University of Idaho
College of Agriculture
Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 365
February 1977

Managing Irrigation and Nitrogen For Moravian Barley In Southern Idaho

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Moravian barley has become an important variety in southern Idaho and its acreage is still increasing. This 2-row barley tends to lodge soon after heading. The risk of lodging is greater if excess nitrogen is present and if the crop is well-watered before the boot stage. Lodging decreases the barley's malting quality and may lower yield because of harvesting problems.

The main quality factors of 2-row malting barley that are influenced by irrigation and nitrogen management are:

Protein content - Maltsters and brewers prefer 12% or less protein.

RECOMMENDATIONS

1. Before planting, obtain a soil test for residual nitrate-nitrogen, especially following crops like potatoes, onions and sugarbeets. If the residual nitrate-nitrogen is over 120 lb./acre, do not apply nitrogen fertilizer.

2. If nitrogen fertilizer is needed, apply only enough that the residual plus fertilizer nitrogen does not exceed 120 lb./acre.

3. If winter precipitation has wet the root zone and if germination and tillering are good, delay the first irrigation until the boot stage or the last week in May in the Twin Falls area. Irrigating earlier can cause longer straw which increases the risk of lodging.

4. After the first irrigation, apply 3 to 4 inches of water every 12 to 14 days until the soft dough stage or until the last 5 days in June in the Twin Falls area.

Percent plump kernels - Maltsters require at least 80% and prefer over 90% plump kernels.

Germination - Maltsters prefer barley with over 96% germination.

EXPERIMENTS

The objectives of these studies were (1) to determine if straw length and lodging could be decreased by delaying irrigations before the boot stage and (2) to determine the amount of nitrogen required for maximum yield and quality.

We used Moravian No. 8 in furrow-irrigated field experiments near Kimberly in 1971 and 1972, Moravian III in sprinkler-irrigated field experiments near Buhl in 1973 and 1974. Seeding rate was 100 lb./acre each year.

The soil series at each site is a typical Portneuf silt loam. This soil has a cemented layer, which generally restricts the roots, beginning at the 16 to 18 inch depth.

Irrigation Treatments

Two irrigation treatments were used each year. For the normal soil moisture treatment (M-1), irrigations were applied to obtain near-maximum yields (about 65% available soil moisture remained at 18-inch depth). For the second soil moisture treatment (M-2), first irrigation was delayed about 1 week during the jointing stage. After the first irrigation, the M-2 plots were irrigated at the same level of soil moisture depletion as the M-1 plots.

Small furrows spaced 24 inches apart and 12-hour irrigation sets were used in the furrow-irrigated experiments. Water was applied to every-other furrow except for the first irrigation of the M-2 plots, where each furrow was used to replace the larger amount of soil

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Table 1. Rainfall from planting to first irrigation.

Year	Planting date	First irrigation date		Rainfall from planting to first irrigation	
		M-1	M-2	M-1	M-2
					(inches)
1971	4/1	6/1	6/8	5.1*	5.6*
1972	3/28	5/19	5/23	0.4	0.7
1973	3/24	5/21	5/30	1.6	1.9
1974	3/28	5/22	5/28	1.1**	1.1**
Average		5/23-24	5/30	2.1	2.3

*Includes 1 inch applied 4/12/71 to improve germination
**Includes 1 inch applied 5/3/74 to improve tillering

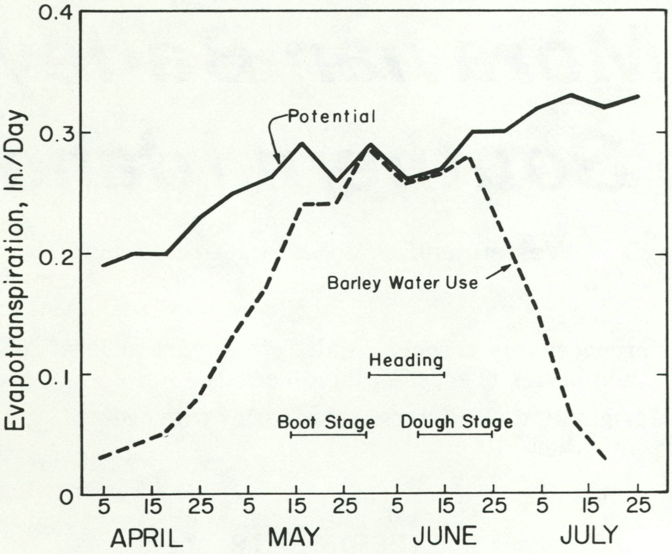

Fig. 1. Estimated daily water use by barley in southern Idaho as compared with daily potential or maximum evapotranspiration.

moisture that had been depleted. The furrows used were alternated for each irrigation.

For the sprinkler irrigation experiments, a solid set system (40- x 50-foot spacing and 9/64-inch nozzles) applied about 3 inches of water at each irrigation, except for the first irrigation on the M-2 plots which received about 4 inches.

The rainfall received from planting to the first irrigation is summarized in Table 1 because the amount of rain during this period determines when the first irrigation is needed. Normally, the M-1 plots were irrigated between May 19 and May 22. In 1971, however, heavy spring rains delayed first irrigation to June 1. On the M-2 plots, the first irrigation was made 6 to 7 days after the M-1 application. Two or three additional irrigations were applied to all plots at about 13-day intervals as indicated by the tensiometers. The last irrigation for both treatments was applied during the soft dough stage (average date, June 27).

Nitrogen Rates

Table 2 shows residual nitrate-nitrogen at each experimental site and the nitrogen fertilizer applied before planting. Soil tests for phosphorus indicated an adequate supply each year (see Current Information Series No. 270, Idaho Fertilizer Guide — Malting Barley).

