Barley and Durum Response to Seeding Rate at Maricopa and Yuma, 1996-97

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Interpretive Summary

A poor stand as a result of a low seeding rate can cost the grower due to decreased yield potential. A seeding rate higher than optimum can also cost the grower not only due to increased seed cost but also due to increased susceptibility to water and nitrogen stress and frost damage. Seeding rates in small grains are usually expressed on a pound per acre basis, but since varieties differ in seed size, different amounts of seed can be planted at equivalent seeding rates. Defining optimum seeding rates are also complicated by the fact that the number of seeds that actually emerge can vary depending on planting conditions. In our studies, emergence varied from 50 to 100% emergence. At the Maricopa location, the optimum seeding rate was obtained with 12 seedlings per square foot, which corresponded to a seeding rate of 75 lbs/A for the small seeded Brooks wheat and 125 lbs seed/A for the large seeded Kronos durum. No differences in yield were detected at the Yuma-Mesa location for barley seeding rates ranging from 75 to 150 lbs seed/A or at the Yuma-Valley location for durum seeding rates from 200 to 250 lbs seed/A. Growers generally seed at rates higher than the optimum suggested by this and other studies, but current commercial seeding rates are seen as cheap insurance against stand establishment problems and may or may not be warranted depending on seedbed conditions and percent emergence.

Introduction

Seeding rate is an important decision a grower faces when growing small grains. The disadvantages of a lower than optimum seeding rate is well known. Inadequate stand establishment decreases yield potential. Higher than optimum seeding rates, on the other hand, wastes money on seed and predisposes the plant to stress. A thick stand is more susceptible to water and nitrogen stress early since the seedlings compete for nutrients in a small portion of the surface soil before root establishment. A thick stand reduces the number of tillers per plant and the crop is uniform in its growth stages. A plant with many tillers will have some tillers at different growth stages than others. High seeding rates may produce a crop that flowers over a 3 to 4 day period, for example, whereas lower seeding rates may result in a crop that flowers over a 7 to 10 day period due to later tillers. Frost or other adverse conditions that occur over a period of a few days may damage a high seeding rate more than a low seeding rate since it is not able to compensate as well. Theoretically, the high seeding rate has a higher yield potential since the main stem of each plant is the highest yielding.

In practice, the optimum seeding rate varies depending on variety, planting date, and growing conditions. Some varieties tiller more than others which affects optimum seeding rate. Many growers try to compensate for late planting by seeding at a higher rate, and optimum seeding rates are often lower at earlier planting dates. Plants tend to tiller more in cool weather, on heavy soils, and if water and nitrogen are plentiful. The pounds of seed planted per acre is not a good indication of seeding rate since varieties can differ greatly in seed size. If the seed is large, fewer seed are planted per acre on a weight basis. However, larger seed can sometimes compensate for low seeding rate since they are more vigorous and establish easier. Settings on the grain drill are also not accurate, since seed of the same size may plant at different rates depending on how the seed flows due to seed shape. Finally, the adequacy of a stand and the seeding rate used is usually related more to the uniformity of the stand than to the average number of seedlings emerged per square foot. The purpose of these studies was to provide us with an idea whether or not standard seeding rates are near optimum.

Procedure

Yuma-Mesa

A study was conducted on the Yuma-Mesa. The previous crop was gourds, the soil type is a Superstition sand, and the preplant soil P was 22 ppm. Plots 10 ft. wide and 660 ft. long were established. Phosphorus was applied on Nov 12, 1996 at a rate of 58 lbs P_2O_5/acre as 0-45-0. Nebula barley was planted with a grain drill into dry soil on Nov 12 at rates of 75, 100, and 150 lbs seed per acre and irrigated up on Nov 13. The experimental design was a complete block with three treatments and four replications. The entire field received 69 lbs N/acre as urea preplant. A total of 65 inches of water was applied to the crop during the season in 13 irrigations of 5 inches each. Nitrogen was applied in the irrigation water as UAN32 (32-0-0) on 8 occassions at a rate of 18 lbs N/A per application. Nitrogen fertilizer application including that at planting totaled 213 lbs N/acre. Banvel herbicide was applied at a rate of 0.25 pint/acre and MCPA was applied at a rate of 0.5 pint/acre. The insecticide dimethoate was applied at a rate of 1 pint/acre. Stand counts were recorded on Nov 25 at the 1 leaf stage on 10 one square foot areas. Four 2 ft x 2 ft areas were harvested by hand for each plot on Apr 17. The grain was threshed with a stationary thresher and grain yield was calculated. Test weight and kernel weight was measured on the harvested grain. Plant height was recorded on Apr 18.

