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2019 Sugar Beet Production Guide

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INTRODUCTION

Plan for Profitable Sugar Beet Production

This production guide will provide useful information to assist you in making timely management decisions. However, it does not give extensive details on any subject discussed. More detailed and complete discussions of weed control, soil fertility, insect and disease control, and most other aspects of sugar beet production in Minnesota and North Dakota are presented in past issues of the Sugarbeet Research and Extension Reports available on the web (www.sbreb.org).

The pesticide use suggestions in this guide are based on federal label clearances and research information from the North Dakota and Minnesota Agricultural Experiment Stations. All pesticide use suggestions are based on the assumption that all chemicals will continue to have a registered label with the Environmental Protection Agency.

The publishers do not assume any responsibility, make any guarantees or offer any warranties with regard to the results obtained from use of the data appearing in this guide.

FERTILIZING SUGAR BEET

Nitrogen and Quality: Sugar beet quality is dependent on the sucrose content in the roots and the level of impurities that must be removed during sugar refining. Production of high-quality sugar is especially important to growers who are paid based on extractable sugar delivered to the factories

Proper nitrogen fertilizer use increases root and sugar yield. However, excessive nitrogen (N) increases impurities and decreases sugar content. More precise nitrogen management within each crop in a sugar beet rotation will help prevent overapplication and buildup of nitrogen in the subsoil.

Nitrogen Fertilizer Use Guidelines: Southern Minnesota Beet Sugar Cooperative 110 lb N/A for 4-foot depth soil sample or 80 lb N/A for 2-foot depth soil sample.

- Nitrogen fertilizer recommendations are similar for **American Crystal Sugar Co.** and **Minn-Dak Farmers Cooperative**. Use 130 lb N/A and 100 lb N/A when sampling to 4-foot and 2-foot soil depth, respectively. See Page 5.
- 65 lb/acre of nitrogen is required in the 0- to 2-foot soil depth to maximize early season crop growth, yield and quality. This amount is needed regardless of the quantity of residual soil nitrogen found below 2 feet.

Guidelines for Adjusting Nitrogen Recommended for Crops Following Sugar Beet

Reduce N by 60 to 80 lb/A next season on areas of green sugar beet tops.

- Reduce N by 20 to 30 lb/A next season on areas of yellow-green sugar beet tops.
- Do not reduce N in zones within sugar beet fields with yellow foliage.

Managing N Throughout the Rotation Using Precision Agriculture Techniques

Lower residual N levels can be achieved prior to sugar beet through a rotation managed with precision ag techniques. Residual nitrate levels can be examined site-specifically through grid or zone-based soil sampling. A composite pre-sample can be used to determine the likelihood of significant spatial variability in nitrate levels.

Choose grid soil sampling if field history is unknown, if fertility is high, when the field has a history of manure applications, when two or more fields are merged or if phosphate levels are particularly important.

Choose zone soil sampling if yield monitoring or remote imagery reveals a pattern relationship with the landscape, if no history is available or manure use has occurred, if the field has a history of relatively low P rates or if mobile nutrient levels, particularly nitrate, are required.

Nitrogen		Phosphorus Soil Test, ppm					
		Test	VL	L	M	H	VH
Soil N + Fertilizer*		Bray 1**	0-5	6-10	11-15	16-20	21+
		Olsen	0-3	4-7	8-11	12-15	16+
lb/a 2ft†	lb/a 4 ft		------ P Soil Test Values (ppm) ------				
100	130		80	55	35	10	0

	Potassium Soil Test, ppm				
	VL	L	M	H	VH
	0-40	41-80	81-120	121-150	150+
	------ K Soil Test Values (ppm) ------				
MN ‡	110	80	50	0	0
ND 1	120	90	50	0	0
ND 2	120	120	90	60	0

* Subtract the amount of NO3-N in the top 2 or 4 feet of soil from these figures to determine the amount of N fertilizer to apply.

**Use the Olsen P test on soils with pH greater than 7. The Bray test is not recommended in North Dakota.

† Southern Minnesota Beet Sugar Cooperative recommends 80 and 110 lb N/A for 2-foot and 4-foot sampling, respectively.

‡ For Potassium in Minnesota, use the MN line. In North Dakota, ND 1 refers to soil with a smectite/illite ratio < 3.5, ND 2 refers to soil with a smectite/illite ratio > 3.5. See the sugar beet publication at www.ndsu.edu/fileadmin/soils/pdfs/Fertilizing_Sugarbeet_In_North_dakota.pdf for a map of where these are located.

Sugar beet is a crop that is especially responsive to banded phosphorus (P) placement. It also is a crop that is especially sensitive to fertilizer salts, so any banded starter fertilizer with the seed must be used at low rates. The following table summarizes recent broadcast and banded P research results:

Guidelines for Sugar Beet Fertilization With P

Soil Test Level		
Olsen, ppm	**Bray, ppm**	**Recommendations**
16+	21+	Apply no P fertilizer
8-16	11-20	Use either 3 gpa 10-34-0 seed-placed or recommended broadcast P rate. Use 3 gpa
<8	<11	10-34-0 seed-placed and 40 lb/A P205 broadcast. (3 gpa 10-34-0 produces yields equal to recommended broadcast P rates).

Following the above guidelines for the use of fertilizer P should address issues of fertilizer input savings with the use of banded P and maintenance of soil test P important to other rotational crops.

Micronutrients

Sugar beet rarely respond to the use of micronutrients. Before using micronutrients on an entire field, try a test strip to determine a possible need.

Fertilizer Application: All P and potassium (K) recommendations in the fertilizer recommendation table are listed as the amount to be broadcast. We recommend that on low- to medium-testing soils, P fertilizer be applied before the deepest tillage operation. On soils testing high and very high, shallow incorporation of these rates is adequate. Exercise caution with seed applications. Applying greater than 5 pounds per acre of $N+K_2O$ in contact with the seed can reduce plant stand emergence.

Common starter phosphorus fertilizer sources and maximum amounts suggested for seed application

Source	Name	Dry or liquid	Maximum amount to apply	Phosphate supplied lb/acre
10-34-0	Ammonium Poly Phosphate (APP)	Liquid	4 gal/A	16
18-46-0	Diammonium Phosphate (DAP)	Dry	28 lbs/A	13
11-52-0	Monoammonium Phosphate (MAP)	Dry	45 lbs/A	24

ROW WIDTHS AND PLANT POPULATIONS

A row width of 22 inches is recommended in Minnesota and North Dakota. Research in the Red River Valley, Michigan and irrigated beet-growing areas indicates 400 to 600 pounds of sugar per acre are lost as row widths increase to 28 or 30 inches. Higher, more uniform, plant populations are easier to establish on narrow rows. Growers interested in row widths greater than 22 inches must consider the anticipated advantages against lower yields per acre.

A good sugar beet plant population at harvest should be about 175 to 200 uniformly spaced plants per 100 feet of row. This population should produce very good yields of high-quality sugar beet.

Planting Rates and Seed Spacing – 22-inch Rows

Inches between seed	6	5.5	5.25	5	4.75	4.5	4	3.5
No. of seeds per/acre	47,520	51,840	54,000	57,024	60,000	63,360	71,280	81,463

For 30-inch row, multiply all table values by 0.73.
For 28-inch row, multiply all table values by 0.79.
For 26-inch row, multiply all table values by 0.85
For 24-inch row, multiply all table values by 0.92

SEEDS AND SEEDING

Many varieties of seeds are available commercially in Minnesota and North Dakota. The Coded Variety Trial provides an excellent comparison of the performance of varieties in this area. Contact your agriculturist or seed company representative for more information on varieties.

Complete coded variety trial results for American Crystal Sugar Co. and Minn-Dak Farmers Cooperative are available in the Sugarbeet Research and Extension Reports (www.sbreb.org).

Sugar beet should be planted as early as weather, soil moisture and temperature conditions permit. The potential for very high yields from early plantings usually is considered worth the risk of frost damage.

1. Plant seed 1 to 1.25 inches deep for maximum germination and emergence. Use shallow depths for earlier planting.
2. Plant sugar beet seeds 4.5 to 5 inches apart in 22-inch rows when planting to stand.
3. A planting speed of 4 miles per hour is recommended for conventional planters and 6 to 8 mph for high-speed planters
4. Perform needed maintenance on planter prior to planting.
5. Please attend planter test stand clinic.

Planter Maintenance Checklist

1. Check the condition of hoppers, disks, drives and chains.
2. Be sure disc furrow openers are clean and turn freely.
3. Check seed ejection tubes for restrictions or blockage.
4. Be sure row spacings are correct and equal, and row markers are adjusted.
5. Lubricate the planter properly.
6. Clean seed hoppers daily.
7. Match seed sizes and planter plates carefully.
8. Test the planter on a hard surface to check the seed distribution pattern.
9. Number plates to match planter units.
10. Calibrate starter and/or fungicide application systems.

Planter Off-season Storage

1. Clean the planter with a pressure washer or high-pressure air; washing off all starter fertilizer is especially important to prevent corrosion; flush all liquid-handling systems.
2. Remove plates and store them on a wood dowel hung horizontally.
3. Remove seed plate doors. Do not stack them on top of each other; use original boxes for storage.
4. Release tension on press wheel springs.
5. Check for missing insecticide spoons or banders.
6. Make a list of needed repairs and parts.
7. Mouse-proof seed tubes (place fabric softener sheets in seed hoppers).
8. Save all new planter plate boxes for warranty use referral.
9. Keep track of how many acres are seeded on a set of plates (write the date of purchase in the owners manual or on the plates).
10. Grease/protect electrical harness.

Sugar Beet Seed Specifications

Size	Company	Diameter	Units/Case	Bulk (Units)
Mini Pellets (Orange Label)	Betaseed	8-10/64	4	Not Available
	Crystal	8-10/64	6	
	SESVanderHave	8-10/64	6	72
	Maribo	8-10/64	4	
	Hilleshog	8-10/64	4	
Agracoat (Green Label)	Seedex	8-10/64	6	72

Sugar Beet Seed Specifications

Size	Company	Diameter	Units/Case	Bulk (Units)
Regular Pellets (White Label)	Betaseed	9.5-11.5/64	4	96
	Crystal	9.5-11.5/64	4	
	ACH	9.5-11.5/64	4	96
	Hilleshog	9.5-11.5/64	4	
	Seedex	9.5-11.5/64	4	48
	SESVanderHave	9.5-11.5/64	4	48
	Maribo	9.5-11.5/64	4	
XTREME (Light Blue)	Crystal	10.5 -13.5/64	3	
Ag S (Yellow Label)	Seedex	10.5 -13.5/64	3	24
LP Pellets (Green Label)	SESVanderHave	10.5 - 13.5/64	3	
S2 (Yellow)	Hilleshog	11 -14/64	4	125-150
	Maribo	11 -14/64	4	
Pro 200 ELS (Gray Label)	Betaseed	11.5 -13.5/64	4	96
	ACH	11.5 -13.5/64	4	

Medium Plate - (H 136445)

Mini Pellets	2 - 3 inches of vacuum
Regular Pellets	Not recommended
S1	2 - 3 inches of vacuum
Agracoat	2 - 3 inches of vacuum

Large Plate - (A 51713)

Mini Pellets	Not recommended
Regular Pellets	2 - 3 inches of vacuum
Agracoat	Not recommended
LP Pellets	2 - 4 inches of vacuum
XTREME	3 - 4 inches of vacuum
Ag S	3 - 4 inches of vacuum

Sorghum Plate - (A 43066)

Mini Pellets	Not recommended
Regular Pellets	3 - 4 inches of vacuum
Pro200	5 - 7 inches of vacuum
ELS	3 - 5 inches of vacuum
XTREME	3 - 5 inches of vacuum
LP Pellets	3 – 5 inches of vacuum
S2	3 - 4 inches of vacuum
Ag S	3 - 5 inches of vacuum

* Central delivery system: Vacuum may need to be higher. Consult your agriculturist or seed representative prior to updating your planting equipment.

Vacuum Planter Comments

Before purchasing a new planter or different planter plates, contact your agriculturist, Norm Cattanach, or your seed salesman to discuss advantages or disadvantages.

John Deere:

1. These are the best plate combinations. Other combinations will work but may result in more skips or multiples. Adjust the vacuum as necessary.
2. Having plastic residue from the production process partially block the air holes in new plates is common. This causes skips and lower than desired population readings on the monitor. Before installing new plates, clean out obstructions by hand with a 1/16 inch drill bit. **Do not enlarge the air hole.**
3. Some new planters have small rough areas on casting from the production process; file them down as necessary.
4. Run units with all seals in place. Without all seals in place, a variation in vacuum levels from unit to unit will be experienced. Replace worn seals.
5. Check the monitor eye in the drop tube to make sure it is positioned properly. Seed may bounce off the monitor eye assembly if it is twisted slightly out of position.
6. In a large-tank central delivery system, remove the fuse that controls agitation in the tank. If not removed, seeds may be damaged.
7. In a large-tank central delivery system, use Sorghum inserts.
8. When unfolding, check to see that all tubes have refilled with seed.
9. Replace “wipers” and knock-out wheels.

Monosem Planter Plates Recommendations

Plate 4016	Plate 4020	Plate 4025	Plate 3622
Mini Pellets /Agracoat S1	Agracoat S1 Mini Pellets/ Regular Pellets	Agracoat S1 Mini Pellets/ Regular Pellets S2 Ag S /ELS Pro 200 LP Pellets XTREME	Regular Pellets Ag S S2 Pro200 ELS LP Pellets XTREME

White Planter Plates Recommendation

854047	N 857115	N 856067
Mini Pellets Agracoat	Regular Pellets	Pro200 ELS LP Pellets Ag S S2 XTREME

Vacuum Planter Comments

MONOSEM NG+:

1. Using plates smaller than recommended may result in seed falling off the plate when the planter bounces in the field.
2. 36-cell plates with the appropriate hole diameter will work, although increased plate turning speed may require higher vacuum levels to avoid seed falling off the plate.
3. When starting out in a field, monitor seed discs to ensure seed is staying on the plate. Increase vacuum if necessary.

White Seed Boss:

1. Use shims to obtain the proper air gap between the plant and meter.
2. Adjustment and/or modification of the tickler brush will improve performance.
3. A sugar beet cutoff brush with metallic bristles helps remove static electricity.

Case Planter:

1. Singulators should be adjusted properly to the percentage of the hole showing and lubricated to work very freely.
2. Running it at a higher vacuum pressure may be better.
3. The planter has no agitation in the large tank; to compensate, use pure graphite or a graphite/talc blend.

