FINE-TUNING A NITROGEN BUDGET SYSTEM FOR SUGARBEETS PRODUCED UNDER SPRINKLER AND FLOOD IRRIGATION

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Objective: To fine-tune nitrogen recommendations for sugarbeets produced under sprinkler and flood irrigation

Procedure: Previous crops were durum in 2003, potatoes in 2002, and safflower in 2001. Residual soil N to 4 feet was 28 lb/ac. Residual soil P to 6 inches was 27 ppm and residual soil K to 6 inches was 483 ppm. Five rates of liquid 28-0-0 were applied September 17, 2003. A check treatment with no applied N was included.

Table 1. Residual soil N and applied soil N on sugarbeets grown under sprinkler and flood irrigation.

Treatment	Soil N to 4 feet	Applied N	Available N
No applied N	28	0	28
Recommended – 50 lb/ac	28	72	100
Recommended – 25 lb/ac	28	97	125
Recommended	28	122	150
Recommended + 25 lb/ac	28	147	175
Recommended + 50 lb/ac	28	172	200

Plots were planted to stand with the variety AC927 on April 22, 2004, with a commercial six-row planter. Five-foot alleys were established soon after emergence to define the plots, which were 30 feet long and six rows (12 feet) wide. Ro-Neet 6E (3.5 lb AI/ac) and Counter (1 lb AI/ac) were applied in 7" bands at planting. Betamix (0.75 pt/ac) was applied on June 2. Headline (9.2 oz/ac) was applied by ground rig application on July 20.

Sprinkler irrigated plots were irrigated on Apr 29, May 4, May 22, Jun 29, Jul 15, Jul 21, Jul 28, Aug 5, Aug 12, Aug 23, and Sep 7 with 1 inch of water applied per irrigation. Flood irrigated plots were irrigated on Jun 22, Jul 7, Aug 4, Aug 17, and Aug 30 with 2.5 inches of water applied per irrigation. Precipitation for April 1 – September 30 in 2004 was 7.62 inches. Average precipitation for April - September period (56-year average) is 10.72 inches. Plots were harvested on Oct 1.

Wells that reached the ground water were placed with two wells on the upper end and two wells on the lower end of each irrigation system, for a total of four wells under each irrigation system. Ground water was sampled for nitrate-N content during the growing season. Water samples were collected by pumping each well dry, then collecting recharge water. Irrigation water was also collected for evaluation of nitrate-N content.

Sugarbeet petioles were collected from each plot five times during the growing season and analyzed for nitrate-N concentration.

Results: Under flood irrigation, the greatest sucrose content was achieved with 125 lb/ac of available N (Table 2). The greatest root yield and sucrose yield were achieved with 200 lb/ac of available N, but this N rate resulted in the most sucrose lost to molasses (Table 3). Under sprinkler irrigation, the greatest sucrose content was achieved with no applied N (28 lb/ac), while the greatest root yield and sucrose yield were achieved with 100 lb/ac of available N (Table 2). The most sucrose was lost to molasses with 125 lb/ac of available N (Table 3).

Sugarbeet petiole nitrate-N concentrations at all testing dates were higher under sprinkler irrigation (Fig. 1) than under flood irrigation (Fig. 2), although petiole nitrate-N concentrations under both irrigation regimes were less than 1000 ppm by the end of August. Petiole nitrate-N increased slightly under flood irrigation in early August. This fluctuation coincided with fluctuations in ground water nitrate-N under flood irrigation and in drainage water nitrate-N (Fig. 3).

Ground water nitrate-N concentration was higher under flood irrigation than sprinkler irrigation throughout the growing season (Fig. 3). The nitrate-N concentration under flood irrigation increased during the growing season, with concentrations in groundwater rising above 10 ppm by mid July. Nitrate-N concentration under sprinkle irrigation increased by about 3 ppm early in the season, then remained fairly constant for the rest of the season. Nitrate-N concentration in irrigation water remained at 0.2ppm or less throughout the season. Nitrate-N concentration in the drainage increased by 2 ppm in June, then dropped off as the season progressed.

