BUL 1003

University of Idaho Extension

IDAHO SUGAR BEETS
QUICK FACTS

2020 Idaho Sugar Beet Facts (National Agricultural Statistics Service-Idaho)

- Area harvested: 169,000 acres (14.8% of US beet fields)
- Average yield: 40.5 tons/acre (US average: 29.4)
- Production: 6,845,000 tons (20.4% of US yields)

Key Factors Affecting Profit

- Clean yield
- Sucrose content
- Sucrose recovery efficiency (Brei nitrate impurities decrease sucrose recovery)

Soil Sampling and Testing

- *Timing*
  - 2–4 weeks before preplant fertilizer application
  - At least once during each crop rotation cycle
  - Same time every year
- *Depth*: 1 ft increments to a depth of 3 ft
- *Number of samples*: 3–5/acre (randomized)

Planting

- *Soil Preparation*
  - Focus on good seed-to-soil contact
  - Eliminate excessive residues from the previous crop
  - Keep good soil moisture around the seed
- Typical planting time: March–April
- Row spacing: typically, 22 inches
- Optimal plant stand: 95 beets/100 ft of row

Fertilization

Nitrogen (N)

- *Source*: Urea, ammonium sulfate, mono-ammonium phosphate, urea ammonium nitrate, manure, and compost
  - Rate: 4.5–5.5 N lb/ton of beet (Table 1)
  - For sandy loam to clay soils: 6 lb N/ton of beet or less
  - For loamy sand to sandy soils: up to 7 lb N/ton of beet
- *Timing*
  - Spring application prior to planting is more favorable—minimizes N losses
  - Fall application slows nitrification and may cause toxicity to germinating seedlings
  - Split N: in-season N to be applied before 4–6 true-leaf stage
  - Low availability of N during the late-growth stages improves sucrose content
- N impurities decrease sucrose recovery efficiency and increase sugar extraction costs
- Sugar content tends to decrease by 0.5% for every 100 ppm increase in Brei nitrate

Phosphorous (P)

- *Soil Tests*
  - Use Olsen or sodium bicarbonate test for soils containing calcium carbonate (pH>6.5)
  - Use Bray-I test for acidic soils (pH<6.5)
- *Rate*
  - Broadcast application depends on residual P in soil and % free lime in the soil (Table 2)
  - If banding, reduce the rate by 50%
- *Place*
  - P must be placed in the upper 0–12 inches
  - If banding, keep at least 2–5 inches between the seed and fertilizer band to avoid toxicity and seed burn

Potassium (K)

- *Rate*: Depends on residual K in soil and sugar beet yield goal (Table 3)

Sulfur (S)

- Broadcast application of 30–40 lb S/acre is required if soil S levels are below 10 ppm in 0–12-inch depth

Table 1. Nitrogen requirements for sugar beets grown under southern Idaho conditions. Recommendations are based on applying 6 lb N/ton beet based on most recent research data on soils textures ranging from clays to sandy loams. For sandier soil textures ranging from loamy sands to sands add 1 lb N/ton beets on top of the table recommended amount. The calculated values were determined as follows: (Yield Goal × 6) – [(N ppm 1st foot + N ppm 2nd foot + N ppm 3rd foot) × 4].

Soil Test	Realistic Yield Goal (beet tons/acre)								
N[1] (ppm)	25	30	35	40	45	50	55	60	65
	N Application Rate (lb N/acre)								
0	150	180	210	240	270	300	330	360	390
5	130	160	190	220	250	280	310	340	370
10	110	140	170	200	230	260	290	320	350
15	90	120	150	180	210	240	270	300	330
20	70	100	130	160	190	220	250	280	310
25	50	80	110	140	170	200	230	260	290
30	30	60	90	120	150	180	210	240	270
35	10	40	70	100	130	160	190	220	250
40	0	20	50	80	110	140	170	200	230
45	0	0	30	60	90	120	150	180	210
50	0	0	0	40	70	100	130	160	190
55	0	0	0	20	50	80	110	140	170
60	0	0	0	0	30	60	90	120	150
65	0	0	0	0	0	40	70	100	130
70	0	0	0	0	0	20	50	80	110
75	0	0	0	0	0	0	30	60	90
80	0	0	0	0	0	0	10	40	70
90	0	0	0	0	0	0	0	0	30
95	0	0	0	0	0	0	0	0	10
100	0	0	0	0	0	0	0	0	0

[1]Soil test N = Sum of nitrate-N (NO3-N) and ammonium-N (NH4-N) in the first, second, and third 3 ft of the soil. When soil test values are not available for 2nd and/or 3rd foot of soil, multiply the first foot by 2 and add the value to the 1st foot.