Plate Recommendation

Pellet Size	Plate No.	Vacuum [in inches of water]
Mini	8020/6020/6023	[16-20]
Regular	8020/6020/6023	[18-22]
Larger than regular	8023/6020/6023	[20-30]

Plate Planters

Size	Planter	Metal	Plastic	Thickness (In.)	Cell Dia. (In.)
Medium	John Deere Milton	B 13304	Blue	0.105	10/64 11 x 7/64
Extra Large	John Deere John Deere	B 29402 B 12733	Brown	0.125 0.125	12/64 11/64 Drill to 12 /64
Mini Pellets Agracoat	John Deere Milton		Orange		12 x 9/64
Regular Pellets	John Deere Milton		Light Green		14 x 11/64

John Deere Plate Planters

1. Plastic plates turn harder than steel, so lubricate the plate, false ring and hopper bottom lightly with talc. The plate should turn easily by hand.
2. Monitor the spring on the drop tube and keep it free of soil. Drop tubes should move freely up and down.

Seeding Rate and Plant Population Establishment (22-inch rows) Plant Establishment*

%	Seed Spacing (Inches)							
	3	**4**	**4.75**	**5**	**5.25**	**6****	7**	8**
	---------- (Plants per 100 feet of 22 inch row) ----------							
90	360	270	228	216	206	180	155	135
80	320	240	202	192	183	160	138	120
70	280	210	177	168	160	140	120	105
60	240	180	152	144	137	120	103	90
50	200	150	127	120	115	100	86	75
40	160	120	101	96	92	80	69	60
30	120	90	76	72	69	60	52	45

* Average stand establishment is about 68 percent.
** Not recommended.

Plant Population

Plants per 100 ft. of row		75	100	125	150	175	200	225
Plants/acre	22-inch rows	17,852	23,803	29,754	35,705	41,397	47,607	53,894
Plants/acre	30-inch rows	13,068	17,424	21,780	26,136	30,302	34,848	39,450

Tractor Speed Calibration Chart

mph	100 ft.	200 ft.	300 ft.
	--- Time in seconds required to travel a given distance ---		
4	17	34	51
5	14	28	42
6	11	22	33
7	10	20	30

WEED CONTROL

The timing of herbicide application is extremely important for maximizing weed control and recoverable sucrose per acre. Properly identify weeds and apply Roundup* to small (1- to 2-inch) weeds in Roundup Ready sugar beet. Use maximum Roundup* rates, even in fields with weeds with low-level resistant biotypes because 1- to 2-inch weeds are easier to kill than 3- to 4-inch weeds, and dead weeds cannot produce resistant progeny. Research indicates that allowing weeds at high density to get larger than 2 inches in height may reduce sugar beet root yield.

Apply Roundup* in tank-mixes for waterhemp, kochia, ragweed and lambsquarters control. Manage glyphosate-resistant waterhemp with residual herbicides. Apply Nortron*, Ro-Neet SB or Dual Magnum* PPI/PRE, or Dual Magnum*, Warrant or Outlook* early postemergence (lay-by) in tank- mixtures with Roundup* at full rates + Nortron* at 4 to 6 fluid ounces per acre) (fl oz/A).

Residual herbicides applied lay-by must be rainfall-activated before waterhemp emerges in fields. Scout fields and spray Betamix (highest rate possible) or UpBeet at 1 oz/A + Nortron* + Roundup* when waterhemp is 1 to 2 inches in height.

Control 1-inch glyphosate-resistant common ragweed with Stinger* at 2 fl oz/A followed by Stinger at 2 fl oz/A at approximately 14 days. Control 3-inch common ragweed with Stinger at 4 fl oz/A followed by Stinger at 4 fl oz/A at 14 days. Tank-mixes providing effective weed control in the field across crops in sequence with sugar beet, including corn, soybean and wheat, are the most effective weed management strategy for control of tough weeds, including glyphosate- resistant biotypes.

Wild oat populations resistant to ACC-ase-inhibitor herbicides, such as Assure II*, are found in the Red River Valley. Manage wild oat resistant to ACC-ase-inhibitor herbicides with Far-Go and/or Select* or Select Max* alone at full rates to small wild oat, and repeat the application as necessary, on approximately 14- to 21-day intervals.

Maximize weed control in conventional sugar beet by scouting fields and applying herbicide treatments when weeds are at the cotyledon to first-true-leaf stage. Scout the field before making the next herbicide treatment to determine the effectiveness of the previous application; make sequential herbicide applications on five- to –seven-day intervals. Use full herbicide rates and effective adjuvants to kill weeds.

*Or generic equivalent

Weed Control Recommendations

The weed control suggestions in this production guide are based on the assumption that all herbicides mentioned will have a registered label with the Environmental Protection Agency. Herbicides no longer registered or have not received registration for sugar beet yet should **not be used**. Sugar beet treated with a nonregistered herbicide may have an illegal residue, which, if detected, could cause condemnation of the crop. Nonregistered herbicide use is illegal, and a user could be subject to a heavy fine, even without detectable residue.

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks
Far-Go (triallate[8]) **Far-Go** EC 	**1.5 qt EC** **15 lb 10 G** (1.5 lb)	Wild oat	Spring PPI. Fall incorporated after Oct. 15 until freeze-up or snow cover	Incorporate immediately after application with a tillage tool set 3 to 4 inches deep. A second incorporation at an angle different from the first pass will improve wild oat control. One pass in the fall followed by spring seedbed preparation is sufficient for fall application. Will control wild oat that have developed resistance to ACC-ase (SOA1) inhibitor POST herbicides.
Eptam (EPTC[8])	**2.3 to 3.4 pt** (2 to 3 lb)	Annual grasses and some broadleaf weeds	PPI	Eptam may cause reduced sugar beet stands and temporary early season growth reduction. Injury increases in light soils with low OM. Strong on foxtail species. Weak on wild mustard.
	4 to 5 pt (3.5 to 4.38 lb)		Fall. After Oct.15 until freeze-up	
Eptam (EPTC) + **Ro-Neet SB** (cycloate[8])	**1.1 to 2.3 pt + 2.7 to 3.3 pt** (1 to 2 + 2 to 2.5)	Annual grasses and some broadleaf weeds	PPI	Less potential for sugar beet injury than from Eptam alone and is less expensive than Ro-Neet SB alone. Adjust rate for soil texture and OM. Improved foxtail, wild oat and pigweed control than from Ro-Neet SB alone.
	1.1 to 2.9 pt + 2.7 to 4 pt (1 to 2.5 + 2 to 3)		Fall. After Oct. 15 until freeze-up	
Ro-Neet SB (cycloate)	**4 to 5.3 pt** (3 to 4 lb)	Annual grasses and some broadleaf weeds including waterhemp	PPI	Sugar beet has better tolerance to Ro-Neet SB than to Eptam, especially on coarse-textured, low-OM soil. Weak on wild mustard Weed control poorer on fine-textured, high-organic-matter soils.
	5.3 pt (4 lb)		Fall. After Oct. 15 until freeze-up.	
Nortron* (ethofumesate[8])	**6 to 7.5 pt** (3 to 3.75 lb)	Good pigweed and waterhemp and fair to good kochia control	PPI or PRE	Incorporation may improve weed control. Band application reduces cost and risk of carryover into next year, especially on wheat and corn.
	3 to 12 fl oz (0.094 to 0.375 lb)	Improves control of kochia, pigweed, waterhemp and lambsquarters	POST in combination with Betamix, or UpBeet and Roundup* up to 90 days PHI	Apply Nortron* POST two times at 6 fl oz/A or three times at 4 fl oz/A, but do not apply POST more than 12 fl oz/A total during the growing season due to crop rotation restrictions. May be mixed with Roundup* + HSMOC + AMS to improve control of kochia, lambsquarters and pigweed species including waterhemp. Allow a 90-day PHI (Willowood Ethofumesate 4SC is a 45-day PHI)

*Or generic equivalent

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks
Stinger* (clopyralid[4])	**2 to 10.6 fl oz** (0.05 to 0.25 lb ae)	Cocklebur, sunflower, marshelder, wild buckwheat, ragweed and Canada thistle	POST. Sugar beet: Cotyledon up to the eight-leaf stage	Singer* may be mixed with Betamix and UpBeet. Stinger may be mixed with Roundup* + AMS to improve control of volunteer soybean, common and giant ragweed, biennial wormwood and wild buckwheat. Allow a 45-day PHI.
UpBeet (triflusulfuron[2])	**0.25 to 1.0 oz** (0.125 to 0.5 oz)	Annual broadleaf weeds	POST. Weeds: Cotyledon to two- leaf stage	Apply two or more times in combination with Nortron*, Betamix or Stinger*. Do not exceed 2.5 oz/A/season. May be mixed with Roundup* + HSMOC + AMS to improve control of common mallow, common ragweed, common lambsquarters, wild buckwheat, waterhemp and velvetleaf. Be aware of ALS resistant biotypes. Allow a 60-day PHI.
Betamix (desmediphan[5] and phenmediphan[5])	**0.75 to 7.5 pt** (0.06 to 0.6 lb + 0.06 to 0.6 lb)	Annual broadleaf weeds	POST. Sugar beet: Cotyledon up to 75 days PHI	Risk of sugar beet injury is increased by morning or midday application and by certain environments. Split application with reduced rates has reduced sugar beet injury and increased weed control, compared with single full-dose applications. May be mixed with Roundup* + Nortron + HSMOC+ AMS for control of waterhemp.
Betamix + **Nortron*** (desmediphan and phenmediphan + ethofumesate[8])	**0.52 to 4.6 pt** + 3 to 12 fl oz (0.042 to 0.374 & 0.042 to 0.374 lb + 0.094 to 0.375 lb)		Broadleaf weeds: Cotyledon up to four-leaf stage	Do not add HSMOC or any adjuvant when applying full rates. Allow a 75-day PHI.

Betamix + **UpBeet** + Stinger* + MSO Adjuvant Or **Betamix**+ Nortron* + **UpBeet** + Stinger* + MSO Adjuvant	**Micro-Rate Program** 8 to 12 fl oz + 0.125 oz + 1.3 fl oz + 1.3 fl oz + 2 pt/A Or 8 to 12 fl oz + 3 to 4 fl oz + 1.3 fl oz + 2 pt/A **Mid-Rate Program** 12 to 16 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A Or 8 to 12 fl oz + 3 to 4 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A	Annual broadleaf weeds and fair to good annual grass control. ***Generally provides poor control of ALS-resistant kochia***. Increasing Stinger* rate from 1.3 to 2.6 fl oz will improve control of lanceleaf sage with some risk of increased sugar beet injury carryover risk	POST Sugar beet Apply a minimum of three times with **subsequent treatments at five- to seven-day intervals**. Micro-rate can be applied starting at cotyledon sugar beet stage	Use midrate program for difficult weed problems or when any application has been delayed. A herbicide for grass control at ½ to 1 times normal rate can be added. Nozzle plugging from herbicide precipitation in the spray tank can be reduced by: -Mixing in warm water -Raising water pH to 8 or 9 -Remixing UpBeet -Use of grass herbicide -Frequent sprayer cleaning Allow a 75-day PHI unless using Nortron, then 90-day PHI.

Herbicide	Product/A (ai/A)	Weeds	When to Apply	Remarks
Assure II Targa (quizalofop[1])	**7 to 12 fl oz** (0.77 to 1.32 oz)	Annual grasses, quackgrass, and volunteer grass crops	POST. Sugar beet: Cotyledon to PHI Weeds: annual grass weeds and volunteer wheat or barley 2 to 6 inches tall	Apply with oil adjuvant at 1% v/v but not less than 1.25 pt/A. Oil adjuvant at more than 1 qt/A is not needed. See Select Max* label for detailed adjuvant recommendations. Apply with AMS or UAN fertilizer for greater control of certain grass species. Only Assure II*, Fusilade DX, Select* or Select Max* should be used to control volunteer Roundup Ready corn. Results from 2014 indicated excellent control of V5 corn from Assure II at 2 oz/A, SelectMax at 6 oz/A or Assure II + SelectMax at 1 + 1 oz/A. Include an oil adjuvant with Select* or Assure II* to control volunteer Roundup Ready corn or HSMOC if combined with Roundup*. NDSU research indicates less antagonism of grass control with Select* 2 EC tank-mixed with Betamix than Poast or Assure II*. Allow a 40-day PHI for Select*/Select Max* Allow a 45-day PHI for Assure II* Allow a 60-day PHI for Poast Allow a 90-day PHI for Fusilade DX
Fusilade DX (fluazifop[1)])	**5 to 12 fl oz** (1.25 to 3 oz)			
Select* (2 EC) (clethodim[1])	**6 to 8 fl oz** (1.5 to 2 oz)			
Select Max* (1 EC) (clethodim[1])	**9 to 17 fl oz** (1.1 to 2 oz)			
Poast (sethoxydim[1])	**0.5 to 1.5 pt** (0.1 to 0.3 lb)	Annual grasses		

Treflan* (trifluralin[3])	**1.5 pt** (0.75 lb)	Late emerging annual grass and some broadleaf weeds	POST. Sugar beet: two true leaf to 6 inches tall and well-rooted prior to incorporation	Must be incorporated. Beet root must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugar beet.
Dual Magnum* (S-metolachlor[15])	**1.33 to 1.67 pt** (1.25 to 1.6 lb)		POST. Sugar beet: two-leaf stage to canopy closure	Emerged weeds not controlled. Precipitation or irrigation required for activation. May be applied more than once but seasonal total applied must not exceed 2.6 pt/A for Dual Magnum*, 24 fl oz/A for Outlook* or 4 qt/A for Warrant. Lay-by Dual Magnum*, Outlook* or Warrant should be applied cautiously where PPI or PRE Nortron* was used because sugar beet injury may occur. May be mixed with Roundup* + adjuvant + AMS to provide residual weed control. Allow a 60-day PHI for Dual Magnum*. Allow a 60-day PHI for Outlook*, except the PHI is 95 days for Outlook* applied to nine-leaf through 12-leaf sugar beet. Allow a 70-day PHI for Warrant.
Outlook* (dimethenamid-P[15])	**12 to 21 fl oz** (0.56 to 0.98 lb)		POST. Sugar beet: two- to eight-leaf stage	
Warrant (Acetochlor[15])	**1.25 to 2 qt** (0.94 to 1.5 lb)		POST. Sugar beet: two- to eight-leaf stage	

*Or generic equivalent

Roundup Ready Sugar Beet

<table>
<tr><th>Herbicide</th><th>Product/A
(lb ai/A)</th><th>Weeds</th><th>When to Apply</th><th>Remarks</th></tr>
<tr><td rowspan="2">Roundup*
(glyphosate[9])

