
Hard Red Spring Wheat and Durum Wheat Production Guide (continued)

A-1050, May 1998

Weed Control

Using good cultural practices is one of many methods of controlling weeds. Always plant weed free seed, prevent weed seed proliferation, and clean tillage and harvest equipment between fields to minimize weed infestations. Selective herbicides, if used properly, will control weeds satisfactorily without damaging the crop.

Herbicide effectiveness is influenced by crop tolerance, weed species, and environment. Herbicides are generally most effective when climatic conditions promote vigorous plant growth. Weeds which are growing under environmental stress generally absorb less herbicide and are more difficult to control than actively growing plants. However, crops under stress may be more susceptible to herbicide injury. The ideal temperature for applying most post emergence herbicides is between 65 and 85 F. Herbicides are generally less active at low temperatures than high temperatures (except fenoxaprop and diclofop). Weeds usually die very slowly or not at all if cool weather occurs during and after treatment. Herbicides usually become more active at high temperatures, so crop injury is more likely to occur if herbicides are sprayed on extremely hot days.

Herbicide Resistance

Herbicide resistance has occurred in three weeds of North Dakota:

- Kochia resistance to sulfonylurea herbicides.
- Green foxtail resistance to the dinitroaniline herbicides.
- Wild oat resistance to ACCase inhibitor herbicides.

ALS resistant kochia has moved across much of North Dakota. Extensive use of ALS herbicides has caused resistance to ALS.

ALS herbicides consist of three different classes: 1) Sulfonylurea herbicides, 2) Imidazolinones (Assert, Pursuit and Raptor), and 3) Triazolopyrimidine sulfonanilides (TPS) (Broadstrike/Python, and FirstRate). Common use and repeated exposure of any ALS herbicide to kochia will contribute to resistance if used without following resistant management strategies. This demonstrates the

need to rotate herbicides with different modes of action when planning a long-term weed control strategy.

Trifluralin (DNA) resistant green foxtail has occurred across much of North Dakota where consecutive use of trifluralin was used in small grain crops, row crops, and fallow. Continuous small grains, small grain/fallow, or small grain/ sunflower rotation allows continuous DNA use. Also, the residue resulting from high rates of trifluralin usually applied in sunflower may partially control green foxtail in a successive small grain crop. Continuous use and residue from high rates increases selection pressure for expression of DNA resistant green foxtail.

ACCase resistant wild oat is found mainly within the Red River Valley but has occurred in northern North Dakota. ACCase resistant wild oat is attributed to extensive use of Hoelon and herbicides containing fenoxaprop (Dakota, Puma, Tiller and Cheyenne) for wild oat and grass control in small grains and yearly single and/or multiple applications of Assure II and Poast in sugarbeet.

Herbicide resistant weeds are most likely to develop by using:

- Single-site-of-action herbicides.
- Long residual herbicides.
- Same mode of action herbicides applied over several consecutive years or multiple times during a growing season or with a long residual herbicide.
- Herbicides used as "stand alone" products, without using other weed control options, such as cultivation.

For a thorough discussion on weed resistance and management strategies, refer to the current North Dakota Weed Control Guide, Circular W-253.

Post Applied Herbicides

Weed control from POST herbicides is influenced by crop tolerance, weed species, weed size, and climatic conditions. These factors should be considered in determining the herbicide selection and rate. A range of rates is given for most of the herbicides in this circular. The lowest rate of POST herbicides will be effective under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of drought or prolonged cool weather, or for well established weeds, use the highest suggested labeled rate.

Ideal temperatures for applying most POST herbicides are between 65 and 85 F. Most weeds are killed slowly below 60 F. There is danger of some herbicides injuring crops if applied above 85 F. Avoid applying volatile herbicides such as 2,4-D ester, MCPA ester and dicamba during hot weather, especially near susceptible broadleaf crops, shelterbelts, or farmsteads.

Rainfall shortly after POST herbicide application often reduces weed control because the herbicide is washed off the leaves before absorption is complete. Herbicides vary in rate of absorption and in ease of being washed from leaves; therefore, herbicides vary in

response to rainfall. The amount and intensity of rainfall influence the washing of herbicide from leaves.

Minimum interval between application and rain for maximum POST weed control.

Herbicide	Time Interval	Herbicide	Time Interval
Achieve	1 hr	Harmony Extra	4 hr
Ally	4 hr	Hoelon	1 hr
Amber	4 hr	Landmaster BW	6-12 hr
Assert	3 hr	Liberty	4 hr
Avenge	6 hr	MCPA amine	4-6 hr
Banvel/SGF/Clarity	6-8 hr	MCPA ester	1 hr
Bromoxynil	1 hr	Moxy	1 hr
Bronate	1 hr	Peak	4 hr
Campaign	6-12 hr	Puma	1 hr
Canvas	4 hr	Roundup/RT	6-12 hr
Cheyenne	4 hr	Roundup Ultra/RT	1-2 hr
Curtail/M	6-8 hr	Stampede 80EDF	4 hr
Dakota	1 hr	Stinger	6-8 hr
Express	4 hr	Tiller	1 hr
Finesse	4 hr	Tordon 22K	6-8 hr
Glyphosate	6-12 hr	Touchdown	2 hr
Gramoxone Extra	0.5 hr	2,4-D amine	4-6 hr
Guardzman	4 hr	2,4-D ester	1 hr

