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MICHIGAN SUGAR

Growers' Guide for Producing Quality Sugarbeets

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MICHIGAN SUGAR COMPANY MISSION STATEMENT

As a grower-owned sugar cooperative, our mission is to maximize shareholder value by efficiently producing quality products, from seed to shelf, while enhancing our employees' future.

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REFERENCE GUIDE

Where Can You Find… The most recent Approved Seed Varieties?

- Log in to the Michigan Sugar members website (members.michigansugar.com)
- Click on 'Agriculture'
- Click on 'Research Information'
- Under Categories, choose '02-Variety Approval', then click the blue Find Documents button.
- Choose the most recent year's Approved Varieties document, and a PDF will open.

This document can also be found in your latest Research Results book and Variety Trial Results book!

How To… Update and verify your membership information and notifications.

To update your contact information for phone blasts, DSV notifications, emails, Agronomy Updates and more, visit the member website.

- Click on 'My Info', then choose 'Contact Information & Notifications'.
- There, you can add or remove phone numbers, email addresses and update which notifications you would like to receive.
- On the 'My Info' page, you can also find Harvest and Payment documents, print lime and top soil coupons, and complete your contracting.

Where to Find… An Ag Department phone list.

You can find the most recent Ag Department phone list on the member website homepage, or on the 'MSC Contact' section of our MSC Mobile App!

FERTILITY

Soil Test: Soil sampling may be the most important part of soil testing. Grid sampling or separating the field by differences in soil texture, organic matter, slope, or past management (i.e., cropping or tillage system) tends to pro-vide the most accurate recommendations. Within each sampling zone, collect about 20 cores to a depth of 8 inches and mix thoroughly.

Soil pH: The pH of soil is very important. It tells if the soil is acid, neutral or alkaline. Soils below pH 6.5 (acid) should have lime applied for optimum sugarbeet production. Soils above pH 7.2 (alkaline) may require manganese in starter fertilizer or sprayed on foliage to correct a deficiency.

Liming: Limestone is a naturally occurring nutrient vital for healthy soil in Michigan. Whether you own a large farm or a small farm, lime can play a big part in higher crop yields, decrease disease pressure and improve soil health and tilth. Liming can:

- Raises pH - reducing acidity; increases efficiency of fertilizers; helps aerate soil by boosting microorganisms and decreasing seedling diseases; stabilizes soil aggregates to slow erosion; encourages activity of soil bacteria; and releasing valuable nutrients.

NITROGEN

Michigan Sugar Company and Michigan State University researchers recommend applying 40 to 50 pounds of N in a 2x2 (2 inches below the seed level and 2 inches away from the row) for 30 inch and 22 inch rows respectively at planting. This is most significant when planting into high residue crops such as corn and wheat stubble.

Sugarbeets require N early to attain canopy closure with smaller amounts of N required later for canopy maintenance. In the autumn canopy color should be declining and leaves yellowing otherwise significant sugar losses may occur if green and vigorous at harvest time.

Excess N late in the season will not increase yield but will reduce quality and sugar per ton. The total amount of N required depends on the amount of residue from the previous crop.

Nitrogen Recommendations

Crop	Early Delivery Nitrogen (total lbs. N/A) 2X2 placement only	Campaign Season Nitrogen (total lbs. N/A) 40 lbs. of N in a 2X2, Rest of N is sidedress
Corn/Wheat	40	140-160*
Soybeans/Dry Beans	40	100-120

*Use Higher N Rate following high residue crop.

Sugarbeets following high residue crops (corn and wheat) typically require 130-160 pounds of N while low residue crops (soybean and dry bean) typically require 90-130 pounds of N. Three factors that may reduce N application rates include: 1) high soil organic matter (> 3%); 2) manure application; and 3) clover or alfalfa plowed down. A plow down of a legume (e.g. clover) after wheat may supply anywhere from 40-80 pounds N per acre depending on the stand density, growth, and timing of the plow-down. Sugarbeet Advancement research indicated that 10,000 gallons of dairy manure applied in the fall may supply most of the sugarbeet N needs in addition to 40 pounds of N applied as a 2x2 at planting.

PHOSPORUS & POTASSIUM

Starter Fertilizer: Fields with high soil test levels of phosphate and potash may not require fertilizer application. However, starter fertilizer may be beneficial in cold, wet spring weather conditions. When banding starter fertilizer, place it 2 inches to the side and 2 inches below the seed. Closer placement to the seed may cause seedling injury (especially high rates) and poor seed to soil contact. Under certain environmental conditions, sugarbeet stand has been reduced with in-row starter fertilizer, especially pop-up fertilizers.

Broadcast Fertilizer: This method of fertilizer application speeds up the planting operation, however high rates of fertilizer can cause beet injury. More phosphorus and nitrogen may be needed when applied as a broadcast compared to banded, since broadcast fertilizer is spread over the entire field.

Michigan's P and K recommendations follow the build-up, maintenance, and drawdown philosophy which allow for a build-up of P and K when soil test levels are below critical. Sugarbeets growing on soils that test below critical in P or K have a greater opportunity to respond to applied fertilizer and often result in an economic benefit to the grower.

Phosphate Recommendations

Soil Test Available Phosphorus Pounds	Amount of Phosphate (P2O5) to Apply (lbs.)						
	Yield Goal - Tons						
	18	20	22	24	26	28	30
20	120	130	140	150	160	170	180
40	100	110	120	130	140	150	160
60	70	80	90	100	110	120	130
80	50	60	70	80	90	100	110
100	20	30	40	50	60	70	80
120	0	0	20	30	40	50	60
140+	0	0	0	0	0	0	0

Potassium Recommendations

Soil Test Available Potassium Pounds	Amount of Potassium (K2O) to Apply (lbs.)						
	Yield Goal - Tons						
	18	20	22	24	26	28	30
50	190	210	230	250	270	290	310
100	150	170	190	210	230	250	270
150	110	130	150	170	190	210	230
200	70	90	110	130	150	170	190
250	30	50	70	90	110	130	150
300	0	0	30	50	70	95	95
350	0	0	0	0	30	95	95
350+	0	0	0	0	0	95	95

MICRO-NUTRIENTS

Of the micronutrients, Boron (B) and Manganese (Mn) are the two that may often be considered for sugarbeets. Typically the most effective application method is in a 2x2 band at planting.

A Mn application of 4 - 18 pounds of Mn would be recommended in actual Mn-deficient situation. If applying as a preventative application, 1-2 pounds of Mn in a starter 2x2 band at planting would be recommended. If Mn is not applied as a starter fertilizer, then a foliar application of 1 to 2.5 pounds Mn per acre is recommended as Mn sulfate or Mn chelate. This application rate may need to be spread over multiple spray intervals. Soil application of foliar chelates is not recommended as other cations (e.g., Ca or Fe) often replace Mn in the chelate and may convert to unavailable forms. Use a spray grade Mn and apply the higher rate on larger plants.

Mn deficiency in sugarbeets often appears as yellowing between leaf veins while veins remain dark green. Since Mn is not a mobile nutrient, chlorosis usually begins on the younger leaves. Do not confuse Mn deficiency with N deficient plants. N deficient plants tend to not have green veins whereas Mn deficient plants have uniform leaf yellowing with green veins.

Research in Michigan has indicated need a need for applications of B on sugarbeets grown in all types of soils. Sugarbeets growing on sandy or sandy loam soils may especially benefit from a B application. When applied early in the growing season (typically prior to mid- June) foliar and granular B applications seem to be equally effective. Application of 1 to 3 pounds of granular B in a 2x2 at planting would be recommended (1 pound for heavier soils and 3 pounds for sandier soils). Foliar applications may require 1-2 sprays of 0.15 - 0.25 pounds.

Like Mn, B is not mobile and symptoms of B deficiency in sugarbeets start with younger leaves, thus causing cessation of the terminal bud and white, netted chapping of the upper leaves and wilting of tops. Plants later exhibit crosswise cracking of petioles, death of the growing point, and heart rot of the root.

CULL BEETS AND BEET PULP

Sugarbeets that are left in the field and sugarbeet pulp can be a good source of nutrients for crops grown the following year. If a sugarbeet field is not harvested it is important to chop the beets into smaller pieces using a disk or similar tool. It is also important to mix the beets into the soil to maximize soil and microbe contact. This will ensure the breakdown of the sugarbeet pieces to reduce issues with moisture and nutrient availability in the spring.

Following is the nutrient composition and physical characteristics of sugarbeet roots and pulp. A 30 ton per acre sugarbeet crop if left in the field will contain ~30-40 lbs of P, 80 to 120 lbs of K and 120 to 350 lbs of total N per acre however, only 10% of the nutrients may be available for the following year. As much as 10% or 35 lbs of N per acre could be credited for the spring of the following year with an additional 50 lbs of N per acre available later in the season. The remainder of the N would be released over the following growing seasons.

More credit may be taken for the P depending on soil test levels. Sugarbeets are an excellent source of organic matter as well. Since most of the nutrients in the sugarbeets are associated with organic matter, applying a minimum amount of starter fertilizer for the following crop is recommended. Contact your MSC field consultant for specific recommendations.

Chemical Characteristics of Beets for Nutrient Application

Total P (lb/ton)	.94
Total K (%)	.20
Total N (%)	.61
NH4-N (lb/ton)	0.016
NO3-N (lb/ton)	0.06
Organic Carbon (%)	27.4
C:N	45

AGRICULTURAL LIME

Michigan Sugar uses limestone in the processing of sugar beets. After the limestone has been used in the clarification of beet juice, it is converted to dry material that is ideal for use as agriculture lime.

According to Michigan State University Bulletin E-471 (copies available upon request), soil test summaries indicate that the average lime requirement to correct soil acidity in Michigan is one ton per acre per year. This amount is approximately enough to neutralize the acidity produced by annual applications of nitrogen in Michigan.

Physical and Chemical Properties - Typical Analysis

Calcium	27.4%
Calcium Carbonate Equiv.	76.0%
Magnesium	0.65%
% Moisture	20 – 30%
R.N.V.	1323
E.N.V.	81%

% Passing: Mesh Screen

8 Mesh	30 Mesh	60 Mesh	100 Mesh
99.4	96.3	94.8	90

SEED SIZE TERMINOLOGY

ACH Seeds, Crystal Band (Teal Green)				
Seed Number	**Seed Size**		**Primed**	**Units per Box**
Mini Pellets	MP	8.0-10.0/64	Yes-Ulti-Gem	4
Regular Pellets	RP	9.5-11.5/64	Yes-Ulti-Gem	4
ELS/Pro 200		11.5-13.5/64	Yes-Ulti-Gem	4
Source: Andy Bernia, District Market Manager, Crystal Seed				

BetaSeed (Blue)				
Seed Number	**Seed Size**		**Primed**	**Units per Box**
Mini Pellets	MP	8.0-10.0/64	Yes	4
Regular Pellets	RP	9.5-11.5/64	Yes	4
Pro 200		11.5-13.0/64	Yes	4
Source: Rob Gerstenberger, Sales Manager, BetaSeed				

Hilleshög (Orange)			
Seed Number	**Seed Size**	**Primed**	**Units per Box**
4M	10-12/64	Yes	4
S2	11-14/64	Yes	4
2M	8-10/64	Yes	4
Source: Doug Ruppal, Sugarbeet Specialist, Hilleshög			

SEEDEX (Pink)				
Seed Number	**Seed Size**		**Primed**	**Units per Box**
Agracoat 2M	MP	8.0-11.0/64	Yes, XBEET	6
Regular Pellets 4M	RM	9.5-11.5/64	Yes, XBEET	4
Agracoat 5M	JP	11.5-13.0/64	Yes, XBEET	3
Source: Dave Wishowski, Regional Sales Manager, SEEDEX				

Maribo (Green)			
Seed Number	**Seed Size**	**Primed**	**Units per Box**
4M	10-12/64	Yes	4
S2	11-14/64	Yes	4
2M	8-10/64	Yes	4
Source: Mitch Wilson, Brand Manager – Nutrien			

SEED AND SEED PLATES

There are multiple sizes of seed available. The amount of seed in each size varies from year to year. Check with your Michigan Sugar Company Field Consultant each year for the sizes available and be sure you have the proper plates. Do not plant seed with the wrong plate. To determine your seed spacing, refer to the following table and choose the expected emergence on your field. Remember, there are worse problems besides too many sugarbeets!

Determination of Proper Seed Spacing

Expected %	Sugarbeets/100 Ft.	Sugarbeets/100 Ft.
	180	150
Emergence Seed Spacing (Inches) Needed to Achieve		
40	2.7	3.2
50	3.3	4
60	4	4.8
70	4.7	5.6
80	5.3	6.4

*Note: Normal emergence is approximately 60-70% in Michigan. Producers should strive for emergence of a minimum final stand of 175-225 beets per 100 feet in both narrow and wide rows. In 30 inch rows, 200 beets would be 35,000 plants per acre. And in 22 inch rows that would equate to 48,000 plants per acre.

Sugarbeet Advancement Seed Spacing Chart

Field Emergence Conditions	Poor Emerging Variety	Average Emerging Variety	Excellent Emerging Variety
Ideal Emergence Average 70 to 80%	4.5 Inches	4.75 Inches	5.0 Inches
Fair Emergence Average 40 to 60%	3.5 Inches	4.0 Inches	4.2 Inches
Poor Emergence Average 20 to 30%	3.0 Inches	3.0 Inches	3.0 Inches

Planter Seed Plate Specification

Planter Type	Medium (8-9 /64)	Large (9-10 /64)	X-Large (10-11 /64)	X-Large+ (11.5-13.5 /64)	GEM 50 (8-10 /64)	GEM 100 (9.5-11.5 /64)	Mini Pellet (8-10 /64)	Regular Pellet (9.5-11.5 /64)	ELS (11.5-13.5 /64)
JD						**A 51713***		**A 51713***	
Vacuum	**H 136445***	**H 136445***	**A 51713***	**A 51713***	**H 136445***	**H 136445**	**H 136445***	**H 136445**	**A 43066***
		A 51713	H 136445	A 43066	A 51713	A 43066	A 51713	A 43066	
(Vac)	(0.75-1")	(1-2")	(1.5-2")	(1.5-2")	(1.5-2")	(2-3")	(2")	(2-3")	(3-5")
Monosem	**4016***	**4016***	**4020***	**4025***	**4020***	**4025***	**4020***	**4025***	**4025***
		4020	4016	4020	4016	4020	4016	4020	3622
		4025	4025		4025	3622	4025		
White	**NR**	**NR**	**NR**	**NR**	**85047**	**N 857155**	**85047**	**N 857155**	**N 856067**
Case IH	**80175***	**8020***	**8020***	**8020***	**80175***	**8020***	**80175***	**8020***	**8020***
	8020	8023	8023	8023	8020	8023	8020	8023	8030
(Vac)	--	--	--	--	(20-22")	(23-25")	(20-22")	(23-25")	(20-22")
Milton	**11 X 7 /64**	**12.5 X 7.5 /64**	**NR**	**NR**	**12 X 9 /64**	**14 X 11 /64**	**12 X 9 /64**	**14-11 /64**	**NR**
	Blue Plastic B13304	**Green Plastic** B13931							
JD Plate	(steel)	(steel)	**Brown Plastic**	**NR**	**Orange Plastic**	**Light Green Plastic**	**Orange Plastic**	**Light Green Plastic**	**NR**

*Preferred Planter Plate for this seed size.

