Cultural Practices of One-Irrigation Barley at Marana, 1988

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ABSTRACT

One-irrigation barleys were bred to be grown with only a single irrigation near planting time. To further our understanding of how to manage these new cultivars, two one-irrigation barley genotypes (Seco and 2-22-9) were grown at four seeding rates (20, 40, 60, and 80 lbs seed/A); four nitrogen rates (0, 50, 100, and 150 lbs N/A); two phosphorus rates (0 and 100 lbs P_2O_5/A); four row spacings (6, 12, 18, and 24 inch); and three planting dates (Nov. 19, Dec. 23, and Jan. 22). The optimum seeding rate, fertilizer rate, and row spacing were dependent on genotype and planting date.

The optimum seeding rate was 40 to 60 lbs/A for Seco and 80 lbs/A for 2-22-9. An increase in seeding rate decreased kernel weight and kernel number per head, but increased head number. A positive response to nitrogen fertilizer was not obtained due to the high levels of residual soil nitrogen at planting (20 ppm NO_3-N) except for the case of Seco at the Dec. 23 planting date. Phosphorus fertilizer increased yield only at the Nov. 19 planting date and if accompanied by 100 lbs N/A. Soil phosphorous levels were 2 ppm PO_4-P and a positive response was expected. Kernel weight was not influenced by N or P fertilizer. Kernel number per head increased with certain combinations of genotype and planting date. Head number decreased with N rate but increased with phosphorus. The optimum row spacing was 18 inches at the Nov. 19 planting and 12 inches for Seco at the Jan. 22 planting date. At other combinations of genotype and planting date, no differences in grain yield were detected due to row spacing.

Kernel weight increased with row spacing at the Nov. 19 planting date; kernel number per head was generally not affected; and, head number decreased with row spacing. The results of this study suggest that any recommendations on how to grow one-irrigation barley are gross approximations because of variations due to year, planting date, and genotype.

INTRODUCTION

One-irrigation barleys have been selected to perform on a single irrigation which fills the soil profile to a depth of 4 to 6 feet. In April 1987, a one-irrigation barley named 'Seco' was released for soil conservation and wildlife enhancement purposes.

Some growers have expressed interest in one-irrigation barley for forage, green manure, or grain under conditions of limited water availability. Management of one-irrigation barley involves decisions concerning seeding rate, nitrogen and phosphorus rate, and planting date. This study was conducted to further our understanding of producing one-irrigation barley.

MATERIALS AND METHODS

Field studies were initiated at the Marana Agricultural Center in the 1987-1988 growing season to determine optimum cultural practices of one-irrigation barley. The field was fallow the previous year; the soil type was a Pima clay loam. The seeding rate and row spacing studies were fertilized with a total of 100 lbs N and 100 lbs P_2O_5/A as urea (46-0-0) and monoammonium phosphate (11-53-0). The fertility study received variable rates of nitrogen and phosphorus from urea and triple superphosphate (0- 45-0).

Two one-irrigation barleys (Seco and 2-22-9) were planted with a grain drill at 50 lbs seed/A or at variable rates on the seeding rate trial (20, 40, 60, and 80 lbs seed/A) at three planting dates (Nov. 19, Dec. 23, and Jan. 22). The plots were 10 ft x 18 ft. The experimental design was a split plot with genotype as main plots and with 4 replications.

On November 19 and January 22, the seed was planted in dry soil and then irrigated. The December 23 planting was seeded into moist soil from a rainfall and then irrigated on Jan. 22 at the 1 - 2 leaf stage. For planting dates Nov. 19, Dec. 23, and Jan. 22, the amount of plant available water in the top 5 feet of soil was 8.8, 8.2, and 10.0 inches and the amount of rainfall between planting and physiological maturity was 1.7, 2.7, and 2.1 inches, respectively.

Preplant residual soil nitrate in the top 1 ft. of soil was 20 ppm NO_3-N, which is considered a high level; it is approximately equal to 80 lbs N/A in the top foot of soil. The irrigation water contained 6 ppm NO_3-N, resulting in approximately 14 lbs N/A applied with the water.

Stand counts were obtained on the seeding rate study at the 1 - 2 leaf stage from a 12 sq ft area. Grain yields were obtained with a small plot combine from a 4.5 ft x 12 ft area. Kernel weight was determined from 1,000 kernels; kernels per head was determined from 10 heads; and head number was calculated from 8 ft of row.

RESULTS

Seeding Rates

Plant stand increased linearly with seeding rate at all three planting dates (Table 1). The best stand was achieved on the Dec. 23 planting date due to lack of soil crust formation; the seed was planted in moist soil from a recent rainfall and then irrigated after emergence.

At the Nov. 19 and Jan. 22 planting dates, grain yield was optimum for Seco at 40 to 60 lbs/A and for 2-22-9 at 80 lbs/A. No differences in grain yield were detected at the Dec. 23 planting date. Kernel weight decreased with seeding rate at the first and second planting dates, but was unaffected at the third. Kernel number per head decreased with seeding rate at all planting dates. Head number increased with seeding rate, particularly for 2-22-9.

