Chapter 5 – Weed Control in Dry Edible Beans

This chapter is intended to provide herbicide information for weed control in dry edible beans. To effectively manage weeds, a combination of cultural, chemical, and sometimes even mechanical weed control practices are implemented. Below is a listing of recommendations and considerations that should be followed for effective weed management in dry edible beans.

Recommendations and Considerations:

1. Cultural practices.

A competitive crop can help with weed management in dry beans. Planting dry beans in narrow rows (20-inches or less) improves early-season canopy closure that can help suppress late-emerging weeds.

2. Herbicide-resistant weeds.

Group 2 (ALS) resistant weeds, especially common ragweed and waterhemp, are some of the biggest weed control challenges in dry bean production. Resistance to this group of herbicides and the potential new resistance issues to the **Group 14** (PPO-inhibiting) herbicides can eliminate normally effective herbicides for weed control. It is important to know the specific herbicide site of action (SOA) group(s) that a weed is resistant to in order to select the most effective herbicide for control.

3. Weed control before or at planting.

Effective weed control in dry beans requires that all weeds be controlled prior to dry bean emergence. This is generally accomplished with tillage prior to dry bean planting. However, if weed growth is excessive growers may want to control existing vegetation with a burndown application prior to tillage or planting. Currently, glyphosate, Gramoxone, and Sequence (**Table 5B**) are the only herbicides registered for this use prior to planting dry beans.

4. Soil-applied herbicides.

The use of soil-applied residual herbicides prior to or at dry bean planting is the foundation to an overall season-long weed control program. Soil-applied herbicides can be applied PP, PPI, or PRE. Eptam, trifluralin, and Sonalan need to be incorporated to be effective. Additionally, incorporation can also improve dry bean tolerance to certain herbicides. **Table 5A** provides the effectiveness of soil-applied herbicides and **Table 5B** provides important information on each soil-applied herbicide.

5. Postemergence herbicides.

One postemergence herbicide application will not consistently provide season-long weed control in dry beans. Therefore, it is important that postemergence herbicide applications follow a good soil-applied herbicide program. In some cases, a grower may decide to make two postemergence applications instead. However, all postemergence applications need to be made prior to weeds reaching 2-inches tall. **Table 5A** provides the effectiveness of postemergence herbicides, and **Table 5B** contains important information on each postemergence herbicide. For extended or late-season weed control of grasses and waterhemp, Dual Magnum or Outlook can be tank-mixed and applied with a postemergence herbicide. Consult **Table 5B** for more information.

6. Preharvest herbicide applications.

Preharvest herbicides or “harvest aids” are used to desiccate or dry down “green” plant tissue that can hinder dry bean harvest. The main purpose of these herbicide applications is to desiccate weeds; however, many growers use these herbicide applications to speed up and/or even out the maturing process of dry beans. **Table 5C** provides information on the effectiveness, benefits, and limitations of these applications.

7. Rotation restrictions.

Prior to herbicide use it is always important to determine if the herbicide application that you make this year may affect your crop rotation plan for the following years. **Table 12** provides a complete listing of crop rotation restrictions for all dry bean herbicides.

Abbreviations for this chapter:

Herbicide Formulations: Table 14
Herbicide Sites of Action: Pages 14-15

Application Timings:

PP = preplant
PPI = preplant incorporated
PRE = preemergence
POST = postemergence

Units of Measure:

fl oz = fluid ounces
lb = pounds
oz = ounces
pt = pints
% v/v = % volume/volume

Additives:

AMS = ammonium sulfate
COC = crop oil concentrate
MSO = methylated seed oil
NIS = non-ionic surfactant

Dry Bean Traits:

