Producing Sugarbeets with High Yield and Quality in Texas

Texas Agricultural Experiment Station
Edward A. Hiler, Director
The Texas A&M University System
College Station, Texas
Producing Sugarbeets with High Yield and Quality in Texas

Steven Winter and Charles Rush

1Professors, Texas Agricultural Experiment Station, Amarillo, Texas.

KEYWORDS: Sugarbeet, management, nitrogen, irrigation, pest control.
Acknowledgment

Sugarbeets annually provide about $40 million to the Texas Panhandle economy. Research on sugarbeet production efficiency and quality enhancement has been conducted at Bushland, Texas for 30 years. This publication summarizes numerous field studies, laboratory evaluations, cooperative tests with growers, and joint efforts with Holly Sugar Corporation. Sugarbeets will continue to be a profitable crop for growers if yield levels and quality can be improved to compete in the highly competitive sweetener industry.

This report highlights the field practices and management factors to achieve these goals. Much of this research was conducted by the Texas Agricultural Experiment Station in response to industry needs. Little could have been done without the encouragement and financial support of the Holly-Grower Research Committee, Holly Sugar Corporation, seed suppliers, and agri-chemical firms. The support of the United States Department of Agriculture (USDA), Extension, and industry personnel has been and continues to be crucial. Together we can accomplish much to enhance the industry in the future.
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Introduction

Production of sugarbeets with high yield and sugar at a reasonable cost is the best way to maximize profit. It is difficult to increase profit by cutting expenses because that usually leads to low yield and sugar. Without major improvements in yield and quality, the entire Texas sugarbeet industry faces a difficult future.

It is not necessary to sacrifice root yield to achieve high sugar and low impurities. Many of the agronomic conditions, such as thick stands and good disease control, that improve sugar and lower impurities, also improve root yield. With intensive management, root yields over 35 tons/acre with over 16 percent sugar are possible most years (Table 1). While such yields will be difficult to achieve in large scale commercial production, such results indicate that typical commercial yields are considerably below potential yields.

Growing high yield and quality to maximize profit requires considerable resources. However, the growers that make the most profit also have a very good idea of their expenses and are judicious with all resources. Maximizing beet profit is analogous to having a winning athletic program. To do either, one has to have a goal, believe they can achieve it, have a solid game plan, execute the game plan well, and make constant adjustments as conditions change. In beet growing, nothing is more important than timeliness and making adjustments to changing conditions.

Soil and Climate

In general, soils on the Texas High Plains have few limitations in fertility that would restrict root yield. The only major soil fertility problem is the tendency of local soils to accumulate nitrate nitrogen. This soluble form of nitrogen fertilizer accumulates due to generally very low soil permeability and low rainfall.

High and variable nitrate nitrogen is a major limitation to high sugar and low impurities. Sugarbeet quality is usually higher on the more permeable soils generally found to the southwest of Hereford presumably because nitrogen is easier to manage. Climatic means at Bushland are presented in Table 2. Excessive wind, spring and fall freezes, and hail are the major hazards to sugarbeet production on the Texas High Plains. Excessive rain, snow, and/or freezes in the fall have hampered harvest in roughly 10 of the last 23 years.

Climatic conditions are fairly uniform over the beet growing area. There are some differences due to different soil conditions or other factors. Spring winds are more of a problem on the sandier soils on the southwest side of the beet growing area, while fall rains are more of a problem on the heavier clay loam soils. An estimate of spring freeze risks is presented in the section on planting dates.

Production Methods

Field Selection, Rotations

The major considerations for field selection are soil-borne disease inoculum levels, residual nitrate nitrogen amount and distribution, and weed seed levels. These factors will have an overriding influence on root yield, sugar, and production costs. The successful sugarbeet grower will be working to optimize these factors during the years between beet crops.

Soil-borne disease inoculum in the soil will depend on how severe these diseases were the last time beets were grown on the land in question, how long it has been since beets were last grown, the effects of intervening crops and crop residues, and whether or not any contamination has occurred across the fields. Control strategies would be to lengthen the rotation, have low residue crops immediately preceding beets.

