

A1698

2018 Sugarbeet Production Guide

DO NOT USE THIS GUIDE AFTER DEC. 31, 2018

NDSU EXTENSION
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UNIVERSITY OF MINNESOTA | EXTENSION

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INTRODUCTION

"Plan for Profitable Sugarbeet 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 sugarbeet production in Minnesota and North Dakota are presented in past issues of the Sugarbeet Research and Extension Reports available at the web site (<http://www.sbreb.org>).

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The pesticide use suggestions in this guide are based on Federal label clearances and on 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.

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FERTILIZING SUGARBEET

NITROGEN & QUALITY: Sugarbeet 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 both root and sugar yield. However, excessive nitrogen increases impurities and decreases sugar content. More precise nitrogen management within each crop in a sugarbeet rotation will help prevent over-application and buildup of nitrogen in the subsoil.

NITROGEN FERTILIZER USE GUIDELINES: Southern Minnesota Beet Sugar Cooperative
110 lb. N/A for 4' depth soil sample or 80 lb N/A for 2' depth soil sample.

- Nitrogen fertilizer recommendations are similar for **American Crystal Sugar Company** and **Minn-Dak Farmers' Cooperative**. Use 130 lb N/A and 100 lb N/A when sampling to 4 ft. and 2 ft. soil depth, respectively. See page 5.
- 65 lb/Acre of nitrogen is required in the 0-2 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 Sugarbeet

Reduce N by 60-80 lb/Acre next season on areas of green sugarbeet tops.

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

Managing N throughout the Rotation Using Precision Agriculture Techniques

Lower residual N levels can be achieved prior to sugarbeet through a rotation managed with precision ag techniques. Residual nitrate levels can be examined site-specifically through either grid or zone-based soil sampling. Use of 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 monitor or remote imagery reveals pattern relationship with landscape, if there is no history or manure use, if the field has a history of relatively low P rates, or if mobile nutrient levels, particularly nitrate, are required.

Nitrogen, Phosphate and Potassium Recommendations for Sugarbeet

Nitrogen		Phosphorus					Potassium			
		-----P Soil Test Levels (ppm)-----					---K Soil Test Levels (ppm)--			
		VL	L	M	H	VH	VL	L	M	H
Soil N + fertilizer N needed*	†Bray-1	0-5	6-10	11-15	16-20	21+	0-40	41-80	81-120	121+
	Olsen	0-3	4-7	8-11	12-15	16+				
lb/a 2'	lb/a 4'	-----P ₂ O ₅ , lb/a-----					-----K ₂ O, lb/a-----			
100 †	130	80	55	35	10	0	110	80	50	0

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

**NOTE: Before making available in excess of 130 lb of soil plus fertilizer N to your beet crop, consult with your agriculturalist, extension agent, or university specialist.

†Use the Olsen P test on soils with pH greater than 7.

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

Sugarbeet is a crop that is especially responsive to banded P placement. It is also 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 Sugarbeet 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 P ₂ O ₅ broadcast. (3 gpa 10-34-0 produces yields equal to recommended broadcast P rates).
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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

It is rare for sugarbeet to 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 K recommendations in the fertilizer recommendation table are listed as the amount to be broadcast. It is recommended 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. Caution with seed applications should be exercised. Applying greater than five pounds per acre of N+K₂O 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/acre	16
18-46-0	Diammonium Phosphate (DAP)	Dry	28 lbs/acre	13
11-52-0	Monoammonium Phosphate (MAP)	Dry	45 lbs/acre	24

ROW WIDTHS AND PLANT POPULATIONS

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 400-600 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 sugarbeet plant population at harvest should be about 175 to 200 uniformly spaced plants per 100 ft. of row. This population should produce very good yields of high quality sugarbeet.

PLANTING RATES & SEED SPACING - 22" 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 26-inch row multiply all table values by 0.85

For 28-inch row multiply all table values by 0.79. 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 Company and Minn-Dak Farmers' Cooperative are available in the Sugarbeet Research and Extension Reports (www.sbreb.org).

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

1. Plant seed 1.00 to 1.25 inches deep for maximum germination and emergence. Use shallow depths for earlier planting.
2. Plant sugarbeet 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.
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 spacing's are correct, equal, and row markers 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 planter with a pressure washer or high pressure air; especially important to wash off all starter fertilizer to prevent corrosion; flush all liquid handling systems.
2. Remove plates and store on a wood dowel hung horizontally.
3. Remove seed plate doors – do not stack 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 owner's manual or on the plates themselves).
10. Grease/Protect electrical harness

Sugarbeet 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

Sugarbeet 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	24
S2 (Yellow)	Hilleshog	11 -14/64	4	125-150
	Maribo	11 -14/64	4	
Pro 200	Betaseed	11.5 -13.5/64	4	96
ELS (Gray Label)	ACH	11.5 -13.5/64	4	

Recommendations for John Deere Maxi II Planter *

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.....	2 - 3 inches of vacuum
LP Pellets	3 - 4 inches of vacuum
XTREME.....	3- 4 inches of vacuum

Sorghum Plate -(A 43066)

Mini Pellets	Not Recommended
Regular Pellets.....	3 - 4 inches of vacuum
Pro200	4 - 5 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 Cattnach, 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 vacuum as necessary.
- 2) It is common for some of the new plates to have the air holes partially blocked with plastic residue from the production process. 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 air hole.**
- 3) Some new planters have small rough areas on casting from production process, file 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 monitor eye in drop tube to make sure it is properly positioned. Seed may bounce off monitor eye assembly if it is twisted slightly out of position.
- 6) In large tank central delivery system remove fuse that controls agitation in tank. If not removed, seeds may be damaged.
- 7) In large tank central delivery system use sorgum 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