[Only registered brands may be applied to RR sugar beet]</td><td rowspan="2">Maximum single application up to eight-leaf stage
= 1.125 lb ae

Maximum single application from eight-leaf sugar beet to canopy closed
= 0.77 lb ae

See Remarks</td><td rowspan="2">Emerged annual and perennial grass and broadleaf weeds</td><td rowspan="2">POST. Sugar beet: emergence to 30-day PHI

Weeds: 1-2 inches in height</td><td>
<table>
<tr><th colspan="6">Apply only to RR sugar beet varieties</th></tr>
<tr><td></td><td></td><td>0.77 lb ae</td><td>0.84 lb ae</td><td>0.98 lb ae</td><td>1.125 lb ae</td></tr>
<tr><td>lb ae/gal</td><td>lb ai/gal</td><td colspan="4">----------fl oz/A----------</td></tr>
<tr><td>3</td><td>4</td><td>33</td><td>36</td><td>42</td><td>48</td></tr>
<tr><td>3.75</td><td>5</td><td>26</td><td>29</td><td>34</td><td>38</td></tr>
<tr><td>4/4.17</td><td>5.4/5.1</td><td>25/24</td><td>27/26</td><td>31/30</td><td>36/35</td></tr>
<tr><td>4.5</td><td>5.5</td><td>22</td><td>24</td><td>28</td><td>32</td></tr>
<tr><td>4.72</td><td>6.3</td><td>21</td><td>23</td><td>27</td><td>31</td></tr>
<tr><td>5</td><td>6.1</td><td>20</td><td>22</td><td>25</td><td>29</td></tr>
</table>
- Max single appl. from sugar beet emergence to eight leaves = 1.125 lb ae
- Total maximum from sugar beet emergence to eight leaves = 1.96 lb ae
- Max single application from eight leaves to canopy closure = 0.77 lb ae
- Total max from eight leaves to canopy closure = 1.54 lb ae
- Total max from sugar beet emergence through harvest= 3.38 lb ae
- Maximum for year 8.5 lb ae
- Add AMS fertilizer at 8.5 lb/100 gal
- Refer to labels for tank-mixing restrictions. Allow a 30-day PHI
</td></tr>
</table>

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks
Sequence (glyphosate-K[9] & S-metolachlor[15]) **RR sugar beet only**	**2.5 to 3 pt/A** (0.7 to 0.84 lb and 0.94 to 1.125 lb)	Grass and broadleaf weeds	POST. Sugar beet: two-leaf stage to canopy closure	Maximum rate (two- to eight-leaf sugar beet) = 2.5 pt/A on coarse soils and 3 pt/A on medium to fine soils. Maximum rate (8 if to canopy closure) = 2.5 pt/A. Include additional Roundup* as allowed. Seasonal maximum = 7 pt/A. Allow 60-day PHI.

*Or generic equivalent

Chemical Names, Concentrations, Reentry Interval, Preharvest Interval and Cost

Trade Name and (Manufacturer)	Common Name	Formulation (lb/gal or % ai)	Rentry Interval (hours)	Preharvest Interval (days)	Cost ($/unit)
Arrow (MANA)	clethodim	2 EC	24	40	120/gal
Avadex MA (Gowan)	Triallate	10G	12	-	1.75/lb
Assure II (DuPont)	quizalofop	0.88 EC	12	45	125/gal
Betamix (Bayer)	desmedipham and phenmediphan	0.65 and 0.65 EC	24	75	90/gal
Brawl Tenkoz)	S-metolachlor	7.62 EC	24	60	112/gal
Charger Basic (Winfield)	S-metolachlor	7.62 EC	24	60	70/gal
Cinch (DuPont)	S-metolachlor + safener	7.64 EC	24	60	135/gal
Clean Slate (Nufarm)	clopyralid	3 SL	12	45	150/gal
Clethodim (several)	clethodim	2 EC	24	40	85/gal
Clopyr Ag (UPI)	clopyralid	3 SL	12	45	410/gal

Dual Magnum (Syngenta)	S-metolachlor	7.62 EC	24	60	120/gal
Eptam (Gowan)	EPTC	7 EC 20 G	12	_	60/gal
Establish (Tenkoz)	dimethenamid-P	6 EC	12	60/95	180/gal
Ethofumesate 4SC (Willowood USA)	ethofumesate	4 SC	12	45 (Post)	70/gal
Ethotron SC (UPI)	ethofumesate	4 SC	12	90 (Post)	95/gal
Far-Go (Gowan)	triallate	4 EC	12	_	60/gal
Fusilade DX (Syngenta)	fluazifop-P-butyl	2 EC	12	90	140/gal
Gramoxone Inteon / SL (Syngenta)	paraquat	2 SL	12	_	38/gal 42/gal
Intensity 100 (Loveland)	clethodim	2 EC	24	40	65/gal
Intensity One (Loveland)	clethodim	1 EC	24	40	90/gal

Chemical Names, Concentrations, Reentry Interval, Preharvest Interval and Cost

Trade Name and (Manufacturer)	Common Name	Formulation (lb/gal or % ai)	Rentry Interval (hours)	Preharvest Interval (days)	Cost ($/unit)
Liberty 280 SL (Bayer)	glufosinate	2.34 SL	12	_	75/gal
Nortron SC (Bayer)	ethofumesate	4 SC	12	90 (Post)	100/gal
Outlook (BASF)	dimethenamid-P	6 EC	12	60/95	150/gal
Poast (BASF)	sethoxydim	1.5 EC	12	60	100/gal
Ro-Neet SB (Helm Agro)	cycloate	6 EC	12	_	165/gal
Roundup*/others (many companies)	glyphosate	several	12	30	30-38/gal
Section (Winfield)	clethodim	2 EC	24	40	120/gal
Section Three (Winfield)	clethodim	3EC	24	40	115/gal
Select Max (Valent)	clethodim	1.0 EC	24	40	120/gal
Sequence (Syngenta)	glyphosate-K and S-metolachlor	2.25 and 3.0 SC	24	60	60/gal
Shadow (Arysta)	clethodim	3 EC	24	40	130/gal

Spur (Albaugh)	clopyralid	3 SL	12	45	200/gal
Stinger (Dow)	clopyralid	3 SL	12	45	480/gal
Tapout (Helena)	clethodim	1 EC	24	40	100/gal
Targa (Gowan)	quizalofop	0.88 EC	12	45	130/gal
Transline (Dow)	clopyralid	3SL	12	45	190/gal
Treflan* /others (many companies)	trifluralin	EC G	12	_	30-32/gal 1.20-1.30/lb
Trigger (Albaugh)	clethodim	2 EC	24	40	120/gal
UpBeet (DuPont)	trifusulfuron	50 DF	4	60	20/oz
Vaquero (Wilbur-Ellis)	clethodim	2EC	24	40	-
Volunteer (Tenkoz)	clethodim	2 EC	24	40	80/gal
Warrant (Monsanto)	acetochlor (encapsulated)	3ME	12	70	40/gal

* Or generic equivalent

Rainfastness Guide

Rainfall shortly after application often reduces weed control from postemergence herbicides because the herbicide partially is washed from the leaves. Herbicides vary in absorption rate and the ease of being washed from leaves. The rainfall effect also can vary depending on rainfall amount and intensity. The approximate time between application and rainfall needed for maximum weed control is given in the following table.

Herbicide	Time Between Application and Rain (hours)
Assure II /Targa	1
Betamix	6
Fusilade DX	1
Gramoxone*	4 to 6
Liberty 280	4
Nortron*	6
Poast	1
Roundup*	6 to 12
Select* / Select Max*	1
Stinger*	6
UpBeet	6

*Or generic equivalent

Herbicide Combinations

Sugar beet herbicides may be tank-mixed legally if all herbicides in the mixture are registered for use on sugar beet and if no prohibitions against tank-mixes appear on a label. However, the user must assume liability for any resulting crop injury, inadequate weed control, or illegal and/or harmful residues. When a nonregistered combination is used, none of the manufacturers of the product used in the combination will stand behind its products.

Combinations of postemergence herbicides can improve spectrum and provide greater total weed control, compared with individual treatments. The risk of sugar beet injury also increases with combinations, so combinations should be used with caution.

Roundup* can (and should) be tank-mixed with herbicides to improve control of tough-to-control weeds in 'RR' sugar beet. Roundup* can be applied in combination with Nortron*, Betamix, Stinger* or UpBeet, depending on broadleaf weed species, to improve control in the field. Roundup* also may be tank-mixed with Dual-Magnum, Outlook* and Warrant to provide residual grass and small-seeded broadleaf weed control.

In general, annual grass and broadleaf control from Roundup* will not be antagonized by tank-mix partners, provided Roundup* is applied at full rates. Field research in 2014 suggested that Stinger* may antagonize waterhemp control from Roundup*, although no statistical difference was found from Roundup*-alone herbicide treatments.

Adjuvant applied with postemergence herbicides in tank-mixes with Roundup* is important. Roundup* is very water-soluble. High water solubility causes slow absorption through waxy plant cuticles. Nonionic surfactant (NIS) increases retention of spray droplets and improves control of hard-to-wet species such as lambsquarters.

Most herbicides applied with glyphosate are oil-soluble. Oil adjuvants, including crop oil concentrate (COC) and methylated seed oil (MSO), greatly enhance oil-soluble herbicides but antagonize glyphosate. NIS is less effective with oil-soluble herbicides. MSO-based "high surfactant oil concentrate" adjuvants (HSMOC) contain a higher

* Or generic equivalent

concentration of surfactant than COC and MSO and enhance oil-soluble herbicides such as Nortron*, Betamix, Stinger* or UpBeet without decreasing Roundup* activity and, thus, should be used in tank-mixes with glyphosate.

Always add ammonium sulfate (AMS) to glyphosate. AMS enhances glyphosate absorption and translocation and deactivates antagonistic hard water salts such as Na, Ca, Mg and Fe.

Glyphosate Combined With Other Pesticides

Liquid foliar insecticide and/or fungicide tank-mixes do not antagonize grass or broadleaf weed control from Roundup* and are efficacious against insects and diseases, according to research conducted at NDSU. However, some tank-mix products and combinations have the potential to cause sugar beet injury under certain environmental conditions and at certain growth stages and/or other circumstances.

For example, other herbicides, insecticides and/or fungicides combined with Roundup* are formulated with surfactants that may increase the potential for sugar beet injury. Consider excluding NIS or HSMOC from insecticide containing tank-mixes with Roundup*, especially when applied to cotyledon to two-leaf sugar beet.

Tin fungicides plus sugar beet herbicides, including Roundup*, may cause more sugar beet leaf burn than the tin fungicides alone. Injury tends to increase as the temperature and humidity at application increase. Quadris plus Roundup* (water- based) is safe for sugar beet when applied without NIS or other oil adjuvants. However, Quadris plus other herbicides, such as Betamix, Dual Magnum* or Outlook* (oil-based), typically cause more sugar beet injury than Quadris applied alone.

Roundup* may be applied with clear liquid fertilizers such as 28-0-0 or 10-34-0 but at less than 5 percent volume to volume (v/v) because the salt solution will cause excessive leaf burn, limit translocation of glyphosate and give erratic control of certain broadleaf and grass weeds. Do not use glyphosate with suspension-type liquid fertilizers.

* Or generic equivalent

Physical incompatibility may occur with herbicide, insecticide and/or fungicide tank mixtures and will result in the formulation of gels, creams, oil scums or other precipitates that may or may not be sprayable. If the incompatible tank-mixture is applied over the crop, an uneven spray distribution may occur and result in unacceptable performance.

Herbicide Carryover

Herbicide residue or the persistence of phytotoxic levels of a herbicide for more than one year can be a problem with some of the herbicides used in North Dakota and Minnesota. Herbicide residues are most likely to occur following years with unusually low rainfall because chemical and microbial activity needed to degrade herbicides is limited in dry soil.

Some herbicides, such as Pursuit, Python and Raptor, carry over more in low pH soils, while other herbicides, such as the sulfonylureas Accent, Ally, Beacon and Classic, carry over more in high-pH soils.

Crop damage from herbicide residues can be minimized by the application of the lowest herbicide rate that provides effective weed control, by using band rather than broadcast applications and by moldboard plowing before planting the next crop.

Moldboard plowing reduces phytotoxicity of some herbicides by diluting the herbicide residue in a large volume of soil and by providing untreated surface soil in which sugar beet can germinate and begin growing.

The number of trade names for herbicides and herbicide combinations is increasing each year. The active ingredients of a herbicide should be identified prior to use to avoid unpleasant surprises with unexpected crop injury from carryover. Several herbicides are listed in the following table. These same herbicides could occur in mixtures under different brand names.

