Late Season Irrigation Management for Optimum Sugarbeet Production

C. Dean Yonts, Irrigation Engineer
Karen L. Palm, Research Assistant
David L. Reichert, Research Assistant

University of Nebraska
Panhandle Research and Extension Center
Scottsbluff, Nebraska 69361

Introduction

Water for irrigation is of critical concern whether it is due to increased cost of pumping, depleting ground water supplies, decreases in snow pack, or the increasing competition for surface water resources. Whatever the reason, irrigated agricultural production will need to become more efficient in the use of their current water resources.

A number of trials have been conducted to study the effect of limited irrigation on sugarbeet production. A portion of these studies have concentrated on deficit irrigation by reducing the amount of water supplied to the sugarbeet for the entire growing season. Other studies have established cutoff irrigation dates during a prescribed time during the growing season. Carter, Traveller and Rosenau conducted a study in Idaho to evaluate mid- to late-season water stress. They found sucrose yield to be affected very little if irrigations were stopped after filling the profile on August 1.

The ability to reduce irrigations during the August and September time period could save large quantities of water and reduce production costs. Pivot producers could see their pumping costs reduced as well as reducing the impact on limited ground water supplies. Irrigators that rely on surface waters could improve their overall water supplies by reducing demand. It would also provide greater flexibility for irrigation districts to supply water during high water use periods during the growing season.

As water supplies become more limiting, an understanding of the impact of limiting irrigation and the timing of those irrigations will be critical. This study will address both furrow and sprinkler irrigation and narrow the scope on deficit irrigation during the later stages of the growing season when the roots generally decrease growth patterns and increase in the manufacture of sugar.

Objective

Improve the water use efficiency of sugarbeets for furrow and sprinkler irrigated systems.

1) Determine the effect of late season water stress on the yield of sugarbeets.

Methods

The study was conducted at the University of Nebraska, Panhandle Research and Extension Center. Two separate trials were conducted, one using furrow irrigation and the other using center pivot sprinkler irrigation. The irrigation treatments were replicated six times in a randomized complete block design. Plots were a minimum of 50 feet long. Plots were twelve rows wide (22in. row spacing) for the center pivot study and eight rows wide (22in. row spacing) for the furrow study.

The irrigation treatments included the following:

1) Full irrigation through harvest
2) Limited irrigation after mid August
3) No irrigation after mid August

Planting date, variety, irrigation treatment start date and harvest date are given in Table 1. The irrigation treatment start date coincided with scheduled irrigation events for the furrow and sprinkler trials. Both the sprinkler and furrow trials were irrigated after planting each year to aid in germination and emergence.

Cultural practices were the same throughout the season for all plots within the sprinkler and furrow sites other than the late season irrigation treatments. All plots were harvested with a mechanical harvester. Samples were collected and sent to the Western Sugar Tare Lab to determine tare and sucrose.

Table 1. Planting date, variety, irrigation treatment start date, and harvest date for sprinkler and furrow irrigation trials.

Sprinkler Trial					
		1995	1996	1997	1998
	Planting Date	5/5	4/23	4/28	5/7
	Variety	Monohikari	Seedex Halt	Seedex Halt	Beta 4546
	Irrigation Treatment Start Date	8/8	8/12	8/7	8/12
	Harvest date	-	10/16	11/5	11/11
Furrow Trial					
		1995	1996	1997	1998
	Planting Date	4/27	4/18	4/24	4/21
	Variety	Monohikari	ACH 184	Laser	Beta 4546
	Irrigation Treatment Start Date	8/10	8/6	8/8	8/13
	Harvest date	10/24	10/9	10/30	11/12

Results

Tables 2 and 3, give the irrigation schedules and the irrigation application amounts for 1998 for both the sprinkler and furrow trials, respectively. This tables provide an example of the irrigation schedules used in the trials. From August 12 to the end of the season in the sprinkler trial, the no irrigation treatment received only 1.0 in. of irrigation compared to 7.9 in. of irrigation received by the full irrigation treatment. The limited irrigation treatment received 4.5 in. of irrigation.

For the furrow irrigation trial in 1998, irrigation was the same for each treatment through August 13. From August 13, the no irrigation treatment received one irrigation of 2.7 in. The full irrigation treatment was irrigated five times and had approximately 13.5 in. of water applied. The limited irrigation treatment was irrigated three times

during this same time period and had approximately 8.1 in. of water applied. For the furrow irrigation treatments, it was assumed that the soil profile was filled to a depth of 3.0 ft following each irrigation.

Table 4 gives the total water applied for each of the different irrigation treatments used in the sprinkler and furrow trials during 1995 - 1998.