Table 1. Five-year record of the best sugarbeet plots grown at Bushland in 30-inch rows. Yields are an average of 4 to 6 replicated plots of one treatment unless otherwise noted.

<table>
<thead>
<tr>
<th>Year</th>
<th>Root yield</th>
<th>Sugar</th>
<th>Recoverable sugar</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tons/acre</td>
<td>%</td>
<td>%</td>
<td>0-4 foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Residual</td>
</tr>
<tr>
<td>1989</td>
<td>36.8</td>
<td>16.78</td>
<td>87.9</td>
<td>10,850</td>
</tr>
<tr>
<td>1990</td>
<td>29.1</td>
<td>18.11</td>
<td>90.2</td>
<td>9,510</td>
</tr>
<tr>
<td>1991</td>
<td>39.1</td>
<td>16.00</td>
<td>89.2</td>
<td>11,180</td>
</tr>
<tr>
<td>1992a</td>
<td>39.7</td>
<td>16.86</td>
<td>88.6</td>
<td>11,850</td>
</tr>
<tr>
<td>1993b</td>
<td>41.9</td>
<td>15.62</td>
<td>84.6</td>
<td>11,070</td>
</tr>
<tr>
<td>1993c</td>
<td>45.8</td>
<td>16.74</td>
<td>88.4</td>
<td>13,560</td>
</tr>
<tr>
<td>1993d</td>
<td>42.6</td>
<td>15.60</td>
<td>86.0</td>
<td>11,430</td>
</tr>
</tbody>
</table>

a Production from a 1.35 A test plot.
b Best single plot, five plot average was 43.0 tons with 16.76% sugar.
c Production from a 2.08 A test plot. Applied N was double the intended rate of 120 lbs/acre due to faulty application equipment.
placement of beet tailings where they won't contami­
nate any potential beet ground, and minimization of 
soil movement between fields due to equipment, flow­
ing water, wind, or cattle movement. Experience indi­
cates that five year rotations are generally not ade­
quate to control soil-borne diseases in Texas.

Soil Preparation

High sugarbeet yields have been produced on 
ground where previous crop residues were de­
composed prior to planting beets. Early decom­
position of residues can reduce certain soil-borne diseases 
(mainly Rhizoctonia) and will avoid early season nitro­
gen competition between the seedling beets and 
decomposing, low-nitrogen residues. Of course, the 
downside of this low residue strategy is an increase 
in soil erosion, crusting, and runoff. Maintaining sur­
face residues will increase water intake and control wind erosion.

Regardless of residue management strategy, early 
soil preparation is usually advantageous and is more 
likely to allow early planting. However, preparing 
beds prior to February can lead to a severe soil blow­
ing problem in March or April unless some type of soil cover is maintained. Experience is the best guide 
in a particular area.

A two-year experiment on Pullman clay loam at 
Bushland indicated that using a hipper ripper while 
listing was as effective as cross ripping and used only 
42 percent as much fuel (Table 3). After listing, care 
should be taken to avoid excessive soil compaction. 
Compaction in the furrows will be good or bad de­
pending on whether water intake is excessive or defi­
cient. Compaction in the bed past a certain point can hinder root growth of seedlings or tap root ex­
pansion later in the season. If seedlings at the 2 to 4 
leaf stage are slow growing and have small, gray, wa­
ter stressed leaves, excessive soil compaction in the 
upper 3-4 inches of the bed may be suspected. In 
some cases, a light irrigation may be needed to get 
these seedlings growing. However, with furrow irri­
gation at this time of year (April or May), a salt prob­
lem may be developing in the bed if the weather has 
been dry. Additional furrow irrigation while the beets 
are small could aggravate the salt damage. Rainfall or 
sprinkler irrigation would be preferable. Excessive 
compaction in the bed can also lead to harvest prob­
lems. This compacted soil can be very hard in a dry 
harvest season and beet tails can be broken off caus­
ing some loss in harvested root yield.