RESULTS

The estimated daily water-use rate by barley is compared with the maximum or potential rate of evapotranspiration in southcentral Idaho in Fig. 1. Barley will use about 0.25 inch per day from the boot stage through the soft dough stage (from about May 20 until June 20). Before the boot stage, the estimated water-use rate rapidly increases and approaches the potential rate

Table 2. Effect of nitrogen and irrigation on straw length, lodging and yields.

Year	Residual nitrate-nitrogen (N_n) (0-24 inch depth)	Nitrogen fertilizer rates (N_f)	$N_n + N_f$	M-1 plots Straw length[1]	M-1 plots Lodging	M-1 plots Yield	M-2 plots Straw length	M-2 plots Lodging	M-2 plots Yield
	lb./acre	lb./acre	lb./acre	inches	%	bu/acre	inches	%	bu/acre
				Furrow irrigated					
1971	56	0	56	—	0	80.6	—	7	94.9
		60	116	—	50	73.9	—	67	69.7
		120	176	—	52	80.5	—	80	74.4
1972	29	0	29	—	0	49.7	—	0	48.4
		30	59	—	0	65.3	—	0	61.4
		80	109	—	0	84.8	—	0	84.9
				Sprinkler irrigated					
1973	50	0	50	33	15	111.2	29	0	108.3
		25	75	37	27	112.8	31	5	117.3
		75	125	38	73	123.3	33	10	114.3
		150	200	41	92	101.6	38	15	111.7
1974	17	0	17	25	0	43.0	23	0	56.1
		50	67	33	0	71.3	27	0	74.7
		100	117	36	2	81.9	29	0	88.9
		200	217	36	37	84.6	28	1	83.6

[1]Measured only in 1973 and 1974

Table 3. Effect of available nitrogen on average yield, protein content and kernel plumpness.[1]

Available nitrogen[2]	$(N_n + N_f)$	Yield	Protein	Kernel plumpness
lb./acre	lb./acre	bu./acre	%	%
50 to 70	58	83.5	9.8	90
70 to 120	104	89.3	11.0	81
Over 120	180	96.3	12.3	67

[1]Average of 8 treatments, 1971-1974.

[2]Residual nitrate-nitrogen, 0 to 24 inch depth, plus fertilizer nitrogen.

as crop cover develops. After June 20 the estimated water-use rate decreases as the crop matures, even though the potential rate is still increasing.

Delaying the first irrigation 6 to 7 days on the M-2 plots decreased the straw length and decreased lodging without decreasing yields each year except in 1971 (Table 2). Greater lodging on the M-2 plots in 1971 resulted from above normal rainfall during the jointing stage (Table 1). Straw length averaged 30 inches on the M-2 plots and 35 inches on the M-1 plots in 1973 and 1974.

Straw length and lodging increased significantly with additional available nitrogen on both irrigation treatments. The severity of lodging caused by excessive nitrogen generally was not as great on the M-2 plots as on the M-1 plots. When available nitrogen was greater than 120 lb./acre, the average lodging on the M-2 plots was 26% compared with 64% on the M-1 plots. These results indicate that delaying the first irrigation 6 to 7 days during the jointing stage can significantly decrease straw length and decrease the risk of lodging, even at higher nitrogen levels. We also observed that irrigating in alternate furrows after boot stage decreased lodging since alternate strips of the surface remained dry.

There was no significant yield difference between the two irrigation treatments except at the lowest nitrogen level in 1971 and 1974 when yields were greater on the M-2 plots (Table 2). Because of the small differences in yields between the irrigation treatments, we combined and grouped the nitrogen treatments into three levels of available nitrogen (Table 3). With 70 to 120 lb./acre available nitrogen, yields were maximum, protein content was acceptable (less than 12%) and percentage of plump kernels was greater than 80%. When residual nitrate plus fertilizer nitrogen exceeded 120 lb./acre, yields were high but protein content exceeded 12% and percentage of plump kernels was less than 80%. This barley would have been rejected for malting use because of its quality. Grain from all treatments exceeded 98% germination.

CONCLUSIONS

Good yields of high quality 2-row Moravian barley can be produced in southern Idaho if the residual plus fertilizer-nitrogen is less than 120 lb./acre. A field containing more than 120 lb./acre residual nitrogen should not be planted to malting barley since the risk of lodging and decreased quality will be greater.

In this study, nitrogen taken up by the barley from mineralized soil organic matter seemed to be nearly constant each year. Adjustments in nitrogen fertilizer rates will have to be made where levels of soil mineralizable nitrogen are potentially different. Additional recommendations for nitrogen fertilizer are included in Current Information Series No. 270, Idaho Fertilizer Guide — Malting Barley.

Straw length can be decreased 4 to 6 inches without decreasing barley yield or malting quality, by delaying the first irrigation 6 to 7 days during the jointing stage. When the first irrigation is delayed, one less irrigation may be needed and a higher nitrogen efficiency will be achieved when nitrogen limits production.

Malting barley should be irrigated at about 13-day intervals on Portneuf silt loam in southern Idaho after the first irrigation. The last irrigation should be applied at the soft dough stage, or the last 5 days in June. Normally, only three irrigations during the growing season are needed on this soil to supply enough water for the estimated daily water use shown in Fig. 1.

About This Publication . . .

This research was conducted by personnel of the Western Region, Agricultural Research Service, USDA, in cooperation with the University of Idaho Research and Extension Center, Kimberly. B. J. Ruffing is research technician; M. E. Jensen is agricultural engineer; D. T. Westermann is soil scientist, ARS-USDA, at the Snake River Conservation Research Center, Kimberly.

Part of the funds for the study were provided by the Malting Barley Improvement Association, Milwaukee, WI. Barley seed and brewing quality analyses were provided by Adolph Coors Co., Golden, CO.

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