Table 2. Phosphorous application rates based on soil test-P and % free lime.

Olsen P[1] (pH > 6.5)	Bray-I P[1] (pH > 6.5)	% Free Lime			
ppm	ppm	0	4	6	12
		Application rate, lb P_2O_5 per acre			
0	0	280	320	360	400
5	7	200	240	280	320
10	14	120	160	200	240
15	22	40	80	120	160
20	29	0	0	40	80
25+	37+	0	0	0	0

[1]Soil test P (ppm) in the top 0–12-inch depth of soil.

Table 3. Potassium application rates based on soil test-K and yield goal.

Soil test K[1] ($NaHCO_3$/ Olsen method)	Soil test K[1] (Acetate method)	Beet Yield Goal (beet tons per acre)				
ppm	ppm	20	25	30	35	40
		Application rate, lb K_2O per acre				
40	47	210	240	270	300	330
60	70	150	180	210	240	270
80	93	90	120	150	180	210
100	117	30	60	90	120	150
120	140	0	0	30	60	90
140	163	0	0	0	0	30
160	187	0	0	0	0	0

[1]Soil test K for the top 0–12-inch depth of soil.

Irrigation

Proper irrigation timing can maximize sugar beet yields while minimizing disease, water costs, fertilizer loss, and soil erosion.

Water Requirements

- Sugar beet plants have deep roots (6 ft); most water uptake (70%) is within the top 2 ft of soil; soil moisture levels should be maintained above 65% available moisture
- Sugar beets require 22–28 inches of water during the growing season
- When the root system is fully developed, a sugar beet crop typically would use more than 0.25 inches of water per day

Overirrigation (most common with furrow irrigation) may cause

- Reduced yield through increased incidence of disease, loss of nutrients from the soil root zone, and reduced supply of oxygen to roots
- Reduced sugar beet quality (lower sugar %)
- Increased root diseases such as rhizomania and rhizoctonia root and crown rots

Underirrigation may cause

- Limited water flow into the plant and reduced movement of water, nutrients, and photosynthates within the plants
- Reduced yield and quality due to water stress
- Dark green color of the sugar beet leaves—an obvious sign of water/heat stress; immediate irrigation is required
- Increased sensitivity: sugar beets are most sensitive to moisture stress early in the growing season—during germination and seedling emergence stages

Tillage

- *Method*: Conservation tillage may improve sugar beet production
- *Broadcasting Fertilizers*
    - » Use subsurface fertilizer application in strip-till systems
    - » Increase soil nutrient level before strip tillage
- *Timing*
    - » For both conventional and strip-tillage systems, fall (preferred) or spring tillage is necessary
    - » Early fall residues incorporated into soil by plowing may improve yield and sucrose content

Cropping History

- *Factors to be considered*: Manure or compost application timing before crop uptake, irrigation method, other fertilization practices, previous crops, plus disease, weed, and insect pressure
- Following small grains, increase N by 15–50 lb N/acre
- Following alfalfa, decrease N by 80–100 lb N/acre
- Following potatoes, beans, and onions, no adjustment in soil N is required
- *Fields with cattle manure application*:
    - » Late-season release of N from manure can lower sugar recovery efficiency
    - » Keep Olsen P levels below 40 ppm
    - » Avoid planting beets in fields with EC (electrical conductivity) levels above 2.0 dS/m (1st ft)

Currently registered pesticides can be found in the PNW Pest Management Handbooks series, https://pnwhandbooks.org/.