N = no specific trait required

TABLE 5A — Weed Response to Herbicides in Dry Edible Beans*

			Annual Broadleaves											Annual Grasses								Perennials			
Preplant Incorporated	**Site of Action**	Dry Bean Tolerance**	Cocklebur	Horseweed (marestail)[a]	Jimsonweed	Lambsquarters	Nightshade (E. black)[b]	Pigweed	Ragweed (Common)	Smartweed	Velvetleaf	Waterhemp[c]	Wild mustard	Barnyardgrass	Crabgrass	Giant foxtail	Green foxtail	Yellow foxtail	Fall panicum	Witchgrass	Sandbur	Bindweed (Field & Hedge)	Canada thistle	Quackgrass	Yellow nutsedge
Dual Magnum, others	15	2	N	P	N	P	F	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	**G**
Eptam	15	2	P	N	P	**G**	F	F	F	F	F	P	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	F	F
Outlook	15	3	N	N	N	P	**G**	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
Prowl H_2O/Prowl	3	1	N	P	N	**G**	P	F	P	P	F	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N
Pursuit	2	3	F	N	F	P	**E**	**E**	P	F	F	N	**G**	P	P	F	F	F	P	P	P	N	N	N	F
Sonalan	3	1	N	P	N	**G**	F	**G**	P	P	N	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N
Trifluralin	3	1	N	P	N	**G**	N	**G**	N	P	N	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N
Preemergence																									
Dual Magnum, others	15	2	N	P	N	P	F	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
Outlook[d]	15	4	N	N	N	P	**G**	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
Permit/Sandea	2	3	F	N	F	F	P	**E**	**G**	P	**G**	N	**E**	N	N	N	N	N	N	N	N	N	N	N	F
Pursuit	2	3	P	N	P	P	**E**	**E**	P	F	P	N	**G**	P	P	F	F	F	P	P	P	N	P	N	F
Reflex	14	2	P	N	P	**G**	**E**	**E**	**G**	**G**	P	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N
Sequence	9/15	2	N	P	N	P	F	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
Postemergence																									
Assure II	1	1	N	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	F	**E**	**E**	**E**	N	N	**E**	N
Basagran	6	2	**E**	F	**G**	F	P	P	F	**E**	**G**	N	**E**	N	N	N	N	N	N	N	N	N	**G**	N	**G**
Fusilade DX	1	1	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N
Permit	2	3	**E**	N	**G**	N	P	**E**	**G**	F	**G**	N	**E**	N	N	N	N	N	N	N	N	P	P	N	**E**
Poast	1	1	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	F	N
Pursuit	2	3	F	N	P	P	**E**	**E**	P	F	F	N	**E**	P	P	F	P	P	P	P	P	N	P	N	F
Pursuit + Basagran	2/6	2	**E**	P	**G**	F	**E**	**E**	F	**G**	**G**	N	**E**	P	P	F	P	P	P	P	P	N	**G**	N	**G**
Raptor	2	3	F	N	F	F	**E**	**E**	P	F	**G**	N	**E**	F	P	F	P	P	P	P	P	N	P	N	P
Raptor + Basagran 5L (6.4 fl oz)	2/6	2	**G**	P	F	F/**G**	**E**	**E**	F	**G**	**G**	N	**E**	F	P	F	P	P	P	P	P	N	F	N	F
Raptor + Basagran 5L (12.8 fl oz)[e]	2/6	2	**E**	F	**G**	**G**	**E**	**E**	F	**E**	**G**	N	**E**	P	P	F	P	P	P	P	P	N	**G**	N	F
Reflex	14	2	P	P	F	P	**G**	**G**	**E**	P	P	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N
Reflex + Basagran	14/6	2	**E**	F	**G**	F	**G**	**G**	**E**	**E**	**G**	**G**	**E**	N	N	N	N	N	N	N	N	N	F	N	**G**
Reflex + Raptor	14/2	3	F	P	F	F	**E**	**E**	**E**	F	**G**	**G**	**E**	F	P	F	P	P	P	N	N	N	P	N	P
Select Max	1	1	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N
Varisto	2/6	2	**E**	F	**G**	**G**	**E**	**E**	F	**E**	**G**	N	**E**	P	P	F	P	P	P	P	P	N	**G**	N	F
Postemergence Layby[f]																									
Dual Magnum, others	15	2	N	P	N	P	F	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	**G**
Outlook	15	2	N	N	N	P	**G**	**G**	P	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F

TABLE 5A — Weed Response to Herbicides in Dry Edible Beans*

Herbicide Site of Action: The site of action key is located on pages 14-15. Herbicide Effectiveness: P=Poor; F=Fair; **G**=Good; **E**=Excellent; N=None; – = Not enough information to rank

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (cold, wet); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

a Most horseweed populations in Michigan are resistant to ALS-inhibiting herbicides (Group 2). Herbicides that have this site of action group will not provide control and therefore are rated as no control. The best way to manage horseweed in dry beans is with tillage prior to planting.

b Control of hairy nightshade is **G**ood with Basagran and **E**xcellent with Pursuit or Raptor applied postemergence.

