Effect of Dry Conditions on Cereal Yields and Response to Nitrogen

Dry conditions may trouble farmers that may have waited to apply the remaining required nitrogen (N) to their crops. Have yields been severely affected? Will crops respond to the added nitrogen? Some study data may help to answer these questions.

In 2009, Manitoba revised fertilizer nitrogen recommendations for spring wheat, barley and canola so fertilizer cost and crop price economics could be considered in an N rate calculator.[1] Based on the amount of rainfall received and moisture stress, cereal trial results were separated into environments of little moisture stress (MOIST), slight moisture stress (DRY) and very stressed (ARID). Not surprising, wheat and barley did yield and respond differently to nitrogen based on the amount of dry weather stress (Figures 1-2).

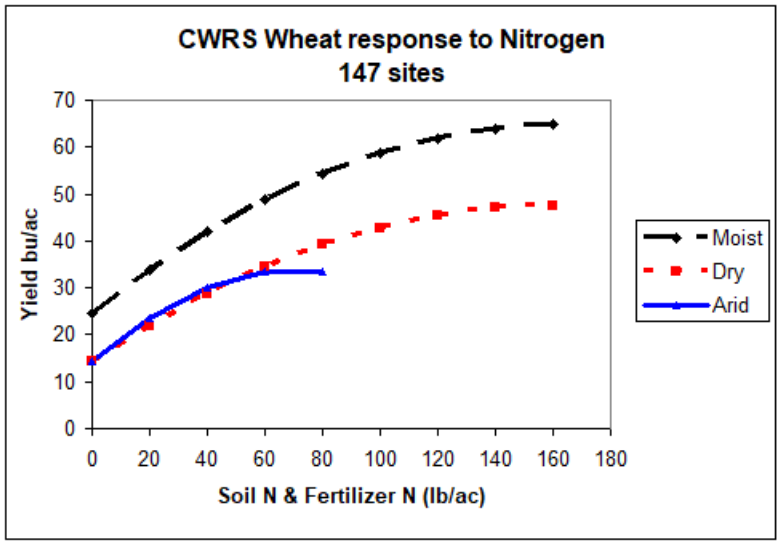

Figure 1. **Wheat response to nitrogen under moist, dry and arid conditions.**

Manitoba

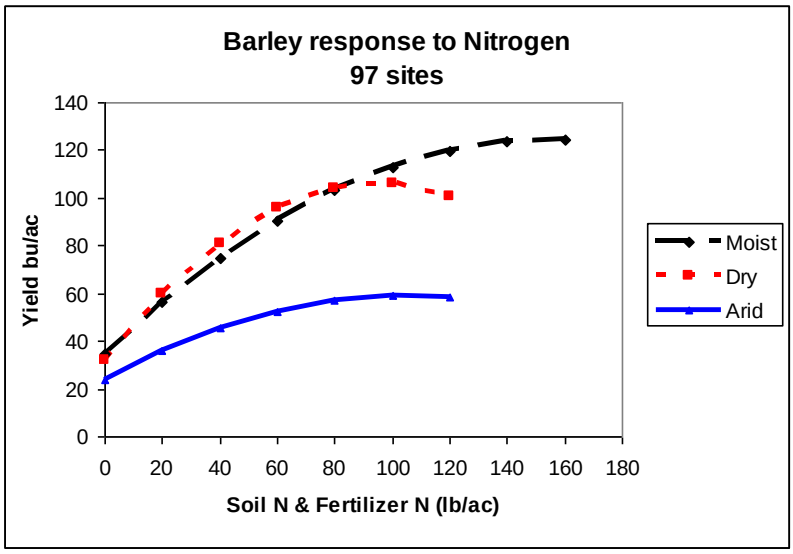

Figure 2. Barley response to nitrogen under moist, dry, and arid conditions.

On soils where moisture was not limiting, cereal yields were high and responded well to high rates of nitrogen (Figure 1 and Table 1 for spring wheat, Figure 2 and Table 2 for barley).

Table 1. Wheat yield under different moisture regimes

	Soil Moisture Category		
	Moist	Dry	Arid
# of experimental sites	25	77	53
Max average yield	65 bu/ac	48 bu/ac	34 bu/ac
Economically optimal N rate with good prices and 30 lb/ac residual soil N	100 lb N/ac	90 lb N/ac	30 lb N/ac
Yield at optimal N rate	63 bu/ac	45 bu/ac	33 bu/ac

Under dry soil conditions, wheat yield potential was 18 bu/ac less, but the response to N fertilizer similar, with only a slightly lower amount (90 vs 100 lb N/ac) required to maximize profit. But under very dry conditions, yields were almost half and little N fertilizer was warranted (30 lb N/ac).

An option in our N Rate calculator is to exercise greater risk aversion, by demanding a higher return on the last amount of N applied. Under a more risk averse criteria requiring $1.5 return for the last $1 spent on N, rates on all categories were reduced by 10 lb N/ac.

Table 2. Barley yield under different moisture regimes

	Soil Moisture Category		
	Moist	Dry	Arid
# of experimental sites	18	70	9
Max average yield	124 bu/ac	106	59
Economically optimal N rate with good prices and 30 lb/ac residual soil N	100 lb N/ac	50 lb N/ac	40 lb N/ac
Yield at optimal N rate	122 bu/ac	104 bu/ac	57 bu/ac

Under dry soil conditions, barley yield potential was only 18 bu/ac less, but the response to N fertilizer very different, with only about half the N fertilizer required (50 vs 100 lb N/ac). Under very droughty conditions, yields were less than half and little N fertilizer was warranted (40 lb N/ac). Similar to wheat, using a more risk averse approach would reduce these N rates for barley by about 10 lb N/ac.

Even in normal years it is tough to predict crop yield potential. The above data may assist growers in making fertilization decisions during dry conditions. Manitoba wheat research has shown good yield and protein response to nitrogen when applied between the stem elongation and flag leaf emergence, but rainfall is essential in order to move the N into the root zone.

References:

[1] Nitrogen Rate Calculator for Wheat, Barley and Canola https://www.gov.mb.ca/agriculture/crops/soil-fertility/nitrogen-rate-calculator.html