Additional Comments: John Deere Central Delivery Systems may require higher vacuum. Fine tune vacuum and/or singulator along with plate/ size combinations to each specific seed lot for maximum performance.

Approximate Units of Sugarbeet Seed Per Acre

Row Width					
Seed Spacing	**20”**	**22”**	**24”**	**28”**	**30”**
3"	1	0.95	0.87	0.75	0.7
4"	0.78	0.71	0.65	0.56	0.52
5"	0.63	0.57	0.52	0.45	0.42
6"	0.52	0.48	0.44	0.37	0.35
Linear foot of row/A	**26,131**	**23,764**	**21,780**	**18,669**	**17,424**

PLANTER SPEED

Planter speeds of less than 4 M.P.H. will result in a more uniform depth of seed placement, so seedlings will emerge more evenly. Depth of planting will vary with soil types and moisture conditions. The 1” depth is generally the most satisfactory. When planting begins, seed depth should be checked on each unit. As disks wear, seed depth may be something different than originally desired. One unit is 100,000 seeds.

PLANT POPULATIONS

A poor stand of sugarbeets can reduce sucrose by as much as 2.5 percentage points. Many factors can affect your stand establishment including: variety, crusting, planting depth, seedling disease, insects and a host of other maladies. Research has shown that seedling emergence in Michigan is generally between 60-75%. The Research Education Advisory Council (REACh) recommends a final stand of 175-225 beets per 100 feet in both narrow and wide rows. In 30 inch rows, 200 beets would be 35,000 plants per acre. And in 22 inch rows that would equate to 48,000 plants per acre. Most growers in Michigan are targeting seed spacing at planting between 4 - 4.5 inches to achieve the desired plant population. Not all of the seed planted will make a sugarbeet due to germination problems, soil crusting, seedling disease, insects, herbicides and other factors may reduce the final sugarbeet stand. A producer needs to be realistic when predicting percent emergence expected with management practices on their farm.

Seeds Planted at Various Row Widths and Seed Spacings

Seed per 100 feet of row	Seed Spacing (inches)	Seeds planted per acre			
		20" rows	22" rows	28" rows	30" rows
480	2.5	125,203	114,048	89,609	83,635
436	2.75	114,770	103,680	81,463	76,032
400	3	104,336	95,040	74,674	69,696
369	3.25	96,511	87,729	68,930	64,335
343	3.5	88,686	81,463	64,007	59,739
320	3.75	83,469	76,032	59,739	55,757
300	4	78,252	71,280	56,006	52,272
282	4.25	73,035	67,087	52,711	49,197
267	4.5	70,427	63,360	49,783	46,464
253	4.75	65,210	60,025	47,163	44,019
240	5	62,602	57,024	44,805	41,818
229	5.25	59,993	54,309	42,671	39,826
218	5.5	57,385	51,840	40,731	38,016
209	5.75	54,776	49,586	38,960	36,363
200	6	52,168	47,520	37,337	34,848
192	6.25	49,560	45,619	35,844	33,454
185	6.5	46,951	43,865	34,465	32,167
178	6.75	46,430	42,240	33,189	30,976
171	7	44,343	40,731	32,003	29,870

SEED TREATMENT

Emergence of sugarbeet seedlings is a major factor limiting satisfactory stand establishment. Variability in emergence is caused in part by differences in germination and seedling vigor among seed cultivar, or between cultivars. Factors affecting sugarbeet seed germination and emergence include underdevelopment and immaturity of seed; cultural practices, soil fertility, climate and maturity at harvest also influence germination and emergence of sugarbeet seeds.

Seed treatments are convenient, economic, and effective methods (typically giving four weeks of activity, except for CLARIVA™) of reducing seed rot and damping-off diseases and managing early season insect pest. Some seed treatments have activity against one pathogen while others have activity against two or more pathogens. NOTE: For some seed treatments they are not meant to replace your normal pesticide applications, for example, Quadris for Rhizoctonia control, but rather add another mode-of-action to your IPM program. Refer to your Michigan Sugar Company Field Consultant for more information on seed treatments.

- **Allegiance®** (metalaxyl) is a seed treatment fungicide that provides systemic protection for the seed, roots and emerging plants against diseases such as Pythium, systemic downy mildew and Phytophthora. Register in USA and Canada.
- **Apron® XL** (mefenoxam) is a seed treatment fungicide that provides effective protection against Pythium sp and Damping-off. Register in USA and Canada.
- **CLARIVA™** (Pasteuria nishizawae) a biological nematode seed treatment product based on natural soil bacteria for protection against nematodes on soybeans and sugarbeets. Register in USA .
- **CruiserMaxx®** (thiamethoxam + mefenoxam + fludioxonil) for sugarbeets is a combination of Cruiser, Apron XL, and Maxim that offers protection against both early- season insects and diseases. Insect protection: sugarbeet leaf hopper, sugarbeet root maggot, springtails and wireworms, while fungicide activity protects against seedling diseases such as Pythium and Rhizoctonia. Register in USA and Canada.
- **DYNASTY®** (azoxystrobin) is a broad spectrum, preventative seed treatment fungicide with systemic properties recommended for the control of seed rot/pre-emergence damping-off caused by Rhizoctonia solani. Register in USA and Canada.
- **Kabina ST™** (penthiopyrad) a seed treatment fungicide with an effective mode of action against Rhizoctonia seedling disease. Register in USA.
- **Maxim® 4FS** (fludioxonil) is a seed-delivered fungicide that provides defense against early-season diseases while increasing plant stand, vigor and yield potential. Maxim is effective against Rhizoctonia. Register in USA and Canada.
- **Metlock®** Suite (metconazole) provides contact and systemic control, with "inside-out" protection against sugarbeet diseases, including Rhizoctonia and Fusarium. Register in USA.
- **NipsIt INSIDE®** (clothianidin) is an insecticide that provides seed and seedling protection against: Black Bean Aphid; Cutworms; Flea Beetle; Springtail; Sugarbeet Leafminer, and Wireworm. Register in USA.
- **NipsIt SUITE®** Sugarbeets (Clothianidin + Metconazole, + Metalaxyl) combines three super-systemic active ingredients. Insects: sugarbeet root maggot, springtail and wireworm, and diseases: Rhizoctonia, Fusarium and Pythium. Register in USA.

- **Poncho® Beta** (clothianidin + beta-cyfluthrin) a systemic insecticide seed treatment designed to control a range of sugarbeet pests. Provides early season protection against cutworms (black), sugarbeet leaf hopper, sugarbeet root maggot, sugarbeet leafminers, springtails and wireworms. Register in USA.
- **Rizolex™** (tolclofos-methyl) is a seed fungicide for long-lasting and unrivaled protection against Rhizoctonia damping-off plus Fusarium and other soil-borne and seed-borne diseases. Register in USA.
- **Systiva®** (fluxapyroad) a seed treatment fungicide with an effective mode of action against Rhizoctonia seedling disease. Register in USA.
- **Tachigaren®** (hymexazol) is a fungicide that is active for a few weeks after planting, depending on the rate applied to seed, soil moisture and temperature and microbial activity. It is the only registered fungicide that controls Aphanomyces and Pythium. Available in 20 or 45 grams. Register in USA .
- **Thiram** (tetramethylthiuram disulfide) is an industry standard with contact activity against multiple seedborne and soilborne fungi. Key pests that Thiram control are Decay- Seed, Damping off, and Blight-Seedling. Register in USA and Canada.

PESTICIDE APPLICATION AND SAFETY CHECK-OFF LIST

1. Read the label–know the toxicity level of chemical in use.
2. Use adequate protective clothing - wash often and do not mix with household laundry.
3. Drain and wash all sections of spray system including pump and filter.
4. Calibrate sprayer.
5. Triple-rinse pesticide cans and put rinsate into tank–dispose of containers in proper fashion (note label instructions).
6. Store pesticides in original containers - never cross labels.
7. Store bulk (mixed herbicides) in proper drums for reuse or disposal.
8. Store sprayer system rinsate in proper disposal containers or apply on vacant land as per label guidelines.
9. Keep adequate field pesticide history records.
10. Enter pesticide applications in crop records.

MIXING INSTRUCTIONS

Herbicides should be added to the spray tank in the proper order to insure they stay in suspension, and spray uniformly. Herbicides should be added in the following order after filling spray tank 3/4 full.

- AMS (water conditioners)
- Generally, wettable powder (WP) and dry flowable (DF) or water-dispersible granule (WDG) products should be added first.
- Followed by flowable (F, FL) and microencapsulated (ME) products.
- Add emulsifiable concentrates (EC) next
- Followed by any solution (S) or soluble powder (SP) products.
- Any crop oils and/or surfactants should be added last.

Dry formulations should be preslurried (mixed with a little water) before adding them to the spray tank; this is also a good idea (even with ECs) if you are using liquid fertilizer as the carrier. Finally, continue adding your carrier to the desired level.

Some spray mixtures are difficult to keep in suspension. A compatibility agent may be used to insure spray uniformity.

Prepare only enough herbicide for the immediate day. Never leave spray in the tanks overnight; it may separate out or have an adverse effect on activity.

APPLICATOR CALIBRATION

Using the correct amount of chemical during pesticide application is crucial to achieving the best results from a pest control product. Most performance complaints involving pesticides, however, are directly related to dosage errors or improper application. Therefore, proper calibration, or adjustment, of the sprayer is essential to ensure it is applying the correct amount of chemical evenly over a given area.

Use the following table to determine gallons per acre applied and add the recommended amount of pesticide to achieve your goals. Most performance complaints involving pesticides, however, are directly related to dosage errors or improper application. Therefore, proper calibration, or adjustment, of the sprayer is essential to ensure it is applying the correct amount of chemical evenly over a given area. NOTE: 85% of pesticide failure are due to poor calibrations, dirty or contaminated spray systems.

1. Select desired speed of travel (gear + rpm) and row width.
2. Clean all nozzles and screens - fill sprayer with water.
3. Run spray pump at same speed used when spraying.
4. Collect spray for one minute from one nozzle.
5. Determine gallons/ acre from chart at right.
6. If output is too low, raise pressure. If too high, lower pressure.
7. Recalibrate and adjust pressure for desired output.
8. Add chemicals – Fill tank – Spray at speed decided above.

Speed in MPH	Time Required in SECONDS to travel a distance of:		
	100 ft	50 ft	200 ft
3	23	34	45
3.5	20	29	39
4	17	25	34
4.5	15	22	30
5	14	20	27

Selecting Nozzle – Screens

Selection of proper nozzles is very important. When applying pesticides in a band, it is important to use even spray tips which have uniform coverage across the spray pattern. When broadcast applying pesticides, it is important to match spray tips and set nozzle height so that the spray pattern overlaps by 30% on each edge. This ensures uniform coverage. Nozzles should be checked for volume and wear frequently and should be replaced if they vary + /– 10%.

Using 50 mesh screens in line strainers and tip strainers will work well in most cases when applying pesticides in sugarbeets. A cleaning kit of water, brush or compressed air and disposable gloves should always be handy.

Formula to Determine Gallons per Minute (GPM) =	$\frac{\text{GPA} \times \text{MPH} \times \text{W}}{5{,}940 \text{ (Per Nozzle)}}$
Formula to Determine Gallons per Acre (GPA) =	$\frac{\text{GPM} \times 5{,}940}{\text{MPH} \times \text{W}}$

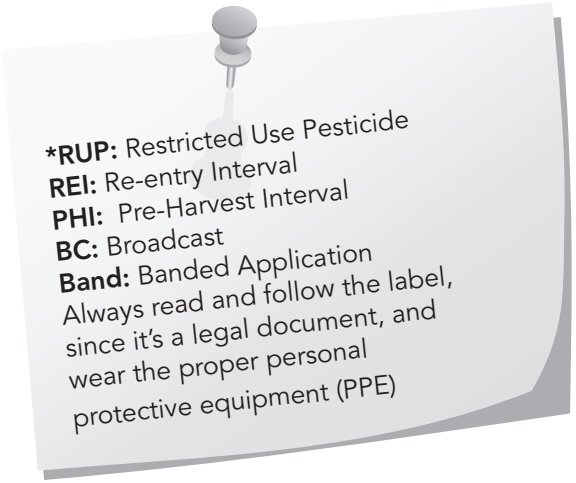
Gallons Per Minute = **GPM**; Gallons Per Acre = **GPA**; Miles Per Hour = **MPH**; Nozzle spacing in inches for broadcast spraying) = **W**

Sprayer Calibration Chart

To calibrate your sprayer accurately and be certain you apply the recommended gallons, use a measuring cup marked in ounces and a watch with a second hand. Shown below are the fluid ounces per minute to receive from each nozzle in order to apply gallons of spray solution per acre:

Nozzle Spacing or Row Width	MPH	Gallons Per Acre				
		5	7.5	10	12.5	15
		Fluid Ounces Per Minute/Nozzle				
20"	3	6.40	10.62	12.80	16.64	19.20
	4	8.96	12.80	16.64	21.76	25.60
	4.5	10.24	14.08	19.20	24.32	29.44
	5	10.88	16.64	21.76	26.88	32.00
22"	3	7.68	10.24	14.08	17.92	21.76
	4	8.96	14.08	19.20	24.32	28.16
	4.5	10.24	16.64	21.76	26.88	32.00
	5	11.52	17.92	24.32	29.44	35.84
28"	3	8.96	14.08	17.92	23.04	26.88
	4	11.52	17.92	24.32	30.72	35.84
	4.5	14.08	20.48	26.88	34.56	40.96
	5	15.36	23.04	30.72	37.12	44.80
30"	3	10.24	14.08	19.20	24.32	29.44
	4	12.80	19.20	25.60	32.00	38.40
	4.5	14.08	21.76	29.44	35.84	43.52
	5	16.64	24.32	32.00	40.96	48.64

7.5 to 12.5 gallon rates can be obtained from 10-gallon nozzles by adjusting pressure.



Pesticide Rotation Restrictions

When selecting field locations for sugarbeets, check for potential pesticide carryover for at least four years prior to sugarbeets. This chart lists popular pesticides with sugarbeet restrictions.