Sprayer Clean Out

Crop injury may occur from a contaminated sprayer. The risk of damage is greatest when spraying crops highly susceptible to the previous herbicide and when the previous herbicide is very active in small amounts. Rinsing with water is not adequate to remove all herbicides. Some herbicides have remained tightly adsorbed in sprayers through water rinsing and even through several tank-loads of other herbicides. Then, when a tank-load of solution including an oil adjuvant or nitrogen solution was put in the sprayer, the herbicide was desorbed, moved into the spray solution, and damaged susceptible crops. Highly active herbicides that have been difficult to wash from sprayers and have caused crop injury include Banvel, Pursuit, and sulfonylurea herbicides.

Herbicides that are difficult to remove from sprayers are thought to be attaching to residues remaining from spray solutions that

deposit in a sprayer. The herbicide must be desorbed from the residue or the residue removed in a cleaning process so the herbicide can be removed from the sprayer. Sprayer clean out procedures are given on many herbicide labels and the procedure on the label should be followed for specific herbicides. The following procedure is given as an illustration of a thorough sprayer cleanup procedure that would be effective for most herbicides. Common types of cleaning solutions are chlorine bleach, ammonia, and commercially formulated tank cleaners. Chlorine lowers the pH of the solution which speeds the degradation of some herbicides. Ammonia increases the pH of the solution which increases the solubility of some herbicides. Commercially formulated tank cleaners generally raise pH and act as detergents to help remove herbicides. Read the herbicide label for recommended tank cleaning solutions and procedures.

WARNING: Never mix chlorine bleach and ammonia, as a dangerous and irritating gas will be released.

Sprayers should be cleaned as soon as possible after use to prevent the deposit of dried spray residues. A sprayer should not remain empty over night without cleaning. Fill the tank with water to prevent dried spray deposits from forming. A clean sprayer is essential to prevent damage to susceptible crops from herbicide contamination. See herbicide labels or the current North Dakota Weed Control Guide for more information.

Spray and Vapor Drift

Movement of herbicides off target is a problem in North Dakota as herbicides move from target fields into non-target areas containing crops or other susceptible plant species. (Refer to NDSU Extension Circular A-657, Herbicide Spray Drift for additional information.)

All herbicides can drift as spray droplets, but some herbicides are sufficiently volatile to cause plant injury from vapor or fume drift. Herbicide volatility and consequent risk of damage to susceptible plants increases with increasing temperature. High volatile esters of 2,4-D or MCPA may produce damaging vapors at temperatures as low as 40 F while low volatile esters may produce damaging vapors between 70 and 90 F. Amine formulations are essentially non-volatile even at high temperatures. Temperature on the soil surface is often several degrees warmer than air temperature. Thus, low volatile ester could be exposed to temperatures high enough to cause damaging vapor formation, even when the air temperature is below 70 F. Banvel/SGF/Clarity (dicamba) is also volatile and can drift as droplets or vapor. Herbicide vapor drifts farther and over a longer time than spray droplets. A wind blowing away from susceptible plants during application will prevent damage from droplet drift, but a later wind shift toward the susceptible plants could move damaging vapors to the plants. To minimize the risk of drift injury, 2,4-D ester, Banvel, Banvel SGF, Clarity, and MCPA ester should not be used near susceptible plants.

Damaging drift to non-target plants is primarily a problem with herbicides that are toxic in small amounts, such as 2,4-D, Banvel, Banvel SGF, Clarity, Cyclone CF, Express, Glyphos, Gramoxone Extra, Harmony Extra, MCPA, Pinnacle, Pursuit, Roundup/RT, and Tordon. However, all herbicides may drift and cause significant damage to susceptible nontarget plants, so caution must be observed with all herbicide applications.

Herbicide-Insecticide Combinations — Some combinations have been shown to increase crop injury compared to either pesticide applied alone. Severe crop injury may result from tank-mixing SU herbicides with organophosphate insecticides. Most SU labels do not allow addition of Lorsban or malathion. SU herbicides and insecticides should be tank-mixed only when experience or research indicated crop safety. Do not tankmix Stampede 80EDF + MCPAe + oil additive with any organophosphate or carbamate insecticide as serious crop injury will result. Apply Malathion 14 days after application.

Herbicide + Fungicide Combinations can provide weed control and maintain crop protection from some diseases. Information on pesticide labels usually do give all possible registered combinations for each crop. The following table gives information on many possible combinations.

Herbicide/fungicide combinations for small grains.