Rotation Restrictions for Several Crops

Herbicide	Sugar Beet	Barley	HRS/Drm	Corn	Dry Bean	Potato	Soybean
	----------(months after application)----------						
Acuron/Flexi	**18**	4	4	0	18	10	10
Ally Extra (e) (0.2 oz/A)	**22b**	10	1/10	22	22	22	22
Anthem/Max	**15**	11	4	0	11	4	0
Anthem Flex	**12**	11	1	0	11	4	0
Armezon/Pro (0.5 fl oz)	**18**	3	3	0	18n	9	9
atrazine* (0.38 lb ai)	**NCSb**	NCS	NCS	0	NCS	NCS	10
atrazine* (0.38-0.5 lb ai)	**2CSb**	NCS	2CS	0	2CS	NCS	10
atrazine* (0.5-1 lb ai)	**2CSb**	2CS	2CS	0	2CS	2CS	10
Authority Assist	**40b**	9.5	4	10	4	26	0
Authority Elite	**36b**	4.5	4.5	10	0	4	0
Authority First/Sonic	**30b**	12	4	10	12	18	0
Authority MTZ	**24b**	4	4	10	12	12	0
Autumn Super (i)	**24**	9j	3	1	18	18	2
Balance Flexx (j)	**18**	6	6	0	18	6	6
Banvel[4]* (1 pt)	**NCS**	3d/oz	3d/oz	NCS	NCS	NCS	45d
Banvel[4]*(1 to 2 pt)	**NCS**	NCS	3d/oz	NCS	NCS	NCS	90d
Beyond	**18t**	18t	3	8.5	0	18t	0
Boundary	**18**	8	8	4	12	0	0
BroadAxe XC	**36b**	4.5	4.5	10	0	4	0
Capreno (i)	**18**	10	4	0	18	18	10
Callisto/GT	**18**	4	4	0	18	10	10
Callisto Xtra	**18**	NCS	NCS	0	18	NCS	NCS
Clarity[4]* (8 fl oz)	**4**	22d	22d	4	4	4	4
Clarity[4]*(16 fl oz)	**6**	44d	44d	6	6	6	6
Corvus (i)	**17**	9	4	0	17	17	9
Curtail*/M*	**5**	1	1	1	10.5m	18	10.5m
DiFlexx Duo	**10**	4	4	0	10	10	6
Everest 2.0/Sierra	**NCS**	9	0/4	NCS	9	9	9
Extreme	**40b**	18	4	8.5	4	26	0
Facet L	**24b**	10	0	10	24b	24b	10
Far-Go	**NCS**	0	0	NCS	NCS	NCS	NCS
Fierce	**15**	11	1	7d/1	11	4	0
FirstRate	**30b**	12	4	9	9	18	0
Flexstar/GT 3.5	**18**	4	4	10	0	0	0
Halex GT	**18**	4.5	4.5	0	18	10	10
Harness*	**NCS**	NCS	4	0	NCS	NCS	NCS
Huskie	**9**	0.25	0.25	9	9	9	4
Huskie Complete	**9**	9	3	9	9	18b	9
Impact	**18**	3	3	0	18n	9	9
Instigate	**18**	18	9	0	18	10	10
Laudis	**10g**	4	4	0	10g	10	8
Liberty 280	**0**	2.33	2.33	0	6	2.33	0

*Or generic equivalent

Herbicide	Sugarbeet	Barley	HRS/Drm	Corn	Dry bean	Potato	Soybean
Lumax EZ (<3 pt/A)	**18**	4.5	NCS	0	18	18	NCS
Marvel	**18**	4	4	10	0	0	0
Matrix*	**18**	9/18p	9	0	10	0	4
Metribuzin* (u)	**18**	8u	8u	4	12	12	4
Milestone (b)	**B**	B	B	12b	B	B	B
Nortron*	**0**	12	12	12	12	12	12
Olympus (0.2-0.4oz)	**10**	10	0/4	10	10	B	10
Osprey	**10**	1	0.25	12	3	10	3
PerfectMatch	**9**	9	1	9	10.5	18	10.5
Permit*	**36**	2	2	1	9	9	9
Plateau	**48b**	24	12	36	36	48b	18
PowerFlex HL	**9**	9	1	9	9	9	5
PrePare	**9**	9	0/4	NCS	9	9	9
Prequel	**18j**	9	9	0	18j	6	10
Prowl EC/H2O	**2CS**	NCS	NCS	0s	0	0	0
Pursuit	**40b**	18	4	8.5	4	26	0
Quelex	**15**	0	0	3	9	18	3
Raptor	**18t**	18t	3	8.5	0	18t	0
Raze	**9**	9	0/4	NCS	9	9	9
Realm Q	**18**	9	9	0	18	10	10
Reflex	**18**	4	4	10	0	0	0
Require Q/Resolve Q	**18**	9	9	0	10	0	10
Resicore	**18**	10.5	4	0	18	18	10.5
Revulin Q	**18**	10	10	0	18	10	10

Rimsulfuron* (1 oz DF/A)	**10j**	9	9	0	10	0	10
Sharpen (1 fl oz/A) (v)	**4**	0	0	0	4	4	0-1
Sharpen (2 fl oz/A) (v)	**5**	0	0	0	5	5	1-2
Sharpen (3 fl oz/A) (v)	**6**	0	0	0	6	6	2-3
Solstice	**18**	4	4	0	18	10	10
Sonalan	**2CS**	NCS	NCS	NCS	0	NCS	0
Spartan Charge	**24b**	4	4	4	0	4	0
Spartan Elite	**36b**	4.5	4.5	10	0	4	0
Starane Flex	**9**	0	0	3	9	9	9
Status (h)	**4**	4	1	0.25	4	4	4
Stinger*	**0**	0	0	0	10.5m	18	10.5m
SureStart II	**26b**	NCS	4	0	12/18	18	NCS
Surpass*	**NCS**	NCS	4	0	NCS	NCS	NCS
Surveil	**30b**	B	3	9	9	18	0
Talinor	**15**	1	1	0	9/12a	9	10
Tordon (1.5 oz)	**2CS**	NCS	NCS	2CSx	2CS	2CS	2CS
Travallas (e)	**B**	1day	1day	12	22	B	12
Treflan* (y)	**2CS**	NCS	NCS	NCS	0	0	0
TripleFlex II	**26b**	NCS	4	0	12/18	18	NCS
Valor/Chateau (2 oz/A)	**4**	3	14d	1	3	0	0
Varisto	**18t**	18t	3	8.5	0	18t	0
Varro	**9**	9	3	9	9	18b	3
Widematch*	**0**	0	0	0	10.5	18	10.5
Wolverine Advanced	**9**	1	1	9	9	9	4
Zidua (2 oz)	**12**	11	1	0	11	4	0

Zidua (4 oz)	**15**	18	6	0	11	4	4
Zidua Pro	**40b**	18	4	8.5	11	26	0

*Or generic equivalent

NCS = Next cropping season after herbicide application.
2CS = Second cropping season after herbicide application.
MAA = months after application.

Field Bioassay Instructions – Refer to the label or paragraph Y6 in the Narrative Section of the "North Dakota Weed Control Guide."

a Refer to label - rotation restriction may be adjusted based on herbicide rate, rainfall, tillage, soil type, soil pH and bioassay.

B or b = Bioassay. Do not plant until field bioassay indicates it is safe. Crop rotation after atrazine* is rate and soil pH dependent.
Python, Hornet and SureStart/TripleFlex = 26-month rotation + successful field bioassay.
FirstRate = 30-month rotation + successful field bioassay. Pursuit = 40-month rotation + successful field bioassay.

c Requires thorough tillage and 12 inches of rain.

d days

e Above soil pH 7.9, soil bioassay must be performed.

g Cumulative precipitation between application and planting of dry beans, pea and sugar beet is 20 inches. 10 MAA rotation interval applies to all dry bean types except red kidney and cranberry (18 MAA). Thorough tillage must precede planting of sugar beet.

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h Any rotational crop may be planted 120 days following application of dicamba at 1.5 pt/A or less, excluding days when ground is frozen. For all crops and rates greater than 1.5 pt/A allow 45 days per 1 pt/A of dicamba used excluding days when ground is frozen.

i Crops with a nine- or 10-month rotation restriction require 15 inches of cumulative precipitation after application. Crops with a 17- or 18-month rotation restriction require 30 inches of cumulative precipitation after application. Soil at 7.5 pH or above require crop rotation to be extended from nine or 10 months to 17 or 18 months and from 17 or 18 months to 24 months.

j Requires 15 inches of cumulative precipitation during the growing season following application. An 18-month restriction applies to Prequel and rimsulfuron* applied above rates indicated or if drought follows application. Refer to label if higher rates are used.

k See label - 0.2 oz/A has less restrictive rotation restrictions than at higher rates. Requires 24 inches of accumulated precipitation.

m Do not plant dry bean, dry pea, soybean or sunflower for 18 months on soil with less than 2 percent OM and rainfall less than 15 inches during the 12 MAA OR may be planted 12 MAA if risk of injury is acceptable. Perform a field bioassay prior to planting for areas that receive less than 15 inches of rainfall and have less than 2 percent OM. Do not plant lentil, potato or any other broadleaf crop grown for seed for 18 months unless the risk of injury is acceptable.

n Dry bean can be planted after nine months at Armezon/Impact rates of 0.5 fl oz/A or less.
Field pea can be planted after nine months at Armezon/Impact rates of 0.75 fl oz/A or less.

p Barley can be planted nine months after application in Cass, Grand Forks, Pembina, Towner, Traill and Walsh counties of North Dakota. In all other counties of North Dakota, allow an 18-month rotation restriction before planting barley.

s Corn can be planted only if Prowl*/H20 are applied PRE. **Do not apply PPI.**

t Rotation to barley is: 9 months if (>18 inches water + >6.2 soil pH) or (moldboard plow with <18 inches water or <6.2 soil pH) or 18 months if (<18 inches water or soil pH <6.2).
Rotation to potato is: 9 months: soil pH >6.2 and rainfall is >18 inches/year or 18 months: soil pH <6.2 and rainfall is <18 inches/year
Rotation to sugar beet: 18 months: soil pH >6.2 or 26 months if soil pH is <6.2.

u Must add two months if soil pH is 7.5 or above. Wheat and barley can be planted 4 MAA following lentil or soybean.

v Do not include time when soil is frozen. Sunflower and safflower are the most sensitive crops. For Verdict: Fall seeded cereals can be planted four months after application. All crops can be planted the spring following application.

w CRP grasses may be planted 13 MAA, but a field bioassay must be performed prior to planting CRP grasses. The manufacturer assumes no liability for injury. Fall is recommended as the best time to plant CRP grasses.

x Do not plant corn or sorghum until soil samples analyzed for Tordon residue indicates no detectable levels present. Restriction is based on nonlegal herbicide residue that may be found in corn and sorghum and not on crop safety.

y Oats, sorghum and annual or perennial grass crops may be planted at least 12 MAA in areas that received 20 inches or more of precipitation during the growing season. CRP grasses may be planted 18 MAA if Treflan* is spring-applied or 21 MAA if fall-applied.

z For rotation to field pea in 10.5 months, precipitation must be greater than 7 inches during the 10.5 months following application and greater than 5.5 inches of precipitation from June 1 to Aug. 31 following application. Otherwise allow 18 months.

*Or generic equivalent.

Relative Response of Weeds to Soil Residual Herbicides Applied PPI, PRE or EPOST[a]

Herbicide	Barnyardgrass	Buckwheat, wild	Buffalobur	Cocklebur, common	Foxtail	Kochia	Lambsquarters	Mallow, common	Mustard, wild	Nightshade, E. black	Oat, wild	Pigweed, prostrate	Pigweed, redroot	Ragweed, common	Smartweed	Sunflower, volunteer	Thistle, Canada	Thistle, Russian	Waterhemp, (ALS Res.)
Dual Magnum	P-E	N-P	P	N	F-E	N-P	P-F	-	N	N	P-F	F-G	F-G	N	N	N	N	P	F-G
Nortron*	P	F-G	F	P-F	F-G	F-G	P-F	P	P-F	F-G	G	G-E	G-E	P	G-E	P	N	F-G	F-G
Outlook	G-E	N	P	N	G-E	N	F-G	N	P-F	F-G	P-F	-	G-E	N	N	N	N	N	G
Ro-Neet SB	E	P-F	G	P	E	P	F-G	F-G	P	F-G	G	G	G	P	P	N	N	P	F-G
Warrant	E	N	P	N	G-E	P	F	-	P	F-G	P	-	G-E	N	N	N	N	N	G

E = Excellent (90 to 99 percent), G = Good (80 to 90 percent), F = Fair (65 to 80 percent), P = Poor (40 to 65 percent), N = None

[a]Tables give a general comparative rating of the relative effectiveness of herbicides to weeds. Under very favorable conditions, control may be better than indicated. Some herbicides rated good to excellent may give erratic or unfavorable results under unfavorable conditions.

* Or generic equivalent

Relative Response of Weeds to POST Herbicides[a]

Weeds	Roundup* (POST only to RR varieties)	Nortron at 32 fl oz/A	Roundup* + Nortron*	Betamix	Betamix + Nortron*	Stinger*	UpBeet	Assure II*, Fusilade DX, Poast, or Select*
Barnyardgrass	E	N	E	P	P	N	N	E
Buckwheat, wild	P-G	-	F-G	F	F-G	F	F	N
Buffalobur	G-E	-	G-E	G	G	F-G	-	N
Cocklebur	E	-	E	F	F	G-E	P	N
Foxtail species	E	N	E	F	F-G	N	N-P	F-E
Kochia	F-E[c]	-	G-E[c]	F-G	F-G	N	F-E[c]	N
Lambsquarters	P-E	P	P-E	P-F	F-G	N	N	N
Marshelder	G-E	-	G-E	G	G	G-E	N	N
Mallow, common	P-G	-	P-G	N	N	F	G	N
Mallow, Venice	G-E	-	G-E	P	P	P	F	N
Mustard, wild	G-E	-	G-E	G-E	G-E	N	G-E	N
Nightshade, eastern black	P-G	-	F-G	F-G	G	G-E	F	N
Oat, wild	G-E	N	G-E	N	N	N	N	G-E[c]
Pigweed, redroot	E	N-P	E	F-G	G	N	F	N
Ragweed, common	F-E[c]	-	F-E[c]	F	F-G	F-E	F[c]	N
Ragweed, giant	F-E[c]	-	F-E[c]	P	P	F-E	N	N
RR canola	N	P	N	N	N	N	F-G[d]	N
RR corn	N	N	N	N-P	N-P	N	P-F[d]	E[b]
RR soybean	N	N	N	N-P	N-P	G-E	F[d]	N
Sage, lanceleaf	E	-	E	P	P-F	P	N-P	N
Smartweed species	P-E	-	F-E	F	F-G	G	F	N
Sunflower, common	G-E	-	G-E	P	P	G	N	N
Thistle, Canada	G-E	N	G-E	N	N	F-G	N	N
Thistle, Russian	G	-	G	P	P	P-F	N-P	N
Velvetleaf	G	-	G	P	P	P	G-E	N
Waterhemp (ALS-Res)	P-F[c]	N-P	P-F[c]	F	F	N	F[c]	N
Wormwood, biennial	F-E	-	F-E	P	P	G-E	N	N

E = Excellent (90 to 99 percent), G = Good (80 to 90 percent), F = Fair (65 to 80 percent), P = Poor (40 to 65 percent), N = No control

[a]Table is a general comparative rating of the relative effectiveness of herbicides to weeds. Under very favorable conditions, control might be better than indicated. Some herbicides rated "good" to "excellent" might give erratic or unfavorable results under adverse conditions or with herbicide-resistance weeds.

[b]Only use Assure II*, Fusilade DX, Select Max or Select* to control volunteer corn.

[c]Resistant biotypes will not be controlled effectively.

[d]Apply first application to small crops (canola 2 lf stage; corn 2 to 3 collar; soybean first trifoliolate stage). Apply one or two additional applications on approximately 10-day intervals following the first application.