Yuma-Valley

A field trial was established at the Pasquenelli farm in Yuma, AZ during the 1996 crop season on a Gadsden clay soil. The study was conducted on four level basins: two were about 15 acres and the other two were about 19 acres. Each of the four basins were considered a plot or block. The previous crop was lettuce and the preplant soil nitrate concentration was 26 ppm. The seedbed was prepared by splitting the old lettuce beds, disking three times, and floating. A total of 92 pounds of nitrogen was applied per acre preplant for one replication along with the plant growth regulator Cerone which was applied by air on 20 Mar at early boot (Feekes 9-10) at a rate of 0.5 pt/acre. The other replication received no preplant nitrogen or Cerone. The preplant nitrogen and Cerone had no measurable effect except on plant yield. The durum cultivar Kofa was planted on 18 Jan 96 at a rates of 200 and 250 pounds of seed per acre. A total of seven irrigations were applied using the level basin method on 18 Jan, 17 Feb, 2 Mar, 18 Mar, 30 Mar, 12 Apr, and 19 Apr. Nitrogen fertilizer was applied in the irrigation water on 17 Feb, 2 Mar, 18 Mar, and 30 Mar at a rate of 35 pounds of nitrogen per acre each application as UN32. Stand emergence was estimated on 5 Feb by counting seedlings at the 1-2 leaf stage in 20 areas 1 square foot each. Plant height was determined on 3 Jun from 10 areas in each plot. Lodging was calculated on 3 Jun as the average of visual estimates from two people. Grain yields were calculated on 3 Jun from 8 areas in each plot 1/10,000 of an acre each. A sample of grain was analyzed for test weight, kernel weight, hard vitreous amber count (HVAC), and protein. Kernel weight and HVAC were determined from 10 grams of hand picked kernels. Protein was determined using a NIR whole grain analyzer and expressed on a 12% moisture basis.

Maricopa

Field 109 at the Maricopa Agricultural Center was used for this study. The soil type at this location is a Casa Grande sandy loam. The field was in sorghum the previous summer. Preplant soil phosphate was 7.6 ppm. Nitrogen and phosphorus fertilizer were applied before planting at rates of 85 lbs N/A and 44 lbs P_2O_5/acre as 21-0-0 and 16-20-0. The fertilizer was worked into the soil with a spring tooth harrow. Brooks wheat and Kronos durum were planted in 12 ft. wide strips with a grain drill into dry soil at rates of 75, 125, and 200 lbs/A on December 23, 1996, and a germination irrigation was applied on December 24. The experimental design was a split plot with two varieties as main plots and three seeding rates as subplots, and replicated four times. The plots were trimmed to 100 ft. with a rototiller. Irrigations were applied on Dec 23, Feb 7, Feb 27, March 18, April 3, April 18, and April 29. Urea was topdressed on Feb 6 at a rate of 50 lbs N/acre. UAN32 was applied in the irrigation water at a rate of 25 lbs N/acre on Feb 27 and Apr 2. Stand counts were made on Jan 23 at the 2 to 3 leaf stage on four 2 ft x 2 ft areas in each plot. Heading, anthesis, and physiological maturity dates were noted. The plots were harvested with a small plot combine on May 27 from a 5 ft wide x 96 ft long area. Grain yield was calculated on an "as is" moisture basis and test weight, kernel weight, and plant height were also measure at harvest. No lodging occurred. Kernel weight was determined from 10 g of hand picked seed.

Results and Discussion

The effect of seeding rate on yield and other plant characteristics is presented in Table 1. The number of seed planted per square foot differed greatly among varieties at equivalent seeding rates on a per pound basis due to differences in seed size. The barley was the lightest seed, followed by the wheat and durum, and the seeds planted per square foot was the highest for barley since it is lighter. Seeding rate recommendations on a per pound basis are less for barley than wheat. The number of seedlings emerged for Kronos at a rate of 125 lbs seed/A is similar to that of Brooks at 75 lbs seed/A. The emergence percentage averaged over seeding rates was 64, 95, and 52%, respectively, at Maricopa, Yuma-Mesa, and Yuma-Valley. The relatively high percentage emergence at the Yuma-Mesa location was due to the sandy soil and warm weather at planting time. The only difference in yield due to seeding rate that we were able to detect was for Kronos where a seeding rate of 75 lbs seed/A was lower than rates of 125 and 200 lbs seed/A. We were not able to detect any effect of seeding rate on test weight, kernel weight, plant height, lodging, heading, anthesis, or physiological maturity.