Weed Management

Common Weeds

- Kochia, common lamb's-quarters, redroot pigweed, hairy nightshade, annual sow thistle, green foxtail, and barnyard grass

Weed Control

- Start clean with tillage, burndown herbicide (e.g., Roundup, Aim EC, Gramoxone, etc.), or preemergence residual herbicides (Nortron, Far-GO, Ro-Neet)
- Always include a residual herbicide (applied after sugar beet 2-leaf stage) such as Dual Magnum, Eptam, Outlook, and Warrant in the herbicide program

Herbicide Resistance

- Weeds resistant to Roundup (glyphosate) and UpBeet are widespread in the region
- Use an integrated weed management approach to prevent reliance on the same herbicide each year

Insect Management

Root and Stem Feeders

- Sugar beet root maggot (*Tetanops myopaeformis*)—whitish maggots that feed on roots, reducing stand and causing scarring damage to more mature roots. Control by applying granular insecticides near peak flight of adult flies if action thresholds are reached.
- Wireworms (*Limonius* spp., others)—brownish, hard-bodied larvae of beetles that feed on seedlings and roots, reducing or weakening stands
- Field history of grasses increases crop risk
- Only at-plant insecticides are available

- Cutworms (black cutworm, *Agrotis ipsilon*; army cutworm, *Euxoa auxiliaris*; others)—light gray to dark brown soft-bodied larvae that generally feed at night, usually on roots and stems. Often occur near weedy patches or field borders, so consider spot treating.
- Sugar beet root aphid (*Pemphigus betae*)—yellowish aphids that feed on roots, covering them with a white waxy secretion that gives beets a "moldy" appearance
- Manage using resistant varieties, optimal irrigation, sanitation (i.e., reducing cross contamination among fields), and reducing foliar sprays to conserve a predatory fly that specializes in this pest
- Other occasional root-feeding pests include white grubs, springtails, and the sugar beet crown borer (which may feed on roots and petioles)

Defoliating Leaf Feeders

- Leaf miners (beet leaf miner, *Pegomya betae*; others)—maggots that feed within leaf tissue, leaving winding, irregularly shaped tunnels that eventually decay and brown
- Early season feeding is most damaging; use seed treatments or foliar sprays at first appearance of white cigar-shaped eggs on leaf undersides
- Armyworms (beet armyworm, *Spodoptera exigua*; bertha armyworm, *Mamestra configurata*; others)—similar to cutworms, but generally larger, more brightly colored defoliators that may move en masse from adjacent infested fields (e.g., alfalfa or cereals)
- Webworms (beet webworm, *Loxostege sticticalis*; garden webworm, *Achyra rantalis*; alfalfa webworm, *L. cereralis*)—olive-green larvae with dots and longitudinal stripes on the body
- Feeding initially appears as small transparent "windows," then progresses to ragged skeletonization with webbed leaves
- Other defoliating caterpillars include loopers (alfalfa looper, *Autographa californica*; cabbage looper, *Trichoplusia ni*), "woolybears" (*Estigmene acrea*), and the false celery leaftier (*Udea profundalis*)
- All leaf-feeding caterpillars may be patchily distributed, so spot-treatment with foliar insecticides can be considered

Sap Suckers

- Beet leafhopper (*Circulifer tenellus*)—light yellowish green to grayish brown with a small, wedge-shaped body; these insects are most important as a vector of *Beet curly top virus*
- Resistant varieties are key, coupled with seed treatment
- Aphids (black bean aphid, *Aphis fabae*; green peach aphid, *Myzus persicae*)—small, pear-shaped, usually in plant crown. May cause leaf curling and honeydew buildup that results in sooty mold (primarily bean aphids); vectoring of viruses (primarily green peach aphids) has greater damage potential but is less common
- Natural enemies often control aphids; otherwise, foliar sprays may be used
- Spider mites (two-spotted spider mite, *Tetranychus urticae*; others)—arachnids that puncture leaf tissue and feed on its contents, causing bronzing of foliage and producing webbing
- Dusty conditions, excess N fertilization, weed hosts (e.g., common lamb's quarters and field bindweed), and broad-spectrum insecticides that reduce predators all contribute to spider mite outbreaks
- Other sap-sucking pests include Lygus bugs (*Lygus* spp.) and stink bugs