Trade Name	Months	Trade Name	Months	Trade Name	Months
Accent Q	10/18a	Extreme	40b	Prequel	18
Accuron	18	Field Master	21	Princep	21
Accuron Flexi	18	Fierce	15	Priority	21
Afforia >2.5 – 3.75 oz	5/10	Fierce XLT	30	Prowl, Prowl H2O	12
Anthem	15	Firstrate	30b	Pursuit, Pursuit Plus	40b
Anthem ATZ	18	Flexstar or Flexstar GT	18	Python/Accolade	26b
Anthem Maxx	15	ForeFront HL	24	Raptor	18
Anthem ATZ	18	Fultime	21	Reflex	18
Armezon/Impact	18	Gangster/Surveil	30b	Realm Q	18
Atrazine 1 lb. a.i./A	21	Guardsman Max	21	Require Q	10
Atrazine 2 lb. a.i./A	33	Harness XTRA/Keystone NXT/		Resicore	18
Authority Assist	40b	Keystone LA NXT/		Resolve	10/18
Authority First/Sonic	30b	Breakfree NXT ATZ/		Resolve Q	10/18
Authority MTZ	24	Breakfree NXT Lite	15	Revalin Q	18
Authority XL	36	Halex GT	18	Scepter	26
Authority MAX	36	Hornet WDG/Stanza	26b	Sencor	18
AutumnSuper	18	Huskie	9	Sharpen (2.5 oz)	6
Balance Flexx	10/18	Impact	18	Shotgun	10
Beacon	18	Inspire XT	8d	Sinbar	24
Bicep II Magnum/Cinch ATZ/Parallel Plus	21	Instigate	18	Solstice	18
Bicep Lite II Magnum/ Cinch ATZ Lite	21	IntRRo/Micro-Tech	10	Sonalan	8/13
Boundary		Laudis	18c	Spartan & Spartan Charge	30
Broad Axe	36	Lexar	18	Starane	10
Bullet/Lariat	21	Lightning	40b	Steadfast Q	10/18a
Callisto/ Callisto GT/ Callisto Extra	18	Lumax	18	Steadfast ATZ	18
Canopy or Canopy EX	30	Marksman	21	Stout	10/18a
Capreno	18	Marvel	18	SureStart II / Tripleflex II	26b
Celebrity Plus	10/18a	Matrix	18	Synchrony XP	30
Cheetah Max	18	Metribuzin	18	Trifluralin	12
Classic	30	Milestone	12	Trivence	30
Command	9	Northstar	18	Valor (>2-3 oz)	5/10
Corvus	17e	Op Till/Op Till Pro	40	Valor XLT/Rowel FX	30
Curtail	12	Osprey	10	Varisto	18
Degree Xtra/Fultime NXT	15	OutLook	10	Velpar	12
Dual Magnum/Dual II	10	Parallel/Parellel PCS	10	Warrant Ultra	18
Envive	30	Peak	22	Yukon	21
Eptam	10	Permit/Sandea	21	Zemax	18
Equip	18	PowerFlex HL	9	Zidua	15
Expert	18	Prefix	18	Zidua PRO	40b

a. If the pH is less than 7.5 and 25 inches of rain falls between application and planting sugarbeets, 10 months. If pH or greater, 18 months.
b. Requires the rotation interval and a successful field bioassay.
c. The full rate is not recommended when rotating to sugarbeets. A rotation interval of two growing seasons is recommended for 50% or less of the full rate
d. To avoid possible illegal residues, do not plant any other crop (cereals: wheat, barley, triticale, oats, rye) within 30 days; Corn, sweet corn - 60 days; sugarbeets and soybeans - 0 days.
e. When soil pH is 7.5 or above crop plant back should be delayed to the next interval, and to 24 months for crops listed on label in the 17 month interval, and 30" of cumulative precipitation from application to planting of rotational crop.

Herbicide Carryover

Herbicides that can be used in crops prior to sugarbeets with low risk of carryover at normal rotation intervals. Since labels change year-to-year, please refer to label for updated information.

Aim	Outlook
Assure II/Targa	Poast/Poast Plus Banvel
Axial, Axial XL	Progress
Basagran	Puma
Basis	Pyramin
Buctril/Moxy	Rage D-Tech
Cadet	Resource
Clarity	Require Q
Cobra/Phoenix	Select/Arrow/Select Max Command
Distinct	Sharpen (1 oz./A)**
Dual Magnum	Sharpen (2.5 oz./A)**
Eptam	Stalwart/Stalwart C Dual Magnum II
Express	Starane
Fusilade DX	Status
Fusion	Stinger
Glyphosate	Ultra Blazer
Gramoxone Inteon	Upbeet
Harmony /Unity	Valor (≤ 2 oz./A)
Huskie	Valor (2-3 oz./A)
Liberty/Ignite/Rely	Verdict (5 oz./A)
2, 4-D Ester	Verdict (≥ 10 oz./A)
2,4-D Amine Option	Vida
Osprey	Warrant
Harmony Extra/TNT Broadleaf	Harness//Topnotch/ Degree

Weed Source: 2017 Weed Control Guide for Field Crops. Michigan State University Bulletin E-434.

**Do not count frozen soil months towards rotation restrictions.

PESTICIDE OFF-TARGET/OFF-LABEL

If you suspect any pesticides carryover or off-target drift of pesticides, consult your agriculturist immediately. Remember, Pesticide product labels are legal documents. This statement is found on all registered pesticide product labels in the United States: "It is a violation of Federal law to use this product in a manner inconsistent with its labeling". Violation of the pesticide label is subject to state, federal, and Michigan Sugar Company penalties. Therefore, check your pesticide program before planting and after sugarbeets emergence.

WEED CONTROL

To produce a quality crop of sugarbeets, producers must achieve good weed control. The reduction and, in many cases, elimination of hand labor is now possible through timely and effective chemical weed control. Every producer must correctly identify their weed species and set up a concentrated program to manage those species in all their crops. Therefore, weed control for sugarbeets starts in the crops prior to sugarbeets. Many weed species are difficult to control with sugarbeet herbicides. Sugarbeet herbicides are very effective when used TIMELY at the proper rates.

RESISTANCE WEED MANAGEMENT GUIDELINES

Know the site of action of the potential products to be applied. Note that many products are actually premixes and have multiple sites of action, so READ the label.

- Scout your fields before and after herbicide application.
- Start with a clean field, using either a burndown herbicide application or tillage.
- Control weeds early when they are small. Note: Follow the label for weed size.
- Rotate crops annually. Weed associations with crops vary because of differences in time of weed emergence relative to crop planting.
- When rotating crops, also rotate herbicide sites-of –action, especially with other crops (e.g. corn, wheat, soybeans, dry beans, etc.)
- Do not use the same site-of-action multiple times in one cropping season.
- Use multiple sites-of-action to target the most problematic weed within a field.
- Use cultural practices such as tillage and narrow row widths to reduce the number of annual herbicide applications.
- Clean equipment before moving from field to field to minimize spread of weed seed.

If a grower has or suspects a herbicide-resistant weed, it is imperative that seed production is prevented. Most weeds are prolific seed producers, with seed remaining viable for many years in the soil; hence, resistant weeds will be a problem in subsequent crops if allowed to produce seed. Weed seed can also be easily spread over an entire farm and onto neighboring farms, exacerbating weed management difficulties. Therefore, if weeds are thought to be resistant to a herbicide, use all means available to prevent seed production and spread of the resistant weed.

HERBICIDE USE

Recommendations placed in this producer guide are suggested from research conducted by Michigan Sugar Company, Michigan State University, other universities and the USDA. These are general recommendations and should not be altered unless discussed with your Michigan Sugar Company agriculturist. Remember, Pesticide product labels are legal documents. This statement is found on all registered pesticide product labels in the United States: "It is a violation of Federal law to use this product in a manner inconsistent with its labeling".

Use only the herbicides recommended in this guide; they are registered and approved by the EPA and MDA. The use of a herbicide not registered for sugarbeets is illegal. Using a herbicide not registered, even if no residue is detected, will cause your crop to be condemned.

Generic herbicides may be available for some pesticides with the same active ingredients as the historical products. Contact your company agriculturist for information on these generic products.

Herbicide Rainfastness, Preharvest Interval & Maximum Use Rates

Preemergence herbicides require rainfall after application for effective weed control. Herbicides applied to emerged weeds have time limitations before harvest which need to be taken into consideration before application.

Herbicide	Rainfree Period	Preharvest Interval	Maximum Rate Per Season	Storage Temperature
Assure II/ Targa	1 hour	45 days	25 fluid ounce	Store above freezing
Betamix.	6 hours	75 days	12 pints (Betamix)	If exposed to subzero temperature, product thickens, will return to original consistency when placed in room (over 50˚F) for several days
Betanex			6 pints (Betanex)	
Glyphosate (many)	See Label	See Label	See Label	Store above freezing
Gramoxone	30 mins.	-	12 pts.	Store above 34˚F
Norton SC	6 hours	90 days	1 gal (4lbs. ai/A)	Store above freezing
Poast	1 hour	60 days	5 pints	Store above freezing and below 100˚F
Select Max	1 hour	40 days	32 fluid ounce	Store in cool, dry place
Stinger	6 hours	45 days	2/3 pints	Store above 28˚F or warm up to 40˚F and agitate before use
UpBeet	4 hours	60 days	2.5 fluid ounces	Store in cool, dry place

SUGARBEET CONTROL IN CORN AND SOYBEANS

With Roundup Ready sugarbeets being deregulated in mid-2012, growers should continue to control sugarbeets in soybeans and corn fields for good farm management practices and destroy any sugarbeet bolters. Refer to the tables below. For other crops, contact your field consultant.

Herbicides Used in Soybean to Control Sugarbeets

Herbicide	Rate/A	Rating	REI (hours)	Rainfree (hours)	Comments
Raptor	4 oz.	G	4	1	Will not control sugarbeets above the 10-leaf stage
Harmony SG	0.12 oz.	F	4	1	Will not control sugarbeets above the 10-leaf stage

Herbicides Used in Corn to Control Sugarbeets

Herbicide	Rate/A	Rating	REI (hours)	Rainfree (hours)	Comments
2, 4-D Amine	1 pt.	G	48	8-Jun	Will not control sugarbeets above the 10-leaf stage
					Corn: up to 8" tall. 8" to tasseling (use only directed spray)
2,4-D Ester	0.5 pt.	G	12	1	Will not control sugarbeets above the 10-leaf stage
					Corn: 4-18" tall. Corn over 8" tall use drop nozzles.
Banvel / Clarity	0.5 pt.	G	24	Not Listed on Label	Will not control sugarbeets above the 10-leaf stage
					From spike to 36 inches tall corn or 15 days before tassel emergence

TANK MIXING WITH OTHER PESTICIDES

Research has shown that tank mixing combinations of two or all three types of pesticides which includes: insecticides, fungicides and herbicides generally has no antagonism affect with spray performance. However, COPPER FUNGICIDES SHOULD NOT BE MIXED WITH GLYPHOSATE APPLICATIONS AS SEVERE INJURY CAN OCCUR. Caution is also needed when mixing EBDC fungicides and Super Tin with glyphosate as crop injury and reduced pest control can occur. Antagonism can also happen when mixing glyphosate with some micronutrients, especially some formulations of manganese sulfate. To improve weed control add a quality water conditioner such as 17 lbs/100 of AMS and use a less antagonistic Mn formulation. Read the label and contact your Michigan Sugar Company Field Consultant for more details.

Early Postemergence Herbicides – Rates and Comments

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Broadleaves	Betanex (desmedipham phenmedipham)	3 pt	<Split low rates of Betamix + UpBeet followed by Betamix + UpBeet + Stinger may be applied to sugar beets at early growth stages (less than the 4- true-leaf stage) to control weed seedlings at the cotyledon stage. Weeds not completely controlled by the first treatment will be checked and controlled by the second application.
	+	+	<The second application MUST BE MADE AT LEAST 7 days but not more than 10 days AFTER the first application.
	UpBeet (Triflusulfuron methyl)	0.50 oz	<Growing degree-day recommendations for split low-rate applications: 400 GDD prior to the first application and 350 to 400 GDD prior to the second application.
	FOLLOWED BY		<The rate of Betamix in the second application can be increased to 4.6 pt/A.
			<Adding Stinger to the second application will control cocklebur and common and giant ragweed and improve lambsquarters control.
	Betamix (desmedipham phenmedipham)	3 pt	<Add surfactant at 0.25% v/v to THE SECOND APPLICATION ONLY.
	+	+	<DISPERSE UpBeet thoroughly in the tank before adding other herbicides.
	UpBeet (Triflusulfuron methyl)	0.50 oz	<Rainfall within 6 hours of application may reduce control.
	+	+	<If Stinger is added, DO NOT plant dry beans for 18 months if organic matter is less than 2%.
	Stinger	0.25 pt	
	(clopyralid)		

Postemergence Herbicides – Rates and Comments

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Grasses	Dual Magnum (s-metolachlor)	1.33 pt	<S-metolachlor should be applied to sugarbeets after they have 2 true leaves.
	OR	OR	<Sugarbeets **MUST HAVE** 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction.
	Dual II Magnum	1.33 pt	<Crop safety is greater when s-metolachlor applications are made after beets reach the 4-leaf stage.
	Cinch		<S-metolachlor may be tank mixed with micro-rate or standard-split herbicide applications, or with glyphosate for residual weed control in glyphosate-resistant sugarbeets.
	(s-metolachlor)		<S-metolachlor will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds.
			MSU does not recommend preplant incorporated or premergence applications of s-metolachlor…..severe stand reductions can occur.
Annual Grasses	Outlook	16 oz.	<Sugarbeets **MUST HAVE** 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction.
	(dimethenamid-P)		<Crop safety is greater when Outlook applications are made after beets reach the 4
			-leaf stage.
			<Apply Outlook before sugarbeets exceed the 8-leaf stage.
			<Outlook may be tank mixed with micro-rate or standard-split herbicide applications, or with glyphosate for residual weed control in glyphosate-resistant sugarbeets.
			<Outlook will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds.
			<More than one application of Outlook can be made; maintain a minimum of 14
			days between applications, and the total should not exceed 21 oz/A.

Postemergence Herbicides – Rates and Comments (continued)

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Velvetleaf	Upbeet (triflusulfuron methyl)	0.50 oz	<Sugarbeets **MUST HAVE** 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction.
	+	+	<DISPERSE UpBeet thoroughly in the tank before adding AND surfactant.
	surfactant	0.0025	<**A MINIMUM OF TWO APPLICATIONS ARE NEEDED FOR VELVETLEAF CONTROL.**
		AND REPEAT	<Apply to velvetleaf at the 1-true-leaf stage. **REPEAT** application 7-10 days later.
			<Add 2 qt/A 28% liquid nitrogen or 2.5 lb ammonium sulfate in addition to surfactant if velvetleaf plants have 1 to 2 true leaves and beets are at 2-leaf-pair stage.
			<A third application of 0.5 oz/A of UpBeet + surfactant can be made.
			<The maximum amount of UpBeet that can be applied in 1 year is 2.5 oz/A.
Cocklebur Ragweeds Jimsonweed Volunteer alfalfa Sweet clover Canada thistle Perennial sowthistle Marestail	Stinger (clopyralid)	4 – 8 oz	<**DO NOT** use on sands, loamy sands, or permeable soils where water tables are shallow because of potential groundwater contamination.
	+ COC	1%	<Apply 2 oz/A at 2 true leaves followed by 4 oz/A twice to sugarbeets at the 4 true leaf stage or larger to control glyphosate resistant Marestail.
			<Apply 4 oz/A to control cocklebur, giant ragweed, Canada thistle jimsonweed, volunteer alfalfa and sweet clover up to the Perennial sowthistle 6- leaf stage and common ragweed up to the 5-leaf stage.
			<Smartweed, wild buckwheat, and nightshade up to the 3-leaf stage will be suppressed at 4 oz/A.
			<Tank mix with other postemergence herbicides to control other annual broadleaf weeds.
			<After sugarbeets have reached the third leaf pair, apply 6 oz/A to Canada thistle (just prior to flowering) for control. Increase the rate to 8 oz/A under drought conditions. DO NOT include crop oil concentrate if 8 oz/A is tank mixed with Betamix or Progress.
			<After sugarbeets have reached the third leaf pair, apply 8 oz/A for perennial sowthistle control. Increase the rate to 11 oz/A under drought conditions. DO NOT tank mix with other herbicides for perennial thistle control.
			<**DO NOT** apply within 45 days of beet harvest.
			DO NOT plant dry beans for 18 months if soil organic matter is less than 2%.