c Most waterhemp populations in Michigan are resistant to ALS-inhibiting herbicides (Group 2). Herbicides that have these site of action groups will not provide control and therefore are rated as no control.

d Outlook is best applied preplant incorporated. Preemergence applications can result in significant injury and delays in dry bean maturity.

e Common lambsquarters will be controlled with this tank-mixture if the weeds are less than 2 inches tall and not under drought stress.

f Postemergence Dual Magnum and Outlook will not control emerged weeds, but will provide resiudal control of the weeds listed above.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Assure II 0.88EC (others)	quizalofop	1	POST	7 fl oz + COC 1% v/v	N

- Assure II provides postemergence grass and volunteer corn control. Refer to Table 5A for weed control and crop tolerance ratings.
- Assure II rates range from 5 to 12 fl oz/A and are based on weed size and sensitivity. Refer to Table 2E for maximum weed sizes.
- Apply Assure II with COC (1% v/v) for best results. NIS (0.25% v/v) may replace COC for certain tank-mixtures (see label).
- Apply 5 fl oz/A of Assure II for volunteer corn control up to 18 inches tall; and 8 fl oz/A for corn up to 30 inches tall. Assure II will not control volunteer Enlist corn.
- Apply a minimum of 8 fl oz/A of Assure II for barnyardgrass and large crabgrass control.
- For perennial grass control, higher rates (10-12 fl oz/A) and sequential applications may be needed.
- Tank-mixtures of Assure II with certain postemergence broadleaf herbicides (Groups 6, 14 and certain Group 2 herbicides) can antagonize grass control.
- Applying Assure II either 1 day before or 7 days after the broadleaf herbicide will prevent the antagonism.
- Increasing the Assure II rate by 2 fl oz/A will also improve grass control in certain tank mixtures (i.e., Basagran).
- DO NOT tank-mix Assure II with Basagran and COC if the temperature exceeds 80 F, as excessive burn can occur.
- DO NOT apply more than two applications or 24 fl oz/A/year.
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

Basagran 4L	bentazon	6	POST	1.5 pt + COC 1 qt	N
Basagran 5L	bentazon	6	POST	1.2 pt + COC 1 qt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Beans must have one fully expanded trifoliate before application.
- Most effective on small weeds. Basagran rates can be reduced to 1 pt/A (4L) or 0.8 pt/A (5L) if weeds are smaller than maximum growth stage (see label).
- AMS (2.5 lb/A) can be used instead of COC for improved velvetleaf control. If common ragweed and common lambsquarters are present a COC must also be included.
- Split applications of 1 pt + 1 pt (4L) or 0.8 pt + 0.8 pt (5L) plus COC (1 pt + 1 pt) can be used for more consistent common ragweed and common lambsquarters control. Make the first application when weeds are less than 1 inch tall, and make second application 10-14 days later.
- For Canada thistle and yellow nutsedge control, apply sequential applications of 1.5 pt + 1.5 pt (4L) or 1.2 pt + 1.2 pt (5L) plus COC (1 qt + 1 qt) when Canada thistle is 6-8 inches and yellow nutsedge is 4-6 inches tall. Make second application 7-10 days later.
- Adequate spray coverage is essential; a minimum of 20 gallons/A of spray solution is recommended.
- MSU research has shown significant dry bean injury from Basagran applications to Adzuki beans and does not recommend this application.
- Tank-mixtures of Basagran 4L at 8-16 fl oz or Basagran 5L at 6.4-12.8 fl oz with Raptor or Pursuit can minimize the risk of dry bean injury compared with either of these herbicides applied alone.
- DO NOT apply if dry beans are under stress from herbicide injury, cold or dry weather, or hail damage.
- DO NOT apply more than 4 pt/A/year (4L) or 3.2 pt/A/year (5L).
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Dual Magnum, EverpreX 7.62EC Dual II Magnum 7.64EC	s-metolachlor	15	PP, PPI, PRE	1.33 pt	N
			POST	1 pt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Application rates range from 1 to 2 pt/A and are based on soil texture and organic matter. Rates for course textured soils are 1 to 1.33 pt/A; medium soils 1.33 to 1.67 pt/A; and fine soils 1.33 to 1.67 pt/A with <3% OM; 1.67 to 2 pt/A >3% OM.
- Preplant incorporated (PPI) applications reduce the risk of injury to dry beans compared with PRE applications.
- DO NOT apply if soil is cracking and beans are in the crook stage.
- Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days.
- Dual provides better yellow nutsedge control than Outlook.
- Prowl, trifluralin or Sonalan can be tank-mixed preplant incorporated for lambsquarters control.
- Pursuit (2 fl oz) can be tank-mixed PRE for nightshade and additional broadleaf control.
- MSU research has shown significant dry bean injury from Dual applications to Adzuki beans and does not recommend this application.