The highest economic returns were obtained at the lowest seeding rate where yield was maximized (Tables 2a and 2b). At Maricopa, highest returns were achieved at a 75 lb/A seeding rate for Brooks wheat and a 125 lb/A seeding rate for Kronos durum. If we assume that the yield differences at the Yuma-Mesa location are real even though we were not able to detect differences statistically, a seeding rate of 100 lbs seed/A resulted in the highest return. A seeding rate of 250 lbs seed/A was normally used by the grower at the Yuma-Valley location for late plantings, but the results showed that this higher seeding rate was not economical the year of the study.

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Table 1. Seeding rate effects on yield and plant characteristics at Maricopa, Yuma-Mesa, and Yuma-Valley.

Location	Variety	Seeding Rate	Seeds planted	Seeds emerged	Emergence	Yield	Test weight	1000 Kernel weight	Plant height	Lodging	Heading	Anthesis	Physiological Maturity
		lbs/A	seed/ft^2	seed/ft^2	%	lbs/A	lbs/bu	grams	inches				
Maricopa	Brooks (wheat)	75	17.8	12.2	68	6023	61.4	38.2	—	—	3-23	3-27	5-2
		125	29.6	19.7	67	6124	61.8	39.7	—	—	3-23	3-27	5-2
		200	47.4	30.3	64	6228	61.8	39.9	—	—	3-23	3-27	5-3
Statistical signicance (5%)						No	No	No	—	—	—	—	—
Maricopa	Kronos (durum)	75	13.8	9.6	70	5191	60.3	51.0	—	—	3-23	3-28	5-3
		125	23.1	13.0	56	5742	60.5	50.6	—	—	3-22	3-28	5-2
		200	37.0	22.2	60	5785	60.9	51.0	—	—	3-22	3-28	5-1
Statistical signicance (5%)						Yes	No	No	—	—	—	—	—
Yuma-Mesa	Nebula (barley)	75	20.4	19.0	93	5934	55.8	47.0	30	—	—	—	—
		100	27.2	27.6	101	6797	55.9	46.6	30	—	—	—	—
		150	40.8	36.9	90	6622	56.2	46.0	29	—	—	—	—
Statistical signicance (5%)						No	No	No	No	—	—	—	—
Yuma-Valley	Kofa (durum)	200	36.5	17.7	48	6117	63.2	52.9	35	20	—	—	—
		250	45.7	25.0	55	5928	62.9	51.5	35	35	—	—	—
Statistical signicance (5%)						No	No	No	No	No	—	—	—

Table 2a. Crop budgets - Maricopa: These numbers were generated from information provided by the grower and from budgets and custom rates obtained from the County Crop Budgets.

	Maricopa (Brooks)			Maricopa (Kronos)		
	75 lbs seed/A	125 lbs seed/A	200 lbs seed/A	75 lbs seed/A	125 lbs seed/A	200 lbs seed/A
Operating expenses						
Soil preparation ($/acre)	50	50	50	50	50	50
Planting and seed ($/acre)	24	36	52	24	36	52
Irrigation ($/acre)	90	90	90	90	90	90
Fertilizer ($/acre)	70	70	70	70	70	70
Herbicide ($/acre)	25	25	25	25	25	25
Harvest/Haul ($/acre)	21	21	22	18	20	20
Total ($/acre)	280	292	309	277	291	307
Income						
Yield (lbs/acre)	6023	6124	6228	5191	5742	5785
Grain protein (%)	10.5	10.7	11.0	10.4	9.9	10.1
Price received ($/cwt)	7.08	7.11	7.16	7.56	7.47	7.51
Total ($/acre)	426	435	446	392	429	434
Return over operating expenses($/acre)	146	143	137	115	138	127

Table 2b. Crop budgets - Yuma: These numbers were generated from information provided by the grower and from budgets and custom rates obtained from the County Crop Budgets.

	Yuma-Mesa			Yuma-Valley	
	75 lbs seed/A	100 lbs seed/A	150 lbs seed/A	200 lbs seed/A	250 lbs seed/A
Operating expenses					
Soil preparation ($/acre)	50	50	50	50	50
Planting and seed ($/acre)	22	28	38	52	63
Irrigation ($/acre)	54	54	54	50	50
Fertilizer ($/acre)	72	72	72	30	30
Herbicide/insecticide ($/acre)	18	18	18	0	0
Harvest/Haul ($/acre)	53	56	55	45	45
Total ($/acre)	269	278	287	227	238
Income					
Yield (lbs/acre)	5934	6797	6622	6117	5928
Grain protein (%)	—	—	—	14.1	14.7
Price received ($/cwt)	6.50	6.50	6.50	9.19	9.29
Total ($/acre)	386	442	430	562	551
Return over operating expenses($/acre)	117	164	143	335	313