Table 5 gives the results of the sprinkler irrigation trial for 1996-1998. There were no significant differences in sugarbeet yield among the sprinkler irrigation treatments tested. This includes yield in terms of tare, percent sugar, root weight and pounds of sugar produced.

Yield data is given in Table 6 for 1995-1998 of the furrow irrigation trial. The results are similar to the sprinkler site in that there were no significant differences found in yield among the furrow irrigation treatments tested.

Data were combined for the center pivot system (three years) and the furrow irrigation system (four years). One year under the pivot was lost due to rhizoctonia. Yield results of the seven site years combined are giving in Table 7. Root yield was similar for the full and limited irrigation treatments but both treatments had approximately 1.6 tons/acre higher root yield than the no irrigation treatment. Sugar content and tare were not influenced by late season irrigation. Sugar produced was greatest for the full irrigation treatment at 7880 pounds/acre. No irrigation produced 540 pounds/acre less sugar than full irrigation. The limited irrigation treatment produced similar sugar yield to both the full and no irrigation treatments.

Discussion

No irrigation late in the growing season, after mid-August, decreased sugar yield by nearly 7% when compared to meeting full crop water requirements to the end of the growing season. The yield potential is determined primarily by the early and mid season growth periods of sugarbeets. If irrigation is a limiting factor, having some water stress late in the growing season will have little impact on sugarbeet yield for either sprinkler or furrow irrigation systems. Soil moisture conditions for harvest will still need to be considered.

Table 2. Late season irrigation schedule and application amount (in.) for the full, limited and no irrigation treatments of the 1998 sprinkler irrigation trial.

	Full	Limited	None
August 12	1.0	1.0	1.0
August 21	0.75	0.0	0.0
August 26	0.75	0.75	0.0
August 31	0.9	0.0	0.0
September 3	0.9	0.9	0.0
September 8	0.9	0.0	0.0
September 10	0.9	0.9	0.0
September 18	0.9	0.0	0.0
September 24	0.9	0.9	0.0
Total	7.9	4.5	1.0

Table 3. Late season irrigation schedule and application amount (in.) for the full limited and no irrigation treatments of the 1998 furrow irrigation trial.

	Full	Limited	None
August 13	2.7	2.7	2.7
August 25	2.7	0.0	0.0
September 1	2.7	2.7	0.0
September 11	2.7	0.0	0.0
October 1	2.7	2.7	0.0
Total	13.5	8.1	2.7

Table 4. Total irrigation application amounts for sprinkler and furrow trials in 1995 - 1998 from irrigation treatment start date to end of growing season.

Sprinkler Trial					
		1995	1996	1997	1998
	Full Irrigation	-	4.8	10.1	7.9
	Limited Irrigation	-	3.0	5.5	4.5
	No Irrigation	-	1.8	1.7	1.0
Furrow Trial					
		1995	1996	1997	1998
	Full Irrigation	10.4	10.8	10.8	13.5
	Limited Irrigation	8.1	5.4	5.4	8.1
	No Irrigation	2.7	5.4	2.7	2.7

Table 5. Tare, sugar content, root yield and sugar yield for the pivot irrigation trial combined over 1996-1998.

Treatment	Tare (%)	Sugar (%)	Root Yield (tons/acre)	Sugar Yield (lbs/acre)
Full Irrigation	12.0	15.3	28.9	8830
Limited Irrigation	11.2	15.0	28.5	8520
No Irrigation	11.2	15.3	27.4	8410
	N.S.	N.S.	N.S.	N.S.

Table 6. Tare, sugar content, root yield and pounds of sugar for the furrow irrigation trial combined over 1995-1998.

Treatment	Tare (%)	Sugar (%)	Root Yield (Tons/acre)	Sugar Yield (Lbs/acre)
Full Irrigation	7.6	14.9	23.6	7160
Limited Irrigation	7.8	14.9	23.7	7200
No Irrigation	7.3	14.8	21.7	6540
	N.S.	N.S.	N.S.	N.S.

Table 7. Tare, sugar content, root yield and pounds of sugar for the sprinkler and furrow irrigation trials combined over over seven site years during 1995-1998.

Irrigation Treatment	Tare (%)	Sugar. (%)	Root Yield (Tons/acre)	Sugar Yield (Lbs/acre)
Full	9.5	15.1	25.8	7878
Limited	9.2	14.9	25.7	7769
No	8.9	15.0	24.1	7342
	LSD(0.05) N.S.	LSD(0.05) N.S.	LSD(0.05) 1.3	LSD(0.05) 440