Postemergence Herbicides – Rates and Comments (continued)

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Grasses Volunteer Corn Cereals Quackgrass	Assure II/ Targa (quizalofop-P- methyl) +	5-10 oz	<Apply 7 oz/A to actively growing annual grasses up to 4 inches tall; 8 oz/A is
	COC	1%	required for barnyardgrass and crabgrass control.
	+	+	<Apply 5 oz/A for control of volunteer corn up to 18 inches tall.
	ammonium sulfate	2.5 lb	<Apply 8 oz/A to control spring-seeded cereals up to 4 inches tall.
			<Apply 10 oz/A to control fall-seeded cereals.
			<Make an application of 10 oz/A to 6- to 8-inch-tall quackgrass. A second application of 7 oz/A may be required 14-21 days later.
			<Surfactant may be used instead of crop oil concentrate.
			<Ammonium sulfate is not required for all Assure II/Targa applications.
			<Grass control may be reduced if Assure II/Targa is tank mixed with Betamix, Progress, or UpBeet. Apply 5 days later.
			<**DO NOT** include ammonium sulfate with Betamix, Progress, UpBeet, or Stinger tank mixes.
			DO NOT apply within 45 days of beet harvest.
Annual Grasses Volunteer Corn Cereals Quackgrass	Fusilade DX	12 oz	<Apply 6 oz/A of Fusilade DX to control volunteer corn.
	(fluazifop-P-butyl)	+	<Apply 8 oz/A to control spring seeded cereals up to 6 inches tall.
	+ COC	1%	<Two applications 7-14 days apart are usually needed for control of perennial grasses.
			<**DO NOT** apply more than 48 oz/A of Fusilade DX per season.
			DO NOT apply within 90 days of sugarbeet harvest.

Postemergence Herbicides – Rates and Comments (continued)

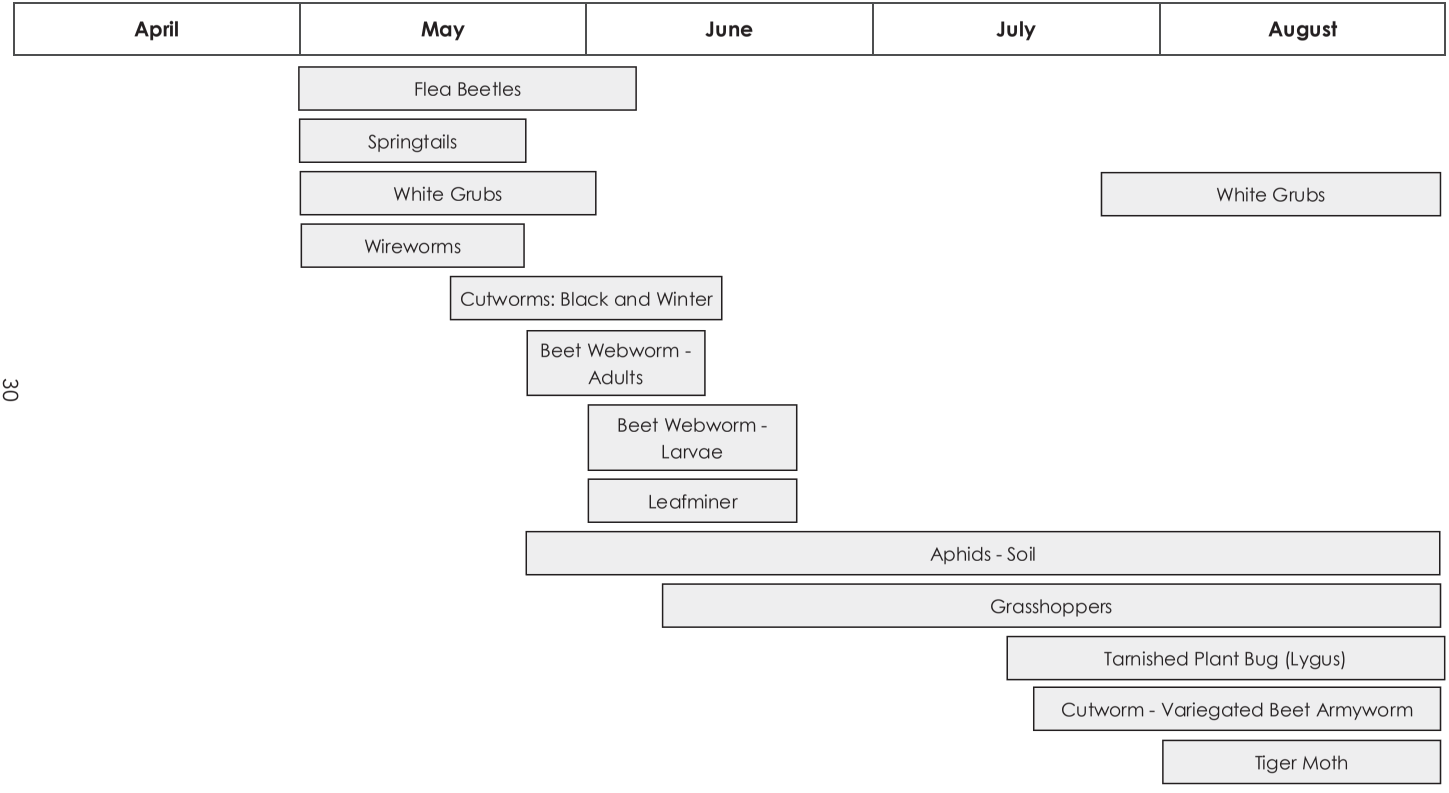
WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Grasses Volunteer Corn Cereals Quackgrass	Poast (sethoxydim)	1-1.5 pt	<Poast is not as effective as the other postemergence grass.
	+ COC	1%	<For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4 inches or less, apply 1 pt/A. The rate can be reduced to 0.75 pt/A if grasses are 1- 4 inches tall.
	+	+	<Apply 1 pt/A for control of volunteer corn up to 20 inches tall.
	ammonium sulfate	2.5 lb	<Apply 1.5 pt/A to cereals prior to tillering (less than 4 inches tall).
			<Make an application of 1.5 pt/A to 6- to 8-inch-tall quackgrass.
			<A second application of 1 pt/A may be required 14-21 days later.
			<Grass control may be reduced if Poast is tank mixed with Betamix, Progress or UpBeet. Apply 5 days later.
			<**DO NOT** include ammonium sulfate with Betamix, Progress, UpBeet or Stinger tank mixes.
			DO NOT apply within 60 days of beet harvest.
Annual Grasses Volunteer Corn Cereals Quackgrass	Select/Arrow (clethodim)	6-16 oz	<For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4 inches or less, apply 6 oz/A. The rate can be reduced to 4-5 oz/A if grasses are 1- 4 inches tall.
	+ COC	1%	<Apply 6 oz/A for control of volunteer corn up to 18 inches tall. The rate can be reduced to 4 oz/A if corn is 4-12 inches tall.
	+	+	<Oats can be controlled with 8 oz/A.
	ammonium sulfate	2.5 lb	<Spring-seeded cereals are labeled for control at 8 oz/A. However, 16 oz/A will provide more consistent control.
			<Apply 16 oz/A to control fall-seeded cereals. Cereals should not exceed 6 inches tall.
			<Two applications of 8 oz/A, 14-21 days apart, are generally needed for quackgrass control.
			<Grass control may be reduced if Select/Arrow is tank mixed with Betamix, Progress or UpBeet. Apply 5 days later.
			<Select/Arrow at 2 oz/A can be added to each micro-rate application for annual grass control.
			<**DO NOT** include ammonium sulfate with Betamix, Progress, UpBeet or Stinger tank mixes.
			DO NOT apply within 40 days of beet harvest.

Postemergence Herbicides – Rates and Comments (continued)

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Grasses Volunteer Corn Cereals Quackgrass	Select Max (clethodim)	6-16 oz	<For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4" or less, apply 9 oz/A. The rate can be reduced to 6 oz/A if grasses are 1-4" tall.
	+		<Apply 6 oz/A for volunteer corn control and oats can be controlled with 12 oz/A.
	surfactant	0.25%	<Apply 24 oz/A to for control of cereals. Cereals should not exceed 6" tall.
	+	+	<Two applications of 12 oz/A 14-21 days apart are generally needed for quackgrass control.
	ammonium sulfate	2.5 lb	<Grass control may be reduced if Select Max is tank mixed with Betamix, Progress or UpBeet. Apply 5 days later.
			<**DO NOT** include ammonium sulfate with Betamix, Progress, UpBeet or Stinger tank mixes.
			DO NOT apply within 40 days of beet harvest.
Annual Grasses Annual Broadleaves Suppression of Perennials	Sequence (glyphosate + s-metolachlor)	2.5 pt	<APPLY TO GLYPHOSATE-RESISTANT SUGAR BEET ONLY.
			<Apply to sugar beet from the 2-true leaf stage to canopy closure.
	+	+	<DO NOT apply within 60 days of beet harvest.
	Ammonium sulfate	17lbs/100 gal	<Sequence is designed to control existing weeds and provide residual control of grasses and some small-seeded broadleaf weeds, including pigweeds and nightshade.
			<On fine and medium textured soils, Sequence can be applied at 3 pt/A prior to 8- true leaf sugar beet.
			<Sequence at 2.5 pt/A contains 22 fl oz/A of Touchdown Total (0.7 lb a.e./A of glyphosate) and 0.98 pt/A of Dual Magnum.
			<**DO NOT** exceed total maximum glyphosate use rate restrictions for glyphosate- resistant sugar beet when using Sequence.
			DO NOT apply more than 7 pt/A of Sequence per season.

Postemergence Herbicides – Rates and Comments (continued)

WEED CONTROLLED	TREATMENT	Brdcst/A	REMARKS AND LIMITATIONS
Annual Grasses Annual Broadleaves Suppression of Perennials	glyphosate	22-32 oz	<APPLY TO GLYPHOSATE-RESISTANT SUGAR BEETS
	+	+	<Glyphosate should be applied at a minimum rate of 0.75 lb a.e./A (22 oz of a 4.5 lb a.e./gal glyphosate.
	ammonium sulfate	17lbs/100 gal	<Always add ammonium sulfate (17 lb/100 gal) to maximize glyphosate performance and reduce antagonism from hard water.
			<The first glyphosate application should be made before annual weeds exceed 2 inches tall. Subsequent applications should be made before additional weed flushes are 4 inches tall to maximize weed control and sugarbeet yield.
			<Two to four applications of glyphosate will be needed for season-long weed control and to maximize sugar beet yield.
			<Maximum in crop glyphosate applications include two applications prior to 8-leaf sugar beets totaling 1.9 lb a.e./A (56 oz/A) and two applications after the 8-leaf stage until 30 days prior to harvest totaling 1.5 lb a.e./A (44 oz/A).
			<Increase the glyphosate rate up to 1.1 lb a.e./A (32 oz/A) to control hard-to- control weeds. This rate can only be used prior to 8-leaf sugarbeets.
			<Stinger at 2 to 4 oz/A should be tank-mixed with glyphosate to control
			VOLUNTEER GLYPHOSATE-RESISTANT SOYBEAN.
			<The addition of micronutrient fertilizers (e.g., manganese) to glyphosate can cause a reduction in weed control. For best results, apply glyphosate and the fertilizers separately or use a full-chelated form of the fertilizer, and always include ammonium sulfate (17 lb/100 gal).
	(fluazifop-P-butyl)	+	Continuous use of the same herbicide can lead to the development of herbicide-resistant weeds. Keep this in mind when planning weed management strategies for the full crop rotation.


April
May
June
July
August
Flea Beetles
Springtails
White Grubs
Wireworms
White Grubs
Cutworms: Black and Winter
Beet Webworm - Adults
Beet Webworm - Larvae
Leafminer
Aphids - Soil
Grasshoppers
Tarnished Plant Bug (Lygus)
Cutworm - Variegated Beet Armyworm
Tiger Moth

APHIDS – ROOT APHIDS

Sugarbeet root aphids are fairly common and cause localized economic populations in Michigan. The sugarbeet root aphids are small, oval to pear shaped, and pale yellow in color with a soft-body. The females overwinter in soil or on roots of lambsquarter, and move to sugarbeets later in the season. Root aphids reproduction is typically parthenogenesis and viviparous, which during the field season, aphids are all female, and give birth to live offspring without mating. There are several generations per year in Michigan. Aphids are sucking pest; that secretes a distinctive white, waxy substance which inhibits water and nutrient uptake by beets. Their population increase during dry, hot weather conditions.

Scouting: Scout fields for aphids or wax on roots, particularly in areas with wilted beets. Maximum of one application per season. Do not place granules in direct contact with the seed as crop injury may occur.

Aphids Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Counter 20G (Terbufos)... Suppression Only	4-8 oz. per 1,000 feet row (banded)	48	110
Variety Selection for risk management this insect	-----	-----	-----

ARMYWORM

Armyworm are occasional economic pests and cause localized economic populations in Michigan. Armyworm defoliation (chewing) the sugarbeet leaves. Armyworm larvae often feed at night. Female moths are attracted to grassy or weedy fields early in the season for egg laying; in midsummer, true armyworms may move from surrounding fields (small grain, pasture, sod) into sugarbeet fields.

Sampling/Scouting/Threshold: Check several areas of the field for larvae. For true armyworms, check the edges of the fields since these tend to be at a greater risk. Biological Control: predatory insects, rodents, and birds feed on armyworms. Cultural Control: good weed management program can reduce infestation from true armyworm. The threshold for armyworms are **25%** or more of foliage damaged by armyworms. Note: Asana only controls Beet Armyworm.

Armyworm Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-Cypermethrin)	3.0 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-Cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt./A (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt./A (band)	24	28
Sevin 4-F (Carbaryl)	1 - 1.5 qts	12	28
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
*Intrepid 2F (Methoxyfenozide)	8-16 oz.	4	7

BEET WEBWORM

Beet webworms rarely occur in significant numbers in Michigan sugarbeet fields. Larvae are slender caterpillars and are very active when disturbed. Early-stage larvae are dark green. Older larvae are olive green and have a dark band flanked on each side by two light-colored stripes running down the center of their back. Full-grown larvae can be up to 1½ inches long. Adults are mottled tan and brown moths with smoky grayish wing margins. The moths first appear in late May and early June. Larvae usually cause problems during the first 3 weeks of June. A second brood is also possible during late August and September.

Threshold: Treatment is recommended if **one to two** webworms are present on **50% to 75%** of sampled leaves.

Beet Webworm Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
Sevin (Carbaryl)	1 - 1.5 qts.	12	28
*Intrepid 2F (Methoxyfenozide)	8-16 oz.	4	7

CUTWORM

Major cutworm pests of sugarbeets in Michigan include the Black, Winter and Variegated.