Table 2. Yield of sugarbeets grown under sprinkle or flood irrigation with six N-rates, 2004.

Available N, N to 4 ft and applied N, lb/ac	Irrigation	Harvest Stand, plants/acre	% tare	Percent sucrose	Root Yield T/acre	Gross Sucrose Yield, Lb/acre	Extractable Sucrose, Lb/acre
28	flood	37990	0.920	19.87	26.6	10910	10460
100	flood	37630	0.917	19.94	28.1	11210	10740
125	flood	40050	0.924	20.27	28.4	11530	11080
150	flood	38720	0.926	20.09	27.6	11110	10670
175	flood	39080	0.908	19.64	28.6	11210	10730
200	flood	39930	0.919	19.43	**30.5**	11710	**11130**
Probability		0.510	0.563	0.034	0.025	0.519	0.598
CV s/mean		6.6	1.8	2.3	6.6	6.7	6.6
$LSD_{0.05}$		ns	ns	0.54	2.2	ns	ns
28	sprinkler	40540	0.917	20.01	28.1	11230	10760
100	sprinkler	41020	0.894	19.61	**30.9**	12090	**11480**
125	sprinkler	41990	0.893	19.26	30.3	11680	11060
150	sprinkler	41500	0.896	19.29	30.4	11740	11160
175	sprinkler	38720	0.901	19.38	29.4	11390	10830
200	sprinkler	42110	0.897	19.32	29.8	11520	10970
Probability		0.590	0.113	0.043	0.256	0.575	0.692
CV s/mean		8.5	1.8	2.3	7.0	7.1	7.1
$LSD_{0.05}$		ns	ns	0.53	ns	ns	ns

Table 3. Quality of sugarbeets grown under sprinkle or flood irrigation with six N-rates, 2004.

Available N, N to 4 ft and applied N, lb/ac	Irrigation	Na ppm	K ppm	Amino-N ppm	Sucrose loss to molasses	Percent extraction
28	flood	159	1497	97	0.784	0.961
100	flood	175	1575	110	0.839	0.958
125	flood	169	1507	103	0.801	0.961
150	flood	186	1479	104	0.800	0.960
175	flood	218	1515	119	0.852	0.957
200	flood	240	1664	130	0.936	0.951
Probability		0.001	0.004	0.131	0.002	0.001
CV s/mean		17.3	5.2	219.6	7.2	0.4
$LSD_{0.05}$		39	96	ns	0.072	0.004
28	sprinkler	174	1512	118	0.826	0.959
100	sprinkler	225	1741	160	0.999	0.949
125	sprinkler	223	1688	185	1.014	0.947
150	sprinkler	208	1599	168	0.949	0.951
175	sprinkler	218	1635	165	0.962	0.951
200	sprinkler	216	1575	147	0.913	0.953
Probability		0.502	0.060	0.096	0.032	0.044
CV s/mean		22.7	8.0	25.1	10.6	0.6
$LSD_{0.05}$		ns	155	47	0.119	0.007

Figure 1. Sugarbeet petiole nitrate-N concentration in ppm under sprinkler irrigation.