Postemergence: Dual Magnum/Dual II Magnum can only be applied after the first trifoliate stage of growth (V1).

- Postemergence applications will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds, including waterhemp.
- Postemergence applications may result in temporary spotting or browning of dry bean leaves and stunting. Tank-mixtures with other herbicides may increase dry bean injury.
- DO NOT apply EverpreX postemergence. This application timing is currently not listed on the EverpreX label.
- DO NOT apply more than 2 pt/A/year total.
- Preharvest interval (PHI): 50 days
- Refer to Table 12 and the label for crop rotation restrictions.

Eptam 7EC	EPTC	15	PPI only	1.25 qt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Eptam needs to be incorporated immediately after application.
- Eptam suppresses common ragweed and wild mustard.
- Prowl, trifluralin or Sonalan should be tank-mixed with Eptam for additional broadleaf control, including lambsquarters.
- Pursuit (2 fl oz) can be added to tank-mixes with Prowl, trifluralin or Sonalan for nightshade control.
- Pursuit (2 fl oz) may also be applied preemergence after preplant incorporated applications of Eptam tank-mixed with Prowl, trifluralin, or Sonalan. See remarks for Pursuit.
- A postemergence application of Basagran, Pursuit or Raptor may be necessary for additional broadleaf control.
- DO NOT use on adzuki beans.
- Preharvest interval (PHI): 45 days
- Refer to Table 12 and the label for crop rotation restrictions.

Fusilade DX 2EC	fluazifop	1	POST	12 fl oz + COC 1% v/v	N

- Fusilade DX provides postemergence grass and volunteer corn control. Refer to Table 5A for weed control and crop tolerance ratings.
- Fusilade DX rates range from 6 to 12 fl oz/A and are based on weed size and sensitivity. Refer to Table 2E for maximum weed sizes.
- Apply Fusilade with COC (1% v/v) for best results. NIS (0.25% v/v) may replace COC for certain tank-mixtures (see label).
- Apply 6 fl oz/A of Fusilade DX for volunteer corn control from 12 to 24 inches tall. Fusilade DX will not control volunteer Enlist corn.
- For perennial grass control, sequential applications (10-21 days apart) are needed; 12 followed by 8 fl oz/A or 16 followed by 14 fl oz/A for heavy grass pressure.
- Tank-mixtures of Fusilade DX with certain postemergence broadleaf herbicides (Groups 6, 14 and certain Group 2 herbicides) can antagonize grass control.
- Applying Fusilade DX either 1 day before or 7 days after the broadleaf herbicide will prevent the antagonism.
- DO NOT apply more than 24 fl oz/A per application or 48 fl oz/A/year to dry beans.
- Preharvest interval (PHI): 60 days
- Refer to Table 12 and the label for crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Outlook 6EC	dimethenamid-P	15	PP, PPI, PRE	14 fl oz	N
			POST	10 fl oz	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Application rates range from 12 to 21 fl oz/A and are based on soil texture and organic matter.
- PPI applications are safer to dry beans than PRE applications and therefore are recommended.
- Navy and black beans are more sensitive to Outlook applications than Dual Magnum.
- Outlook provides better pigweed and nightshade control than Dual Magnum.
- Prowl, trifluralin or Sonalan can be tank-mixed preplant incorporated for lambsquarters control.
- Pursuit (2 fl oz) can be tank-mixed for nightshade and additional broadleaf weed control.

Postemergence: Outlook can be applied from the first to the third trifoliate (V1-V3) stage of dry bean.
- Postemergence Outlook will not control emerged weeds but will provide residual control of annual grasses and some broadleaf weeds, including waterhemp.
- Postemergence applications may result in temporary spotting or browning of dry bean leaves and stunting. Tank-mixtures with other herbicides may increase dry bean injury.
- Outlook can be applied in two split-applications, 10 to 14 fl oz/A for the first application (PPI) and the remaining 7 to 11 fl oz/A POST, as long as the maximum application rate of 21 fl oz/A/year of Outlook is not exceeded.
- DO NOT use on adzuki beans.
- Preharvest interval (PHI): 70 days
- Refer to Table 12 and the label for crop rotation restrictions.