Mini Pellets /Agracoat
S1

Plate 4020

Agracoat
S1
Mini Pellets/ Regular
Pellets

Plate 4025

Agracoat
S1
Mini Pellets/ Regular
Pellets
S2
Ag S /ELS
Pro 200
LP Pellets
XTREME

Plate 3622

Regular Pellets
Ag S
S2
Pro200
ELS
LP Pellets
XTREME

White Planter Plates Recommendation

854047

Mini Pellets
Agracoat

N 857115

Regular Pellets

N 856067

Pro200
ELS
LP Pellets
Ag S
S2
XTREME

VACUUM PLANTER COMMENTS

MONSEM NG+:

- 1) Using plates smaller than recommended may result in seed falling off plate when planter bounces in 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 plate.
- 3) When starting out in field, monitor seed discs to ensure seed is staying on plate. Increase vacuum if necessary.

WHITE SEED BOSS:

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

CASE PLANTER:

- 1) Case planter - singulators should be adjusted properly to percentage of hole showing and lubricated to work very freely.
- 2) Case planter may be better to run at a higher vacuum pressure
- 3) Case planter has no agitation in large tank; to compensate run use pure graphite or a graphite/talc blend.

Plate Recommendation

<u>Pellet Size</u>	<u>Plate No.</u>	<u>Vacuum [in inches of water]</u>
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	B 29402	Brown	0.125	12 /64
	John Deere	B 12733		0.125	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. Plate should turn easily by hand.
- 2) Monitor spring on drop tube and keep 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% -----

** 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.
4	17	34	51
5	14	28	42
6	11	22	33
7	10	20	30

-----Time in seconds required to travel a given distance-----

WEED CONTROL

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 sugarbeet. Use maximum Roundup* rates, even in fields with weeds with low-level resistant biotypes since 1 to 2 inch weeds are easier to kill than 3 to 4 inch weeds and dead weeds cannot produce resistant progeny. Research indicates allowing weeds at high density to get larger than 2 inches in height may reduce sugarbeet 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 4-6 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 sugarbeet including corn, soybean, and wheat, is 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 repeating the application as necessary, on approximately 14 to 21 day intervals.

To maximize weed control in conventional sugarbeet, scout fields and apply the first herbicide application when weeds are at the cotyledon to first true leaf stage. Scout the field before making the next herbicide application to determine the effectiveness of the previous application; make sequential herbicide applications on 5 to 7 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 should **NOT** be used which are **NO** longer registered or have not yet received registration for sugarbeet. Sugarbeet treated with a non-registered herbicide may have an illegal residue which, if detected, could cause condemnation of the crop. Non-registered 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 seed-bed 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 sugarbeet 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 October 15 until freeze-up	

Eptam (EPTC) + Ro-Neet SB (cycloate⁸)	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 sugarbeet 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 October 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	Sugarbeet 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 October 15 until freeze-up.	
Nortron* (ethofumesate⁸)	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.

*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. Sugarbeet: Cotyledon up to the 8-leaf stage	Stinger* 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 (triflusalufuron ²)	0.25 to 1.0 oz (0.125 to 0.5 oz)	Annual broadleaf weeds	POST. Weeds: Cotyledon to 2- 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 & phenmediphan ⁵)	0.75 to 7.5 pt (0.06 to 0.6 lb + 0.06 to 0.6 lb)	Annual broadleaf weeds.	POST. Sugarbeet: Cotyledon up to 75 days PHI.	Risk of sugarbeet injury is increased by morning or mid-day application and by certain environments. Split application with reduced rates has reduced sugarbeet injury and increased weed control compared to single full-dose applications. May be mixed with Roundup* + Nortron + HSMOC+ AMS for control of waterhemp.
Betamix + Nortron* (desmediphan & 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 4-leaf stage	Do not add HSMOC or any adjuvant when applying full rates. Allow a 75 day PHI.

<p>Betamix + UpBeet + Stinger* + MSO adjuvant</p> <p><i>or</i></p> <p>Betamix+ Nortron* + UpBeet + Stinger* + MSO adjuvant</p>	<p>Micro-Rate Program 8 to 12 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A</p> <p><i>or</i></p> <p>8 to 12 fl oz + 3 to 4 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A</p> <p>Mid-Rate Program 12 to 16 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A</p> <p><i>or</i></p> <p>8 to 12 fl oz + 3 to 4 fl oz + 0.125 oz + 1.3 fl oz + 2 pt/A</p>	<p>Annual broadleaf weeds and fair to good annual grass control.</p> <p>Generally provides poor control of ALS resistant kochia.</p> <p>Increasing Stinger* rate from 1.3 to 2.6 fl oz will improve control of lanceleaf sage with some risk of increased sugarbeet injury and carryover risk</p>	<p>POST. Sugarbeet: Apply a minimum of three times with subsequent treatments at 5 to 7 day intervals.</p> <p>Micro-rate can be applied starting at cotyledon sugarbeet stage</p>	<p>Use mid-rate program for difficult weed problems or when any application has been delayed.</p> <p>A herbicide for grass control at ½ to 1X normal rate can be added.</p> <p>Nozzle plugging from herbicide precipitation in the spray tank can be reduced by:</p> <ul style="list-style-type: none"> -Mixing in warm water -Raising water pH to 8 or 9 -Remixing UpBeet -Use of grass herbicide -Frequent sprayer cleaning <p>Allow a 75 day PHI unless using Nortron, then 90 day PHI.</p>
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*Or generic equivalent

