LIMITED IRRIGATION STRATEGIES FOR DRY EDIBLE BEANS AND SUGARBEETS

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SUMMARY

Irrigation water stress early in the season for dry beans reduced crop yield and delayed maturity, Irrigation water stress on sugarbeets late in the growing season reduced yields by approximately 500 pounds of sugar/acre.

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. There are a number of questions being raised concerning the use of water in the U.S. Producers must demonstrate the wise and effective use of available water to meet public demands as well as meeting the water needs of their crop.

There are nearly 500,000 acres of dry beans and 250,000 acres of sugarbeets grown in the central high plains of the United States. All of these crop acres are dependent upon irrigation. Dry beans are normally irrigated for the first time during the end of June or first of July. Through observation, water stress on dry beans during early vegetative growth impacts yield to a small degree yet impacts date of maturity more significantly. Understanding the impact of early season stress combined with good water management during the balance of the season can mean improved yield through earlier harvest. The challenge for the producer is to make these improvements without increasing the total amount of water currently being used to produce the dry bean crop. The loss of dry beans due to late season storms can be reduced by moving the maturity date forward. Earlier harvest dates would not only result in higher yields but also higher quality

beans and easier harvest conditions. Equally important is demonstrating efficient use of available water supplies by dry bean producers.

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 times when crops are not efficiently using soil water could save large quantities of water and reduce production costs. On the other hand, reducing water at the expense of yield is not an acceptable practice. As water supplies become more limiting, an understanding of the impact of limiting irrigation and the timing of those irrigations will be critical. This report summarizes two research studies being conducted in Nebraska to address limited irrigation strategies for dry bean and sugarbeet producers.

OBJECTIVE

To improve the water use efficiency of dry edible beans and sugarbeets for furrow and sprinkler irrigated systems. Specific objectives include:

1) Determine the effect of early season water stress on the yield and maturity of dry beans.

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

PROCEDURES

The studies were conducted at the University of Nebraska, Panhandle Research and Extension Center at Scottsbluff, Nebraska. The sugarbeet study was conducted for four years while the dry bean study, which is still in progress, has been conducted for three years. For both crops two separate trials were conducted, one using furrow irrigation and the other using center pivot sprinkler irrigation.

Dry Edible Bean

In 1997 furrow irrigation treatments were replicated in a randomized complete block design six times. Starting in 1998, both furrow and center pivot trials were conducted. Plots were a minimum of 100 feet long and eight rows wide in the furrow trial and twelve rows wide and 50 feet long in the center pivot trial. The irrigation treatments included the following:

1) No Stress - Full irrigation through harvest
2) Limited Stress - Elimination of first irrigation
3) High Stress - Elimination of first and second irrigation

The variety planted was Great Northern Beryl. Cultural practices were the same throughout the season for all plots other than the early irrigation treatments. The plots were planted in early June and harvested in early to mid September. Yield was determined for each plot by sampling two rows, 50 feet long. Samples were collected from these to determine seed moisture and seed size.

Whole plants were sampled from the plot area beginning approximately two weeks before harvest. Pods were hand threshed and seeds were oven dried to determine seed moisture content.

Sugarbeet

Irrigation treatments were replicated six times in a randomized complete block design. Plots were a minimum of 50 feet long. Plots were 12 rows wide(22in. rows wide) for the center pivot study and eight rows wide 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

The last irrigation for all treatments each year occurred approximately August 15 for each of the sites. This date coincided with scheduled irrigation events for the furrow and sprinkler studies. Cultural practices were the same throughout the season for all plots within the sprinkler and furrow sites other than the late irrigation treatments. Plots were harvested in late October or early November. Samples were collected and sent to the Western Sugar Company Lab to determine tare and sucrose.

RESULTS

Dry Edible Bean

As example of the dry bean irrigation schedule, evapotranspiration, rainfall, and irrigation time and amount are given in Table 1 for the 1997 growing season.

Table 1. Irrigation schedule and application (inches) for no stress, limited stress and high stress irrigation treatments.

	No Stress	Limited Stress	High Stress	Rainfall	ET
June 12 -July 11	2.2	0.0	0.0	0.6	2.2
July 12 - July 18	2.2	2.2	0.0	0.0	1.3
July 19 - July 27	2.2	2.2	2.2	0.1	2.1
July 28 - August 26	2.2	2.2	2.2	2.9	5.6
August 27- September 12	0.0	0.0	0.0	0.0	2.1
Total Application	8.8	6.6	4.4	3.6	13.3

The combined yield from three furrow irrigation trials and one center pivot irrigation trial is given in Table. 2. The high stress water treatment reduced yield by over 260 lb/ac or 5.3 bu/ac.

Figure 1. shows the rate of seed dry down beginning approximately two weeks prior to harvest for the 1997 growing season. Allowing no stress on the dry beans early in the growing season resulted in earlier drydown of the seed.