Planting and Harvest Dates

Early planting can increase root yield by (1) length­
ening the growing season, (2) reducing weed competi­
tion because beets can germinate at colder soil tem­
peratures than many weeds such as pigweed, and (3)
by reducing some disease problems including aphanomyces, rhizomania, and curly top. A potential disadvantage of early planting is an increase in the risk of a freeze-out (Table 4). However, the freeze risk is probably more than offset by a much lower incidence of hail and heavy rain for early planting compared to later planting. Hail frequency has been 0.5, 0.9, and 1.6 occurrences per month for March, April, and May (Table 2). Once beets reach the thinning stage they become more tolerant to hail and heavy rain.

Severe freezes (13 to 18 °F) in 1994 caused total stand loss of some newly emerged beet seedlings and plants in the crook, just before emergence. Damage was worst on wet fields just irrigated. Many dry fields at the same growth stage escaped major damage. The 1994 experience would incline us to lower the freeze risks presented in Table 4 because of greater than expected freeze tolerance by seedling beets.

Harvest date has a substantial effect on gross return and, therefore, potential profit (Table 5). Gross crop value on September 29 was only 82 percent of that on November 9. The only additional cost for the later harvest would be more water use and possibly one more application of foliar fungicides. The major risk of later harvest is freeze or excessive rain which might delay harvest and result in lower return and additional harvesting expenses.

There appears to be little value in the common practice of harvesting the best fields of beets early in harvest except as a risk reduction tool. In fact, the best fields would probably have the highest rate of gain in value per day and would therefore benefit more by later harvest than a field of poor beets.

**Planting to Stand, Stand Density, Replanting, Row Spacing**

Sugarbeets can be planted to stand, but seeding rates need to be higher than those recommended in most other areas. A seeding rate of 88,700 seeds/acre was best in studies at Bushland where establishment averaged only 46 percent (Table 6). This means on average there were 40,800 plants/acre at thinning when the seeding rate was 88,700 seeds/acre (5.09 seeds/foot in 30-inch rows). At this seeding rate, yield averaged 97.8 percent as much as the hand-thinned check. This is outstanding performance because the hand-thinned check in these experiments was nearly a perfect stand in every case (32,000 plants/acre at harvest with no skips). About 40,000 plants/acre at thinning is ideal. Gross return declines much more rapidly with poor stands than with excessively thick stands (Figure 1). With excessively thick stands the only thing that declines is harvested root yield. With thin stands there is a severe reduction in root yield, sugar percent, and beet purity. Having 10 to 20 thousand plants/acre too many is much better than being that many short of optimum. To get 40,000+ plants at lay-by one should probably figure on 50,000+ at emergence. With a typical 50 to 70 percent emergence, that calls for a high seeding rate (70,000 to 100,000 seeds/acre).

<table>
<thead>
<tr>
<th>Harvest date</th>
<th>Root yield</th>
<th>Sugar value</th>
<th>Relative crop value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tons/acre</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>September 1</td>
<td>23.8</td>
<td>13.50</td>
<td>59</td>
</tr>
<tr>
<td>September 15</td>
<td>26.2</td>
<td>14.25</td>
<td>71</td>
</tr>
<tr>
<td>September 29</td>
<td>28.1</td>
<td>14.88</td>
<td>82</td>
</tr>
<tr>
<td>October 13</td>
<td>29.0</td>
<td>15.43</td>
<td>89</td>
</tr>
<tr>
<td>October 27</td>
<td>29.9</td>
<td>15.83</td>
<td>96</td>
</tr>
<tr>
<td>November 9</td>
<td>30.9</td>
<td>15.98</td>
<td>100</td>
</tr>
</tbody>
</table>

![Table 3](image3.jpg)

**Table 3. Sugarbeet production, water intake time, diesel fuel use, and soil penetration resistance with four tillage treatments imposed prior to listing on Pullman clay loam at Bushland. Two year average.**