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. Sugarbeet: 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 either 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. Sugarbeet: 2 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 sugarbeet.
Dual Magnum* (S-metolachlor ¹⁵)	1.33 to 1.67 pt (1.25 to 1.6 lb)		POST. Sugarbeet: 2-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.
Outlook* (dimethenamid-p ¹⁵)	12 to 21 fl oz (0.56 to 0.98 lb)		POST. Sugarbeet: 2- to 8-leaf stage	Lay-by Dual Magnum*, Outlook* or Warrant should be cautiously applied where PPI or PRE Nortron* was used because sugarbeet injury may occur. May be mixed with Roundup* + adjuvant + AMS to provide residual weed control.
Warrant (Acetochlor ¹⁵)	1.25 to 2 qt (0.94 to 1.5 lb)		POST. Sugarbeet: 2- to 8-leaf stage	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 9-leaf through 12-leaf sugarbeet. Allow a 70 day PHI for Warrant

*Or generic equivalent

Roundup Ready Sugarbeet

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks					
Roundup* (glyphosate ⁹) [Only registered brands may be applied to RR sugarbeet]	Maximum single application up to 8 leaf stage = 1.125 lb ae Maximum single application from 8-leaf sugarbeet to canopy closed = 0.77 lb ae See Remarks	Emerged annual and perennial grass and broadleaf weeds.	POST. Sugarbeet: emergence to 30 day PHI Weeds: 1-2 inches in height	Apply only to RR sugarbeet varieties					
					0.77 lb ae	0.84 lb ae	0.98 lb ae	1.125 lb ae	
				<i>lb ae/gal</i>	<i>lb ai/gal</i>	-----fl oz/A-----			
				3	4	33	36	42	48
				3.75	5	26	29	34	38
				4/4.17	5.4/5.1	25/24	27/26	31/30	36/35
				4.5	5.5	22	24	28	32
				4.72	6.3	21	23	27	31
				5	6.1	20	22	25	29
								- Max single appl. from sugarbeet emergence to 8 leaves = 1.125 lb ae - Total maximum from sugarbeet emergence to 8 leaves = 1.96 lb ae - Max single application from 8 leaves to canopy closure = 0.77 lb ae - Total max from 8 leaves to canopy closure = 1.54 lb ae - Total max from sugarbeet 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	

Herbicide	Product/A (lb ai/A)	Weeds	When to Apply	Remarks
Sequence (glyphosate-K ⁹ & S-metolachlor ¹⁵) RR sugarbeet only	2.5 to 3.0 pt/A (0.7 to 0.84 lb & 0.94 to 1.125 lb)	Grass and broadleaf weeds	POST. Sugarbeet: 2-leaf stage to canopy closure	Maximum rate (2 to 8 leaf sugarbeet) = 2.5 pt/A on coarse soils & 3 pt/A on medium to fine soils/. Maximum rate (8 lf 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)	Reentry 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 & phenmediphan	0.65 & 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	90 (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)	Reentry 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 & S-metolachlor	2.25 & 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 is partially washed from the leaves. Herbicides vary in absorption rate and in 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

Sugarbeet herbicides may be legally tank-mixed if all herbicides in the mixture are registered for use on sugarbeet 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 non-registered combination is used, none of the manufacturers of the product used in the combination will stand behind their products.

Combinations of Postemergence Herbicides can improve spectrum and provide greater total weed control compared to individual treatments. The risk of sugarbeet 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' sugarbeet. Roundup* can be applied in combination with Nortron*, Betamix, Stinger* or UpBeet, depending on broadleaf weed species, to improve control in field. Roundup* may also 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 there was no statistical difference 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. Non-ionic 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 enhances 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 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 sugarbeet injury, under certain environmental conditions, 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 sugarbeet injury. Consider excluding NIS or HSMOC from insecticide containing tank-mixes with Roundup*, especially when applied to cotyledon to two leaf sugarbeet.

Tin fungicides plus sugarbeet herbicides including Roundup* may cause more sugarbeet leaf burn than the tin fungicides alone. Injury tends to increase as the temperature and humidity at application increases. Quadris plus Roundup* (water-based) is safe to sugarbeet 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 sugarbeet 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% v/v since the salt solution will cause excessive leaf burn, will limit translocation of glyphosate and will 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 which may or may not be sprayable. If the incompatible tank-mixture is applied over 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, like Pursuit, Python, and Raptor, carry-over more in low pH soils while other herbicides, such as the sulfonylureas Accent, Ally, Beacon, Classic, and others, carry-over more in high pH soils.

Crop damage from herbicide residues can be minimized by 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 sugarbeet 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	Sugarbeet	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
Revolin 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 ND 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 sugarbeet 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 sugarbeet.

- 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 9 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 9 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% 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% OM. Do not plant lentil, potato or any other broadleaf crop grown for seed for 18 months unless risk of injury is acceptable.
- n** Dry bean can be planted after 9 months at Armezon/Impact rates of 0.5 fl oz/A or less.
Field pea can be planted after 9 months at Armezon/Impact rates of 0.75 fl oz/A or less.
- p** Barley can be planted 9 months after application in Cass, Grand Forks, Pembina, Towner, Traill, and Walsh counties of ND. In all other counties of ND 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 sugarbeet: 18 months: soil pH >6.2 or 26 months if soil pH is <6.2.
- u** Must add 2 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 4 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 non-legal 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 August 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 (90-99%), G = (80-90%), F = (65-80%), P = (40-65%), N = None

^aTables 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)	Norton 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	NP	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 – 99%), G=Good (80-90%), F=Fair (65-80%), P=Poor (40-65%), N= No Control

^aTable 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.