Table 2. Seed moisture, test weight, yield and bean size for the center pivot trial (one year) and the furrow irrigation trials (three years) combined for the three irrigation treatments tested.

Treatment	Moisture %	Test Wt. lb/bu	Yield lb/ac	Yield bu/ac	Wt. of 100 beans	Beans/lb
No stress	12.4	57.5	2790	49.4	30.8	1480
Limited Stress	13.1	56.1	2620	47.2	29.9	1520
High Stress	13.0	57.4	2360	41.9	30.3	1530
LSD	0.3	N.S.	180	3.4	N.S.	N.S.

Sugarbeet

Given in Tables 3 and 4, are examples of irrigation application amounts for the sprinkler irrigation and furrow trials in 1998, respectively.

Table 3. 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	3.6	1.0

Table 4. 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	0.0	0.0
Total	13.5	8.1	2.7

Table 5 gives the results of the sprinkler irrigation trials during 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.

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

Table 5. Tare, sugar content, root yield and pounds of sugar for the pivot irrigation trial combined over three years.

Treatment	Tare (%)	Sugar (%)	Root Yield (tons/acre)	Sugar Yield (lbs/acre)
Full Irrigation	12.0	15.3	28.9	8835
Limited Irrigation	11.2	15.0	28.5	8521
No Irrigation	11.2	15.3	27.4	8415
LSD	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 four years.

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	7205
No Irrigation	7.3	14.8	21.7	6538
LSD	N.S.	N.S.	N.S.	N.S.

Data were combined for the center pivot system (three years) and the furrow system (four years). One year under the pivot was lost due to rhizoctonia. Yield results of the seven site years combined are giving in Figure 2. Root yield was similar in 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.

CONCLUSIONS

Dry Bean

Irrigation water stress early in the vegetative period for dry beans can reduce yield and delay maturity. Eliminating water stress early in the growing season can result in greater yields and more timely harvests

Sugarbeet

Irrigation late in the growing season, after mid-August, did little to increase the yield of sugarbeets. The yield potential is determined primarily by the early and mid season growth periods. Eliminating irrigation late in the season did reduced yield and is not recommended. However, 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.

REFERENCES

Carter, J.N., D.J. Traveller, and R.C. Rosenau. 1980b Root and sucrose yields of sugarbeets as affected by mid- to late-season water stress. J. Am. Soc. Sugar Beet Technol. 20:583-596.

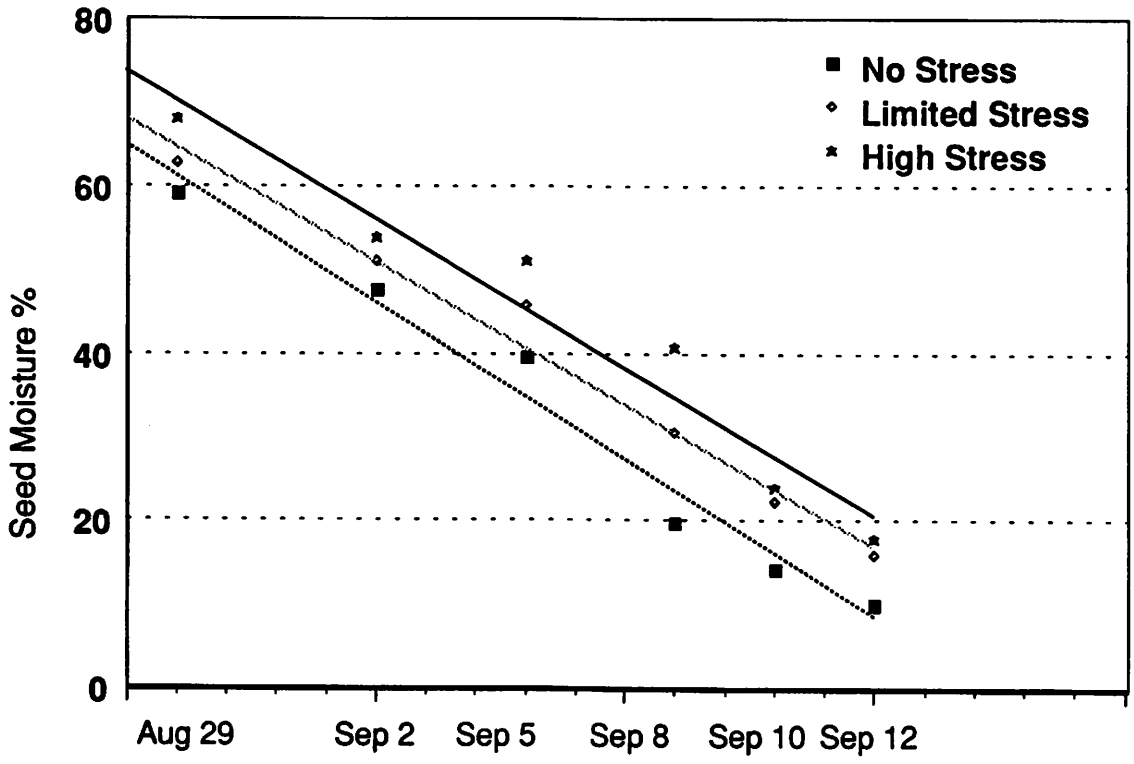

Figure 1. Seed moisture (percent) for three early season water stress treatments in 1997 at six different harvest dates.