- **Black and Variegated Cutworm:** These insects migrate into our region as moths during the spring and are capable of multiple generations within a single growing season. Variegated cutworm larvae have a distinctive row of pale yellow spots down the middle of their backs. They are a climbing cutworm species that primarily feeds in the plant canopy during evening hours. Black cutworms can feed more than 2 inches below ground in later growth stages when soils are too warm near the surface. Therefore, late-season control of these cutworms can be difficult to achieve. Insecticides applications may be repeated as necessary during peak cutworm feeding. Liquid formulations generally provide better control of cutworms, especially during very dry periods. If severe crusting is evident in the field, the crust should be broken up prior to or during the insecticide application.
- **Winter Cutworm:** Were found in large numbers in the fall of 2007 in central and northern Michigan. Sometimes called snow cutworms. In large numbers, caterpillars move across fields and roads, similar to armyworm. However, unlike other caterpillar species winter cutworm is very cold tolerant. The winter cutworm is one of a many insect that lives in a stage of winter dormancy in the soil surface, with the help of an antifreeze like chemical in their body, allowing it to survive subfreezing temperatures. Thus, if a large cutworm-like caterpillar is found late in the fall or during the winter, it is likely Winter Cutworm. The hairless worm-like larvae will emerge in April, begin feeding, and pupate to a moth in May or June and then lay eggs again and start the cycle over.

  Early detection of larval feeding activity is essential to a good control program. Fields should be checked for wilting or dead plants at frequent intervals during periods of cutworm activity. Cutworms will generally be found within 1 to 2 inches of the soil surface near the base of wilting plants. Most feeding activity occurs at night. Young sugarbeet plants are often cut off near ground level. During periods of dry weather, larvae prefer feeding just below the soil surface as they move along the row. They will feed above the surface on leaves and petioles during periods of excessive soil moisture.

Threshold: Cutworm control in young beets is suggested when 4 to 5% cutting of seedlings observed in fields. Control is recommended when a population of **three to five** larvae per square foot is observed in late summer when the plant canopy is developed.

Cutworm Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
*Fastac (Alpha-cypermethrin)	2.2 to 3.8 fl ozs	12	50
Sevin (Carbaryl)	1 - 1.5 qts.	12	28
*Intrepid 2F (Methoxyfenozide)	8-16 oz.	4	7
Poncho Beta Seed Treatment	—	—	—

FLEA BEETLE

The flea beetles most frequently found feeding on beets are shiny black in color and about 1/8 inch in length. All flea beetles are oval-shaped and have enlarged hind legs. When approached or disturbed, they readily jump to escape. Flea beetles overwinter as adults and emerge in late April and May. They feed first on suitable weeds such as winter annuals, and move to field crops as weed hosts are depleted and crop plants begin emerging. Foliar feeding injury from flea beetles consists of small, rounded holes, and gives leaves a shot-hole appearance. Severe shot-holing damage can result in stunting, wilting, and even death of seedling plants. Plant responses will be most dramatic during periods of hot and dry weather.

Threshold: Treatment is usually justified if flea beetles threaten to reduce sugarbeet plant stands to below 35,000 plants/acre.

Flea Beetle Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
*Fastac (Alpha-cypermethrin)	2.2 to 3.8 fl ozs	12	50
Sevin (Carbaryl)	1 - 1.5 qts.	12	28

GRASSHOPPER

Grasshoppers are a common insect and has an occasional outbreaks in Michigan. Grasshoppers overwinter as eggs in the soil, and nymphs hatch in June. Nymphs molt as they grow, and feeding increases with size. Grasshoppers defoliation (chewing) sugarbeets leaves by nymphs and adults. Unplowed or fallow areas next to fields are preferred egg-laying sites, and may contribute to populations in a field. Dry, warm weather often enhances survival of nymphs. Damage to sugarbeets can occur late in season when other crops are scarce.

Sampling/Scouting/Threshold: Check 5 groups of 20 plants for damage. Cultural control includes plowing and cultivation to destroy eggs. Biological control includes a natural fungal pathogen that will kill several eggs and nymphs under wet spring conditions. Natural enemies include animals (birds, rodents, amphibians), parasitic wasps, and ground beetles. The threshold for grasshopper damage is when 25% or more of the sugarbeet leaves have been defoliated.

Grasshopper Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
*Fastac (Alpha-cypermethrin)	2.2 to 3.8 fl ozs	12	50
Sevin (Carbaryl)	1 - 1.5 qts.	12	28

LEAFHOPPERS

Leafhoppers are common insects, rarely economic pests in Michigan. Leafhoppers are small, fast moving, torpedo-shaped insects. Nymphs resemble adults but are much smaller and lack wings. There are several species of leafhoppers found in sugarbeets, with all of them having multiple generations per year. Leafhoppers of sucking pest, that remove nutrients from the leaves. Both adults and nymphs remove plant sap as they feed. Symptoms include leaf curling and yellowing of the sugarbeet leaves.

Threshold: Leafhoppers are not usually a problem in beets. A rough guideline is to treat when large numbers of leafhoppers are seen and leaf curling is present.

Leafhopper Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
Poncho Beta Seed Treatment	—	—	—

TARNISHED PLANT BUG (LYGUS BUG)

Tarnished plant bugs, commonly referred to as "Lygus bugs", have caused late-season injury to Michigan sugarbeets. Most feeding injury appears on new leaves and stems emerging from the sugarbeet plant crown. Feeding symptoms include curling and wilting of leaves, feeding scars on leaf petioles, seepage of a black exudates from petioles of young leaves, and blackening of the new growth near the center of the crown. Multiple generations of Lygus bugs can develop during the growing season, especially if extended periods of unseasonably warm weather prevail during spring and early summer. Populations usually build up in other host plant habitats (e.g., alfalfa and small-seeded broadleaf weeds), then adults migrate to beets in late July through August. Lygus bugs are sporadic pests in this region and their biological profile is not understood well enough to anticipate when or where future problems could arise.

Threshold: Treatment with an insecticide may be justified if an infestation exceeds one Lygus bug per plant (adults and nymphs combined) after checking 30 to 50 plants in a field. Significant economic loss is likely to occur if an infestation reaches four Lygus bugs per plant. Lygus bugs usually infested beets during August. Therefore consideration of pre-harvest interval may be a critical factor in choosing an insecticide.

Tarnished Bug Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	2 pt./A (BC) or 1.33 pt. (band)	24	28

SPINACH LEAFMINER

Leafminer are occasionally an economic pest in Michigan. Leafminer adults are a slender gray fly with white area between eyes. The larvae feed inside leaf mines of the sugarbeet leaves. Leafminer females lay white, oval eggs in groups of three to eight on undersides of beet leaves. Larvae (maggots) move inside the leaf and feed on tissue between the upper and lower surface. Larvae drop out of the leaf, pupate in the soil. There are multiple generations of leafminers, but only the first attacks beets.

The maggots (larvae) create distinctive, winding mines as they feed internally on the leaf. Seedling beets are more susceptible to damage than older beets.

Sampling/Scouting/Threshold: Scouting is crucial, and insecticides are most effective if applied just before or at egg hatch. Check 5 sets of 20 plants for egg masses or small leafminers. Treat if 50% or more of plants have egg masses and small mines are present.

Leafminer (Adults) Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Lorsban 4E (Chlorpyrifos)	1 pt. (BC) or 0.67 pt. (band)	24	28
*Lorsban Advance (Chlorpyrifos)	1 pt. (BC) or 0.67 pt. (band)	24	28
Poncho Beta Seed Treatment	—	—	—

SPRINGTAIL

In the Michigan Sugar Company growing area, there are two types of Springtail: Sub-terrainian and above ground. Above ground Springtail is similar to Flea Beatle. For management and description of above ground Springtail see the Flea Beatle section.

Sub-terrainian Springtail is rare in the Michigan Sugar Company growing area and can be managed by at plant insecticides. Sub-terrainian Springtails are tiny (1/32 to 3/32 inch long), wingless, white- to cream-colored insects with fleshy, forward-pointed antennae. They spend their entire life below the soil surface, and are most harmful to seedlings. Plant injury ranges from a few brown feeding punctures to extensive root scarring. Field symptoms include wilted plants and plant stand losses. Fine-textured (i.e., clay or silty clay) soils with high organic matter content are conducive to springtail problems. Early-planted fields, especially where soils remain cool and wet during early spring, can be especially vulnerable to attack. Field history is a good indicator of risk because springtails do not migrate from one field to another.

Threshold: On newly emerging beets, springtail damage is rare unless populations are very high per square foot). This happens most often in fields with moist soil and high residue or in early- planted fields under cool, wet conditions.

Springtail Insecticide (*RUP)	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	2.4 - 4.3 oz.	12	50
*Mustang MAXX (Zeta-cypermethrin)	2.24 - 4.0 oz.	12	50
*Asana (Esfenvalerate)	5.8 - 9.6 oz.	12	21
Poncho Beta Seed Treatment	—	—	—

WHITE GRUBS

White grubs are common insects, localized problem pests in Michigan. White grubs are white in color, C-shaped larvae of the May and June beetles. White grubs can live for several years in undisturbed grassy areas. White grubs prune small roots, damage larger roots and may sever taproots. Sugarbeets following an established grass sod or fallow are ideal conditions for White grubs. For management, spring and fall plowing of established sod is recommended before crop is planted; Soil insecticide generally not required.

Threshold: Currently, there is no established threshold for white grubs in sugarbeet. The following insecticides labeled for wireworms and sugarbeet root maggot control will usually provide adequate protection from wireworm injury.

White Grub Insecticide (*RUP) AT PLANTING	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	4.3 oz./A. Apply in-furrow or in a 3 - 4" T-Band (band over the open furrow) at planting in a minimum of 3-5 gallons/A.	12	50
*Mustang Max and Mustang MAXX (Zeta-cypermethrin)	4.0 oz./A. Apply in-furrow or in a 3-4 inch T-Band (band over the open furrow) at planting in a minimum of 3-5 gallons/A.	12	50
*Counter 15G (Terbufos)	Banded or Modified In-Furrow: 4.0 - 8.0 oz./1000 ft of row spacing (minimum 20 inches row spacing) or no more than 13.1lbs./A. For Modified In-Furrow applications, apply in-furrow at 2-3" behind seed drop zone. DO NOT incorporate deeper than 2".	48	110
*Counter 20G (Terbufos)	Banded or Modified In-Furrow: 3.0 - 6.0 oz./1000 ft of row spacing (minimum 20 inches row spacing) or no more than 9.8 lbs./A. Modified In-Furrow applications, apply in-furrow at 2-3" behind seed drop zone. DO NOT incorporate deeper than 2".	48	110

WIREWORMS

Wireworm larvae are smooth, somewhat hard-bodied worms varying in length from 0.50 to 1.5 inches long. Their color can range from yellowish-white to a light copper color. Wireworms feed on a wide variety of crops and weeds, and are generally difficult to detect and control. They tend to be more prevalent in light-textured soils or in soil that has not been in crop production for several years. Fields that had grassy weed escapes during the preceding season are also at risk. Frequent cropping and working the soil helps reduce wireworm problems.

Threshold: Currently, there is no established threshold for wireworms in sugarbeet. The following insecticides labeled for sugarbeet root maggot control will usually provide adequate protection from wireworm injury.

White Grub Insecticide (*RUP) AT PLANTING	Rate/A (Product/A)	REI (Hours)	PHI (Days)
*Mustang (Zeta-cypermethrin)	4.3 oz./A. Apply in-furrow or in a 3 - 4" T-Band (band over the open furrow) at planting in a minimum of 3-5 gallons/A.	12	50
*Mustang Max and Mustang MAXX (Zeta-cypermethrin)	4.0 oz./A. Apply in-furrow or in a 3 - 4 inch T-Band (band over the open furrow) at planting in a minimum of 3-5 gallons/A.	12	50
*Counter 15G (Terbufos)	Banded or Modified In-Furrow: 4.0 - 8.0 oz./1000 ft of row spacing (minimum 20 inches row spacing) or no more than 13.1 lbs./A. For Modified In-Furrow applications, apply in-furrow at 2-3" behind seed drop zone. DO NOT incorporate deeper than 2".	48	110
*Counter 20G (Terbufos)	Banded or Modified In-Furrow: 3.0 - 6.0 oz./1000 ft of row spacing (minimum 20 inches row spacing) or no more than 9.8 lbs./A. Modified In-Furrow applications, apply in-furrow at 2-3" behind seed drop zone. DO NOT incorporate deeper than 2".	48	110

SEEDLING DISEASES

Approved varieties have considerable tolerance to seedling diseases or damping off. In addition, all Michigan Sugar Company seed is treated with Apron/Thiram, which is effective in controlling some of the seedling diseases. Tachigaren is available on pellets to aid in controlling Aphanomyces seedling disease.

LEAFSPOT MANAGEMENT

Since Alternaria leafspot has become a larger issue in the Michigan Sugar Company growing region growers should consider Leafspot management strategies that help manage both Cercospora and Alternaria leafspot.

Variety selection is an important tool to consider for your Leafspot management program.

Varieties with high levels of tolerance can provide considerable assistance in managing the diseases.

Fungicide resistance management is critical to maintaining the use of fungicides as an effective tool for managing Leafspot. Please follow Leafspot management programs that are endorsed and recommended by Michigan Sugar Company. Please consult with your Michigan Sugar Company Field Consultant for current fungicide application recommendations for your farm.

It is highly recommended to tank mix products and alternate modes of action (Table 1) during the growing season. Example 1: Triazole (Inspire, Proline, etc.) with a tank-mix partner like an EBDC or Copper. Example 2: Super Tin with a tank-mix partner like Copper or an EBDC (see the below bullet points).

- Topsin has a high number of resistant isolates in Michigan's sugarbeet area, however a three way tank mix of SuperTin + Topsin + EBDC performed well in Michigan Sugar Company trials.
- Apply the suggested rates of all triazoles fungicides. Try not to use the same triazole product in the same growing season.
- Never use reduced rates of any fungicide as it will significantly increase the development of disease resistance
- Do not apply triazoles back-to-back even if you tank mix with another mode of action.
- Do not apply Super Tin back-to-back even if you tank mix with another mode of action.
- Do not mix Coppers with glyphosate or AMS or crop injury may occur. Beware that applying in a spray solution < 6.5 pH may cause phytotoxicity.
- EBDCs and Coppers can be sprayed multiple times with or without a tank mix partner, and can be applied back-to-back.
- Apply fungicides in an approach that ensures maximum coverage, thus improving Cercospora leafspot control.
- Using 20-25 gallons of water with adequate pressure will give better performance. Use surfactants and additives as required by product labels.
- Do not wait until the first spot is noticed, by this time, Cercospora has been there for at least 14 days prior to seeing it. Once Cercospora spots are noticed, it's hard to manage the disease.
- Spray all fungicides as preventative programs, there are no curative fungicides for Cercospora leafspot.
- Use BEETcast (http://www.michiganbeets.com) to help you plan on timely applications, especially your first spray. Follow application programs designed for your area.
- Crop rotation plays a key component in reducing Cercospora leafspot inoculum from over-wintering in plant debris and soils. A four year rotation is recommended.
- Continue your fungicide spray program through October if needed, especially if beets are going to be harvested for permanent piling.

