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Can the yield of late-planted small grains be compensated by nitrogen rates?

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Can Yield of Late-planted Small Grains be Compensated by Nitrogen Rates, 2017?

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Summary

Wheat and barley are often planted later than optimum due to the timing of the previous crop or to reduce the risk of frost damage. It may be possible to partially compensate for lower yield potential of late plantings by increasing nitrogen rates beyond what would have an effect at more optimal plantings. The objective of this study is to evaluate the effect of nitrogen rate on late planted wheat and barley. A trial testing water and nitrogen rates for small grains planted late and at the optimal time was established at the Maricopa Ag Center. The treatments included 3 nitrogen rates (low, medium, and high), 2 varieties ('Tiburon' durum and 'Chico' barley), and 2 planting dates (7 December 2016 and 16 February 2017). In this study, higher rates nitrogen did not increase yield at later planting dates as we hypothesized.

Introduction

Wheat and barley are often planted later than optimum due to the timing of the previous crop or to reduce the risk of frost damage. The seeding rate of late planted small grains is often increased as a way to increase the number of stems and productive spikes per acre, but this practice does not always achieve the desired effect. The problems with late planting are that the growing season is shortened, temperature may be higher than optimum, and water stress may be difficult to avoid, all of which contributes to lower yield potential.

It may be possible to partially compensate for lower yield potential of late plantings by increasing nitrogen rates beyond what would have an effect at more optimal plantings. Early plantings have time to recover from various stresses or the stresses may not be as acute (eg. water stress), but this is not the case with late plantings. Nitrogen fertilizer rates that may be excessive at early planting dates may be necessary to increase tillering at late plantings for potential yield. The objective of this study is to evaluate the effects of nitrogen rates on late planted wheat and barley.

Procedure

A trial was established at the Maricopa Ag Center testing nitrogen rates for small grains planted late and at the optimal time. The field was fallow the previous year and the soil texture is a sandy loam. Soil chemical properties from a sample taken before planting are listed in Table 1. The seed was planted with a grain drill in plots 20 ft wide and 40 ft long. The seeding rate was approximately 150 lbs/acre for durum and 120 lbs/acre for barley. Growing conditions are listed in Table 2.

The experimental design was a strip plot repeated over time with 2 planting dates (December 7, 2016 and February 16, 2017), 2 cultivars as vertical strips (Tiburon durum and Chico barley), 3 nitrogen rates as horizontal strips (low, medium, and high nitrogen), and 4 replications. Irrigation and fertilization dates are provided in Table 3.

The following data was collected: grain yield, test weight, seed weight, plant height, lodging, grain protein, and HVAC. Grain was harvested with a small plot combine and yields are expressed on an "as is" moisture basis. Test weight was calculated from the weight of 1 pint of grain. Seed weight was determined from 200 seed. HVAC was determined from 10 g of seed. Grain protein was determined from total N multiplied by 5.7 and expressed on a 12% moisture basis.

Results and Discussion

The effects of nitrogen rate on yield and yield components are presented in Table 4. For the December 7 planting, nitrogen rate had no effect on yield and yield components. For the February 16 planting, grain yield was decreased by high nitrogen rate (especially for Chico barley) and grain protein was higher in the high nitrogen rate compared to the low nitrogen rate. High nitrogen rate could have made the barley more susceptible to aphid damage, and thus decreased yield. Protein content could have increased in the grain of the low yielding treatment due to lower accumulation of carbohydrate. No variables other than yield and protein were affected by nitrogen rate in the February 16 planting. The lack of response to nitrogen fertilizer could have been the result of high residual nitrogen in the soil at planting (Table 1). Nevertheless, at the February 16 planting, nitrogen fertilizer did not appear to have an effect on tillering or growth in general contrary to what we hypothesized. Therefore, for later planting dates, the only known method to increase stem count is higher seeding rates, but this may not necessarily have an effect on yield.

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Table 1. Soil chemical analysis from a sample collected preplant from the surface 6 inches for a planting date by nitrogen rate trial at the Maricopa Ag Center, 2017.