Permit, Sandea 75DF	halosulfuron	2	PP, PPI, PRE	0.67 oz	N
			POST	0.67 oz + NIS 0.25% v/v	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Reduce the rate of soil-applied Permit/Sandea to 0.5 oz/A on lighter textured soils with low organic matter.
- Soil-applied Permit/Sandea can cause injury under cool-wet growing conditions and may delay dry bean maturity.
- Permit/Sandea applied PPI can be tank-mixed with Eptam for grass and additional lambsquarters control.
- Permit/Sandea can also be tank-mixed with PPI/PRE s-metolachlor products or Outlook for annual grass control.

Postemergence: Apply Permit/Sandea when beans have 1 to 3 trifoliates (V1-V3), but prior to flowering.
- Postemergence applications are most effective on small weeds (less than 2 inches).
- Permit/Sandea can be tank-mixed with other herbicides for additional broadleaf and grass control.
- DO NOT make more than one postemergence application per season.
- Dry bean varieties and classes vary in their tolerance to Permit/Sandea. From MSU research, CAUTION should be taken when applying to kidney and black beans. Under adverse conditions maturity of the treated crop can be delayed which can affect harvest date, yield, and quality.
- DO NOT use on adzuki beans.
- DO NOT make more than two applications of 0.67 oz/A per crop cycle.
- Preharvest interval (PHI): 30 days
- DO NOT plant sugarbeets within 21 months of Permit application. Refer to Table 12 and the label for additional crop rotation restrictions.

Poast 1.5EC	sethoxydim	1	POST	16 fl oz + COC 1 qt + AMS 2.5 lb	N

- Poast provides postemergence grass and volunteer corn control. Refer to Table 5A for weed control and crop tolerance ratings.
- Poast rates range from 12 to 16 fl oz/A and are based on weed size and sensitivity. Refer to Table 2E for maximum weed sizes.
- Apply Poast with COC (1 qt/A) + AMS (2.5 lb/A) or MSO (1.5 pt) + AMS (2.5 lb/A) for best results.
- Apply 24 fl oz/A of Poast to control volunteer and interseeded small grains (barley, oats, rye, and wheat).
- Sequential applications 24 fl oz/A followed by 16 fl oz/A, 7-14 days apart are usually needed for perennial grass control.
- Poast is not as effective for control of volunteer corn or perennial grasses as the other postemergence grass herbicides.
- Tank-mixtures of Poast with certain postemergence broadleaf herbicides (Group 6, 14 and certain Group 2 herbicides) can antagonize grass control.
- Applying Poast either 1 day before or 7 days after the broadleaf herbicide will prevent the antagonism.
- DO NOT apply more than 40 fl oz/A per application or 64 fl oz/A/year.
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Prowl 3.3EC	pendimethalin	3	PPI only	2.4 pt	N
Prowl H_2O 3.8ACS	pendimethalin	3	PPI only	2 pt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Application rates range from 2.4 to 3.6 pt/A of Prowl 3.3EC and 2 to 3 pt/A of Prowl H_2O and are based on soil texture and organic matter.
- Prowl/Prowl H_2O should be incorporated immediately after application.
- Prowl/Prowl H_2O provides better velvetleaf control than trifluralin or Sonalan.
- Prowl/Prowl H_2O can be tank-mixed with Eptam. Other measures may need to be taken for additional broadleaf control.
- DO NOT make more than one application per season.
- Preharvest interval (PHI): none listed
- Refer to Table 12 and the label for crop rotation restrictions.

Pursuit 2L	imazethapyr	2	PP, PPI, PRE	2 fl oz	N
Pursuit 2L + Basagran 5L	imazethapyr + bentazon	2 6	POST	2 fl oz + 6.4 fl oz + NIS 0.25% v/v + AMS 2.5 lb	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- DO NOT not apply to sands or loamy sand soils or if cold and/or wet conditions are present or predicted to occur within one week of application.
- Pursuit may be applied PPI or PRE at rates up to 3 fl oz/A on heavy soils with greater than 2% organic matter and heavy weed pressure.
- Pursuit (2 fl oz) can be tank-mixed and applied PPI with Eptam plus trifluralin; Prowl or Sonalan; or Dual Magnum or Outlook; or PRE with Dual Magnum or Outlook. Pursuit in these mixes will control eastern black nightshade.
- Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days.
- Pursuit will not control common ragweed.