*Or generic equivalent

Maximizing Glyphosate (Roundup) Activity – Best Management Practices

1. Use the correct rate
   A. Annual grass species: 0.77 to 0.84 lb ae/A
   B. Annual broadleaf species: 0.98 to 1.125 lb ae/A
   C. Perennial grass and broadleaf species: 1.125 to 3 lb ae/A
2. Apply over small, actively growing annual weeds and at the appropriate stage for perennial weeds. The larger a vegetative plant, the more difficult it is to control.
   A. Annual grass and broadleaves: 1 to 2 inches
   B. Perennial grass and broadleaf weeds: early bud/boot stage to early flowering or in the fall at a minimum-sized plant
   C. Biennial weed species: fall, after a light frost
3. Always add spray-grade AMS fertilizer at 8.5 to 17 lb/100 gal to increase absorption and translocation and to reduce antagonistic effects from hard water and some herbicide formulations. Use AMS replacements or water-conditioning agents at the equivalent rate of 8.5 lb/100 gal.
4. Apply during conditions when plants are growing actively and avoid fluctuation in temperature. Research data show wide temperature changes (>15 F) two to three days prior to and/or after the application are more likely to reduce weed control than consistently cool conditions. For applications to summer annual or spring applications to perennial weed species, do not apply if the daytime low temperature is below 38 F and the daytime temperature does not exceed 45 to 50 F.
5. Apply between 9 a.m. and 5 p.m., especially if velvetleaf, common or giant ragweed are present in the field.
6. Reduce dust during application by reducing travel speed because it inactivates glyphosate. Increasing spray volume and offsetting (perpendicular to first application is ideal) subsequent applications can decrease the inactivation of glyphosate caused by dust. Always allow a rain-free period after application of at least six to 12 hours, regardless of formulation. This is especially important for lambsquarters control.
7. Applying contact herbicides in a tank-mix with glyphosate may result in antagonism and reduce weed control. Increase the glyphosate rate to the highest single application rate and use a high-surfactant methylated oil concentrate (HSMOC) adjuvant when tank-mixing with a contact herbicide.
8. Always add a high-quality nonionic surfactant (NIS) at 0.25 percent v/v to fully loaded formulations (unless the label prohibits), especially to improve lambsquarters control and at 0.25 to 0.50 percent v/v to partially loaded formulations and at 0.5 to 1 percent v/v to nonloaded formulations.

9. Apply at a 5- to 10-GPA spray volume when applying alone or in combination with another systemic herbicide. Apply at a 15- to 40-GPA spray volume when applying in combination with a contact herbicide or when weeds are tall and dense.
10. Do not tank-mix foliar fertilizers unless necessary. Add spray-grade AMS when necessary to mix with foliar fertilizers.
11. Scout for glyphosate resistance. Identify glyphosate-resistant biotypes early (few plants/field) and remove surviving plants from field by hand-pulling.
12. The interval between glyphosate applications should be approximately 14 days, depending on growing conditions, and weed size and density.
13. Glyphosate products are formulated in many different acid-equivalent concentrations. Use acid-equivalent rates of glyphosate when comparing formulations to be confident of applying the correct product rate.
14. Avoid spraying with heavy dew on plants. Excessive dew on plant foliage at application may reduce weed control by diluting droplet concentration.

INSECT MANAGEMENT

Sugar Beet Root Maggot

2019 Fly Activity Forecast

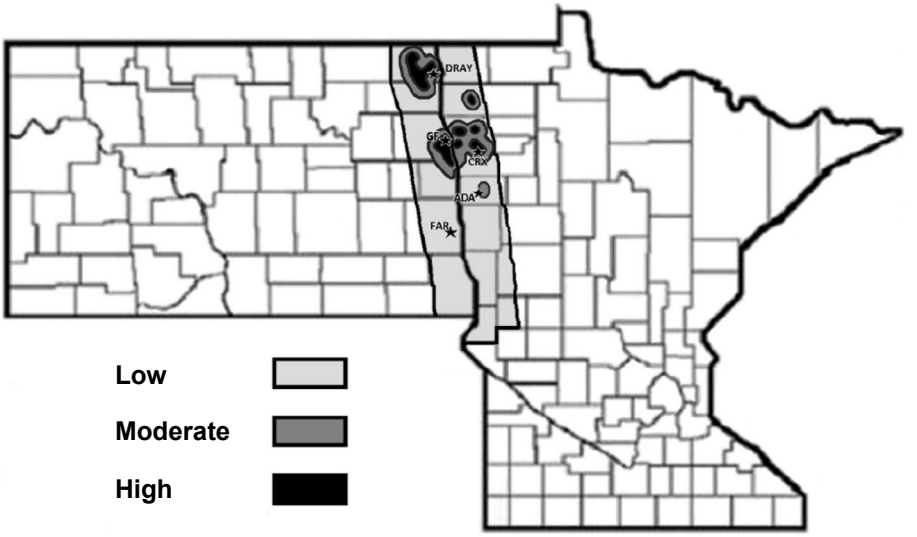
The 2019 sugar beet root maggot (SBRM) forecast map for the Red River Valley (RRV) is shown in the figure below. The significant increases in fly activity and greater-than-expected root injury observed at several RRV locations last year suggest that root maggot infestations in 2019 are expected to be higher than those in recent years.

Areas at highest risk of damaging SBRM infestations include rural Auburn, Bathgate, Bowesmont, Cavalier, Drayton, Grand Forks, Reynolds, St. Thomas and Thompson, N.D., as well as Argyle, Crookston, East Grand Forks, Euclid and Fisher, Minn. Moderate risk is expected in areas bordering those high-risk zones, as well as near Buxton, Cashel, Crystal and Grafton, N.D., and Ada, Eldred and Fisher, Minn. The remainder of the area is at lower risk.

Proximity to previous-year beet fields where SBRM populations were high and/or control was unsatisfactory can increase risk. Sugar beet fields near those where high fly activity occurred in 2018 should be monitored closely in 2019. Growers in high-risk areas should use an aggressive form of at-plant insecticide treatment (granular insecticide) and expect the need for a postemergence rescue insecticide (banded granules or peak-fly spray).

Those in moderate-risk areas using insecticidal seed treatments for at-plant protection should monitor fly activity levels closely in their area and be ready to apply additive protection if justified. Any grower in an area with a history of SBRM problems should pay close attention to fly activity levels in late-May through June to decide if postemergence treatment is needed.

NDSU Entomology will continue to inform growers regarding SBRM activity levels and hot spots each year through radio reports, the NDSU Crop & Pest Report and notification of sugar cooperative agricultural staff when appropriate. Root maggot fly counts for the current growing season and those from previous years can be viewed at www.ndsu.edu/entomology/people/faculty/boetel/flycounts/.



Anticipated risk of SBRM fly activity and damaging larval infestations in the Red River Valley.

Root Maggot Management

Please note the following important terminology used in this guide: 1) **Fly emergence** pertains to the initial appearance of flies emerging from soil in **previous-year** beet fields where they had overwintered as larvae and 2) **fly activity** refers to fly numbers in **current-year** beet fields.

The time between fly *emergence* from previous-year beet fields and *activity* in current-year fields is weather-dependent and varies among years. Forecasts and updates on these events will be provided to growers, personnel in Extension county offices, sugar cooperative agricultural staff and other agricultural professionals by using various media outlets. However, there is no substitute for careful activity monitoring on an individual-field basis.

Cultural Control

Early planting allows for larger beet roots during the period of peak SBRM feeding activity (mid-June to mid-July). Larger roots are more able to withstand feeding injury and can avoid potential yield impacts if adequate rainfall is received.

Roots of smaller, late-planted beets are more vulnerable to feeding injury. Severe injury can kill seedlings and cause major stand reductions or result in smaller, sprangled, bulb-shaped roots at harvest.

Using a **rotary hoe or field harrow** across beet rows in June following egg deposition can help reduce maggot numbers. These tillage practices can move eggs away from beet seedlings and onto the soil surface, which exposes them to predators and the elements. As a result of exposure to heat and dry air, the developing maggots sometimes die before hatch. This cultural strategy works best if hot and dry weather coincides with egg deposition.

Sowing oat **cover crops** immediately before beet planting can reduce SBRM injury to sugar beet roots. Cover crops provide a dense plant canopy and the shading helps keep soils moist. This condition is believed to keep larvae feeding higher in the soil profile (away from tap roots and nearer to insecticide-treated soil). Also, the dense network of oat roots may impair the ability of larvae to locate and feed on beet roots.

Added benefits of cover crops include soil stabilization, protection of beet seedlings from mechanical wind injury and reduced abrasion from wind-blown soil. Cover crops should be killed by applying a grass-killing herbicide during the last week of May or first two weeks of June to avoid sugar beet yield losses due to competition from cover crops for water, sunlight and soil nutrients.

Chemical Control

Suggestions in this guide are based on the assumption that insecticides listed herein will have registration for the suggested use in the current production season. Remember to always **read, understand and follow all** label directions and precautions for the insecticide product you use. Using an insecticide in a manner inconsistent with its label is illegal, and violators may be subject to fines. Nonregistered uses also may result in condemnation of the crop.

Planting-time granular insecticides are important tools for managing sugar beet root maggots in the Red River Valley. A few basic steps in preparation for insecticide applications can increase the probability of accuracy, effectiveness and economical use of these products. Preparation for planting should include serious attention to the following: **1)** accurate calibration, **2)** unrestricted, consistent flow of granules, **3)** even distribution of granules over the row, **4)** adequate incorporation into soil and **5)** protection from wind.

Calibrate all of the planter's granular applicators for the insecticide that will be used and for the exact registered rate needed. This is fairly simple because application rates on granular insecticide labels and in Extension materials are listed in ounces of product per 1,000 row feet. Reconfirming calibration settings for the desired output also is advisable at least once after planting about 50 percent of your anticipated acreage.

Ensure that granules will flow smoothly down the drop tubes. Incorporate insecticide granules well into the upper ¼ inch of soil.

Wind is a perennial challenge to making effective insecticide applications in the Red River Valley. Commonly, as much as 30 percent of the granules can be blown sufficiently far from the furrow to render them ineffective for protecting roots from insect pest injury. As a result, insecticide concentrations applied directly over the rows are greatly diminished.

If winds are too high (20-plus mph), discontinue planting until winds diminish. Calm conditions are more likely to occur during evening and early morning hours, and these times can be more conducive to accurate granule placement when daytime winds are a problem.

The addition of wind shields to planter row units is a practical solution that greatly diminishes the impact of wind on granule placement. **We strongly recommend that wind shields be installed on any sugar beet planter used to apply planting-time soil insecticides.**

Growers anticipating SBRM problems should consider the following management recommendations:

- Apply a granular insecticide application at planting.
- Place granules in 5-inch bands over the row or deliver via "spoon" applicator.
- Incorporate insecticide granules into the upper ¼ inch of soil during application.

Recommended Application Rates for Planting-time Soil Insecticides Based on Expected SBRM Population Level

Insecticide	Rate (lb product/ac) within population level			Timing Options
	Low	Moderate	High	
Counter 20G*	4.5 lb	7.5 lb	8.9 lb	Planting-time or postemergence**
Lorsban 15G	6.7 lb	10.0 lb	13.4 lb	Planting-time or postemergence

*Restricted use pesticide.

**Supplemental labeling for Counter 20G now includes a shortened (90-day) preharvest interval, which, in some years, will allow sufficient time to apply it as a postemergence treatment for sugar beet root maggot control.
Important: Counter can be applied only once per year per field.

Moderate application rates of labeled soil insecticides are recommended in areas where correspondingly moderate SBRM infestation levels are expected. These treatments should be sufficient if adequate soil moisture prevails after planting. High labeled application rates should be used in areas where SBRM populations are expected to be high (see forecast map), especially in areas where SBRM problems were evident during the preceding year.

Replanting Sugar Beet

NDSU research has shown that major yield losses due to SBRM feeding injury are likely if replanting is done without applying a second insecticide treatment in high-risk fields. Beets in replanted fields usually are smaller and more vulnerable to attack during the root maggot larval feeding period than older, more established plants. Therefore, growers in areas where high maggot populations are anticipated are advised to consider two options: 1) apply another granular material at replanting or 2) apply a postemergence liquid or granular insecticide.

Treatment with Counter 20G or Lorsban 15G (and most generic chlorpyrifos-containing granular materials) is limited to one application per year. Therefore, if one of these products was applied at initial planting, another labeled material must be used for re-planting or at postemergence. To avoid future development of insecticide-resistant root maggot strains, rotation to a different active ingredient or even a different chemical class is advised.

Postemergence Insecticides

In areas where moderate to high root maggot infestations are common, additive plant protection may be needed for adequate SBRM control, especially if an insecticidal seed treatment or a low rate of a planting-time insecticide was used for at-plant protection. Consideration of a few factors can help decide whether a postemergence insecticide is needed.

Soil moisture - Good soil moisture enhances the effectiveness of planting-time granular insecticides. Postemergence granules work best under moist soil conditions, and liquids work better than granules in dry soils.

Sugar beet size at peak fly activity - Early planted beets may have sufficient root development and size to withstand some maggot feeding without major yield loss. Therefore, a planting-time granular application may be sufficient. Sugar beet fields in 10- to 14-leaf stages of development or those with an established canopy are generally large enough to withstand moderate levels of feeding. Tolerance to feeding injury can be enhanced with rainfall in early June and through July.

SBRM population level - Growers and crop advisers are encouraged to check individual fields for threatening fly activity levels and to monitor radio, DTN, the NDSU Crop & Pest Report and other media sources for reports on fly activity levels from late May through June.

Postemergence Granules

Any of the following conditions can warrant the use of a postemergence granular insecticide application:

- Replanted beet field (especially if no insecticide was applied during replanting)
- Heavy rainfall after planting (1 to 3 inches or more within first 24 hours or at least 6 inches if received in one or two rainfall events within a week after planting)
- Proximity of current-year beets to previous-year beet fields where high fly populations occurred during the preceding growing season

When a postemergence granular insecticide application is made, a few important factors should be considered. First, granules should be applied around late May or early June and, if possible, ahead of an anticipated rainfall. If optimal timing is in question, erring toward applying granules early is advisable.

Second, granules should be incorporated into the soil. If the soil surface is wet or crusted, drag chains may not sufficiently incorporate the insecticide. Third, moisture is required after the application to move the chemical off its granular carrier and into the soil. Without rain to activate the insecticide, control provided by a postemergence granule likely will be marginal.

Postemergence Liquids

Postemergence liquid insecticides are most beneficial and cost-effective under dry conditions, especially when SBRM fly activity is high. Timing of the liquid spray application is critical. Applications made too early or too late will not produce the desired result and may not be cost-effective.

Liquids work best when applied within three days of (preferably before) peak fly activity. Rain following the application can enhance the performance of foliar insecticides that also have activity against larvae in the soil chlorpyrifos-containing liquid products such as Lorsban Advanced and Lorsban 4E).