CERCOSPORA LEAFSPOT MANAGEMENT FOR ONTARIO

Janice LeBoeuf, Ontario Ministry of Agriculture, Food and Rural Affairs
Cheryl Trueman, Ridgetown Campus – Univ. of Guelph

Fungicide resistance is a major concern for Cercospora leaf spot (CLS) management because:

- There is widespread resistance to Group 11 (i.e. Headline) and Group 1 (i.e. Senator) fungicides. These products repeatedly provided no control of CLS in trials at Ridgetown Campus, University of Guelph.
- There is only one highly effective group of fungicides remaining (Group 3). Usually a pathogen with resistance to one fungicide in a group will have resistance to all other fungicides in the same group.
- Overuse of Group 3 fungicides without the use of tank mixes, tolerant varieties, and cultural control methods will speed up evolution of resistance to these fungicides.
- Tests of Ontario and Michigan CLS samples by Michigan State University show C. beticola is already becoming less sensitive to Group 3 fungicides. Field rates are still effective, but the pathogen is already adapting to higher selection pressure from these fungicides!
- Cescorpora spores travel among fields so it's important that all growers implement resistance management practices; this is a community problem!
- Trials completed in Ontario and Michigan identified no effective fungicides with new modes of action in the fungicide development pipeline.

Cercospora Fungicides Registered in Ontario

Product (active ingredient)	MOA Group #	Performance in Ontario Field Trials
Cevya (Mefentrifuconazole)	3	Good
Inspire (difenoconazole)	3	Good
Proline (prothioconazole)	3	Good
Mettle (tetraconazole)	3	Good, limited data available
Caramba (metconazole)	3	Moderate, limited data available
Priaxor	7 & 11	—
Headline (pyraclostrobin)	11	No control, resistance widespread
Senator (thiophanate-methyl)	1	No control, resistance widespread
Manzate, Penncozeb, etc. (mancozeb), Polyram (metiram)	M3	Fair-moderate, better at shorter intervals
Parasol, Coppercide, etc. (copper hydroxide)	M1	Fair-moderate, better at shorter intervals

Recommended Ontario Spray Program for CLS Management

Be on time with the first fungicide application of the season and plan ahead for subsequent applications (watch the weather forecasts and BEETcast™ DSV accumulations). Disease will continue to develop into the Fall if condition are warm.

Timing	First Spray	Second Spray	Third Spray	Fourth Spray	Fifth Spray	Sixth Spray	Seventh Spray
Product(s)	M3	3+M3	M3 or M3+1+7&11 or M3+M11	3+M3	M3 or M3+M1	3+M3	M3 or M3+M1

CERCOSPORA LEAFSPOT

Cercospora leafspot (Cercospora beticola) is the most serious foliar disease of sugarbeets in the Michigan Sugar Company growing region. When the disease is not properly controlled severe yield and sucrose losses can occur. Economic damage occurs when the leaf area has approximately one spot per square inch. Cercospora infestation levels vary considerably across the Michigan Sugar Company growing area. Significant progress has been made in controlling Cercospora in Michigan with the introduction of fungicides and with the adaptation of the BEETcast prediction model.

This fungus feeds on nutrients in the leaf interfering with root growth and sugar storage.

Beginning with a few spots, it spreads to the entire leaf and can eventually kill the leaf.

Effective control of Cercospora leafspot in sugarbeets requires an integrated and intensive approach. Since the Cercospora fungus overwinters on infected beet leaves, crop rotation is important. A three-year rotation is minimal for reducing carryover of the fungus. Since plant debris and spores can be blown some distance, Beets grown in field next to fields containing beets the previous year are at high risk, especially if Cercospora was present in the field the previous year. Burying beet residue by tillage helps reduce inoculum survival and dispersal. Fall tillage is most effective for reducing Cercospora populations but may increase the severity of soil erosion during open winters.

ALTERNARIA LEAFSPOT

Alternaria leafspot (Alternaria Alternata) has become a more prominent disease in the Michigan Sugar Company sugarbeet growing region. Alternaria leafspot is particularly challenging disease on sensitive varieties. Alternaria leafspot can develop quickly on stressed plants and thrives in a wider temperature range that Cercospora leafspot.

RHIZOCTONIA

Rhizoctonia root rot of sugarbeets is one of the most damaging root diseases in Michigan. Yields can be reduced up to 10 tons per acre and sugarbeet quality can be greatly affected. Corn, soybeans and dry edible beans are all hosts for Rhizoctonia, leaving it difficult to lower inoculum levels. Crop rotations with sugarbeets following wheat or wheat and clover may be helpful.

Sugarbeet varieties with good resistance to the disease should be considered on fields with a chronic history of the disease.

Research over past several years from Michigan State University Sugarbeet Advancement program and Michigan Sugar Company has shown that Rhizoctonia can be effectively controlled with proper placement and timing of Quadris fungicide. Growers who are planting very susceptible varieties, should consider either one or two fungicide applications depending on the suspected severity of the disease. Applications can be made either as a foliar or a T-band in-furrow application. Many growers are using a combination of the two with very effective results.

In-furrow T-band applications are very effective, economical, and can offer protection from both the seedling and root rot phase of the disease. The standard T-band width of 7 inches has worked well, but research has shown band widths of 3 to 4 inches have had similar effectiveness. This application is very economical because the Quadris rate is reduced proportionately to the band width. Growers that were using 10.5 ounces of Quadris in a 7-inch band are now using 5 to 7 ounces in a 3- to 4-inch band. In-furrow application takes the guess work out of timing a foliar application.

All foliar applications should be applied in a band vs broadcast. Broadcast rates would need to be at a minimum of 42 oz/A to be effective The best timing of application can vary depending on environmental factors including soil moisture and temperature. Work conducted by MSU Sugarbeet Advancement and Michigan Sugar Company has indicated that foliar applications at the 4 to 8 leaf stage have been the best timing. When heavy disease pressure is present, the combination of in-furrow and 4 to 8 leaf stage applications offers longer and improved efficacy.

Timing of application of Quadris can very each year according to the planting date, soil temperature, moisture and variety tolerance. Ideally, applications of fungicide should be applied just before or at disease infection. High infection periods occur as soil temperatures at the 4- inch depth approach 70 degrees and have free moisture.

Fields should be scouted regularly to monitor disease occurrence. If early season die off from Rhizoctonia is seen (approximately 8-16 leaf stage), a rescue treatment may be helpful.

Applications should be banded directly in the crown and additional water may be beneficial. These treatments are never as effective as an in-furrow or well-timed foliar application. Quadris should not be broadcast at lower rates because of reduced effectiveness. Also, no oil based insecticides should be added, as leaf injury will occur. Micronutrients such as manganese are compatible and safe to added to Quadris. Always check compatibility and label precautions when tank-mixing with Quadris.

Summary

Rhizoctonia infects a wide range of plants. The fungus affecting the base of the leaf petioles and crown of the sugarbeet, along with the top of the root system. When this pathogen is active, sugarbeets die down the row and in circular patterns in the field. The ideal temperature for the pathogen is 55-95°F; optimal= 70 - 85°F; with adequate soil moisture - ideal would be wet.

POWDERY MILDEW

Powdery mildew is a fungal disease. It is related to the fungi that cause powdery mildews on grain and other crops. The fungus produces spores called conidia. The conidia blow in the wind, and some will land on sugarbeet foliage. The conidia then germinate and start growing. The fungus grows vegetatively by producing strands called hyphae.

Soon after infection, the fungus will begin to produce conidia. The conidia are formed on other specialized hyphae called conidiophores. When the hyphae and conidia form, the leaf will take on a white, powdery appearance. As the infection progresses, the leaf tissue becomes chlorotic, then brown. These symptoms usually form first on the older leaves. Eventually, all leaves may become infected.

The fungal structures are very sensitive to low temperatures and will not overwinter in the sugarbeet production areas of Michigan. The fungus probably overwinters in California or Oregon. It is thought that wind currents during the summer months move the conidia long distances. These spores infect sugarbeets and produce secondary inoculum, and the disease spreads throughout the crop. Some of these secondary conidia will also be blown

long distances, and the cycle repeats. In this way the disease progressively moves from the southwestern part of the country throughout all of the sugarbeet production areas of the United States.

The age of the sugarbeet crop is an important factor in susceptibility to disease. The disease is rarely seen in the field until eight to 12 weeks after emergence. The disease occurs first on the older leaves. If allowed to go unchecked, the disease progresses and within a month will cover all the leaves in a field.

Yield loss due to powdery mildew will occur if the disease is allowed to go unchecked. The earlier the disease occurs during the season, the greater the loss. Loss will occur due to decreased root yield as well as decreased sucrose concentrations. Gross sugar yields may be decreased by as much as 40 percent under severe infection. In addition, powdery mildew will cause a reduction in purity. Infected plants have higher concentrations of sodium and amino- nitrogen in the roots. The decreased purity will reduce the amount of extractable sugar.

To date mildew has not been a serious problem in our sugarbeets. If diseases does become a problem, it can be controlled by applying one of the fungicides, Eminent, Enable, Headline, Inspire XT, or Gem. Cultural practices have not played a big part in powdery mildew control, nor has biological Control.

FUSARIUM

Fusarium is a fungal disease with presumed host-specific strains that attack sugarbeet or dry bean. Severely infected plants become yellowed, wilted and die prematurely, which may cause yield reduction or total crop loss. Because sugarbeets and dry edible beans are commonly grown in a short rotation of less than four years in Michigan, incidence and variability of the pathogens may have increased in recent years.

Reports from Michigan State University, indicate that the disease has been found in more than 40 percent of sugarbeet fields that could cause significant reduction in yield in various fields.

Because yield losses due to this disease vary from year to year and are not easily measured, there has been little effort to develop resistant sugarbeet hybrids.

The pathogen is a soil-borne fungus that survives as microscopic spores (chlamydospores) which germinate and infect the sugarbeet or bean root under favorable conditions. The fungus invades water-conducting tissues of the root and grows upward into leaf petioles and stems of sugarbeet and/or bean plants.

Optimum conditions for infection are a temperature of 80°F degrees or greater, combined with other stress factors such as herbicide, fertilizer, salinity damage to roots, soil compaction, moisture extremes, and poor water drainage.

Symptoms of Fusarium yellows of sugarbeet include wilting of the foliage, yellowing between the veins in the leaves (interveinal chlorosis), and a darkening of the rings in the taproot. Plants can be affected at any stage from seedling until harvest; the majority of plant death appears to occur when plants are in the seedling stage to the four-leaf stage of growth. Dead plants are light brown and many remain visible until harvest. Although diseased plants may be scattered throughout the field, most occur in localized areas. Plants that were infected when young usually are stunted and show severe symptoms of interveinal chlorosis and marginal leaf browning. Plants infected later in the season will be larger in size and usually show mild symptoms, consisting only of minor interveinal chlorosis. When plants are removed and roots sliced in cross section, many show a yellow-brown to gray discoloration of the water- conducting, vascular tissues.

Above ground symptoms on dry bean appear on lower leaves that exhibit yellowing and wilting, which become more pronounced and progress upward into younger leaves. Stunting is evident, especially if plant infection and stress occurred during the seedling and vegetative stages. The margins of infected leaves turn tan to brown, and diseased plants become progressively more yellow. Severely infected plants exhibit permanent wilting and premature defoliation. Vascular discoloration on the main stem is the diagnostic symptom usually evident after the initial appearance of foliar symptoms. The reddish-brown vascular discoloration of root, stem, and petiole tissue of infected plants will vary considerably in intensity, depending on variety reaction, severity of infection, and environmental conditions.

Summary

- Plant certified seed of Fusarium wilt-tolerant or resistant varieties, if available.
- Treat seed with or apply in-furrow recommended fungicides to delay initial infection of seedlings by Fusarium and other soil-borne pathogens including Pythium and Rhizoctonia.
- Don't follow sugarbeet with dry bean; rotate for three to five years with non-host crops such as corn, wheat, barley or alfalfa.
- Good weed management is important to reduce populations of other potential hosts such as pigweed (susceptible to sugarbeet strains of Fusarium).
- Chiseling (sub-soiling) 10 to 20 inches deep between crop rows reduces soil compaction, and promotes water movement and root penetration.

RHIZOMANIA

Rhizomania is caused by beet necrotic yellow vein virus (BNYVV) and transmitted by the soil fungus Polymyxa betae. Both the virus and fungal vector are obligate parasites in that they require a living host to reproduce. Both are host specific and the virus is dependent on the vector for infection. The natural host range, therefore, is limited by those species that P. betae is capable of infecting, and includes primarily species in the same genus as sugarbeets (Beta sp.), a few species in the genus Chenopodium.

The vector, Polymyxa betae, indefinitely survives in the soil as cysts or groups of cysts called cystosori. With free water and soil temperature above 60°F, individual cysts germinate in the vicinity of sugarbeet roots and release a single zoospore that infects primary root tissue, carrying the virus into the plant cell. Severity of infection is directly related to the population viruliferous Polymyxa in the soil. The process continues until the rootlet dies and the plant produces new rootlets. Disease is favored by high soil moisture, optimum temperature of 77°F, short rotation, and neutral to alkaline soils.

Roots are stunted and there is a proliferation of lateral rootlets, giving the root a bearded appearance. The taproot may be constricted and there may be excessive crown growth, giving the root a wineglass shape. Vascular tissue is discolored and the taproot may be rotted. With mild infections, there may only be slight lateral rootlet proliferation on the taproot or lateral roots. The vascular discoloration may not be very obvious in mild infections, but in longitudinal section the vascular bundles have a disorganized or "marbling" appearance in the vicinity of rootlet proliferation. This is in contrast to the parallel vascular bundles in normal, healthy tissue.

Leaf symptoms consist of slight yellowing, erect growth habit, and leaf proliferation.

Leaves are usually uniformly chlorotic. In mild infections, there may be little or no stunting of the foliage, with a slightly perceptible and uniform lime-green leaf color. This contrasts with nitrogen deficiency where older leaves are often chlorotic while younger leaves are green.

Summary

A resistant variety should be planted if there has been any field history of Rhizomania, no matter how small the affected area. If Rhizomania has been found on another field on the farm or on a nearby field, the likelihood that most or all fields are infested is very high.

Planting resistant varieties will make long-term disease management far more effective. At least two or three sugarbeet crops are necessary after a field is first contaminated with Rhizomania before noticeable symptoms develop. With such a long incubation period, once we observe and diagnose the disease, the inoculum has already increased to a high level.

Planting resistant varieties alone will not allow maximum yields to be achieved. A minimum 4-year rotation is essential for good management. For example, research out West has shown that with the best resistant varieties and best management practices except for rotation, measured 16.1 tons with back to back beets, 18.7 tons with a 2-year rotation, 23.8 tons with a 3-year rotation, and 30.7 tons with a 4-year rotation.

The earlier that plants become infected the more severe the damage from Rhizomania will be.

The disease is not active below 60°F, and early planting to establish the crop before infection will reduce losses. Good plant populations can help reduce the severity of Rhizomania. Closing the rows early with high plant populations tends to maintain cooler soil temperature which can reduce the rate of disease development.

SUGARBEET CYST NEMATODE (BCN)

The major nematode affecting sugarbeet production in Michigan is the sugarbeet cyst nematode (BCN). BCN is distributed world-wide, wherever sugarbeets are grown commercially. This nematode was detected in the United States in 1895. Today, BCN is present in 40 different countries and 17 states in the United States.