<table>
<thead>
<tr>
<th>Tillage treatment</th>
<th>Mean root yield</th>
<th>Mean sugar time</th>
<th>Diesel fuel used</th>
<th>Penetration resistance</th>
<th>Water intake time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tons/acre</td>
<td>%</td>
<td>lbs</td>
<td>%</td>
<td>hrs</td>
</tr>
<tr>
<td>Sweep only</td>
<td>26.7 b</td>
<td>15.33 a</td>
<td>0 d</td>
<td>24 d</td>
<td>15.33 a</td>
</tr>
<tr>
<td>Hipper-ripper</td>
<td>29.8 a</td>
<td>15.34 a</td>
<td>2.0 c</td>
<td>18 b</td>
<td>15.34 a</td>
</tr>
<tr>
<td>Cross Rip</td>
<td>30.0 a</td>
<td>15.22 a</td>
<td>4.8 b</td>
<td>14 c</td>
<td>15.22 a</td>
</tr>
<tr>
<td>H-R + C-R</td>
<td>30.6 a</td>
<td>15.09 a</td>
<td>6.8 a</td>
<td>14 c</td>
<td>15.09 a</td>
</tr>
</tbody>
</table>

*Time required for a 4-inch irrigation applied March 10 to completely infiltrate into the soil.

![Table 4](image2.jpg)

**Table 4. Estimated risk of losing a beet stand due to cold temperatures for different dates of emergence irrigation at Bushland.**

<table>
<thead>
<tr>
<th>Emergence water date</th>
<th>Freeze-out risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 15</td>
<td>45</td>
</tr>
<tr>
<td>March 1</td>
<td>35</td>
</tr>
<tr>
<td>March 10</td>
<td>15</td>
</tr>
<tr>
<td>March 20</td>
<td>5</td>
</tr>
<tr>
<td>April 1</td>
<td>2</td>
</tr>
</tbody>
</table>

![Table 5](image1.jpg)

**Table 5. Four-year average sugarbeet production and gross return for six harvest dates at Bushland.**

<table>
<thead>
<tr>
<th>Harvest date</th>
<th>Root yield</th>
<th>Sugar value</th>
<th>Relative crop value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tons/acre</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>September 1</td>
<td>23.8</td>
<td>13.50</td>
<td>59</td>
</tr>
<tr>
<td>September 15</td>
<td>26.2</td>
<td>14.25</td>
<td>71</td>
</tr>
<tr>
<td>September 29</td>
<td>28.1</td>
<td>14.88</td>
<td>82</td>
</tr>
<tr>
<td>October 13</td>
<td>29.0</td>
<td>15.43</td>
<td>89</td>
</tr>
<tr>
<td>October 27</td>
<td>29.9</td>
<td>15.83</td>
<td>96</td>
</tr>
<tr>
<td>November 9</td>
<td>30.9</td>
<td>15.98</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 6. Relative harvested sucrose yield of unthinned sugarbeets at four seeding rates compared to a hand-thinned check during four years including three planting dates in 1977.

<table>
<thead>
<tr>
<th>Seeding rate</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
<th>1977</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>seeds/acre</td>
<td></td>
<td></td>
<td></td>
<td>3-22</td>
<td>4-28</td>
</tr>
<tr>
<td>52,000</td>
<td>87</td>
<td>100</td>
<td>85</td>
<td>94</td>
<td>79</td>
</tr>
<tr>
<td>69,600</td>
<td>91</td>
<td>97</td>
<td>93</td>
<td>95</td>
<td>89</td>
</tr>
<tr>
<td>88,700</td>
<td>99</td>
<td>98</td>
<td>95</td>
<td>99</td>
<td>100</td>
</tr>
<tr>
<td>103,600</td>
<td>101</td>
<td>95</td>
<td>94</td>
<td>99</td>
<td>96</td>
</tr>
</tbody>
</table>

Sugarbeet stand establishment, %

|       | 43    | 54    | 44    | 41    | 63    | 46    |

a The hand-thinned check had a nearly perfect stand averaging 32,000 plants/acre at harvest with no skips.
b Stand establishment is the percentage of planted seed that produced a live seedling at the 6-leaf stage.