If rain is likely five to seven days before peak fly activity, the application should be made before the expected rain. These applications will be more effective if applied at least 24 hours before rain occurs.

The decision to apply liquid chlorpyrifos for fly control and larval suppression following a planting-time granular insecticide should not be made before SBRM fly numbers are estimated. Observation of posted sticky stake capture data can aid in this determination; however, it is no substitute for actual monitoring of individual fields.

If conditions warrant applying a postemergence liquid insecticide, the following recommendations are suggested:

- Apply the insecticide in 7- to 11-inch bands or as a broadcast. If broadcasting, avoid using an exceptionally low (less than 50 percent of labeled maximum) rate.
- Treat slightly (two to four days) before peak fly activity occurs in the current-year beet field.
- If practical, make only one application per season to minimize the likelihood of developing insecticide- resistant root maggot strains.

Insecticides Labeled for Controlling Insect Pests in Sugar Beet

Sugar Beet Root Maggot

Insecticide and Cost	Rate (lb AI/acre)	Remarks/Restrictions
Seed Treatments		
CruiserMaxx Sugarbeets $ /A = 28.00 - 36.00	60-70 g a.i./ 100,000-seed unit	*CruiserMaxx Sugarbeets* is a combination of Cruiser 5FS, Apron XL fungicide and Maxim 4FS fungicide. Apply Cruiser 5FS at 3.39 to 3.95 fl oz per seed unit. See product label for compatible fungicide rates.
NipsIt Inside $ /A = 31.00 - 39.00	60 g a.i./ 100,000-seed unit	For application to seed only by using standard mechanical, slurry or mist-type equipment that can be calibrated to accurately and uniformly apply it. Tank-mixing or using this product with any other product not specifically and expressly authorized by the label shall be the exclusive risk of user, applicator and/or pest management adviser.
Poncho Beta $ /A = 29.00 - 38.00	68 g a.i./ 100,000-seed unit	For application to seed by commercial treaters only. Not for application to seed via hopper-box, slurry-box or similar on-farm seed treatment applicators. Treated areas may be replanted with any crop listed on clothianidin and beta-cyfluthrin labels. Areas planted with treated seed may be replanted immediately with corn or after 30 days with cereal grains, soybeans, dried beans and dried peas.

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Granular Insecticides			
Chlorpyrifos Lorsban 15G $/A = 11.00 - 26. 00 Lorsban 15G Smartbox $/A = 14.50 - 30. 50 generic products $/A = 7.50 - 18. 00	1.0 - 2.0	6.7 - 13.4 lb (4.5 - 9 oz / 1,000 row ft	Apply at planting behind planter furrow openers and ahead of press wheels using band (5-inch) or by using "spoon" applicators. Do not apply in-furrow or modified in-furrow, and do not apply in direct contact with seed. Also may be applied postemergence. Lightly incorporate bands with chains or tines for best results. Do not apply within seven days before sugar beet harvest. Do not apply a liquid form of chlorpyrifos within **10 days** of an at-plant application of a granular chlorpyrifos formulation. **Only one application of granular chlorpyrifos may be made per year. Do not make more than three applications of chlorpyrifos products per season.**
Terbufos Counter 20G Lock 'N Load $ /A = 14.50 - 31.50 *RUP* Counter 20G Smartbox $ /A = 15.00 - 33.00 *RUP*	0.9 - 1.8	4.5 - 8.9 lb (3 - 6 oz / 1,000 row ft)	Apply at planting using 5-inch band, modified in-furrow or "spoon" placement. Avoid direct contact with seed. Also may be banded (5- to 7-inch) over rows at postemergence. Product should be incorporated lightly into soil. Do not harvest sugar beets or feed tops to livestock within 90 days after application. **Only one application may be made per year.** Treated areas must be posted with warning signs.
Thimet 20G $ /A = 13.00 - 21.00 *RUP*	1.0 - 1.5	4.9 - 7.5 lb (3.2 - 5 oz / 1,000 row ft)	Apply in 5- to 7-inch bands over the row and incorporate lightly into soil. Do not apply more than once per year. Do not apply within 30 days of harvest. Treated areas must be posted with **warning signs.**

***RUP* - restricted use pesticide**

Liquid Insecticides Asana XL $/A = 3.25 - 7.25 *RUP*	0.03 - 0.05	5.8 - 9.6 fl oz	Apply postemergence as a band or broadcast when adults are active. Use ground or air equipment and sufficient water (minimum of 2 gal/ac finished spray). Do not apply within 21 days of harvest. To avoid possible crop injury, do **not** tank mix with fungicides containing triphenyltin hydroxide (e.g., "Super Tin").
Chlorpyrifos Lorsban Advanced $/A = 2.20 - 11.00 *RUP*	0.23 - 0.94	0.5 - 2.0 pt	Broadcast or apply in 5- to 7-inch bands. If banding, apply in a minimum spray volume of 7 GPA and do not reduce dose (apply broadcast dose). Do not apply directly in furrow. Apply between seven days before and three days after peak fly activity. Avoid making more than two applications per year when adults are active. If an organophosphate (e.g., Counter, Lorsban) was used at planting, make no more than one application/year. Do not apply more than 6 pt/acre or more than three applications per season. **Do not apply any chlorpyrifos product within 10 days of first post spray or within 10 days after at-plant application of granular chlorpyrifos.**
Lorsban 4E $/A = 2.25 - 11.00 *RUP*	0.25 - 1.00	0.5 - 2.0 pt	
generic products (Govern 4E, Whirlwind 4E, Nufos 4E, Warhawk 4E, etc.) $/A = 2.00 - 9.00 *RUP*	0.25 - 1.00	0.5 - 2.0 pt	
Movento HL $/A = 22.50 - 40.00	0.07 – 0.14	2.25 – 4.5 fl oz	For root maggot suppression. Apply postemergence as a broadcast with ground or air equipment. Must be tank-mixed with a spreading and penetrating adjuvant. Minimum interval between applications is 14 days. Do not apply within 28 days of harvest. Do not apply more than 9 fl oz/ac per crop season.
Mustang Maxx $ /A = 5.25 - 7.25 *RUP*	0.014 - 0.025	2.24 - 4.0 fl oz	Do not apply within 50 days of root or top harvest. Do not apply more than 12 fl oz product per acre per season.

***RUP* - restricted use pesticide**

Wireworms

Wireworms are smooth, somewhat hard-bodied larvae that vary in length from ½ to 1½ inches; however, they are most damaging when they are ½ to ¾ inch in length. They range from yellowish white to bright or deep copper hues. Wireworms feed on a wide variety of crops and weeds, and are difficult to detect and control.

They tend to be more prevalent in light-textured soils and in fields that had a grassy crop the previous season or had not been in crop production for several years. Fields that had grassy weed escapes during the preceding season also are at risk. Frequent tillage helps reduce wireworm problems.

Threshold: No economic threshold has been established for wireworms in sugar beet; however, field history can be a good indicator of risk. The following insecticides should protect sugar beet from wireworm injury. Refer to product labels for more information.

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Seed Treatments			
CruiserMaxx Sugarbeets $ /A = 28.00 - 36.00	60-70 g a.i./ 100,000-seed unit		*CruiserMaxx Sugarbeets* is a combination of Cruiser 5FS, Apron XL fungicide and Maxim 4FS fungicide. Apply Cruiser 5FS at 3.39 to 3.95 fl oz per seed unit. See product label for compatible fungicide rates.
NipsIt Inside $ /A = 31.00 - 39.00	60 g a.i./ 100,000-seed unit		For application to seed only by using standard mechanical, slurry or mist-type equipment that can be calibrated to accurately and uniformly apply it. Tank-mixing or using this product with any other product not specifically and expressly authorized by the label shall be the exclusive risk of user, applicator and/or pest management adviser.
Poncho Beta $ /A = 29.00 - 38.00	68 g a.i./ 100,000-seed unit		For application to seed by commercial treaters only. Not for application to seed via hopper-box, slurry-box or similar on-farm seed treatment applicators. Treated areas may be replanted with any crop listed on clothianidin and beta-cyfluthrin labels. Areas planted with treated seed may be replanted immediately with corn or after 30 days with cereal grains, soybeans, dried beans and dried peas.
Chlorpyrifos (suppression only) Lorsban 15G $/A = 11.00 - 26. 00 Lorsban 15G Smartbox $/A = 14.50 - 30. 50 generic products $/A = 7.50 - 18. 00	1.0 - 2.0	6.7 - 13.4 lb (4.5 - 9 oz / 1,000 row ft	Granular chlorpyrifos products may provide suppression of low to moderate wireworm infestations if banded or applied using "spoon" applicators. Do not apply in-furrow or modified in-furrow, and do not apply in direct contact with seed. Lightly incorporate for best results. Do not apply a liquid form of chlorpyrifos within **10 days** of an at-plant application of a granular chlorpyrifos formulation. **Only one application of granular chlorpyrifos may be made per year. Do not make more than three applications (granular + liquid) of chlorpyrifos products per season.**
Mustang Maxx $ /A = 5.25 - 7.25 *RUP*	0.025	4.0 fl oz	Do not apply within 50 days of root or top harvest. Do not apply more than 0.075 lb active ingredient (or 12 fl oz product) per acre per season.
Terbufos Counter 20G Lock 'N Load $ /A = 14.50 - 31.50 *RUP* Counter 20G Smartbox $ /A = 15.00 - 33.00 *RUP*	0.9 - 1.8	4.5 - 8.9 lb (3 - 6 oz / 1,000 row ft)	Controls wireworms best if applied at planting using spoon or modified in-furrow (2 to 3 inches behind seed-drop) placement. Banding may not provide acceptable control. Avoid direct contact with seed. Incorporate lightly into soil. Only one application may be made per year. Do not harvest beets or feed tops to livestock within 90 days after application. Treated areas must be posted with warning signs.

***RUP* - restricted use pesticide**

Cutworms

Darksided and redbacked cutworms are the most common cutworm pests of sugar beet in the Red River Valley. Eggs of both species hatch into larvae during late May and early June. Fields should be checked frequently during early spring for wilting or dead plants because early detection of injury is essential to good control.

Cutworms can be found within 2 inches of the soil surface near bases of wilting plants. Most feeding occurs at night. Young plants often are cut off near ground level. During periods of dry weather, larvae feed just below the soil surface as they move along the row. They will feed above the soil surface if soil is excessively moist.

Applying insecticides during late afternoon is desirable because it maximizes the amount of insecticide material present during the first nighttime hours following application when larvae are often most active. Applications may be repeated as necessary during peak cutworm feeding.

Liquid formulations generally provide better control of cutworms, especially in dry soils. If severe crusting is evident in the field, the crust should be broken up before or during the insecticide application.

In 2001, variegated and black cutworm infestations caused problems in late July and August. 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. Because variegated cutworms feed above ground, they can be managed effectively by using foliar rescue insecticide applications.

Black cutworms in late-season infestations often feed more than 2 inches below ground. Therefore, late-season control of this species can be difficult and is improbable to achieve.

Threshold: Application of an insecticide labeled for use in sugar beet is advisable in young beets when larval cutting off of seedlings reaches 4 to 5 percent. Control may be justified for late-season infestations of three to five larvae per square foot if they are feeding near or above the soil surface.

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Asana XL $ /A = 3.25 - 7.25 *RUP*	0.03 - 0.05	5.8 - 9.6 fl oz	Apply as an at-plant T-band over open seed furrow or conventional band behind planter rear press wheels. Bands should be 4 to 7 inches wide. Also may be applied postemergence as a band or broadcast treatment. Apply with ground or air equipment using sufficient water to provide uniform coverage (minimum of 2 gal of finished spray per acre). Do not apply within 21 days of harvest. Do not tank mix Asana with fungicides containing fentin hydroxide (triphenyltin hydroxide) such as "Super Tin" because crop injury may result.
carbaryl (Sevin XLR Plus & several generic products) $ /A = varies	1.5	varies	This treatment is most effective against cutworms feeding on upper portions of the plant. Apply up to two times per crop season, but not more often than every 14 days. Do not apply within 28 days of harvest. Do not apply more than 3 pounds of active ingredient per acre per crop per year.
Chlorpyrifos - granular Lorsban 15G $ /A = 17.00 - 26.00 Lorsban 15G Smartbox $ /A = 22.00 - 30.50 generic products $ /A = 11.00 - 18.00	1.5 – 2.0	10.0 - 13.4 lb (6.6 - 9 oz / 1,000 row ft)	Apply in 4- to 5-inch bands (behind planter furrow openers and ahead of press wheels) or by using "spoon" applicators. Do not apply in-furrow or modified in-furrow, and do not apply in direct contact with seed. Also may be applied postemergence. Lightly incorporate bands with chains or tines for best results. Do not apply within seven days before sugar beet harvest. Do not apply a liquid form of chlorpyrifos within 10 days of an at-plant application of a granular chlorpyrifos formulation. **Only one application of granular chlorpyrifos may be made per year. Do not make more than three applications of chlorpyrifos products per season.**

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Chlorpyrifos liquid			
Lorsban Advanced $/A = 2.20 - 11. 00 *RUP*	0.94	2 pt broadcast or 1⅓ pt banded	Broadcast or apply in 5- to 7-inch bands. If banding, apply in a minimum spray volume of 7 GPA and do not reduce dose (apply broadcast dose in bands).
Lorsban 4E $/A = 2.25 - 11. 00 *RUP*	1.0		Do not apply directly in furrow. Do not apply more than 6 pts/acre or more than three applications per season. Do not apply within 30 days of harvest. **Do not apply this or any other chlorpyrifos-containing product within 10 days of first application or within 10 days after an at-plant application of granular chlorpyrifos.**
generic products (Govern 4E, Whirlwind 4E, Nufos 4E, Warhawk 4E, etc.) $/A = 2.00 - 9. 00 *RUP*	1.0		
Methomyl			Apply for *variegated cutworm* control. Do not feed tops to livestock within 30 days of last application. Field re-entry interval is 48 hours. Do not make more than 10 applications per crop. Do not apply within 21 days of root harvest or 30 days of harvest for tops. Do not apply more than 15 pts of Lannate LV per acre per crop. Do not apply more than 5 lb of Lannate SP per acre per crop.
Lannate LV $ /A = 10.00 - 14.00 *RUP*		1.5 pt	
Lannate SP $ /A = 13.00 - 14.50 *RUP*		1.5 pt	
Mustang Maxx $ /A = 5.25 - 7.25 *RUP*	0.014 - 0.025	2.24 - 4.0 fl oz	Do not apply within 50 days of root or top harvest. Do not apply more than 0.075 lb active ingredient (or 12 fl oz product) per acre per season.