Disease Management

Foliar Diseases

- Sugar beet powdery mildew is caused by the fungus *Erysiphe betae*
- Symptoms are initially small, discrete, white patches on both leaf surfaces that can eventually coalesce and cover the entire leaf, causing leaves to discolor and possibly die in severe infections
- Control is through fungicides which should be applied when mildew is first observed or when the disease is predicted to be in the area. Repeat fungicide applications are often necessary.
- Cercospora leaf spot is caused by the fungus *Cercospora beticola*. Symptoms include leaf spots initially found on older leaves.
- Spots are 3–5 mm in diameters and almost circular with tan to light brown centers with brown to reddish-purple borders. Spots coalesce with disease progression.
- High humidity/moisture with high temperatures (77°F–95°F in the daytime) favor disease development; managed through fungicides, crop rotations longer than three years, and by avoiding excess irrigation

Root Diseases

- *Aphanomyces* root rot is caused by the soilborne oomycete *Aphanomyces cochliodes*. This pathogen can cause seedling blight early in the season as well as chronic root rot from June until harvest. This causes undersized plants with water-soaked, tan-colored lesions on taproots (which can also be stunted) that can wilt on hot days. The root diseases eventually destroy the plant. Management strategies include using resistant varieties, extending rotations, avoiding infested fields, and use of seed treatments and soil-applied fungicides.
- *Rhizoctonia* root and crown rot is primarily caused by the soilborne fungus *Rhizoctonia solani*. The fungus can cause seed rots and damping off early in the season and root and crown rots later as the soil warms up from June. Some strains of the fungus can cause a dry rot canker on the roots. Managed through use of soil-applied fungicides, optimum plant health and soil moisture, extended crop rotations, and avoiding rotation crops with susceptibility to *R. solani* AG2-2, such as beans and corn.
- *Pythium* root rot caused by various oomycete *Pythium* species causes brown-black root rot in waterlogged soils. Managed through good soil drainage and avoiding overirrigation. Seed treatments manage early infection.
- *Phoma* root rot is caused by the fungus *Phoma betae*. Symptoms include small, brown, depressed spots on the surface of the roots close to the crown. Seedlings may damp off. Leaves can also develop small brown spots. The fungus is seedborne and seed treatments should be utilized.
- *Fusarium* yellows caused by the soilborne fungus *Fusarium oxysporum* f. sp. *betae*. Symptoms include interveinal yellowing on older leaves, eventually progressing to younger leaves. Leaves may wilt and become dry and brittle; root vascular tissue shows discoloration. Control by rotating plants at least four years and reducing moisture stress. Other fusarium species can cause root rots.

Bacterial Diseases

- Vascular necrosis and rot are caused by *Pectobacterium betavasculorum*. Plant wounding, excessive N or moisture, and warm temperatures encourage disease development. Symptoms include black streaks on petioles as well as blackened crowns which may produce froth. Vascular bundles can be brown, turning pink on exposure to air. Rot can be soft or dry. Most varieties have resistance. Early planting, optimal stands, avoiding excess N, and irrigation minimize injury or reduce the chances of infection.
- Scab is caused by *Streptomyces* species and causes superficial, rough, discolored lesions on the taproot. Common in high pH soils, which should be avoided.

Viruses

- *Beet curly top virus* (BCTV) causes dwarfed, crinkled, and rolled leaves, which also affect young roots. Vectored by the beet leafhopper. Managed with resistant varieties and by reducing vector populations.
- Rhizomania caused by *Beet necrotic yellow vein virus* (BNYVV) is transmitted by the soilborne plasmodiophorid *Polymyxa betae*. Infection typically results in stunted plants and massive production of secondary and tertiary roots. Late-season infection can result in root bearding and constriction lower down on the taproot. Use multisource resistance varieties. Consider extended crop rotations, avoid soil compaction, and promote good soil drainage. Minimize movement of soil from infested fields.

Nematodes

- The sugar beet cyst nematode (SBCN, *Heterodera schachtii*) is of most concern but the root-knot nematode (*Meloidogyne hapla*, *M. chitwoodi*) and stubby-root nematode (*Paratrichodorous* spp., *Trichodorous* spp.) can also cause yield losses in some instances. Infections maybe accompanied by root rot as a result of a secondary invasion of bacteria and fungi.
- Management strategies include crop rotation, nematicides, avoiding planting in infested fields, and the use of resistant varieties where possible.

Further Reading

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