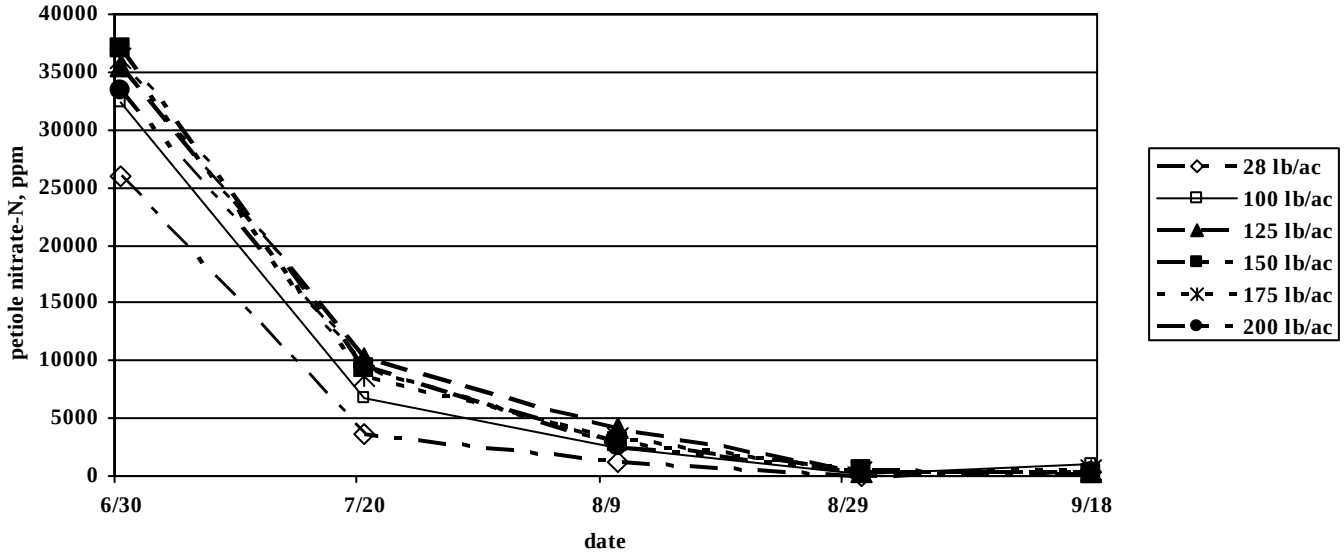


Figure 2. Sugarbeet petiole nitrate-N concentration in ppm under flood irrigation.