Herbicide	Mancozeb	Adjuvant with Mancozeb	Tilt
Ally	not prohibited	yes, if required	not prohibited
Amber	not prohibited	yes, if required	not prohibited
Assert	not prohibited	yes, see label	not prohibited
Avenge	not prohibited	yes, see label	not prohibited
Banvel/SGF	not prohibited	not recommended	not prohibited
Bronate	see product bulletin 2ee	not needed	not prohibited
Buctril	see product	not needed	not prohibited
Cheyenne	PROHIBITED	PROHIBITED	PROHIBITED
Curtail	not prohibited	yes, if required	not prohibited
Dakota	see Dakota label	PROHIBITED	not prohibited
Express	not prohibited	yes, if required	not prohibited
Hrmny Extra	not prohibited	yes, if required	not prohibited
Hoelon	see Hoelon label Spring wheat only	oil additive	not prohibited
MCPA	not prohibited	yes, if required	not prohibited
Stampede	see current label	oil additive only	PROHIBITED
Tiller	see tiller label	PROHIBITED	yes
2,4-D	not prohibited	yes, if required	not prohibited

Herbicide Storage Temperatures

Excess herbicide quantities may be exposed to freezing temperatures in storage. The following information gives the minimum storage temperature to avoid risk of reduced herbicide activity.

Do not store below 40 F

Assert, Avenge, Fallow Master, Landmaster BW, Treflan, Tri-4

Do not store below 32 F

Agri-Dex, Far-Go EC, Gramoxone Extra, Puma, Stampede 80EDF, Stinger,

Do not store below 20 F

Hoelon, Weedar 64

Do not store below 10 F

Cheyenne, Curtail/M, Dakota, Roundup, Tiller.

Do not store below 3 F

Bronate, bromoxnil.

Rotation restrictions for crops grown in North Dakota.

Herbicide	Barley	Flax	Oat	HRS/ Durum
				months
Accent	8	18	8	8
Accent Gold	8	a	8	8
Achieve	1	4	1	1
Ally ^b	10	22 ^c	10	1/10
Amber	18 ^d	a	18 ^d	0
Assert	0	15	15	0
Aatrex/Atrazine	a	a	a	a
Balance	<i>(see label)</i>			
Banvel/SGF (< 0.25 pt/A) ^e	NCS	NCS	NCS	3
Banvel/SGF (> 1 qt/A) ^e	2CS	2CS	2CS	3 ^e
Basis	8	18	8	8
Basis Gold	18	18	18	18
Broadstrike + Dual	4.5	a	4.5	4.5
Broadstrike + Treflan	4	a	18	4

Broadstrike Plus	4	a	4	4
Buckle	0	NCS	16	NCS ^f
Canvas ^b	10	22 ^c	10	1/10
Clarity (< 0.25 pt/A) ^e	NCS	NCS	NCS	3
Curtail/M	1	12	1	1
Exceed	<i>(do not use in North Dakota)</i>			
Far-Go	0	NCS	18	0
Finesse	16	a	10	0
FirstRate	a	a	a	3
Flexstar	4	2	4	4
Harness	NCS	NCS	NCS	4
Hornet	4	a	4	4
Lexone ^g	8 ^g	12	12	8 ^g
Matrix	9	12	9	9
Lightning	9.5	40	18	4
Peak	0	0	0	0
Permit	3	a	3	3
Prowl	NCS	NCS	NCS	NCS
Pursuit	18	26	18	4
Python	4	26 ^a	4	4
Raptor	4	18	9	3
Scorpion III	4	a	4	4
Sencor ^g	8 ^g	12	12	8 ^g
Sonalan	NCS	NCS	NCS	NCS
Stinger	0	10.5	0	0
Surpass	NCS	NCS	NCS	4
Tordon (1.5 oz)	NCS	NCS	NCS	NCS
Treflan/Trifluralin ^h	NCS	0	18	NCS

NCS = Next cropping season after herbicide application.

2CS = Second cropping season after herbicide application.

Field Bioassay Instructions – Refer to label.

- a. Do not plant until field bioassay indicates it is safe. Crop rotation after Aatrex/Atrazine is rate and soil pH dependant.
- b. Do not use on soil with pH greater than 7.9.
- c. Requires 22 months and 22 inches of precipitation west of Hwy 1 or 34 months and 34 inches of precipitation east of Hwy 1.
- d. Barley can be planted 6 months after application west of highway 83 on soil with pH less than 7.9.
- e. Any rotational crop may be planted following an in-crop application of less than 0.25 pt/A and a normal wheat, barley, or oat harvest. If interval before harvest is shortened or if herbicide is fall applied do not rotate to a sensitive crop. For other conditions, allow 45 days per 1 pt/A of Banvel/Clarity or 2 pt Banvel SGF used excluding days when ground is frozen.
- f. Buckle is labeled as a fall treatment in durum wheat and spring PPI application for durum and HRSW (some varieties excluded).
- g. Must add 2 months if soil pH is 7.5 or above. Wheat and barley can be planted 4 months after application following lentils or soybeans.
- h. Oats, sorghum, and annual or perennial grass crops may be planted at least 12 months after application in areas that received 20 inches or more of precipitation during the growing season.

[[CONTINUE](#)] [[INDEX](#)]

A-1050, May 1998

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