^bOnly use Assure II*, Fusilade DX, Select Max or Select* to control volunteer corn

^cResistant biotypes will not be effectively controlled

^dApply first application to small crops (canola 2 lf stage; corn 2 to 3 collar; soybean 1st 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 3.00 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 effect 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 actively growing 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 9:00 AM to 5:00 PM, especially if velvetleaf, common, or giant ragweed are present in the field.
6. Reduce dust during application by reducing travel speed since 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 6 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 non-ionic surfactant (NIS) at 0.25 % v/v to fully loaded formulations (unless the label prohibits), especially to improve lambsquarters control and at 0.25 to 0.50 % v/v to partially loaded formulations and at 0.5 to 1.0 % v/v to non-loaded formulations.
9. Apply in 5 to 10 GPA spray volume when applied alone or in combination with another systemic herbicide. Apply in 15 to 40 GPA spray volume when applied in combination with a contact herbicide or when weeds are tall and dense.

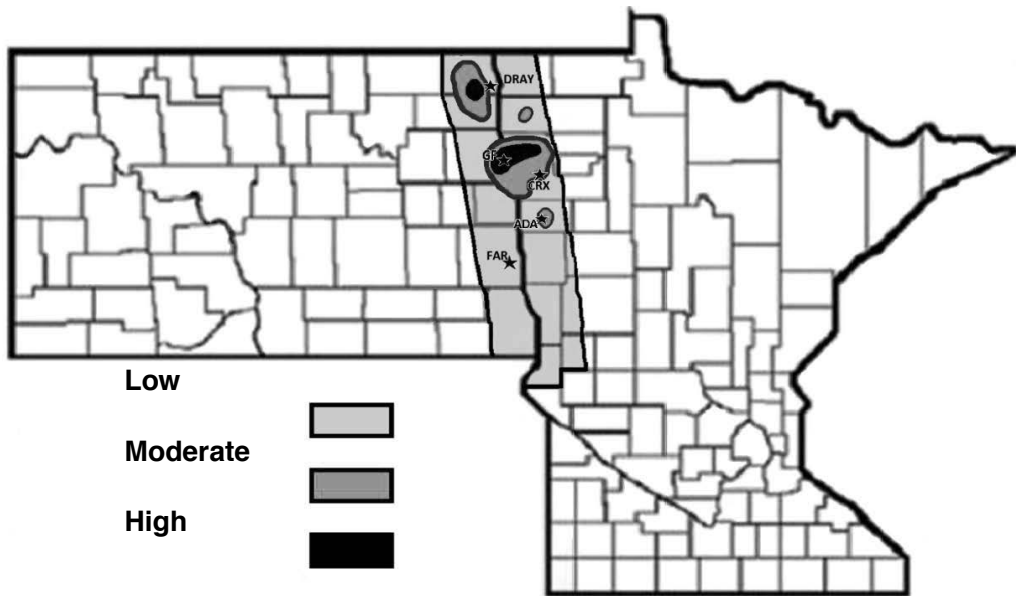
10. Do not tank-mix foliar fertilizers, unless necessary. Add spray grade AMS when necessary to mix with foliar fertilizers.
11. Scout for glyphosate resistance. Identify glyphosate-resistant biotypes early (few plants/field) and remove surviving plants from field by hand-pulling.
12. The interval between glyphosate applications should be approximately 14 days depending on growing conditions, 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

Sugarbeet Root Maggot

2018 Fly Activity Forecast

The 2018 sugarbeet root maggot (SBRM) forecast map for the Red River Valley is shown in the figure below. Areas at highest risk include rural Grand Forks, Merrifield, St. Thomas, and Thompson, ND, as well as East Grand Forks and Euclid, MN. Moderate risk is expected near Auburn, Bathgate, Buxton, and Reynolds, ND, and in the vicinity of Argyle and Climax, MN. Other areas that should be monitored closely this year include Glasston and Oakwood, ND, and Ada, Fisher, and Stephen, MN. The remainder of the area is at lower risk. Root maggot infestations are expected to be lower in 2018 than in the past few years. However, some fields will still be at high risk of damaging infestations this year. SBRM populations can increase rapidly from year to year. Proximity to previous-year beet fields where SBRM populations were high and/or control was unsatisfactory during the previous year increases risk. Sugarbeet fields near those where high fly activity occurred in 2017 should be closely monitored in 2018. Growers in high-risk areas should use an aggressive form of at-plant insecticide treatment (i.e., granular insecticide) and a postemergence rescue insecticide (i.e., banded granules or peak-fly spray). Those in moderate-risk areas using insecticidal seed treatments for at-plant protection should monitor fly activity levels in their area, and be ready to apply additive protection if needed. All growers in known SBRM areas 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 count information for the current season and from previous years can be viewed at: <http://www.ndsu.edu/entomology/people/faculty/boetel/flycounts/>.



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

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 period between *emergence* from old beets and *activity* in current beet fields is weather-dependent and varies among years. Forecasts and updates on these important events will be provided to growers, county extension personnel, sugar cooperative agricultural staff, and other agricultural professionals by using various media outlets. However, there is no substitute for careful evaluation of insect activity 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 either 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 sugarbeet 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 1st two weeks of June to avoid sugarbeet 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. Non-registered use may also result in condemnation of the crop.

Planting-time granular insecticides are important tools for managing sugarbeet 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 since application rates on granular insecticide labels and in extension materials are listed in ounces of product per 1,000 row feet. It is also advisable to reconfirm calibration settings for the desired output at least once after planting about 50% of your anticipated acreage. Ensure that granules will flow smoothly down the drop tubes. Incorporate insecticide granules well into the upper 1/4 inch of soil. Wind is a perennial challenge to making effective insecticide applications in the Red River Valley. Commonly, as much as 30% of the

granules can be blown off the row sufficiently far to render them ineffective for protecting roots from insect pests. As a result, insecticide concentrations applied directly over the rows are greatly diminished. If winds are too high (20+ 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. **It is strongly recommended that wind shields be installed on any sugarbeet planter used to apply planting-time soil insecticides.**

Growers anticipating SBRM problems should consider the following management recommendations:

1. Apply a planting-time granular insecticide application.
2. Place granules in a 5-inch band over the row, or deliver via “spoon” applicator, and incorporate with soil.