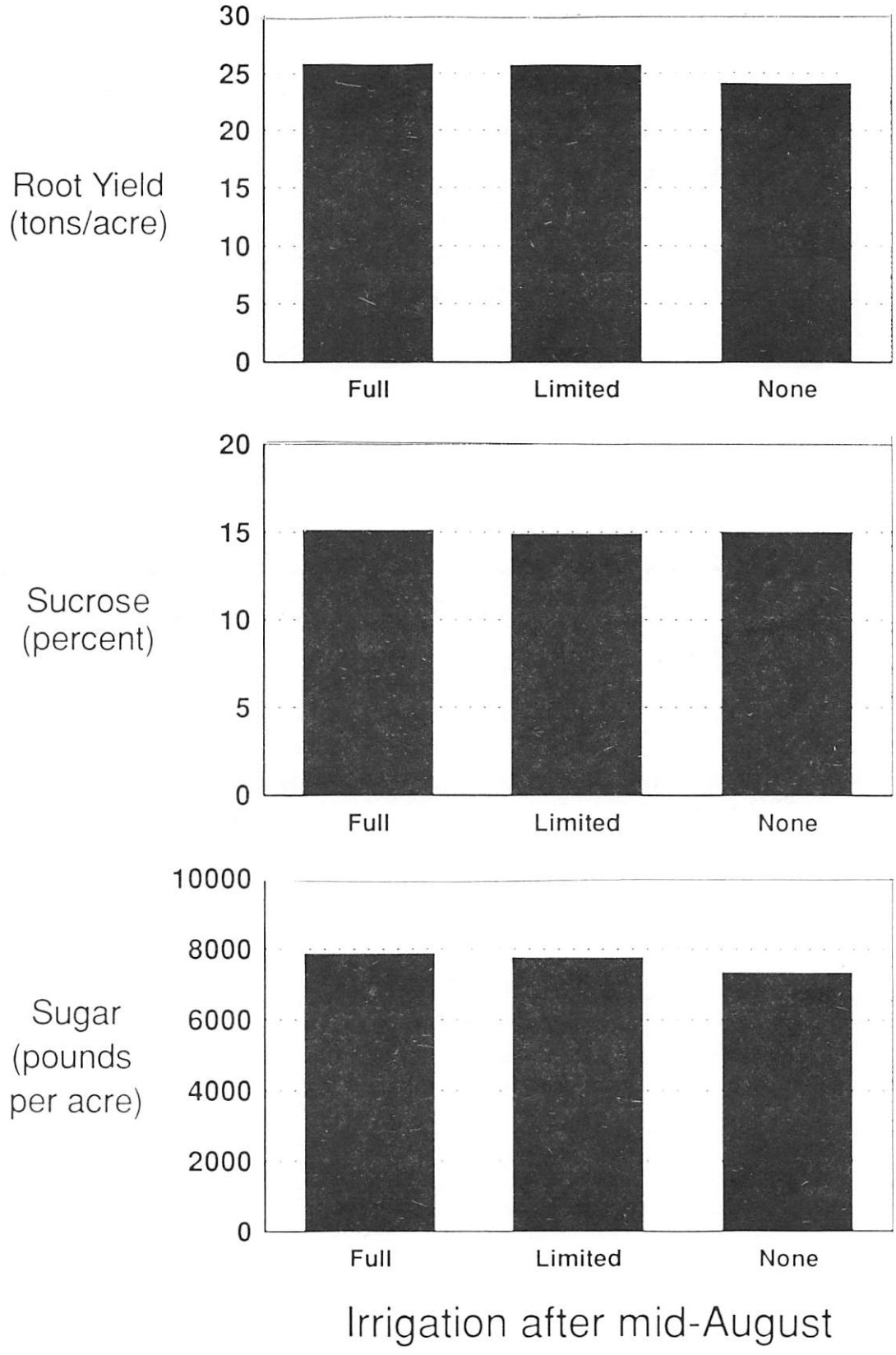

Figure 2. Root yield, sucrose and sugar yield for full, limited, and no irrigation treatments after mid-August combined over 7 site years.