![Gross return vs. harvest stand for three planting dates in 1977.](image)

Figure 1.

by the number of growing degree days that it takes to progress from emergence irrigation to the 2 to 4-leaf stage (the difference in planting dates in Figure 1), cuts gross return by nearly $200/acre. Because of the large effect of planting date on gross return, it is profitable to replant a poor stand of sugarbeets only if there is a substantial improvement in percent unoccupied area (Table 7). Since the information presented in Table 7 is rather complicated, an example may help. If the original planting has 25 percent unoccupied area (skips over 18 inches, roughly 76 plants/100 foot in 30-inch rows), yield will be about 74 percent of a full stand. To equal or exceed that with replants (watered when the original planting has 2 to 4 leaves), a stand with 10 percent or less skips would be necessary. A perfect stand with replants would yield 83 percent of the original planting with a perfect stand. Thus, a perfect stand on replants would gross about 9 percent more than the original (83 to 74 percent), barely enough to cover the cost of replanting. Given the fact that the second planting could also have a poor stand, at least 25 percent skips (unoccupied area) would be necessary to justify replanting. The primary consideration is how much sunlight will be intercepted by beet leaves over the growing season. Thus, unoccupied area is a better measure of the adequacy of a stand than is stand density. A fairly thin but uniformly spaced stand will probably outyield a thicker stand with more unoccupied area. Replant decisions should be based on unoccupied area using Table 7, not Figure 1.

Row spacing affects root yield, purity, and sugar. Basically one could expect roughly a 15 percent increase in gross return by going from 40-inch to 30-inch rows. Going from 30-inch to double row 40-inch would likely increase gross return by another 10 to 12 percent. Converting from 40-inch rows to 30-inch or double row 40-inch is a major improvement. Converting 30-inch rows to a narrower system is more questionable. Double 40-inch or single 22-inch rows will be more expensive to grow. Changing row spacings can be expensive and the entire farming system must be considered since beets are grown in a long rotation.
Nitrogen Management

Nitrogen is difficult to manage on the slowly permeable soils of this area. Excessive and highly variable residual nitrate is the major problem. The 0 to 4-foot residual nitrate value needs to be below 120 lb/acre to maximize beet quality. Achieving this level without shortchanging preceding crops can be a real challenge mainly because residual nitrate is so variable in many fields.

It is unlikely that area growers will ever achieve high quality beets unless we undertake an intensive soil nitrate sampling program. Sampling should be conducted for at least the two crops prior to beets that are to receive nitrogen fertilizer as well as the beet crop. Samples should be taken to at least 4-foot depth. A good sampling plan in a 40 to 50 acre 0.5 mile-long field would be five cores from each fifth, top to bottom, with the five cores composited into the surface 1-foot sample and a 3-foot subsoil sample. This results in 10 samples per field. One person with the best available equipment could sample several such fields in a day’s time, record data, and haul them to a central processing facility. The industry should strongly consider such a program possibly including community sharing of sampling equipment and a central processing/analysis facility. All samples industry wide would be best analyzed at one place with the best possible equipment to reduce bad and confusing data. With proper soil sampling, longer rotations, and the other recommendations given here, factory average yields of 25 tons/acre and 15 percent sugar would be a reasonable five-year goal.

Nitrogen placement and the type of nitrogen fertilizer used have no effect on beet yield or quality. The cheapest source of nitrogen is recommended. Ordinarily this means anhydrous ammonia applied preplant. On very permeable soils, part of the nitrogen could be sidedressed after thinning to reduce leaching losses. The only restriction on placement of nitrogen should be to avoid placement close to the seed at planting.

An important nitrogen consideration in furrow irrigated fields is spatial variability. Typically long furrow irrigated fields have nearly twice as much residual nitrogen on the lower end as on the upper end. A 25 field average was 148 lb/acre on the upper end versus 279 lb/acre on the lower end. This difference resulted in average sucrose values measured in late September of 14.37 percent on the upper end compared to 12.95 percent on the lower end. Reducing fertilizer applications on the lower ends of these fields would make a major contribution to improved crop quality.