BCN is a microscopic plant-parasitic roundworm that feeds on beet roots stealing nutrients from the plants. General nematode injury begins in fields as small patches of poorly growing plants that can exhibit stunted growth, yellowing foliage, and other symptoms of nutrient deficiency. Infected plants may wilt on warm days, and wilting may persist even with adequate soil moisture. Small seedlings are especially susceptible to death in heavy infestations, and surviving beets are typically small with excessively hairy roots. If a plant is carefully removed from the soil, the small, white, lemon-shaped females and brown cysts may be seen on the beet roots. Yield reductions increase as infection severity increases.

If the infestation is severe enough, entire seedling stands can be lost. No one knows for certain how long the sugarbeet cyst nematode can survive without a host, but a small percentage of eggs within cysts reportedly can survive fallow conditions for over 12 years. Eggs must be inside cysts to survive such long periods without a host. The annual rate of decline of viable eggs and larvae in fields after removal of sugarbeet or another host crop can vary from 40 to 50 percent. The actual rate of decline depends on the type

of soil, soil temperature, soil moisture, history of pesticide use (including herbicides), susceptibility and availability of host plants (including weeds), and the presence of predators and parasites.

Summary

- There are several BCN resistant sugarbeet varieties available. Use of a resistant variety in fields heavily infested in BCN has increased yields by 10-15 tons per acre when compared to non-resistant varieties.
- BCN will develop and reproduce on these resistant varieties, but will not get the nutrition as they would on non-resistant varieties, thus decreasing their number, but not eliminating them. Growers should use these varieties cautiously as overuse may lead to a race-shift and breakdown in the resistance to BCN.
- Activities that decrease soil movement will decrease the spread of BCN; this would include equipment movement between fields, soil erosion, and tare soil.
- Oilseed radish has been used successfully as a trap crop for BCN; however, the cultivars of oilseed radish that can be used for this purpose include: Defender, Colonel, and Biofume. Other "tillage" type radishes can increase BCN population 100 fold.
- Growing non-host crops can reduce BCN population density. Grains (grasses), clover, corn, soybeans, dry beans and pickles are good choices as non-host crops. Wheat under seeded with clover can reduce BCN and improve soil health.
- Reduce BCN population density of the pathogen. This can be accomplished utilizing several tactics alone or in combination; these tactics include crop rotation, resistant varieties, trap crops, and nematicides (but is costly).
- BCN Testing Program: Since 2012, 422 samples have been taken and screened for BCN. Remember: You must include root hairs (3-4) with the soil sample. This will eliminate the need for a bioassay if cyst are found in the sample.

RATE CONVERSIONS

Recommended Quadris In-Furrow Rates Based on Band Width and Row Spacing

Band Width	30" Rows	28" Rows	24" Rows	22" Rows	20" Rows
7 inch	10.5	11.2	13.1	14.3	15.8
6 inch	9.0	9.6	11.3	12.3	13.5
5 inch	7.5	8.0	9.4	10.2	11.3
4 inch	6.0	6.4	7.5	8.1	9.0
3.5 inch	5.3	5.6	6.6	7.1	7.9
3 inch	5.3	5.6	6.6	7.1	7.9

Quadris Rates in fl.oz./A
Band Widths narrower than 3 inches are not recommended.
If band width is reduced, reduce rate accordingly.
Example: 28 inch row, 4-inch band width: Apply 6.4 fl.oz./A

FUNGICIDES AVAILABLE FOR CERCOSPORA AND ALTERNARIA

Product	Class(Chemical)	Action	FRAC	Cercospera Efficacy	Alternaria Efficacy	Broadcast Rate/Acre	App Interval Days	REI (hrs)	PHI (days)	Maximum Product Per Season
Agri-Life*	Copper Sulfate Pentahydrate	Contact	M1	P+	P+	38 fl oz	10	48	0	7.86 lbs
Agri Tin	TPTH	Contact	30	G+	G	8 fl oz	10-14	48	21	24 fl oz
Badge*	Copper Oxychloride/Copper Hydroxide	Contact	M1	F	F	1 qt	10	48	0	13.8 qts
Champ*	Copper Hydroxide	Contact	M1	F	F	2.62 lbs/a	10	48	0	15.7 lbs
C-O-C-S*	Copper Oxychloride/Copper Sulfate	Contact	M1	F	F	2 lbs	10	48	0	15.2 lbs
Cuprofix Ultra*	copper sulfate	Contact	M1	F	F	2 lbs	10	48	0	19.65 lbs
Delaro**	triazole(prothiconazole) and strobi	Systemic	3&11	G+	F+	11 fl oz	14	12	21	33 fl oz
Dithane	EBDC	Contact	M3	F+	F+	1.6 qts	10	24	14	11.2 qts
Eminent	triazole(tetraconazole)	Sytemic	3	G-	F-	13 fl oz	14	12	14	13 fl oz
Enable	triazole(fenbuconazole)	Slightly Systemic	3	G-	F-	8 fl oz	14	12	14	16 fl oz
Flint Extra(Gem)	strobilurin(trifloxystrobin)	Slightly Systemic	11	F-	F	3.6 fl oz	10-14	12	21	10 fl oz
Headline SC	strobilurin(pyraclostrobin)	Slightly Systemic	11	F-	F	12 fl oz	14	12	7	48 fl oz
Inspire XT	triazole(difenoconazole+propiconazole)	Slightly Systemic	3	G	F-	7 fl oz	14	12	21	21 fl oz
Kocide 3000*	Copper Hydroxide	Contact	M1	F	F	2 lbs	10	24	0	26.2 lbs
Koverall	EBDC	Contact	M3	F+	F+	2 lbs	10	24	14	14 lbs
Lucento	triazole(flutriafol) and carboxamide	Systemic	3&7	G	F	5.5 fl oz	14	12	21	11 fl oz
Manzate Pro-Stick	EBDC	Contact	M3	F+	F+	2 lbs	10	24	14	14 lbs
Manzate Max	EBDC	Contact	M3	F+	F+	1.6 qts	10	24	14	11.2 qts
Minerva	triazole(tetraconazole)	Systemic	3	G-	F-	13 oz	14	12	14	13 fl oz
Minerva Duo	triazole(tetraconazole) and TPTH	Systemic/Contact	3&30	G+	G	16 fl oz	14	48	14	16 fl oz
Penncozeb 75DF or 80WP	EBDC	Contact	M3	F+	F+	2 lbs	10	24	14	15 lbs
Priaxor	strobi(pyraclostrobin) and carboxamide	Slightly Systemic	7&11	F	F+	8 oz	14	12	7	24 fl oz
Proline	triazole(prothiconazole)	Systemic	3	G	F-	5.7 fl oz	14	12	7	17.1 fl oz
Propulse	triazole(prothiconazole)+carboxamide	Systemic	3&7	G+	F+	13.6 fl oz	14	12	7	34.2 fl oz
Provysol	triazole(mefentrifuconazole)	Systemic	3	G	F-	5 fl oz	14	12	21	10 fl oz
Quadris	strobilurin(azoxystrobin)	Systemic	11	N	F	15 oz	7-14	4	0	123 fl oz
Roper DF	EBDC	Contact	M3	F+	F+	2 lbs	10	24	14	14 lbs
Serifel	bacillus		44	P	P	4-16 fl oz	7-14	4	0	-
Super Tin 4L	TPTH	Contact	30	G+	G	8 fl oz	10-14	48	7	24 fl oz
TopGuard	triazole(flutriafol)	Systemic	3	G-	F-	14 fl oz	14	12	21	28 fl oz
TopGuard EQ	triazole(flutriafol) & strobi(azoxystrobin)	Systemic	3&11	F+	F-	7 fl oz	14	12	21	16 fl oz
Topsin 4.5FL***	benzimidazole	Systemic	1	F+	F	20 fl oz	10	24	21	60 fl oz
Topsin 70 M-WSB***	benzimidazole	Systemic	1	F+	F	1 lb	10	24	21	3 lbs
Veltyma	triazole(mefentrifuconazole) and strobi	Systemic	3&11	G+	F	10 fl oz	14	12	21	20 fl oz

*Do not mix with glyphosate or AMS, severe crop injury may occur. Appling in a spray solution having a pH of < 6.5 may cause phytoxicity.

**The addition of 1.7 fl oz of Proline is required when applying Delaro

***Due to high levels of resistance to benzimidazole, a maximum of one application per season is recommended.

BEETCAST™

The improved BEETcast™ model can alert Michigan sugarbeet producers when to apply Cercospora leaf spot and Rhizoctonia root rot fungicides, and glyphosate. BEETcast™ is sponsored by Michigan Sugar Company and consists of a network of over 50 weather stations that are strategically located in the sugarbeet growing region of Michigan and Ontario. Weather Innovations Inc. originally developed this model to help the Great Lakes sugarbeet industry better predict timely applications of fungicides for Cercospora leaf spot control. Recent modifications to BEETcast™ will now also help improve Rhizoctonia fungicide timing and glyphosate applications. By imputing specific background information and field locations, along with how a producer prefers to be contacted, alerts will be sent to growers indicating when applications should be considered.

The website has a new look with additional tools and information that will allow producers to better time pesticide applications. Because specific producer and field information is used, a sugarbeet producer will need to "create an account" that has a username and password for login. There will be no cost for this and its only purpose is maintaining privacy. Producers that create a login account will be able to input specific field information and agronomic details and produce a field map. BEETcast™ will monitor environmental conditions including air and soil temperatures, leaf wetness, rainfall and growing degree days. The model can then provide alerts for timing applications for Cercospora leaf spot, Rhizoctonia and glyphosate applications. Producers will be able to create for each field a custom alarm notification sent to them via email or text message when application timings approach.

This tool will aid in Rhizoctonia and glyphosate applications are average daily soil temperature at the 4" depth and a Growing Degree Day accumulator (GDD). The best fungicide timing for Rhizoctonia control is variable. Research suggests that high levels of control are usually obtained from applying fungicides when the 4" soil temperature reaches and is expected to remain above the mid 60's°F. BEETcast™ will notify growers who input field information when the soil temperature reaches their defined alarm temperature, with the default now set at 63°F. Growers will also be able to get alerts from the GDD accumulator to aid in glyphosate applications.

Other new features include: estimated beet growth stages, site specific weather forecast, 24- hour rainfall and SPRAYcast®. The 24-hour rainfall map now updates frequently and shows real time totals. The SPRAYcast® tool predicts wind speed and spraying conditions hourly for the next three days in advance. This will give producers the best opportunity to safely apply crop protection materials.

In the past, the BEETcast™ model has been a valuable asset to the Great Lakes sugarbeet producers for controlling Cercospora leaf spot. With the recent updates, its value has been further enhanced by providing additional information for control of Rhizoctonia, weeds and other environmental conditions. Sugarbeet producers are highly encouraged to become a registered user of this site. Growers can get additional information and are able to access and input information through the Internet at the Michigan Beets website at http://www.michiganbeets.com/

Source: Steve Poindexter

Table 1 – Ontario

Sugarbeet (Processing) Weed Control

Because the Ontario sugarbeet crop is processed entirely in the United States, all pesticides used must have both Canadian and United States registrations on sugarbeets. Check with your Michigan Sugar Company field consultant before spraying.

Preemergence/Postemergence

Active Ingredient TRADE NAME	**PRODUCT RATE PER HECTARE**	
(Formulation)	**(active rate/ha)**	**PRECAUTIONS**
NORTRON SC (480 g/L) ethofumesate	**Light Soils:** Sands and Loamy Sands • **Broadcast:** 3.2 - 4.5 L/ha • **18 cm band width 55 cm** row: 1.0 - 1.6 L/ha **Medium Soils:** Silt and Clay Loams which contain < 3% organic matter • **Broadcast:** 4.5 - 6.75 L/ha • **18 cm band width 55 cm row:** 1.6 – 2.25 L/ha **Heavy Soils:** Clay Loam and Clays including those which contain > 3% organic matter • **Broadcast:** 6.75 - 8.25 L/ha • **18 cm band width 55 cm** row: 2.25 – 2.8 L/ha	Apply NORTRON Flowable herbicide before or at planting time and incorporate into the soil to a depth of 2.5 to 5.0 cm. Deeper incorporation may reduce effectiveness. **Do not rotate** with any crops other than sugarbeets for 12 months after application. Thorough tillage, including moldboard plowing, should precede the planting of crops other than sugarbeets. Do not use NORTRON Flowable Herbicide on muck or peat soils.
DUAL II MAGNUM (915 g/L) s-metolachlor/ benoxacor	1.25-1.75 L/ha 1.14-1.6 kg/ha	Apply to sugarbeets between cotyledon-4 leaf stage before weed emergence. **Do Not** apply more than 1 application/season. **Do Not** feed sugarbeet tops to livestock. Preharvest Interval: 120 days. Apply by ground equipment only.

Table 2 – Ontario

Sugarbeet (Processing) Weed Control

Because the Ontario sugarbeet crop is processed entirely in the United States, all pesticides used must have both Canadian and United States registrations on sugarbeets. Check with your Michigan Sugar Company field consultant before spraying.

Postemergence

Active Ingredient TRADE NAME	**PRODUCT RATE PER HECTARE**	
(Formulation)	**(active rate/ha)**	**PRECAUTIONS**
ASSURE II (96 g/L) + SURE-MIX quizalofop p-ethyl + oil concentrate	0.38 - 0.75 L/ha 5L/1,000 L water 0.036-0.072 kg/ha 0.5% v/v	Apply POST when annual grasses and volunteer cereals are in the 2-leaf to tiller stage and volunteer corn and quackgrass are in the 2 to 6 lead stages. Apply before the crop canopy closes to maximize spray coverage. Use the 0.38 L/ha (0.15 L/ac) rate for annual grasses and volunteer cereals. Use the 0.75 L/ha (0.30 L/ac) rate for quackgrass. Use a second application of 0.38 L/ha (0.15 L/ac) rate for control late emerging weeds. **Do Not** exceed an accumulative seasonal use rate of 0.75 L/ha (0.30 L/ac). **Do Not** use flood jet nozzles. **Do Not** apply if rain is expected within 1 hour after application. Preharvest interval is 80 days.
Pyralid (300g/L) LONTREL 360 (360 g/L) clopyralid	0.28 to 0.83 L/ha Plus any other herbicide approved as a tank-mix at the recommended rate in sufficient water to ensure thorough coverage (100 to 200 L/ha of spray solution) by ground equipment only at pressures of 200 to 275 kPa.	Should be applied when sugarbeets are in the cotyledon to 8 leaf stage. For the most effective control of Canada thistle, apply Lontrel 360 herbicide as a broadcast treatment to the entire infested area. **Do not** apply within 90 days of harvest.

Table 3 – Ontario

Sugarbeet (Processing) Weed Control

Because the Ontario sugarbeet crop is processed entirely in the United States, all pesticides used must have both Canadian and United States registrations on sugarbeets. Check with your Michigan Sugar Company field consultant before spraying.