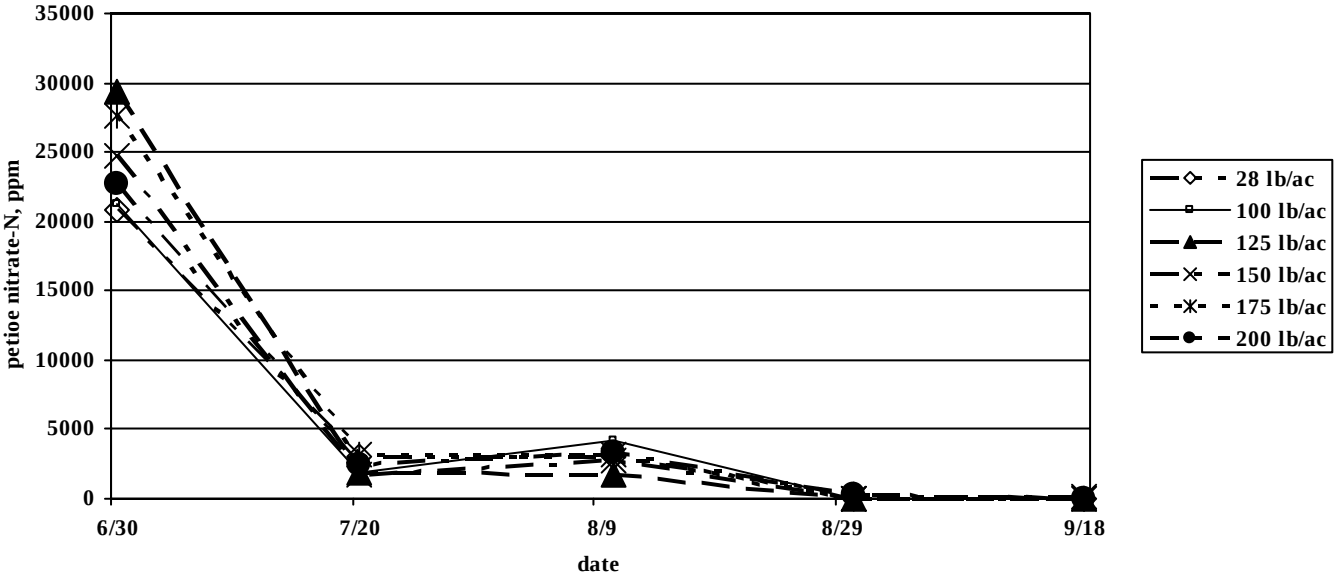
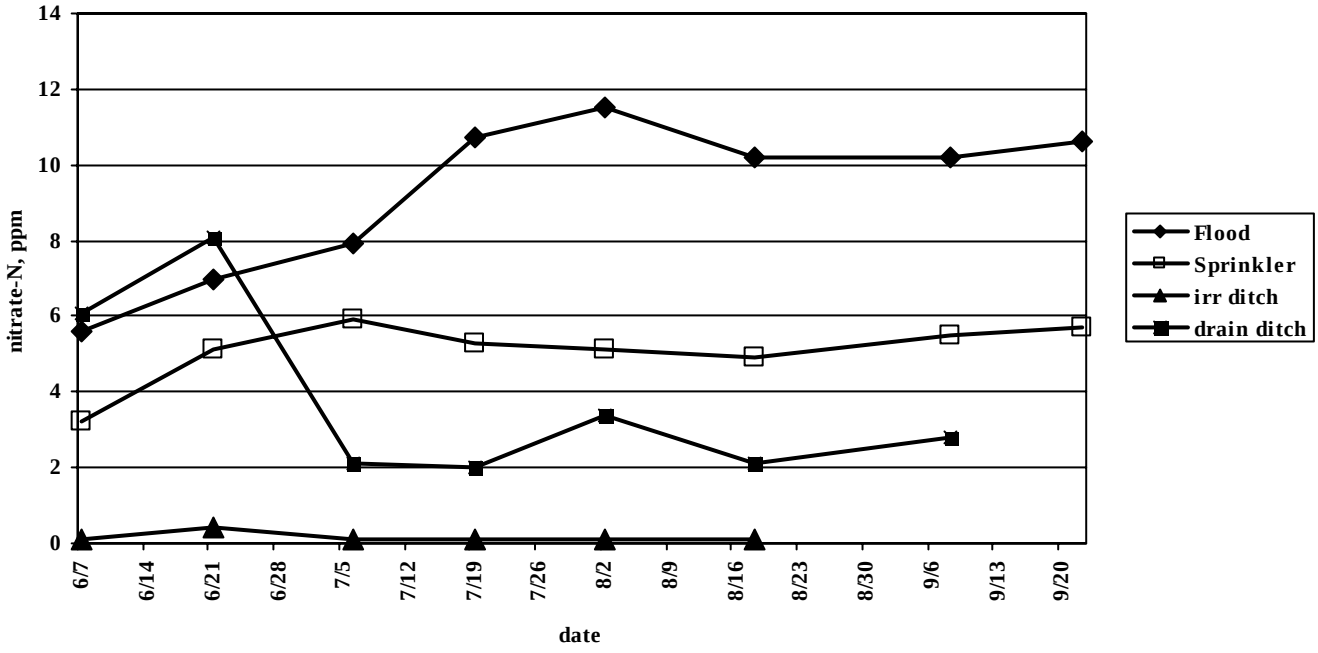


Figure 3. Nitrates in irrigation water, drainage water, and ground water under sprinkler and flood irrigated sugarbeets. Each ground water value is an average concentration from four wells.



Summary: Sugarbeets grown under sprinkler irrigation achieved greatest root and sucrose yield with lower rates of available N than sugarbeets grown under flood irrigation. Sprinkler irrigated sugarbeets had greater loss to molasses than flood irrigated sugarbeets. Sprinkler irrigated sugarbeets had greater petiole nitrate-N concentrations than flood irrigated sugarbeets. A higher concentration of nitrate-N was detected in ground water under flood irrigation than under sprinkler irrigation.