A general rule of thumb has been that 0 to 4-foot residual plus fertilizer nitrogen applied to beets should not exceed 8 lb/ton of roots. In four experiments conducted in the 1970s with mean residual of 66 lb/acre, optimum applied nitrogen was 169 lb/acre and mean root yield was 28.6 tons/acre. This gives a nitrogen requirement of 8.2 lb/ton. Experiments conducted in the late 1980s and early 1990s have found an applied nitrogen requirement as high as 300 lb/acre to achieve root yields of 35+ tons/acre when residual N was near zero. However, when residual N exceeded 150 lb/acre, and even in some cases with

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Table 7. Relative harvested sucrose yield and harvest loss of original and replanted sugarbeets at Bushland.

<table>
<thead>
<tr>
<th>Unoccupied area</th>
<th>Relative harvested sucrose yield&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Approximate stand&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Harvest loss&lt;sup&gt;c&lt;/sup&gt;</th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>beets/100 feet</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original planting</td>
<td>Replanted</td>
<td>Approximate stand</td>
<td>Harvest loss</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>100</td>
<td>95</td>
<td>90</td>
<td>84</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>83</td>
<td>&gt;178</td>
<td>1.6</td>
<td>5</td>
<td>95</td>
<td>78</td>
<td>147</td>
</tr>
</tbody>
</table>

<sup>a</sup>Percent of field area not occupied by sugarbeets. Calculated as % of row length represented by skips over 18 inches long.

<sup>b</sup>All yields are % of the highest yielding situation, namely, the original planting with no unoccupied area. These yields are the harvested portion only, i.e., roots lost at harvest are not included here.

<sup>c</sup>This is roughly the stand in 30-inch rows which would be equivalent to the given corresponding % unoccupied area.

<sup>d</sup>The relationship between harvest loss and stand density was the same for the original planting and for replanted sugarbeets. Thus, the values given here apply to both situations.

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The switch from 30-inch to a narrow row system should probably only be undertaken after other, easier methods to increase return have been utilized. For most growers now in 30-inch rows, investing in thicker stands, better weed control, better nitrogen management, and better disease control would probably have a better benefit/cost ratio than switching to a narrow row system. After these improvements (thick stand, N management, etc.) are in place, a switch to narrow rows should represent another step in the conversion to a high yield, high quality, and high profit system of production.
as low as 80 lb/acre, there has been very little, if any, profit to applying additional N. These experiments had yield levels of 35 to 45 tons/acre. The nitrogen requirement at these yield levels averaged about 5 lb/ton and in some cases was as low as 2.3 lb/ton. Additional nitrogen may be required during the growing season if severe or repeated hail storms cause excessive defoliation. Thus, conditions vary considerably even on similar soils. Each producer, will need to adjust his nitrogen based on the visual responses, petiole nitrate analysis, and sugar levels achieved in previous seasons.

Adequate N should be available to provide vigorous growth until the rows are covered, usually in June. If the rows cover in June, there will probably be no significant root yield loss due to nitrogen deficiency even if the tops shrink back in July. Defoliation by hail may void this rule. Under normal conditions, the tops should shrink back by August or they probably never will. By late August or mid September the tops should be small, hopefully with the rows still covered, but new growth should have small leaves and short petioles. In 30-inch rows, full ground cover is seldom possible in the fall with proper N deficiency. New growth should be more prostrate than upright. Some cultivars remain a good green color while others may yellow more. Intense yellowing, especially with upright petioles, usually indicates a serious disease problem. Petiole NO₃-N should fall rapidly from June to August with less than 5,000 ppm in July and less than 1,000 ppm in August indicating favorable conditions. If these conditions and symptoms don’t develop on a regular basis, the producer has either too much residual N or is applying too much N to the beet crop and should reduce applications to previous crops and/or the beet crop regardless of what the soil test numbers say. High quality beets, 16 percent or higher sugar, that do not have the described appearance are unusual. Also, beets which develop these characteristics, small tops and low petiole NO₃-N, usually have good quality. If the fall is wet and cold, 15 percent may be near maximum on sugar but usually 16 to 17 percent is possible with a November harvest when residual N is low and applied N is not excessive. Properly done, N management will result in high quality beets even on these very difficult soils.