Fertilizer Rates

The results of the fertilizer study are presented in Table 2. Grain yield was not influenced by nitrogen at the Nov. 19 planting date. At the Dec. 23 planting date, nitrogen increased grain yield of Seco but decreased grain yield of 2-22-9. Grain yield of Seco was decreased by nitrogen at the Jan. 22 planting date while grain yield of 2-22-9 was not affected. Phosphorus with 100 lbs N/A increased grain yield at the Nov. 19 planting date. Phosphorus without nitrogen decreased yield of Seco at the Dec. 23 planting date but did not affect 2-22-9. Phosphorus did not influence grain yield at the Jan. 22 planting date.

Kernel weight was not influenced by either N or P fertilizer. Kernel number per head was not influenced by nitrogen but was increased by phosphorus at the first planting date. At the second planting date, kernel number per head was increased by N and P, except for 2-22-9 receiving phosphorus without nitrogen. Kernel number was not affected by N or P fertilizer at the third planting date except for decreased kernel number for 2-22-9 receiving 50 or 100 lbs N/A compared to 0 or 150 lbs N/A. Head number decreased with N rate for 2-22-9 at the Nov. 17 planting date, but increased with P fertilizer with no N applied. At the Dec. 23 planting date, head number decreased with nitrogen rate and increased with phosphorus. Head number was not influenced by the fertilizer treatment for the third planting date.

Row Spacing

The influence of row spacing on grain yield and yield components is listed in Table 3. Grain yield was highest for the Nov. 19 planting date at the 18-inch row spacing. At the Dec. 23 planting date, no differences in grain yield due to row spacing were detected. Grain yield was highest at a 12-inch row spacing for Seco at the Jan. 22 planting date while no differences were detected for 2-22-9.

Kernel weight increased with row spacing at the first planting date, but was unaffected by row spacing at the other planting dates. Kernel number per head was not affected by row spacing at the first two planting dates, but was greatest at the 12- and 18-inch row spacings at the third planting date. Head number decreased with row spacing.

DISCUSSION

The results obtained this year indicate that the influence of seeding rate, N and P fertilizer, and row spacing depend on the genotype and planting date. Information obtained over the past two years demonstrate that response to the above-mentioned cultural practices is also dependent on the year. For example, in similar studies conducted over past years, the optimum seeding rate was 20 lb/A in 1986, 40 to 60 lbs/A in 1987, and 40 to 60 lbs/A for Seco and 80 lbs/A for 2-22-9 in 1988.

The influence of nitrogen fertilizer on grain yield was equally variable. A positive response to nitrogen was not expected this year due to high levels of residual soil nitrogen at planting time. Nevertheless, nitrogen increased the grain yield of Seco at the Dec. 23 planting date. Nitrogen either decreased yield or did not affect yield for the other combinations of genotype and planting date.

A response to phosphorus fertilizer was expected due to low soil test values. However, phosphorus increased yield only at the first planting date accompanied by nitrogen fertilizer.

The results indicate that row spacings other than 6 inches may be optimum for grain yield, especially at earlier planting dates. Row spacings of 18 inches were optimum at the Nov. 19 planting date, for example. A positive response to wider row spacings is dependent on weed-free fields.

All cultural practice decisions for one-irrigation barley must be made before the crop is planted. With other cropping systems the inputs can be adjusted during the growing season to account for weather differences. Optimum cultural practics of one-irrigation barley cannot yet be predicted with an acceptable level of certainty. Variations in response to seeding rate, fertilizer, and row spacings are expected over years, planting dates, genotypes and locations. Recommendations on how to grow one- irrigation barley are gross approximations at best.

Table 1. The influence of seeding rate on grain yield, yield components, and plant stand of two one-irrigation barley genotypes at three planting dates.

Plant-int Date	Genotype	Seeding Rate	Grain Yield	Kernel Weight	Kernel Number	Mean Number	Plant Stand
		lb/A	lb/A	g/1000	kernel/ head	head/ ft^2	plants/ ft^2
11/19	Seco	20	1335	39.7	62.2	11.2	2.9
		40	1785	35.7	56.8	20.3	4.7
		60	1688	35.6	51.8	27.9	9.4
		80	979	31.9	47.8	20.9	12.0
	2-22-9	20	1020	38.6	61.6	16.6	3.2
		40	1184	35.4	52.0	17.3	5.4
		60	1218	34.4	47.0	19.6	8.5
		80	2146	34.8	46.6	29.2	12.7
Seeding rate			*	**	**	**	**
Genotype x seeding rate			**	NS	NS	**	NS
12/23	Seco	20	2043	40.5	57.9	17.0	5.6
		40	1742	37.6	52.4	18.8	12.1
		60	2039	38.8	53.4	21.0	16.1
		80	1681	36.5	44.1	20.2	21.7
	2-22-9	20	1326	37.5	56.1	17.2	5.3
		40	1905	36.9	53.4	19.4	11.0
		60	1439	36.8	49.0	19.5	16.8
		80	2117	37.6	43.8	24.9	23.9
Seeding rate			NS	*	**	*	**
Genotype x seeding rate			NS	NS	NS	NS	NS
01/22	Seco	20	330	37.7	59.0	11.6	2.3
		40	615	39.4	55.4	14.2	4.8
		60	614	37.2	54.6	13.8	8.2
		80	305	37.0	49.0	13.2	11.5
	2-22-9	20	194	37.6	62.4	10.1	2.9
		40	325	34.8	52.0	12.2	5.5
		60	509	37.0	52.4	16.2	8.6
		80	1017	35.8	49.0	15.6	13.0
Seeding rate			*	NS	**	*	**
Genotype seeding rate			+	NS	+	NS	NS

NS, +, *, ** Not significant at P = 0.10, and significant at P = 0.10, 0.05, and 0.01, respectively.