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 sugarbeet root maggot control.

IMPORTANT: Counter can only be applied 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 Sugarbeet:

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 are usually 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.

Sugarbeet 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. Sugarbeet 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 advisors 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 consideration of a postemergence granular insecticide application:

1. Replanted beet field (especially if no insecticide was applied during replanting)
2. Heavy rainfall after planting (1 to 3 inches or more within first 24 hours or at least 6 inches if received in 1 or 2 rainfall events within a week after planting)
3. Close proximity of current-year beets to previous-year beet fields where high fly populations occurred during the preceding growing season

When a postemergence application of a granular insecticide 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, it is advisable to err toward applying the granule early. Second, the granules should be incorporated into the soil. If the soil surface is crusted, drag chains will not effectively 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 will likely 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 3 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 (e.g., chlorpyrifos-containing liquid products such as Lorsban Advanced and Lorsban 4E). If rain is likely 5 to 7 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 application of a postemergence liquid insecticide, the following recommendations are suggested:

1. Apply the insecticide in a 7- to 11-inch band or as a broadcast. If broadcasting, do not use a low rate.
2. Treat slightly (2 to 4 days) before peak fly activity occurs in the current-year beet field.
3. 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 Sugarbeet

SUGARBEET ROOT MAGGOT

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		<i>CruiserMaxx Sugarbeets</i> 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 \$ /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 advisor.
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 both 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			
<i>Chlorpyrifos</i> 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. May also be applied postemergence. Lightly incorporate bands with chains or tines for best results. Do not apply within 7 days before sugarbeet harvest. Do not apply a liquid form of chlorpyrifos within <u>10 days</u> 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 3 applications of chlorpyrifos products per season.
<i>Terbufos</i> Counter 20G Lock 'N Load \$ /A = 14.50 - 31.50 Counter 20G Smartbox \$ /A = 15.00 - 33.00	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. May also be banded (5- to 7-inch) over rows at postemergence. Product should be incorporated lightly into soil. Do not harvest sugarbeets 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	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.

INSECTICIDE and COST	RATE (lb AI/acre)	PRODUCT per acre	REMARKS / RESTRICTIONS
Liquid Insecticides			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").
Asana XL \$ / A = 3.25 - 7.25 <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	
<i>Chlorpyrifos</i>			
Lorsban Advanced \$ / A = 2.20 - 11.00 <i>RUP</i>	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 (i.e., apply broadcast dose). Do not apply directly in furrow. Apply between 7 days before and 3 days after peak fly activity. Avoid making over 2 applications per year when adults are active. If an organophosphate (e.g., Counter, Lorsban) was used at planting, make no more than 1 application/year. Do not apply more than 6 pt/acre or more than 3 applications per season. Do not apply any chlorpyrifos product within 10 days of 1st post spray or within 10 days after at-plant application of granular chlorpyrifos.
Lorsban 4E \$ / A = 2.25 - 11.00 <i>RUP</i>	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 <i>RUP</i>	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 <i>RUP</i>	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 1/2 to 1½ inch long; however, they are most damaging when they are between 1/2 to 3/4 inch in length. They range in color 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 are also at risk. Frequent tillage helps reduce wireworm problems. **Threshold:** there is no established economic threshold for wireworms in sugarbeet; however, field history can be a good indicator of risk. The following insecticides should protect sugarbeet from wireworm injury. Refer to product labels for more information.

INSECTICIDE and COST	RATE (lb AI/acre)	PRODUCT per acre	REMARKS / RESTRICTIONS
<i>Chlorpyrifos</i> (suppression only)			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 <u>10 days</u> 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 3 applications of chlorpyrifos products per season.
Lorsban 15G \$/A = 11.00 - 26.00	1.0 - 2.0	6.7 - 13.4 lb (4.5 - 9 oz / 1,000 row ft	
Lorsban 15G Smartbox \$/A = 14.50 - 30.50			
generic products \$/A = 7.50 - 18.00			

INSECTICIDE and COST	RATE (lb AI/acre)	PRODUCT per acre	REMARKS / RESTRICTIONS
Mustang Maxx \$ /A = 5.25 - 7.25 <i>RUP</i>	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.
Counter 20G Lock 'N Load \$ /A = 14.50 - 31.50 <i>RUP</i>	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 (2-3 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.
Counter 20G Smartbox \$ /A = 15.00 - 33.00 <i>RUP</i>			
CruiserMaxx Sugarbeets (seed treatment) \$ /A = 28.00 - 36.00	60-70 g a.i./ 100,000-seed unit		<i>CruiserMaxx Sugarbeets</i> 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 advisor.
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 both 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**

Cutworms

Darksided and Redbacked cutworms are the most common cutworm pests of sugarbeet in the Red River Valley. Eggs of both species hatch into larvae during late May and early June. Fields should frequently be checked 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 are often 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.

It is desirable to apply insecticides during late afternoon. This maximizes the amount of insecticide material present during the first nighttime hours following application, which is 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 effectively managed by using foliar rescue insecticide applications. Late-season infestations of black cutworms often feed more than 2 inches below ground. Therefore, late-season control of this species can be difficult and is improbable to achieve.

Threshold: Control in young beets is suggested when 4 to 5% cutting of seedlings is observed. Control may be justified for late-season infestations of 3 to 5 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 <i>RUP</i>	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 - 7 inches wide. May also 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" as crop injury may result.
<i>carbaryl</i> (Sevin XLR Plus and 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 2 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.
<i>Chlorpyrifos - granular</i> 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. May also be applied postemergence. Lightly incorporate bands with chains or tines for best results. Do not apply within 7 days before sugarbeet harvest. Do not apply a liquid form of chlorpyrifos within <u>10 days</u> 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 3 applications of chlorpyrifos products per season.