There has been no response to phosphate applied to Pullman clay loam when soil tests were 10 to 24 ppm (low to medium soil test). There has likewise been no measurable response to potassium, zinc, or boron on Pullman soil at Bushland. A good soil test is the best indication of any soil nutrient deficiencies. Manure is a good source of most nutrients, however its use within three or four years prior to planting sugarbeets is discouraged because it is difficult to spread uniformly and because it gives a slow release of nitrogen.

Irrigation Management

Sugarbeets are drought tolerant and can be successfully grown at a range of irrigation levels. On Pullman clay loam soil, root yields with only an emergence irrigation will be about 50 percent of fully irrigated yields provided the soil is near field capacity to at least 6 foot depth at planting. We averaged yields of 17 ton/acre with only emergence irrigation over a seven year period when growing season rainfall averaged 15 inches and runoff was eliminated. Each additional acre/ inch of irrigation water supplied can produce 0.75 ton/acre of roots. These values are for healthy, weed-free beets with a full stand. Deep soil and a fully wet soil profile at planting are an excellent start to producing high sugar beet yields.

To maximize yield, water requirement during the three summer months is about 0.33 inch per day, or 2.3 inches per week. This requirement can be met by rainfall, irrigation, and soil water depletion. Normal application rates by sprinkler or furrow would be more like 1.5 to 2.0 inches per week. Furrow irrigations of as little as 5 inches every 4 weeks can produce good yields.

Narrow rows and thick stands are best at all irrigation levels. The only danger is that if yield levels drop too low, many roots may be too small to harvest. In 30-inch rows, a 6-inch within row spacing is best even with limited irrigation provided yields are at least 15 to 20 tons/acre.

Certain soil-borne diseases (aphanomyces, rhizomania) can be aggravated if the soil is kept too wet for too long. Producers with a soil-borne disease problem should consider adapting the program of Charles Schlabs which includes an eight-year rotation, disease resistant cultivars, reduced irrigation (late start and three-week interval), preplant fumigation with Telone, and thick stands in narrow rows.

Disease Control

Recommendations have just been given for dealing with soil-borne disease problems in relation to irrigation. In addition to the recommendations given there, strict sanitation will aid in reduction of soil-borne disease. Of paramount importance is being very careful with tare dirt returned from the beet piler.

Curly top can be controlled very well by using varieties with some tolerance to the disease and by using Phorate applied preplant 4 to 6 inches below
the seed at the rate of 1 lb ai/acre. Curly top can destroy a crop if this precaution is not taken.

The major foliar diseases are powdery mildew and Cercospora leaf spot. Mildew is best controlled with sulfur. While copper or tin fungicides are needed for leaf spot. Producers should consult their fieldmen for current recommendations. With both diseases, the spray materials need to be in place before infection occurs. Therefore, spraying must commence at the very first sign of disease or even before. A ground rig with at least 10 gallons/acre of spray solution gives better leaf coverage and therefore better control than typical aerial applications. A wise program would be to apply ground applications when conditions permit and switch to aerial application as a supplement if wet weather or other circumstances preclude ground spraying.

Foliar diseases can be expected soon after canopy closure in June or July. At Bushland, a preventive spray of sulfur and tin hydroxide is applied after canopy closure if mildew and leaf spot have been detected anywhere by Holly's fieldmen. Unsprayed check plots are left in the earliest beets with the largest tops. Application of a second spray occurs when disease is noted in check plots. This procedure avoids a serious disease outbreak even if the fields are too wet to spray immediately when disease is first observed.

Control of foliar diseases is important because the entire basis of sugar production is the green leaves. In an optimum beet production system considerable effort goes into producing a good leaf canopy that intercepts as much light as early in the growing season as possible. Then in mid-season leaf growth should slow greatly due to nitrogen deficiency. It makes no sense to expand effort and money to grow the proper leaf canopy only to let leaf spot or mildew destroy those leaves. A high-profit system will avoid these inefficiencies.