***RUP* - restricted use pesticide**

Springtails

Springtails that damage Red River Valley beet fields are tiny (1/32 to 3/32 inch long), wingless, white to cream-colored insects with fleshy, forward-pointed antennae. Species that affect valley beets are subterranean, spending their entire life below the soil surface. They are most harmful to seedlings, and injury ranges from a few brown feeding punctures to extensive root scarring, severed tap roots and seedling death. Symptoms include wilted plants and stand loss, often in patches of 0.3 to 5 acres.

Fine-textured soils with high organic matter content are conducive to springtail problems. Early planted fields, especially in years 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.

Insecticides registered for use in sugar beet against other soil-dwelling pests can be used for springtail control; however, manufacturers are not legally bound to guarantee acceptable control if springtail control is not listed on the product label. NDSU research indicates the following:

Counter 20G provides good springtail control at rates between 0.9 and 1.5 lb AI (4.5-7.5 lb product) per acre.

Some growers have reported unsatisfactory control from Mustang Maxx. To maximize performance, apply it:

1. Directly in-furrow at planting using conventional nozzles (not microtubes)
2. At full rate of 4 oz. of product per acre and
3. Tank-mixed with strained 10-34-0 starter fertilizer at a ratio of 60:1 (fertilizer to insecticide)

Lorsban 15G and chlorpyrifos-based generics do not provide adequate protection from springtail injury.

CruiserMaxx, NipsIt Inside and Poncho Beta seed treatments also provide good springtail control.

NOTE: Seed treatment insecticides reportedly have failed to control springtails in the MonDak area. The alleged failures could have resulted from extremely high infestations, or possibly could have involved a different springtail species from those that occur in the Red River Valley. Please report suspected failures to Mark Boetel at NDSU.

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Counter 20G Lock 'N Load $ /A = 14.50 - 26.50 *RUP* Counter 20G Smartbox $ /A = 15.00 - 28.00 *RUP*	0.9 - 1.5	4.5 - 7.5 lb (3 - 5 oz / 1,000 row ft)	Apply at planting time using band (5-inch), modified in-furrow or "spoon" placement. All applications should be incorporated lightly into soil. Avoid direct contact with seed. Only one application may be made per year. Do not harvest beets or feed tops to livestock within 90 days after application. Treated areas must be posted with warning signs.
CruiserMaxx Sugarbeets (seed treatment) $ /A = 28.00 - 36.00	60-70 g a.i./ 100,000-seed unit		CruiserMaxx Sugarbeets is a combination of Cruiser 5FS, Apron XL fungicide and Maxim 4FS fungicide. Apply Cruiser 5FS at 3.39 to 3.95 fl oz per seed unit. See product label for fungicide rates.
NipsIt Inside (seed treatment) $ /A = 31.00 - 39.00	60 g a.i./ 100,000-seed unit		For application to seed only by using standard mechanical, slurry or mist-type equipment that can be calibrated to accurately and uniformly apply it. Tank-mixing or using this product with any other product not specifically and expressly authorized by the label shall be the exclusive risk of user, applicator and/or application adviser.
Poncho Beta (seed treatment) $ /A = 29.00 - 38.00	68 g a.i./ 100,000-seed unit		For application to seed by commercial treaters only. Not for application to seed via hopper-box, slurry-box or similar on-farm seed treatment applicators. Treated areas may be replanted with any crop listed on clothianidin and beta-cyfluthrin labels. Areas planted with treated seed may be replanted immediately with corn or after 30 days with cereal grains, soybeans, dried beans and dried peas.

***RUP* - restricted use pesticide**

Lygus Bugs

Darksided and redbacked cutworms are the most common cutworm pests of sugar beet in the Red River Valley. EggTarnished plant bugs, commonly referred to as "Lygus bugs," occasionally have caused late-season injury to Red River Valley sugar beet fields since the late 1990s. Most feeding injury appears on new leaves and stems emerging from the sugar beet plant crown. Feeding symptoms include leaf curling and wilting, leaf-tip burn, feeding scars on leaf petioles and seepage of a black exudate from petioles of young leaves.

Lygus bugs are sporadic pests in this region. Two to three generations can develop during a single growing season in the Red River Valley. Mild winters or those in which frequent snowfalls provide adequate insulation for overwintering adults, followed by early spring warmups or generally warm growing seasons, increase the likelihood of a third generation being produced. Populations usually build up in other host plant habitats (e.g., alfalfa, canola, small-seeded broadleaf weeds), and then adults migrate to beets in late July through August.

Threshold: Insecticide treatment may be justified if an infestation **exceeds** one Lygus bug per plant (nymphs and adults combined). NDSU research suggests that insecticide treatment is not likely to be economically beneficial if the application is made within three weeks of harvest. The insecticide *preharvest interval* is a critical factor in choosing a product for Lygus bug control because these pests usually infest beets late in the growing season.

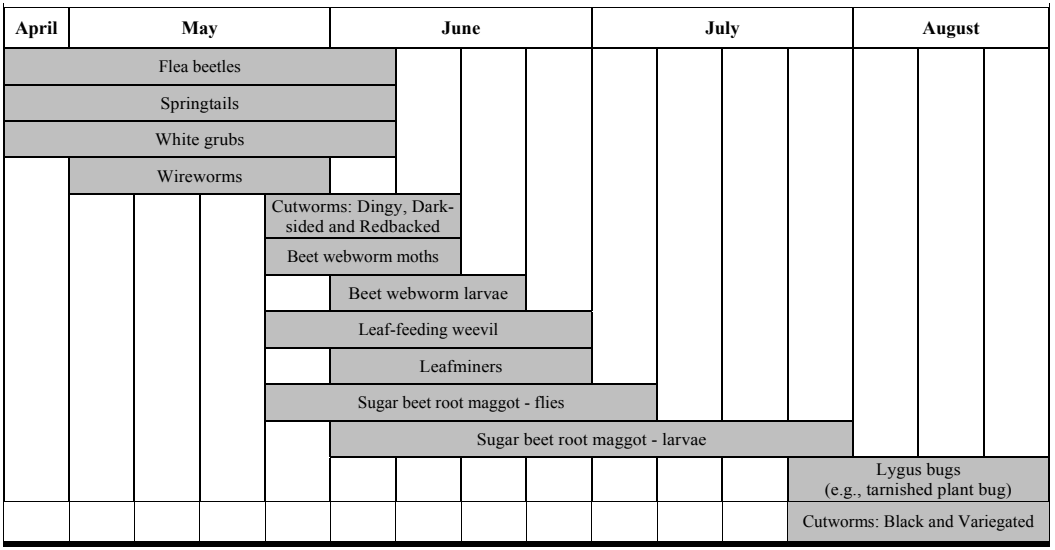
A number of insecticides approved for use in sugar beet have activity against Lygus bugs; however, the most common species that attacks Red River Valley sugar beet fields (*Lygus lineolaris*, the tarnished plant bug) is not listed as a target pest in the sugar beet portion of those labels. Examples include Asana XL, carbaryl (Sevin XLR Plus and several generic products), Lannate LV and Lannate SP. Applying an insecticide to sugar beet is legal when it is labeled for use in the crop; however, if the specific target pest is not listed for sugar beet, effective control is not implied by the manufacturer, and growers who choose to use the product assume all liability for any unsatisfactory performance.

Insecticide and Cost	Rate (lb AI/acre)	Product per Acre	Remarks/Restrictions
Chlorpyrifos liquid			
Lorsban Advanced $/A = 2.20 - 11. 00 *RUP*	0.94	2 pt broadcast or 1⅓ pt banded	Apply as a broadcast treatment. Do not apply more than 6 pt/acre or more than three applications of any chlorpyrifos-containing products per season.
Lorsban 4E $/A = 2.25 - 11. 00 *RUP*	1.0	2 pt broadcast or 1⅓ pt banded	Do not apply within 30 days of harvest. **Do not apply this or any other chlorpyrifos-containing product within 10 days of first application or within 10 days after an at-plant application of granularchlorpyrifos.**
generic products (Govern 4E, Whirlwind 4E, Nufos 4E, Warhawk 4E, etc.) $/A = 2.00 - 9. 00 *RUP*	1.0	2 pt broadcast or 1⅓ pt banded	
Dibrom 8 Emulsive $ /A = 11.00 - 11.75 *RUP*	0.94	1 pt	Apply by air in 1 to 5 gal or by ground in a minimum of 30 gal of finished spray per acre. Do not apply more than 5 pt per acre per season. Do not apply within two days of harvest. Allow a minimum of seven days between applications. Do not make more than five applications per season.

IMPORTANT: Other insecticides labeled for use in sugar beet, but **not** specifically labeled for Lygus control in the crop, are mentioned in the paragraph preceding this table. Please note the disclaimer stated therein if considering them for Lygus bug control in sugar beet.

***RUP* - restricted use pesticide**

Sugar Beet Insect Pest Activity Calendar for the Red River Valley



SUGAR BEET DISEASE MANAGEMENT

I. Seedling and Root Diseases

Aphanomyces typically causes postmergence damping-off, and seedlings are very susceptible when they are 2 to 3 weeks old, especially when soils are wet and warm. Tachigaren (hymexazol) is highly effective against Pythium at lower rates and **Aphanomyces** at higher rates. Tachigaren persists for only three to four weeks and will provide protection only for the emerging seedling; it does not provide full-season protection from Aphanomyces.

Commercial seed treaters apply Tachigaren to sugar beet seeds. Tachigaren can be used at 20 to 30 grams per unit (100,000) of seed on minimum buildup pelleted seed or 45 to 90 grams per unit of seed on standard pelleted seed. Rates greater than 45 grams of Tachigaren per unit of seed may cause phytotoxicity.

The rate of 20 to 30 grams of Tachigaren is recommended on fields with light to medium disease pressure. However, the 20- or 30-gram rate may be inadequate f or medium disease pressure when the soil is warm after a heavy rainfall or when these conditions are prolonged within three weeks after planting. The rate of 45 grams of Tachigaren is recommended for fields with heavy disease pressure.

For season-long management of Aphanomyces, the best approach is to use varieties with partial resistance to Aphanomyces treated with Tachigaren. The sugar factory byproduct "waste lime" at 10 tons/acre is very effective against Aphanomyces for up to 10 years. Early planting and good drainage also may help reduce early season losses from Aphanomyces seedling disease. An Aphanomyces soil test should be done to determine if the soil is infested with Aphanomyces and the level of infection.

Rhizoctonia can cause pre- and postmergence damping-off of the seedlings when the soils are warm and moist. In severely infested fields, plant resistant varieties early, avoid "hilling" soil on sugar beet crowns, increase the length of rotation and rotate with nonhost crops such as small grains.

Seed treatment such as Kabina ST (Penthiopyrad), Vibrance (Sedaxane) or Systiva (Fluxapyroxad) will provide early season protection for about four to five weeks. Products such as Rizolex (Toclofosmethyl) provide some level of protection. Other products may be labeled but do not provide effective control of *R. solani*. Quadris (azoxystrobin), including generics such as Aframe, Satori and AZteroid, and Headline (pyraclostrobin), applied in-furrow will provide early season control. In-furrow-applied fungicides can affect stands under cold and dry conditions, especially when used with a starter fertilizer.

Rhizoctonia also can be managed by applying Quadris, Priaxor (fluxapyroxad + pyraclostrobin) or Proline (prothiconazole) in a 7-inch band over the crowns from the four- to eight-leaf stage. Broadcast application is not as effective as band application. These fungicides provide better protection when application is done just prior to a ¼- or ½-inch rainfall. Fields with a history of severe disease may need a second post-application in warm and wet conditions for season-long control.

Rhizomania (crazy root) is caused by the *beet necrotic yellow vein virus* (BNYVV), which is transmitted by the soil-borne protozoan vector *Polmyxa betae*. The vector can survive in soil or root debris. High soil moisture and warm temperature will favor the vector to transmit BNYVV into plants as they infect roots.

Rhizomania is characterized by stunted taproots with masses of hairy lateral roots, giving them a bearded appearance. The root often is constricted and the vascular tissues become discolored. The leaves, with elongated petioles, become fluorescent yellow, similar to nitrogen deficiency symptoms.

Rhizomania can be managed by early planting of approved resistant varieties in well-drained fields on a three- to four- year rotation. Select varieties with high resistance levels for areas with a known history of severe Rhizomania. Recent research shows that new strains of this virus are developing; these strains may overcome the existing resistance in the current cultivars. Please let your agriculturist know if you suspect Rhizomania in your field(s).

Fusarium yellows and Fusarium yellowing decline typically are caused by the fungus *Fusarium oxysporum* f. sp.*betae* and *F. secorum*, respectively. Fusarium yellows/yellowing decline may cause seedling death or poor growth and even death of older plants.

Symptoms first appear on older leaves as chlorosis (yellowing) between the larger veins. As the disease progresses, younger leaves also become chlorotic, and the older, symptomatic leaves become necrotic. Occasionally, only half of a leaf is chlorotic or necrotic (a symptom more typical of Verticillium wilt, which also was identified recently on sugar beet in this region). Entire leaves eventually die but remain attached to the plant and collapse in a heap around the crown.

No external root symptoms are associated with Fusarium yellows/yellowing decline. A transverse section through the root shows a grayish-brown vascular discoloration. Infection of mature plants may not cause death, but the disease causes significant reduction in root yield and recoverable sucrose. In storage, the quality of infected roots may deteriorate more rapidly, compared with non-infected roots.

The disease is favored by high soil temperatures. Fields that are waterlogged or have poor soil structure provide favorable conditions for infection. Crop rotation may reduce inoculum buildup in the soil, but this practice is unreliable because the pathogens have a wide host range and chlamydospores can survive for many years. Use approved Fusarium-resistant varieties to manage this disease. See publication PP1247 for more information on Fusarium yellows of sugar beet.

II. Leaf Spots

Various leaf spot diseases can affect sugar beet.

Cercospora leaf spot, caused by *Cercospora beticola*, is the most common and destructive disease in this area. The severity of Cercospora varies from year to year, depending on weather conditions, inoculum potential and varietal resistance. Cercospora can cause losses in susceptible varieties through reduced tonnage, reduced sucrose content, increased impurities and poorer storage after harvest when the beets are in piles.

Bacterial leaf spot generally does not cause economic damage. Bacterial leaf spot may develop in wet weather; no fungicide is registered for its control. See publication PP1244 for a comparison of Cercospora and bacterial leaf spot in sugar beet.

Leafspot Management

Management of Cercospora requires an integrated approach that includes early incorporation of infected debris, crop rotation, the use of varieties that are less susceptible, disease scouting, timely application of fungicide, adherence to appropriate application intervals and more frequent applications when environmental conditions are favorable for disease development.