Postemergence

Active Ingredient TRADE NAME	**PRODUCT RATE PER HECTARE**	
(Formulation)	**(active rate/ha)**	**PRECAUTIONS**
UPBEET (50 DF) + AGRAL 90 or AG-SURF or CITOWETT PLUS or SURE-MIX triflusulfuron-methyl + non-ionic surfactant or adjuvant	35 - 70 g/ha 2.5 L/1,000 L water 2.5 L/1,000 L water 2.5 L/1,000 L water 2.5 L/1,000 L water 17.5-35 g/ha 0.25% v/v 0.25% v/v	In situations of stress, delay application until both weeds and sugarbeets resume growth. Apply no later than 60 days before harvest. Tankmix partners will vary in their Preharvest intervals. Chlorosis (yellowing) of the crop may be observed following an application of UPBEET but the effect is only temporary. If UPBEET is to be applied alone, an adjuvant must be included. The maximum use rate of UPBEET is 100 grams per hectare per growing season. **Do Not** apply while dew is present. **Do Not** spray if rainfall is excepted within 6 hours.
POAST ULTRA (450 g/L) + MERGE sethoxydim + surfactant/solvent	0.32-1.1 L/ha 0.25-2.0 L/ha 0.14-0.5 kg/ha 0.25-2.0 L/ha	For annual grasses: use 0.32 L/ha. Apply at the 2-5 leaf stage. For volunteer grains: 0.47 L/ha. Apply at 2-5 leaf stage. For quackgrass: 1.1 L/ ha. Apply up to the 3 leaf stage. Do not graze treated crops. Spray tips angled forward 45° has better coverage. Do Not use flood jet or hollow cone nozzles. Do Not apply herbicides other than LONTREL 4 days of application. Do Not spray if rainfall is excepted within 1hour after application. Preharvest interval is 85 days.

Table 4 – Ontario

Sugarbeet (Processing) Weed Control

Because the Ontario sugarbeet crop is processed entirely in the United States, all pesticides used must have both Canadian and United States registrations on sugarbeets. Check with your Michigan Sugar Company field consultant before spraying.

Postemergence

Active Ingredient TRADE NAME	**PRODUCT RATE PER HECTARE**	
(Formulation)	**(active rate/ha)**	**PRECAUTIONS**
UPBEET (50DF) BETAMIX ((1:1) 150 g/L) triflusulfuron methyl + desmedipham/ phenmedipham	35 - 70 g/ha 1.75 - 3.5 L/ha	In situations of stress, delay application until both weeds and sugarbeets resume growth. Apply no later than 60 days before harvest. Rainfall within 6 hours may reduce weed control. Make 2 applications 5-10 days apart, or as weeds emerge, to weeds with fewer than 4 true leaves. Best control when weeds have less than 2 leaves. The total grams of product applied must not exceed 100 g/ha per growing season. Yellowing of the crop may occur, but sugarbeets will recover. Do not use an adjuvant when tank mixing BETAMIX with UPBEET. If velvetleaf is the predominant weed, use UPBEET alone with adjuvant. Applications made to larger weeds or to weeds under stress may result in unsatisfactory control. **Do Not** apply while dew is present. **Do Not** spray if rainfall is excepted within 6 hours.

Table 5 – Ontario

Sugarbeet (Processing) Weed Control

Because the Ontario sugarbeet crop is processed entirely in the United States, all pesticides used must have both Canadian and United States registrations on sugarbeets. Check with your Michigan Sugar Company field consultant before spraying.

Postemergence

Active Ingredient TRADE NAME	**PRODUCT RATE PER HECTARE**	
(Formulation)	**(active rate/ha)**	**PRECAUTIONS**
BETAMIX ß EC ((1:1) 153 g/L) phenmedipham/desmedipham	2.75 to 4.75 L in 100 to 200 L/ha of water Repeat Application: For control of later germinating weeds, make a second application of BETAMIX ß EC HERBICIDE. Use 2.75 to 3.5 L/ha Refer to the label for the amount to use for band applications.	Apply only to sugarbeets past the 2-true leaf stage. **Do Not** apply under water or heat stress. Allow at least 7 days between first and second applications. **Do not spray** while dew is present. Rainfall within 6 hours of spraying may reduce weed kill. **Do not** spray in excess of a total of 16.5 L/ha of BETAMIX HERBICIDE per season. **Do not** apply BETAMIX to Sugarbeets later than 60 days prior to harvest.
AIM EC (240 g/L) + AGRAL 90 **or** AG-SURF **or** MERGE carfentrazone-ethyl + non-ionic surfactant **or** surfactant/solvent	36.5-117 mL/ha 2.5 L/1,000 L 2.5 L/1,000 L 1 L/1,000 L 8.8-28.1 g/ha 0.25% v/v 0.1% v/v	**Broadleaf Herbicide** Apply POST with hooded sprayer between the rows. Apply to actively growing weeds up to 10 cm tall. Apply in a minimum of 100 L/ha water. Do Not apply closer than 1 day to harvest. Apply once/growing season.
ROUNDUP WEATHERMAX (540 g/L)or ROUNDUP ULTRA 2 (540 g/L) glyphosate	0.83 – 1.67 L/ha 0.45-0.9 kg/ha	**Roundup Ready Sugarbeet Only.** Apply Roundup to emerged weeds up to 15 cm. Up to 4 applications of glyphosate. Allow a minimum of 10 days between applications. Do not harvest Roundup Ready® sugarbeets within 30 days after the final application of glyphosate

Table 6 – Ontario

Disease and Insect Control Recommendations for Sugarbeets

Trade Name	Common Name	Group (FRAC Code)	Rate	DHI 1	Notes
Caramba2	Metconazole	triazole (3)	1.0 – 1.25 L/ha	14	**Control** for Cercospora leaf spot. Use the higher rate when disease pressure is high.
Inspire2	Difenoconazole	triazole (3)	292 – 512 mL/ha	14	**Control** for Cercospora leaf spot and Powdery mildew. If disease pressure is high, use the highest rate and shortest interval
Mettle 125 ME2	Tetraconazole	triazole (3)	950 mL/ha	14	**Control** for Cercospora leaf spot and Powdery mildew. If disease pressure is high, use the highest rate and shortest interval
Proline2	Prothioconazole	triazole (3)	315 –415 mL/ha	7	**Control** for Cercospora Leaf Spot Use the higher rate and shorter intervals when conditions are favorable for severe disease pressure.
Headline 250 EC 2, 3	Pyraclostrobin	strobilurin (11)	670 - 900 mL/ha	7	**Control** for Cercospora Leaf Spot and Powdery Mildew Use the higher rate when disease pressure is high.
Flint2	Trifloxystrobin	strobilurin (11)	182-244 g/ha	21	**Control** for Powdery mildew - 12 REI hrs
Quadris	Azoxystrobin	strobilurin (11)	4-6 mL/100 m of row	100	**Control** for Rhizoctonia root and crown rot.
			0.5-1.1L/ha (over -the-row)		Apply once in-furrow at seeding or a banded application over the row soon after emergence but before the 6th leaf stage.
Manzate Pro Stick	Mancozeb	dithiocarbamates (M3)	2.25 kg/ha	21	**Control** for Cercospora leaf spot. Repeat at 7 to 10 day intervals.
Penncozeb 80WP			2.25 kg/ha	21	
Polyram DF			2.25 kg/ha	21	
Priaxor	Fluxapyroxad & Pyraclostrobin	SDHI (7) and strobilurin (11)	0.45 L/ha	7	**Control** for Cercospora leafspot
Quadris Top	Azoxystrobin & Difenconazole	strobilurin (11) and triazole (3)	0.566 - 1.0 L/ha	7	**Control** for Cercospora leafspot
Vertisan	Penthiopyrad	SDHI (7)	1 to 1.5 L/ha	7	Powdery mildew
			15.5 - 31 ml per 100 m of row		Crown and root rots
Cevya	Mefentrifluconazole	Triazole(3)	0.19-0.375 L/ha	21	**Control** for Cercospora leafspot. Use the higher rate when disease pressure is high.

Table 7 – Ontario

Disease and Insect Control Recommendations for Sugarbeets

Trade Name	Common Name	Group (FRAC Code)	Rate	DHI 1	Notes
Parasol WP or Coppercide WP	Copper Hydroxide	inorganic (M1)	2.25-4.25 kg/ha	1	**Control** for Cercospora Leaf Spot.
			2.25-4.25 kg/ha		Spray every 10 to 14 days depending on weather conditions .Do not mix with glyphosate and AMS or crop injury may occur. Appling in a spray solution having a pH of < 6.5, phytotoxicity may occur
Senator 70WP2	Thiophanate-methyl	benzimidazole (1)	420-560 g/ha	21	Systemic Fungicide
					Control for control of Cercospora leaf spot Maximum of one applications per growing season.
Vertisan	Penthiopyrad	pyrazole-4-carboxamides (7)	Soil: 15.5 mL/100m of row	7	**Control** for Rhizoctonia root and crown rot. Apply once in-furrow at seeding or a banded application over the row soon after emergence but before the 6th leaf stage.
Ambush 500 EC	Permethrin	pyrethroid	140 - 300 mL/ha	1	**Control** for Cutworm. Where cutworms are large(near full maturity - 2.5 to 4 cm), use 225 to 300 mL/ha.
Perm-UP	Permethrin	pyrethroid	180-390 mL/ha	1	**NOTE:** will only control surface feeding or climbing stages of cutworms.
Coragen	Chlorantraniliprole	diamide	250mL/ha	1	**Control** for Cutworm.
DiBrom	Naled	organophosphate	2.1 L/ha	5	**NOTE:** will only control surface feeding or climbing stages of cutworms.
					Control for Red spider mites and leafhoppers.
Lorsban 4E, Pyrinex 480 EC, Warhawk 480EC	Chlorpyrifos	organophosphate	1.2 – 2.4 L/ha	90	**Control** for Cutworm (Pale western and, Redbacked)
					Do not apply more than once per season. **Do not** enter treated fields until 1 day after application.
Malathion 85E	Malathion	organophosphate	535 mL/ha	-	**Control** for flee beetles only.

CONVENIENT CONVERSION FACTORS

Multiply	By	To Get
Temperature (°C)	1.8 (+32)	Temperature (°F)
Temperature (°F)	0.5555 (-17.88)	Temperature (°C)
Ton (Short)	2,000	Pounds
Yards	3.0	Feet
Yards	36.0	Inches

CAPACITY MEASURE, LIQUID

Fl. ounce - 2 tablespoons
Fl. ounce - 6 teaspoons
Fl. ounce - 29.56 milliliters
Fl. ounce - 1.805 cu. in

Teaspoon - 5 milliliters
Teaspoon - 0.17 fl. ounce
Teaspoon - 60 drops
Pint - 2 cups
Pint - 16 fl. ounces
Pint - 473 milliliters
Pint - 28.87 cu. in.
Pint - 0.125 gallon
Pint - 0.473 liter
Pint - 32 tablespoons

Cu. ft. - 29.92 liq. qt.
Gallon - 128 fl. ounces
Gallon - 231 cu. in.
Gallon - 3,785 milliliters

Cup - 8 fl. ounces
Cup - 0.5 pint
Cup - 236.5 milliliters
Cup - 0.25 quart
Cup - 16 tablespoons
Cup - 48 teaspoons

Tbsp - 3 teaspoon
Tbsp - 15 milliliters
Tbsp - 0.50 fl. ounces

Quart - 32 fl. ounces
Quart - 2 pints
Quart - 57.75 cu. in.
Quart - 946 milliliters
Quart - 0.25 gallon
Quart - 0.94 liter

Liter - 2.1 pints (liquid)
Liter - 1.06 quarts (liquid)
Liter - 1,000 milliliters (liquid)
Liter - 1,000 cc (volume)

STANDARD POUNDS PER BUSHEL

Barley 48
Beans 60
Corn 56
Millet 48
Milo 50
Oats 32
Wheat 60
Sugarbeets (cu. ft.) 40

CONVERSION FACTORS		
Multiply	**By**	**To Get**
Acres	43,560	Square feet
Acres	4,840	Square yards
Acres	0.4047	Hectares
Bushels	2,150.42	Cubic inches
Bushels	1.2445	Cubic feet
Bushels	64	Pints
Bushels	32	Quarts
Cubic feet	1,728	Cubic inches
Cubic feet	0.03704	Cubic yards
Cubic feet	7.4805	Gallons
Cubic feet	59.84	Pint (liquid)
Cubic feet	29.92	Quarts (liquid)
Cubic yards	27	Cubic feet
Cubic yards	46,656	Cubic inches
Cubic yards	0.7646	Cubic meters
Cubic yards	202	Gallon
Cubic yards	1,616	Pints (liquid)
Cubic yards	807.9	Quarts (liquid)
Feet	12	Inches
Feet	0.33333	Yards
Feet per minute	0.01667	Ft. per second
Feet per minute	0.01136	Miles per hour
Gallons	0.1337	Cubic feet
Gallons	231	Cubic inches
Gallons	128	Ounces (liquid)
Gallons	8	Pints (liquid)
Gallons	4	Quarts (liquid)
Gallon of water	8.3453	Lbs. of water
Grams	0.0353	Ounces
Grams per liter	1,000	Parts per million
Hectares	2.471	Acres
Inches	2.54	Centimeters
Inches	0.08333	Feet
Inches	0.02778	Yards

CONVERSION FACTORS (CONTINUE)		
Multiply	**By**	**To Get**
Meters	0.001	Kilometer
Meters	1,000	Millimeter
Meters	1.094	Yards
Miles	5,280	Feet
Miles	320	Rods
Miles	1,760	Yards
Miles per hour	88	Feet per minute
Miles per hour	1.467	Feet per second
Miles per minute	88	Feet per second
Miles per minute	60	Miles per hour
Ounces (dry)	0.0625	Pounds
Ounces (liquid)	1.805	Cubic inches
Ounces (liquid)	0.0078125	Gallons
Ounces (liquid)	29.563	Milliliter (liquid)
Ounces (liquid)	0.0625	Pints (liquid)
Ounces (liquid)	0.03125	Quarts (liquid)
Parts per million	0.0584	Grains per U.S. gallon
Parts per million	0.001	Grams per liter
Parts per million	8.345	Pounds per million gallons
Pints (dry)	0.015625	Bushels
Pints (dry)	33.6003	Cubic inches
Pints (dry)	0.0625	Pecks
Pints (dry)	0.5	Quarts (dry)
Pints (liquid)	28.875	Cubic inches
Pints (liquid)	0.125	Gallons
Pints (liquid)	0.4732	Liters
Pints (liquid)	16	Ounces (liquid)
Pints (liquid)	0.5	Quarts (liquid)
Pounds	16	Ounces
Pounds	0.0005	Short ton
Pounds of water	0.01602	Cubic feet
Pounds of water	27.68	Cubic inches
Pounds of water	0.1198	Gallons
Quarts (dry)	67.20	Cubic inches

CONVERSION FACTORS (CONTINUE)		
Multiply	**By**	**To Get**
Quarts (dry)	0.125	Pecks
Quarts (dry)	2	Pint (dry)
Quarts (liquid)	57.75	Cubic inches
Quarts (liquid)	0.25	Gallons
Quarts (liquid)	0.9463	Liters
Quarts (liquid)	32	Ounces (liquid)
Quarts (liquid)	2	Pints (liquid)
Rods	16.5	Feet
Square feet	144	Square inches
Square feet	0.11111	Square yards
Square inches	0.00694	Square feet

POISON CONTROL CENTERS

Anywere in the United States
1.800.222.1222

Poison Centers provide poison expertise and treatment advice by phone. Poison centers are staffed by pharmacists, physicians, nurses and poison information providers who are toxicology specialists. Have pesticide label available when calling.

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PIONEER • BIG CHIEF
MICHIGAN SUGAR

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