INSECTICIDE and COST	RATE (lb AI/acre)	PRODUCT per acre	REMARKS / RESTRICTIONS
<i>Chlorpyrifos - liquid</i>			
Lorsban Advanced \$ / A = 2.20 - 11.00	0.94	2 pt broadcast or 1½ 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 (i.e., apply broadcast dose in bands). Do not apply directly in furrow. Do not apply more than 6 pt/acre or more than 3 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 1st application or within 10 days after an at-plant application of granular chlorpyrifos.
Lorsban 4E \$ / A = 2.25 - 11.00	1.0		
generic products (Govern 4E, Whirlwind 4E, Nufos 4E, Warhawk 4E, etc.) \$ / A = 2.00 - 9.00	1.0		
<i>Methomyl</i>			
Lannate LV \$ / A = 10.00 - 14.00		1.5 pt	Apply for <i>variegated cutworm</i> control. Do not feed tops to live stock within 30 days of last application. Field re-entry interval is 48 hours. Do not make over 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 <u>Lannate LV</u> per acre per crop. Do not apply more than 5 lb of <u>Lannate SP</u> per acre per crop.
Lannate SP \$ / A = 13.00 - 14.50		0.5 lb	
Mustang Maxx \$ / A = 5.25 - 7.25	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 sugarbeet 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.

Mustang Maxx has reportedly provided unsatisfactory control in some cases. To maximize performance, apply Mustang:

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 have reportedly failed to provide springtail control in the MonDak area. The alleged failures could have resulted from extremely high infestations, or possibly could have involved a different species from springtails that occur in the Red River Valley. Please report possible failures to Dr. Mark Boetel.

INSECTICIDE and COST	RATE (lb AI/acre)	PRODUCT per acre	REMARKS / RESTRICTIONS
Counter 20G Lock 'N Load \$ /A = 14.50 - 26.50 <i>RUP</i>	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.
Counter 20G Smartbox \$ /A = 15.00 - 28.00 <i>RUP</i>			
CruiserMaxx Sugarbeets (seed treatment) \$ /A = 28.00 - 36.00	60-70 g a.i./ 100,000-seed unit		<i>CruiserMaxx Sugarbeets</i> 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 advisor.
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 both 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

Tarnished plant bugs, commonly referred to as “Lygus bugs”, have occasionally caused late-season injury to Red River Valley sugarbeet fields since the late-1990s. Most feeding injury appears on new leaves and stems emerging from the sugarbeet 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 warm ups 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. Insecticide *pre-harvest 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 on sugarbeets have activity against Lygus bugs; however, the species that attacks Red River Valley sugarbeet fields (*Lygus lineolaris*, the tarnished plant bug) is not listed as a target pest in the sugarbeet portion of those labels. Examples include Asana XL, carbaryl (Sevin XLR Plus and several generic products), Lannate LV, and Lannate SP. It is legal to apply an insecticide to sugarbeet when it is labeled for use in the crop; however, if the specific target pest is not listed for sugarbeet, 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
<i>Chlorpyrifos - liquid</i> Lorsban Advanced \$/A = 2.20 - 11.00	0.94	2 pt broadcast or 1½ pt banded	Apply as a broadcast treatment. Do not apply more than 6 pt/acre or more than 3 applications of any chlorpyrifos-containing products per season. Do not apply within 30 days of harvest. Do not apply this or any other chlorpyrifos-containing product within 10 days of 1st application or within 10 days after an at-plant application of granular chlorpyrifos.
Lorsban 4E \$/A = 2.25 - 11.00	1.00	<i>RUP</i>	
generic products (Govern 4E, Whirlwind 4E, Nufos 4E, Warhawk 4E, etc.) \$/A = 2.00 - 9.00	1.00	<i>RUP</i>	
Dibrom 8 Emulsive \$/A = 11.00 - 11.75	0.94	1 pt	Apply by air in 1-5 gallons 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 2 days of harvest. Allow a minimum of 7 days between applications. Do not make more than 5 applications per season.

RUP - restricted use pesticide

Calendar of Potential Insect Pest Activity in Red River Valley Sugarbeet Fields											
April	May			June			July			August	
	Flea Beetles										
	Springtails										
	White Grubs										
	Wireworms										
				Cutworms - Dingy, Dark-sided and Redbacked							
				Beet Webworm - adults							
				Beet Webworm - larvae							
				Leaf-feeding Weevil							
				Leafminers							
				Sugarbeet Root Maggot - adults							
				Sugarbeet Root Maggot - larvae							
										Lygus Bugs (incl. Tarnished Plant Bug)	
										Cutworms - Black and Variegated	

SUGARBEET DISEASE MANAGEMENT

I. Seedling and Root Diseases

Aphanomyces typically causes postmergence damping-off, and seedlings are very susceptible when they are 2-3 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 3-4 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 sugarbeet 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 gram of Tachigaren per unit of seed may cause phytotoxicity. Use rate of 20 to 30 grams of Tachigaren is recommended on fields with light to medium disease pressure. Growers with medium disease pressure, however, should be cautioned that use of 20 or 30 gram rate may be inadequate when soil is warm after a heavy rainfall or when these conditions are prolonged within 3 weeks after planting. Use 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 apply Tachigaren to varieties with partial resistance to Aphanomyces. The sugar factory by-product “waste lime” at 10 Tons/Acre is very effective against Aphanomyces. Early planting and good drainage may also 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 both pre- and post-mergence damping-off of the seedlings when the soils are warm and moist. In severely infested fields, plant resistant varieties early, avoid “hilling” soil on sugarbeet crowns, increase the length of rotation, and rotate with non-host crops. Seed treatment such as Kabina ST (Penthiopyrad), Vibrance (Sedaxane) or