**Insect Management**

The major sugarbeet insect pests in this region are the sugarbeet root aphid which sucks sugar from the roots during late summer and fall, the beet leaf hopper which vectors curly top in the spring, beet armyworms which eat the leaves during warm weather, cutworms which destroy seedlings after emergence, and flea beetles which attack seedling leaves.

The root aphid is best controlled with resistant cultivars. The problem is much worse with limited irrigation and on a cracking soil since this allows easy access and easy spreading of the aphids. Susceptible cultivars can be a total loss under dry conditions. Losses are more likely to be 20 to 30 percent if root aphid susceptible cultivars are adequately watered.

Phorate application for leaf hopper control was discussed in the disease section since curly top is the only concern with leaf hoppers. Beet armyworms, cutworms, and flea beetles are occasional pests that can be controlled with proper chemicals. Early detection is critical especially when seedlings are involved. The producer should scout for these problems several times per week during the emergence period.

**Weed Control**

The weed control battle is largely won or lost during the growing of preceding crops (Table 8). But even in fields with high weed seed numbers a successful battle against most weeds can be waged. In this case, early planting will be critical to get the beets ahead of as many weeds as possible. Then a full complement of preplant, postemergence, and lay-by chemicals should be used. If grasses are a problem, there are now chemicals which give excellent control and great crop safety. Up-to-date recommendations for various weed problems and chemicals are best obtained from agriculturists, chemical representatives, or Extension specialists.

<table>
<thead>
<tr>
<th>Weed seed density</th>
<th>Weed control treatment</th>
<th>Hoe time hrs/acre</th>
<th>Weed control cost $/acre</th>
<th>Gross above weeds $/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand hoe only</td>
<td>121</td>
<td>629</td>
<td>126</td>
<td></td>
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<tr>
<td>Nortron</td>
<td>16</td>
<td>133</td>
<td>622</td>
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<td>Betamix</td>
<td>21</td>
<td>137</td>
<td>642</td>
<td></td>
</tr>
<tr>
<td>Nortron + Betamix</td>
<td>11</td>
<td>130</td>
<td>602</td>
<td></td>
</tr>
<tr>
<td>Nortron + Betamix + Treflan</td>
<td>1</td>
<td>92</td>
<td>640</td>
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<td><strong>Low</strong></td>
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</tr>
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<td>Nortron + Betamix</td>
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<td>911</td>
<td></td>
</tr>
<tr>
<td>Nortron + Betamix + Treflan</td>
<td>0</td>
<td>86</td>
<td>905</td>
<td></td>
</tr>
</tbody>
</table>

*Gross return above the cost of weed control.
Putting It All Together

Growing a high profit, sugarbeet crop is like doing anything else well. Success is directly proportional to the knowledge, experience, desire, effort, and resources brought to bear on the problem. The necessary resources include not only equipment, capital, labor, and good land, but also the absence of severe limitations like high soil-borne disease levels.

One key to a high profit system is to have all elements as much in balance as possible. For example, it makes no sense to spray frequent doses of foliar fungicides on bare ground caused by a thin stand or on weeds. Conversely, when one achieves a good stand, has proper nitrogen levels, etc, it makes no sense to allow foliar diseases to destroy the leaf canopy.

The most successful producers will be those that stick to the basics mentioned in this guide. Using just the basic inputs it is possible to grow high yields and sugar most years although it may take several years of intensive soil sampling to get soil residual nitrate values into the proper zone to maximize quality. Other than soil nitrate and soil-borne diseases, most constraints to high yields and quality can be overcome fairly quickly and fairly consistently. Of course, even the best program will have failures; nature is just too fickle and the list of occasional problems is too long to assure success at every turn. However, properly applied, these principles should assure frequent success.

Recommended Reading

(For additional information and details)

Soil Preparation


Planting to Stand, Stand Density, Replanting, Row Widths, Harvest Date


Nitrogen Management


Irrigation Management


Disease Control


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