Chemical measurement	Unit	Value	Unit	Value
Total Exchange Capacity	(meq/100 g)	20.62	---	---
pH	(pH)	8.4	---	---
Organic Matter	(%)	0.92	---	---
Estimated Nitrogen Release	(lb N/acre)	37	---	---
NO_3-N	(ppm)	37.7	---	---
NH_4-N	(ppm)	24.3	---	---
S	(mg/kg)	30	---	---
P	(mg/kg)	4	---	---
Ca	(mg/kg)	3237	(%)	78.49
Mg	(mg/kg)	221	(%)	8.93
K	(mg/kg)	332	(%)	4.13
Na	(mg/kg)	259	(%)	5.46
Fe	(mg/kg)	3	---	---
Mn	(mg/kg)	6	---	---
Cu	(mg/kg)	1.28	---	---
Zn	(mg/kg)	0.73	---	---

Table 2. Cultural practices for a planting date by nitrogen rate trial trial at the Maricopa Ag Center, 2017

Cultural information	Early planting	Late planting
Previous crop	Fallow	Fallow
Soil texture	Sandy loam	Sandy loam
Planting date	12/07/2016	2/16/2017
Irrigation dates and amounts	See Table 3	See Table 3
Nitrogen dates and rate	See Table 3	See Table 3
Phosphorus fertilizer	None	None
Plant growth regulator	Palisade EC at 14.2 oz/acre on 2/14	Palisade EC at 14.2 oz/acre on 4/6
Herbicide	Bromoxynil at 1.02 pts/acre on 2/24	None
Insecticide	None	Lambda-Cy at 2.1 oz/acre on 5/3
Harvest date	5/24/2017	6/9/2017

Table 3. Irrigation and fertilization schedule for a planting date by nitrogen rate trial at the Maricopa Ag Center, 2016.

December 7, 2016 planting date					February 16, 2017 planting date				
		Nitrogen rate					Nitrogen rate		
Date	Irrigation	Low	Medium	High	Date	Irrigation	Low	Medium	High
	inches	---------- lbs N/acre ----------				inches	---------- lbs N/acre ----------		
12/07/16	3.50	0	0	0	02/16/17	5.38	0	0	0
01/09/17	3.42	0	0	0	03/16/17	4.09	50	100	150
01/31/17	3.80	51	102	153	03/30/17	4.00	25	50	75
02/27/17	4.16	26	51	77	04/13/17	4.07	25	50	75
03/16/17	4.09	28	56	84	04/26/17	3.80	25	50	75
03/30/17	4.00	19	39	58	05/08/17	4.96	0	0	0
04/13/17	4.07	0	0	0	05/18/17	3.72	0	0	0
04/26/17	3.80	0	0	0	Sum	30.03	125	250	375
Sum	30.84	124	248	372					

Table 4. Effect of nitrogen rate at two different planting dates on yield and yield components of 'Chico' barley and 'Tiburon' durum for a trial at the Maricopa Ag Center, 2017. The yields of 'Chico' barley were low at the February 16 planting due to aphid damage.

Planting date	Variety	Nitrogen rate	Grain yield	Test weight	Kernel weight	Plant height	HVAC	Grain protein
			lbs/acre	lbs/bu	mg	inches	%	%
Dec 7	Chico	124	6765	54.5	35.2	28	---	11.0
		248	6720	54.6	34.7	30	---	12.3
		372	6178	54.2	35.3	28	---	11.8
	Tiburon	124	6310	63.4	61.0	33	100	14.2
		248	6611	63.0	59.2	35	100	14.6
		372	6421	62.9	59.3	35	100	14.9
	Avg	124	6538	59.0	48.1	31	100	12.6
		248	6666	58.8	47.0	33	100	13.5
		372	6300	58.6	47.3	32	100	13.4
	N rate x variety		ns	ns	ns	ns	---	ns
	$LSD_{.05}$		ns	ns	ns	ns	ns	ns
	CV (%)		3.8	0.4	2.1	3.7	0	8.2
Feb 16	Chico	125	1543	52.3	30.1	16	---	14.1
		250	1309	52.4	30.7	16	---	14.2
		375	951	49.9	30.1	16	---	15.3
	Tiburon	125	3856	60.6	44.8	24	100	14.8
		250	3890	60.4	45.6	24	100	16.2
		375	3751	60.4	45.7	24	100	16.4
	Avg	125	2700	56.5	37.5	20	100	14.5
		250	2600	56.4	38.2	20	100	15.2
		375	2351	55.2	37.9	20	100	15.9
	N rate x variety		ns	ns	ns	ns	---	ns
	$LSD_{.05}$		301	ns	ns	ns	ns	1.0
	CV(%)		9.6	0.48	4.1	2.7	0	5.5