Systiva (Fluxapyroxad) will provide early season protection for about 4-5 weeks. Products such as Rizolex (Toclofosmethyl) provide some level of protection. Other products may be labeled but does not provide effective control of *R. solani*. Quadris and generics such as Aframe and Satori (azoxystrobin) and Headline (pyraclostrobin) applied in-furrow will provide early season control. Rhizoctonia may also be controlled by applying Quadris, Priaxor (fluxapyroxad + pyraclostrobin) or Proline (prothiconazole) in a 7 inch band before infection occurs, or when the average daily soil temperature at the 4" depth is about 60° to 62° F. These fungicides provide better protection when application is done just prior to ¼" or ½" 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 *beet necrotic yellow vein virus* (BNYVV) that is transmitted by the soilborne 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 is often constricted and the vascular tissues become discolored. The leaves, with elongated petioles become fluorescent-yellow in color, similar to nitrogen deficiency symptoms. Rhizomania may be managed by early planting of approved resistant varieties early in well drained fields on a 3-4 year rotation. Select varieties with high resistance levels for areas with known history of severe Rhizomania. Recent research shows that new strains of this virus are developing that may overcome the existing resistance in the current cultivars.

Fusarium yellows and Fusarium yellowing decline are typically 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 a leaf is chlorotic or necrotic (a symptom more typical of *Verticillium* wilt, which also was recently identified on sugarbeet in this region). Entire leaves eventually die but remain attached to the plant and collapse in a heap around the crown.

There are no external root symptoms 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, quality of infected roots may deteriorate more rapidly compared to non-infected roots. The disease is favored by high soil temperatures. Fields that are waterlogged, or with 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 circular PP-1247 for more information on *Fusarium* yellows of sugarbeet.

II. Leaf Spots

There are various leaf spot diseases of sugarbeet. 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 Circular PP-1244 for a comparison of *Cercospora* and Bacterial

leaf spots in sugarbeet.

Leafspot Management. Management of Cercospora requires an integrated approach which includes early incorporation of infected debris, crop rotation, use of varieties that are less susceptible, disease scouting, timely application of fungicide, adherence to appropriate application intervals and more frequent applications when disease conditions are favorable. Avoid planting next to last year's sugarbeet. 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 is already prevalent, fungicide applications must be more frequent than when disease pressure is low.

Resistance and Tolerance to Fungicides. The terms "resistance" and "tolerance" are often 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 ppm (parts per million) 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 ppm or at 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 to 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), TPTH, and mixtures of TPTH and Topsin, TPTH or Topsin in mixtures with the triazoles or QoIs used in a rotation program, will effectively control Cercospora leaf spot. Since *C. beticola*, under favorable conditions, develops resistance very rapidly to QoI fungicides, it is recommended to mix QoI fungicides always with a protectant for control of CLS. In mixtures, individual fungicides should be used at least at 0.75 to 0.80 times their labeled full rates or at full rates.

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In 2016, *C. beticola* populations resistant to QoI fungicides were found throughout the sugarbeet 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, 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 should also be used.

The first fungicide used for Cercospora control in 2018 should not be the same fungicide, or a fungicide from the same class of chemistry as the last fungicide application in 2017.

If aerial application is made, make sure that areas around power lines and trees are side-dressed by use of ground equipment. Aerial applicators should use a minimum of 5 gal water/A; 7-10 gal/A gives better coverage. Improperly sprayed areas become focal points for Cercospora spread. Best results with ground equipment are obtained by using

high pressure (100 psi) and high volume (20 gal/A) of water.

Pre-harvest Intervals (PHI). Fungicides may be needed well into September to control *Cercospora* in some years; stopping 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. It may be preferable to spray a field but leave the headland and a strip (or strips) in the middle untreated, 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 application interval to 10 to 12 days. EBDCs may be required at 7 to 10 day intervals for effective control.

Variety Selection and *Cercospora* Management. There are differences in *Cercospora* susceptibility among approved varieties. *Cercospora* may be somewhat easier to manage on varieties with higher than average tolerance to *Cercospora*. Conversely, varieties which are more susceptible than the average may need extra fungicide applications in years that are highly favorable for *Cercospora*. 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 circular PP-967 for more information on powdery mildew.

FOLIAR SPRAYS - LEAFSPOTS

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 (0 d PHI). Re-entry interval (REI) – 4hr	Always alternate with a non- QoI fungicide. Effective for 14 days
Pyraclostrobin Headline\$/A = 15.47–20.63	9-12 fl oz/A	7 d PHI REI – 4hr	Always alternate with a non- QoI fungicide. Effective for 14 days
Priaxor\$/A= 22.50-30.00	6-8 fl oz/A	7 d PHI ; REI – 12hr	Alternate with non-SDHI and non-QoI fungicide
Trifloxystrobin Gem \$/A= 26.95	3.5 fl oz/a	21 d PHI REI – 12hr	Always alternate with a non-QoI fungicide.
Triazoles Eminent/Minerva \$/A = 15.44	13 fl oz/A	14 d PHI REI – 12hr	Always alternate with a non-triazole fungicide
Inspire XT \$/A = 17.94	7 fl oz/A	21 d PHI REI – 12hr	Always alternate with a non-triazole
Proline \$/A = 19.53	5 fl oz/A	7 d PHI REI – 48hr	Alternate with a non-triazole fungicide.
Topguard \$/A = 11.33-15.86	10-14 fl oz/A	21 d PHI	Alternate with non-triazoles.
Minerva Duo \$/A = 21.00	16 fl oz/a	14 d PHI; REI-48hr	Alternate with non-triazole fungicide