Table 2. The influence of nitrogen and phosphorus fertilizer on grain yield and yield components of two one irrigation barley genotypes at three planting dates.

Planting Date	Genotype	Fertilizer N	Fertilizer P_2O_5	Grain Yield	Kernel Weight	Kernel Number	Head Number
		lb/A		lb/A	g/1000	kernel/ head	head/ ft^2
11/19	Seco	0	100	2244	39.6	55.4	22.1
		50	100	2379	36.6	57.0	23.2
		100	100	1967	38.4	54.0	19.2
		150	100	2193	38.2	56.0	25.6
		0	0	2026	40.1	62.7	17.8
		100	0	1507	38.6	57.0	20.1
	2-22-9	0	100	2296	40.2	54.6	24.8
		50	100	1995	38.1	51.0	22.5
		100	100	2044	38.5	51.0	20.9
		150	100	1895	38.3	50.6	18.6
		0	0	1516	36.8	59.2	16.2
		100	0	1162	36.6	59.4	16.8
Fertilizer				*	NS	*	*
Genotype x fertilizer				NS	NS	NS	NS
12/23	Seco	0	100	825	30.7	45.2	20.1
		50	100	1279	33.5	46.8	18.1
		100	100	1765	34.6	45.6	18.3
		150	100	1429	33.5	49.5	17.8
		0	0	1630	36.4	51.9	17.2
		100	0	1564	36.2	52.0	16.6
	2-22-9	0	100	1717	34.7	42.0	20.5
		50	100	1996	34.8	47.7	22.9
		100	100	1299	34.5	45.0	18.2
		150	100	1252	33.5	47.0	18.4
		0	0	1393	33.8	50.0	16.9
		100	0	992	33.6	41.1	15.1
Fertilizer				*	NS	**	*
Genotype x fertilizer				*	NS	*	NS
01/22	Seco	0	100	1648	42.9	58.4	14.9
		50	100	1785	43.8	60.3	17.7
		100	100	958	42.4	59.4	15.1
		150	100	1047	42.8	60.6	16.6
		0	0	1202	40.6	57.3	15.1
		100	0	1133	42.2	60.4	17.8
	2-22-9	0	100	1171	39.3	58.5	15.2
		50	100	937	38.0	55.4	15.0
		100	100	1043	39.2	54.3	17.2
		150	100	998	39.4	57.2	15.9
		0	0	1129	39.2	57.3	19.2
		100	0	1320	38.8	57.0	17.7
Fertilizer				+	NS	+	NS
Genotype x fertilizer				NS	NS	NS	NS

NS, +, *, ** Not significant at P = 0.10, and significant at P = 0.10, 0.05, and 0.01, respectively.

Table 3. The influence of row spacing on grain yield and yield components of two one-irrigation barley genotypes at three planting dates.

Planting Date	Genotype	Row Spacing	Grain Yield	Kernel Weight	Kernel Number	Head Number
		inches	lb/A	g/1000	kernel/head	head/ft^2
11/19	Seco	6	2377	39.4	57.0	27.0
		12	2570	39.0	54.8	22.1
		18	2843	40.5	57.6	21.7
		24	2425	40.5	57.9	21.4
	2-22-9	6	2780	38.2	53.6	30.5
		12	2281	37.6	57.3	21.0
		18	2969	39.4	55.6	20.8
		24	2568	40.4	54.2	18.7
Row spacing			+	**	NS	**
Genotype x row spacing			NS	NS	NS	NS
12/23	Seco	6	1881	37.9	53.0	18.2
		12	1511	36.3	52.6	16.8
		18	2020	39.6	55.2	19.4
		24	1510	37.9	51.8	13.8
	2-22-9	6	-	-	-	-
		12	-	-	-	-
		18	-	-	-	-
		24	-	-	-	-
Row spacing			NS	NS	NS	NS
Genotype x row spacing			-	-	-	-
01/22	Seco	6	1744	41.2	53.7	23.2
		12	2609	39.6	52.8	19.1
		18	2218	39.0	57.9	15.4
		24	1896	42.5	50.8	14.2
	2-22-9	6	1574	40.8	55.5	25.7
		12	1682	40.2	57.8	17.8
		18	1668	40.2	57.4	16.0
		24	1885	40.4	50.6	14.8
Row spacing			*	NS	**	**
Genotype x row spacing			+	NS	NS	NS

NS, +, *, ** Not significant at P = 0.10, and significant at P = 0.10, 0.05, and 0.01, respectively.