Avoid planting next to last year's sugar beet. This is especially important if last year's fields had high levels of Cercospora. In high-risk situations, select approved varieties that are less susceptible than the average.

Begin checking for Cercospora in late June or early July after row closure, making sure to check near last year's fields or shelter belts. The first fungicide application should occur when conditions first favor disease or at disease onset.

If the first application is late, control will be difficult all season, even if shorter than normal application intervals are used once applications start. When conditions favor disease or disease already is prevalent, fungicide applications must be more frequent than when disease pressure is low.

Resistance and Tolerance to Fungicides

The terms "resistance" and "tolerance" often are used interchangeably. However, in the following discussion, they are used with specific different meanings. Resistance is used to indicate that the Cercospora fungus is unaffected by a level of fungicide that previously prevented growth in the laboratory. Tolerance is used to indicate that growth of the Cercospora fungus is reduced in the laboratory by a level of fungicide that previously prevented growth in the laboratory.

Resistant isolates of Cercospora are not controlled by field applications of a fungicide. If tolerant strains are present, a reduced level of control will occur.

The systemic fungicide thiophanate methyl (benzimidazole) has federal registration for Cercospora control and is in the benzimidazole class of fungicides. Thiophanate methyl can be used in a tank-mix with TPTH but only once in a season.

The tank-mix should be used as the first or second fungicide application.

Benzimidazole-resistant isolates grow normally in the laboratory in the presence of 5 parts per million (ppm) of benzimidazole fungicide. Sensitive isolates do not grow at all in the presence of 5 ppm of benzimidazole fungicide. Some isolates of the Cercospora fungus have been found that were resistant to the benzimidazole class of fungicide and tolerant to TPTH.

Strains of Cercospora with tolerance to TPTH were confirmed for the first time in southern Minnesota and the southern Red River Valley in 1994. Tolerance was detected in fields where control was not as good as expected. Such tolerance is difficult to distinguish from inadequate application technique or a late start in application.

Tolerance is best defined as an ability of the fungus to grow in the laboratory in the presence of TPTH at 0.2 or 1 ppm. Sensitive strains do not grow at all when subjected to these levels of TPTH, but tolerant strains grow at a reduced rate, compared with growth in the absence of TPTH. Effective fungicides from different classes should be alternated to delay the development of tolerant or resistant strains of the pathogen.

C. beticola was confirmed to be resistant to QoI fungicides, especially pyraclostrobin, which is found in Headline and Priaxor. Populations resistant to QoI fungicides have the G143A mutation and are not controlled when these fungicides are applied, which may lead to field failures.

Managing Cercospora Leaf Spot With Fungicides

In areas where the *C. beticola* population is sensitive to QoI fungicides, the fungicides Headline, Priaxor, Gem (QoIs), Proline, Inspire XT, Eminent/ Minerva/ Minerva Duo, Topguard (triazoles) and TPTH, and mixtures of TPTH and Topsin, TPTH or Topsin in mixtures with the triazoles or QoIs used in a rotation program, will control Cercospora leaf spot effectively. Because *C. beticola*, under favorable conditions, develops resistance very rapidly to QoI fungicides, we recommend you always mix QoI fungicides with a protectant for control of Cercospora Leaf Spot (CLS). In mixtures, individual fungicides should be used at least at 0.75 to 0.80 times their full labeled rates or at full rates.

In 2016, *C. beticola* populations resistant to QoI fungicides were found throughout the sugar beet production area. Growers should not use QoI fungicides to manage populations with known QoI resistance. Mixtures of fungicides such as TPTH and triazoles, TPTH + Topsin, TPTH + EBDCs, TPTH + Copper, EBDCs + Copper, Triazoles + Copper and triazoles + EBDCs with different modes of action should be used in a rotation program to manage CLS in areas with known QoI resistance. Varieties with higher CLS tolerance also should be used.

If aerial application is made, make sure that areas around power lines and trees are side-dressed by the use of ground equipment. Aerial applicators should use higher water volume to get better coverage. Improperly sprayed areas become focal points for Cercospora spread. Best results with ground equipment are obtained by using high pressure (100 pounds per square inch) and a high volume (20 gal/A) of water.

Preharvest Intervals (PHI): Fungicides may be needed well into September to control Cercospora in some years; stopping the application of fungicides before this time may result in late-season damage that can reduce tonnage, sucrose and quality. Do not allow the PHI to be an excuse for missing an application late in the season. Spraying a field but leaving the headland and a strip (or strips) in the middle untreated may be preferable, thereby allowing pre-pile harvest in untreated areas.

Application Intervals: Generally, the application interval for most of the fungicides recommended is 14 days. During periods of regular rainfall, shorten the application interval to 10 to 12 days. EBDCs (ethylene bisdithiocarbamates) may be required at seven- to 10-day intervals for effective control.

Variety Selection and Cercospora Management: Differences occur in Cercospora susceptibility among approved varieties. Cercospora may be somewhat easier to manage on varieties with higher than average tolerance to Cercospora. Conversely, varieties that are more susceptible than the average may need extra fungicide applications in years that are highly favorable for Cercospora. The use of more tolerant varieties can be an important part of an integrated disease management plan.

Powdery Mildew Control: Mixtures of triazoles or QoIs and sulfur fungicides will provide effective control. See the NDSU publication "Plant Disease Management: Sugar Beet Powdery Mildew" for more information.

Foliar Sprays – Leaf Spots

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
QoIs Azoxystrobin Quadris $/A = 10.20-17.56	9.0 -15.5 fl oz/A	May be applied up to harvest (zero days PHI). Re-entry interval (REI) – four hours	Always alternate with a non-QoI fungicide. Best used in mixtures for effective CLS control.
Pyraclostrobin Headline$/A = 15.47–20.63	9-12 fl oz/A	Seven-day PHI; REI – four hours	Best used in mixtures for effective CLS control.
Priaxor$/A = 22.50-30.00	6-8 fl oz/A	Seven-day PHI; REI – 12 hours	Best used in mixtures for effective CLS control.
Trifloxystrobin Gem $/A = 26.95	3.5 fl oz/A	21-day PHI REI – 12 hours	Best used in mixtures for effective CLS control.
Triazoles Eminent/Minerva $/A = 15.44	13 fl oz/A	14-day PHI REI – 12 hours	Always alternate with a non-triazole fungicide. Best used in mixtures for effective CLS control.
Inspire XT $/A = 17.94	7 fl oz/A	21-day PHI REI – 12 hours	Best used in mixtures for effective CLS control.
Proline $/A = 19.53	5 fl oz/A	Seven-day PHI REI – 48 hours	Best used in mixtures for effective CLS control.
Topguard $/A = 11.33-15.86	10-14 fl oz/A	21-day PHI	Best used in mixtures for effective CLS control.
Minerva Duo $/A = 21.00	16 fl oz/A	14-day PHI; REI – 48 hours	Best used in mixtures for effective CLS control.

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
Benzimidazole			
Topsin M WSB Thiophanate Methyl 85 WDG	0.5 lb/A 0.4 lb/A	Do not apply within 21 days of harvest (21-day PHI).	Resistance to benzimidazole fungicides is common. Use only in a tank-mix with other modes of action.
Topsin M4.5F $/A = 3.44	10 fl. oz/A	REI - 12 hours	Do not exceed one application/year. See text.
EBDC's			
Mancozeb Manzate 75 DF Dithane F-45/M45 Penncozeb DF $/A= Dry 5.10-6.80 $/A = Liquid 8.85-14.75	1.5-2 lb/A 1.5-2 lb/A	Do not apply within 14 days of harvest (14-day PHI). REI - 24 hours	Effective for about seven to 10 days. Do not enter treated areas within 24 hours without protective clothing.

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions	Remarks/Restrictions
Copper			
Champ DP	1.33-3.33 lb/A	0 days	Do not exceed 21 lb/A per year.
Champ WG	2-2.5 lb/A	0 days	
Champ Formula 2 Flowable	1.33-3.33 pt/A	0 days	Do not apply more than 21.7 pt/A per year.
ChampION++	0.75-2 lb/A	0 days	Max amount per year is 26.2 lb/A.
Cuprofix Ultra 40 Disperss	1.29-3.0 lb/A	0 days	Max amount per year is 19.65 lb/A.
Kocide 3000	0.75-2 lb/A	0 days	Do not apply more than 26.2 lbs/A per year.
Mastercop	0.5-1.5 pt/A	0 days	Do not exceed 7.5 pt/A per year.
ET-F	19-38.4 oz/A	0 days	Do not apply more than 7.86 lbs/A.
Badge X2	1-4 lbs/A	0 days	Do not tank mix with Glyphosate.
Badge SC	1-4 fl pt/A	0 days	Do not tank mix with Glyphosate.

$/A = 4.69-18.75

Foliar Sprays – Leaf Spot

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
Triphenyl Tin Hydroxide (TPTH)			Restricted-use pesticide.
Super Tin 80WP $/A = 4.95-6.60	3.75 -5 oz/A	Do not graze or feed beet tops to livestock. REI - 48 hours. Seven-day PHI	Use 5 oz/A rate for WP formulation. Do not enter treated fields within 48 hours of treating without protective clothing.
Agri Tin Super Tin 4L $/A = 4.92-6.56	6-8 fl oz/A		Do not exceed 15 oz/A of TPTH 80 WP or 24 fl oz/A of TPTH 4L per season. Ground application must be with closed

The following are registered fungicides used for controlling Cercospora leaf spot and their class of chemistry:

QoIs	**Sterol Inhibitors**	**Ethylenebisdithiocarbamates (EBDC)**
Gem	Eminent	Mancozeb
Headline/Priaxor	Enable	Penncozeb
Quadris	Minerva/Minerva Duo	
	Proline	
Benzimidazole	Inspire XT	**Triphenyltin Hydroxide (TPTH)**
Topsin M	Topguard	SuperTin
		AgriTin

PS: Products must be labeled before they can be used for controlling disease on sugar beet.

Rhizoctonia Root Rot Control

Fungicide and Estimated Cost $/A	Label Rate/A	Harvest Restrictions (PHI)	Remarks/Restrictions
Quadris/Satori/Aframe $10.42-16.20 (Quadris) $8.98-13.96 (Satori/Aframe)	9.2-14.3 fl oz	May be applied up to harvest (0-day PHI) Re-entry interval (REI) - four hours	In-furrow applications for 22-inch rows; mixing with starter fertilizer not recommended
Xanthion $18-26.50	7.2 - 10.8 fl oz	Seven-day PHI	In-furrow application
AZteroid	11.9 fl oz	0-day PHI	In-furrow application
Quadris/Satori/Aframe $10.42-18.88 (Quadris) $8.98-16.21 (Satori/Aframe)	9.2-16.6 fl oz	0-day PHI	POST Application 7-inch band application in 22-inch rows before average soil temp at 4-inch depth reaches 65 F or four- to eight-leaf stage when an effective seed treatment is used.
Proline $22.27	5.7 fl oz NIS 0.125% v/v	May be applied to seven-day PHI	
Priaxor $22.50-30.00	6-8 fl oz	Seven-day PHI	
AZteroid $14.88-23.63	11.9 fl oz-18.9 fl oz	0-day PHI	

Sugar Beet Crop Record

Field Number	1	2	3	4	5	6
Acres						
Units/A preplant N						
Date N applied						
Units/A phosphate						
Date P applied						
Other fertilizer						
Date applied						
Seed variety						

Field Number	1	2	3	4	5	6
Sprocket size						
Planting date						
Seed spacing						
Pre-emerge insecticide						
Rate/A						
Emergence date						
PPI herbicide						
Rate/A						

Field Number	1	2	3	4	5	6
Post-herbicide						
Rate/A						
Post-herbicide						
Rate/A						
Post-herbicide						
Rate/A						
Post-herbicide						
Rate/A						
Labor costs/A						

Field Number			1	2	3	4	5	6
Fungicide used: Date	Rate/A	App.						
		1.						
		2.						
		3.						
		4.						
Other insecticides								
Rate/A								
Harvest date								
Yield/A; % S								

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NDSU Diagnostic Laboratory 701-231-7854
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PESTICIDE SAFETY RULES

1. Read the label carefully before using the product.
2. Store chemicals under lock and key.
3. Keep chemicals in original containers.
4. Use chemicals only on crops specified and at the correct rate and schedule.
5. Do not eat or smoke while applying pesticides.
6. Wear protective clothing and masks as directed.
7. Wash clothing and your skin immediately if chemicals should come in contact with them.
8. Avoid chemical drift from one crop to another.
9. Keep a record of materials, amounts used and the date of application.
10. Dispose of empty containers in a way that they no longer are hazardous.
11. In case of accidental poisoning, call a physician or take the patient to a hospital immediately.
12. See the inside back cover of this publication for poison control center telephone numbers.

For additional copies of this guide or
suggestions for improvements

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Available on line at www.sbreb.org

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Do not use this publication after Dec. 31, 2019.

USE OF PESTICIDES

The pesticide recommendations in the "Sugar Beet Production Guide" are based on the assumption that all pesticides mentioned will have a registered label with the U.S. Environmental Protection Agency. Pesticides should not be used if they no longer are registered or have not yet received registration for sugar beet. Sugar beet treated with a pesticide not registered for sugar beet may have an illegal residue which, if detected, could cause condemnation of the crop. Nonregistered pesticide is illegal and a user could be subject to a heavy fine even without detectable residue.

All pesticide users should read and understand the pesticide label prior to pesticide use. Inclusion of all label details in the "Sugar Beet Production Guide" is not possible and labels sometimes are modified after the annual guide's printing is completed.

2019

JANUARY 2019

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

FEBRUARY 2019

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24	25	26	27	28		

MARCH 2019

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					1	2
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24	25	26	27	28	29	30
31						

APRIL 2019

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7	8	9	10	11	12	13
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28	29	30				

MAY 2019

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19	20	21	22	23	24	25
26	27	28	29	30	31	

JUNE 2019

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						1
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30						

JULY 2019

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21	22	23	24	25	26	27
28	29	30	31			

AUGUST 2019

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				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

SEPTEMBER 2019

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

OCTOBER 2019

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NOVEMBER 2019

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER 2019

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Poison Control Centers

North Dakota statewide number:
800-732-2200

Minnesota statewide number:
800-764-7661

Fargo Poison Control number:
701-234-5575

Call the nearest poison control center for recommended treatments for any type of pesticide poisoning.

Have pesticide label information available when calling.

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www.sbreb.org

For more information on this and other topics, see www.ag.ndsu.edu/extension

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