FOLIAR SPRAYS – LEAF SPOTS

Fungicide And Estimated cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
Benzimidazole Topsin M WSB	0.5 lb/A	Do not apply within 21 days of harvest (21 d PHI).	Resistance to benzimidazole fungicides is common. Use only in a tank mix with a protectant
Thiophanate Methyl 85 WDG	0.4 lb/A		
Topsin M4.5F \$/A =3.44	10 fl. oz/A	REI - 12 hr	Do not exceed 1 application/year. See text.
EBDC's Mancozeb	1.5-2 lb/A	Do not apply within 14 days of harvest (14 d PHI).	Effective for about 7-10 days. Do not enter treated areas within 24 hours without protective clothing
Manzate 75 DF Dithane F-45/M45 Penncozeb DF			
\$/A = Dry 5.10-6.80 \$/A = Liquid 8.85- 14.75		REI - 24 hr	

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 Dispress	1.29-3.0 lb/A	0 Days	Max amount per year is 19.65 lb/A
Kocide 2000	1.5-3.75 lb/a	0 Days	Additions of spreader/sticker recommended
Kocide 3000	0.75-2 lb/A	0 Days	Additions of spreader/sticker recommended
MasterCrop	0.5-1.5 pt/A	0 days	Minimum retreatment interval is 10 days
Badge X2	1-4 lbs/A	0 Days	Do not tank mix with slyphosate
Badge SC \$/A=4.69-18.75	1-4 fl pt/A	0 Days	Do not tank mix with slyphosate

FOLIAR SPRAYS LEAFSPOT

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		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 graze or feed beet tops to livestock. REI - 48 hr.7 d PHI	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 sugarbeet.

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-d PHI). Re-entry interval (REI) – 4hr	In-furrow applications for 22” rows; mixing with starter fertilizer not recommended
Headline \$15.47-20.63	9-12 fl oz	7-d 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-d PHI	7” band application in 22” rows before average soil temp at 4” depth reaches 65°F or 4-6 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 7-d PHI	
Priaxor \$22.50-30.00	6-8 fl oz	7-d PHI	
AZteroid \$14.88-23.63	11.9 fl oz-18.9 fl oz	0-d 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								

FACTORY DISTRICT REPRESENTATIVES

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PESTICIDE SAFETY RULES

1. Read label carefully before using product.
2. Store chemicals under lock and key.
3. Keep chemicals in original containers.
4. Use chemicals only on crops specified and at 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 skin immediately if chemicals should come in contact with same.
8. Avoid chemical drift from one crop to another.
9. Keep a record of materials, amounts used and date of application.
10. Dispose of empty containers in such a way that they are no longer hazardous.
11. In case of accidental poisoning, call a physician or take patient to a hospital immediately.
12. See inside back cover for poison control center telephone numbers.

For additional copies of this guide or
suggestions for improvements

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Funds were made available for printing of this guide
by “The Sugarbeet Research and Education Board of
Minnesota and North Dakota”.

DO NOT USE THIS PUBLICATION AFTER DECEMBER 31, 2018
USE OF PESTICIDES

The pesticide recommendations in the 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 which are no longer registered or have not yet received registration for sugarbeet. Sugarbeet treated with a pesticide not registered for sugarbeet may have an illegal residue which, if detected, could cause condemnation of the crop. Non-registered 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 Production Guide is not possible and labels sometimes are modified after the annual Production Guide printing is completed.

2018

JANUARY							JULY						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6	1	2	3	4	5	6	7
7	8	9	10	11	12	13	8	9	10	11	12	13	14
14	15	16	17	18	19	20	15	16	17	18	19	20	21
21	22	23	24	25	26	27	22	23	24	25	26	27	28
28	29	30	31				29	30	31				
FEBRUARY							AUGUST						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3			1	2	3	4	
4	5	6	7	8	9	10	5	6	7	8	9	10	11
11	12	13	14	15	16	17	12	13	14	15	16	17	18
18	19	20	21	22	23	24	19	20	21	22	23	24	25
25	26	27	28				26	27	28	29	30	31	
MARCH							SEPTEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3							1
4	5	6	7	8	9	10	2	3	4	5	6	7	8
11	12	13	14	15	16	17	9	10	11	12	13	14	15
18	19	20	21	22	23	24	16	17	18	19	20	21	22
25	26	27	28	29	30	31	23/30	24	25	26	27	28	29
APRIL							OCTOBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7	1	2	3	4	5	6	
8	9	10	11	12	13	14	7	8	9	10	11	12	13
15	16	17	18	19	20	21	14	15	16	17	18	19	20
22	23	24	25	26	27	28	21	22	23	24	25	26	27
29	30						28	29	30	31			
MAY							NOVEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
		1	2	3	4	5				1	2	3	
6	7	8	9	10	11	12	4	5	6	7	8	9	10
13	14	15	16	17	18	19	11	12	13	14	15	16	17
20	21	22	23	24	25	26	18	19	20	21	22	23	24
27	28	29	30	31			25	26	27	28	29	30	
JUNE							DECEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2								1
3	4	5	6	7	8	9	2	3	4	5	6	7	8
10	11	12	13	14	15	16	9	10	11	12	13	14	15
17	18	19	20	21	22	23	16	17	18	19	20	21	22
24	25	26	27	28	29	30	23/30	24/31	25	26	27	28	29

Poison Control Centers

North Dakota state-wide number is:

(800) 732-2200

Minnesota state-wide number is:

(800)764-7661

Fargo Poison Control number is:

(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.

Published with support from
Sugarbeet Research and Education Board
of Minnesota and North Dakota
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