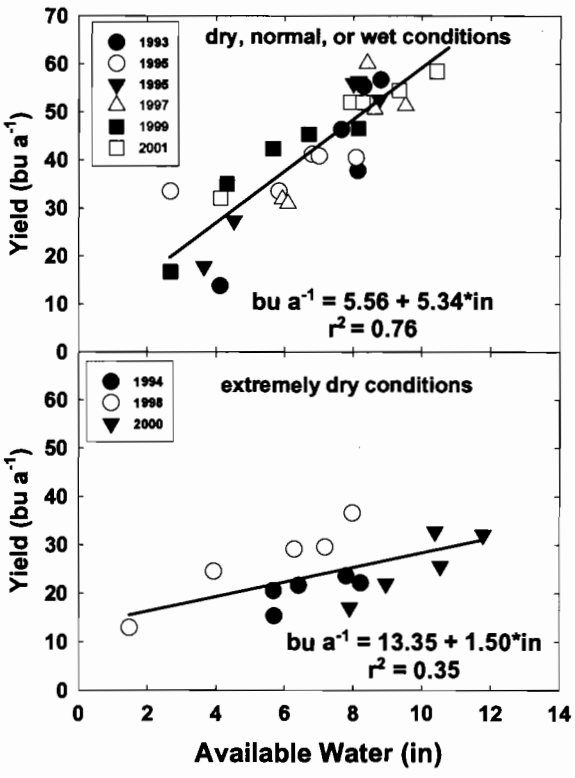
Winter wheat is well adapted to the climatic conditions of the central Great Plains. But dryland yields can vary widely from year to year due to the strong influence of water (soil water, timing and amount of precipitation, and total seasonal water use) on grain production.

Grain yields recorded at Sidney, NE (average of the five highest yielding varieties in the University of Nebraska variety trial) show a range of 19 to 92 bu/acre (average 52 bu/acre) over the time period of 1992 to 2004. At the Central Great Plains Research Station near Akron, CO, the wheat yields in an alternative crop rotation study ranged from 66 to 28 bu/acre (average 44 bu/acre). While there are some influences on yield from insects, weeds, diseases, frost, and hail, most of the variation noted in the graph arises from differences in the amount of water available for crop production.



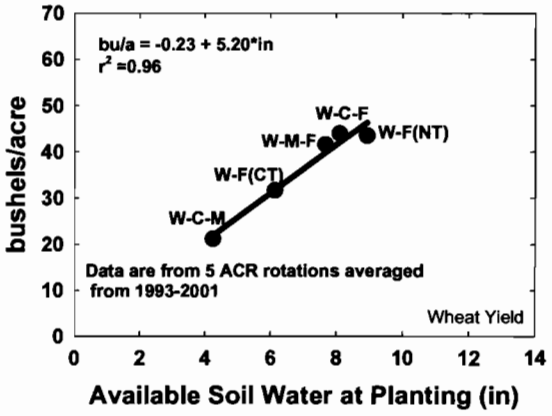
One of the water factors important to winter wheat grain production is stored soil water. Generally, wheat yield increases by 5.3 bu/acre for every inch increase in stored soil water available at planting time. But under extremely dry conditions [when total pan evaporation in April, May, and June is greater than precipitation by 25 inches], wheat yield increases by only 1.5 bu/acre for every inch increase in stored soil water. These very dry conditions occur in about 13% of the years of record.



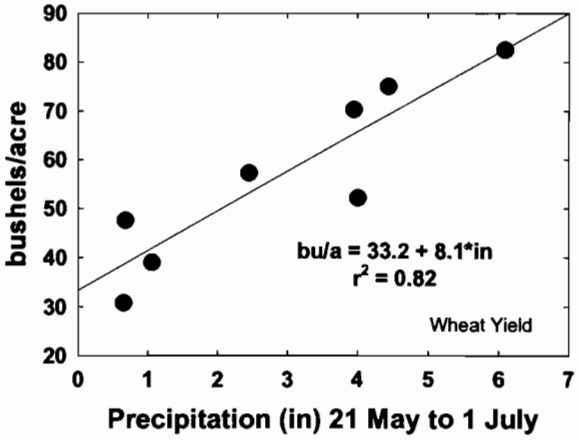
The amount of stored soil water is determined by how much soil water the previous crop used, how much precipitation fell during the non-crop period, and how efficiently that precipitation was stored. Precipitation storage efficiency (PSE) increases with tillage reduction and

increases with amount of crop residue on the soil surface. PSE is higher during the fall, winter, and spring than during the warm months of summer.

These effects of previous crop and differences in precipitation storage efficiency with time of year and amount of crop residue are seen in the figure to the right. These data, averaged over 1993 to 2001, show available soil water at wheat planting ranging from 4.3 inches in the wheat-corn-proso millet rotation to 8.9 inches in the wheat-fallow no-till system. The average response of wheat yield to available water at planting was seen to be 5.2 bu/acre per inch of stored soil water. The effect of tillage to control weeds during the summer fallow period on both soil water and wheat yield is seen in the comparison of wheat-fallow no-till (soil water=8.9 inches, yield=43.5 bu/acre) to wheat-fallow conventional-till (soil water=6.7 inches, yield=31.6 bu/acre).



Many crops have growth stages which are very sensitive to water availability. For most crops, the growth stages of flowering and grainfilling are the most sensitive. In reviewing wheat yield response to timing of precipitation, we have found that grain yield is most highly correlated with rain that falls during the period of May 21 to July 1. This is the time that encompasses wheat heading through maturity. Yields increase about 8.1 bu/acre for every inch of rain that falls during this six-week period.



Another way of looking at the response of wheat yield to water is to determine the water use-yield production function. Water use is the change in soil water content that occurs between planting and harvest plus the precipitation that falls over that time interval. Data from Akron, CO over four years from a variety of cropping sequences shows a fairly well-defined linear relationship between total seasonal water use and yield, in which yield increases about 4.5 bu/acre for every inch of water used by the plant. A little more than five inches of water is needed to get the plant to the grain production stage.