Postemergence: Apply Pursuit at rates up to 3 fl oz/A when beans have at least one fully expanded trifoliate (V1), but prior to flowering (R1).

- Postemergence applications are most effective on small weeds (less than 2 inches).
- At least 8 fl oz of Basagran 4L or 6.4 fl oz (5L) must be tank-mixed with Pursuit, if AMS is added. Basagran minimizes the risk of crop injury from this application.
- Increase the rate of Basagran to 16 fl oz (4L) or 12.8 fl oz (5L) when tank-mixed with Pursuit to control common cocklebur and jimsonweed, and to provide good control of common lambsquarters (less than 2 inch tall).
- Delayed maturity may result from applications of Pursuit. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity.
- Dry bean varieties vary in their sensitivity to Pursuit. Use only on great northern, navy, black, pinto, red kidney, and cranberry beans.
- Pursuit can also be applied to adzuki beans.
- Pursuit can be tank-mixed with postemergence grass herbicides for volunteer corn control only.
- Preharvest interval (PHI): 60 days
- Pursuit is very persistent and can limit rotational crops. Rotation to sugarbeets, cucumbers, and tomatoes requires 40 months and a successful bioassay. Refer to Table 12 and the label for additional crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Raptor 1SL + Basagran 5L	imazamox + bentazon	2 6	POST	4 fl oz + 6.4 fl oz + COC 1% v/v + AMS 2.5 lb	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Apply Raptor at 4 fl oz/A when beans have at least one fully expanded trifoliate (V1), but prior to flowering (R1).
- Postemergence applications are most effective on small weeds (less than 2 inches).
- Apply Raptor with COC (1% v/v) or NIS (0.25% v/v).
- At least 8 fl oz of Basagran 4L or 6.4 fl oz (5L) must be tank-mixed with Raptor. Basagran minimizes the risk of crop injury from this application.
- Increase the rate of Basagran to 16 fl oz (4L) or 12.8 fl oz (5L) when tank-mixed with Raptor to control common cocklebur and jimsonweed, and to provide good control of common lambsquarters (less than 2 inch tall). These rates of Basagran will antagonize grass control.
- Delayed maturity may result from applications of Raptor. DO NOT apply if planting is delayed and frost is likely to occur priot to maturity.
- Raptor can be applied to adzuki beans.
- DO NOT use the combination of Raptor + Basagran on adzuki beans. Basagran causes significant injury to adzuki beans.
- Raptor can be tank-mixed with postemergence grass herbicides for volunteer corn control only.
- DO NOT make more than one application of Raptor to dry beans per year.
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

Reflex 2SL	fomesafen	14	PP, PRE	1 pt	N
			POST	1 pt + COC 1% v/v	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Soil-applied Reflex will provide 4-5 weeks of control and/or suppression of broadleaf weeds.
- Rainfall that splashes treated soil onto newly emerged seedlings can cause temporary crop injury.
- Tank-mixtures or sequential herbicide applications are needed to broaden the spectrum of weed control.
- Reflex and other fomesafen products can only be applied at a maximum use rate of 1 pt/A every other year and only in the Lower Peninsula of Michigan.
- Reflex is best used postemergence in dry beans due to the limited amount that can be used per season.

Postemergence: Apply Reflex at rates up to 1 pt/A when beans have at least one fully expanded trifoliate (V1), but prior to flowering (R1).
- Postemergence applications are most effective on small weeds: common ragweed, pigweeds and waterhemp 4-inches tall or less and eastern black nightshade 2-inches tall or less.
- Reflex at 0.5 pt/A will control common ragweed 2-inches tall or less.
- NIS at 0.25-0.5% v/v or COC at 0.5-1.0% v/v must be included for effective control.
- Reflex can be tank-mixed with Basagran, Raptor or Pursuit. Include a COC when tank-mixing Reflex + Basagran. Only include NIS when tank-mixing with Raptor or Pursuit. DO NOT add AMS or 28% N or significant injury can occur.
- Tank-mixtures with other herbicides will be needed to broaden the spectrum of weed control. Tank-mixtures for postemergence grass control may lead to grass antagonism under certain conditions. Applying the postemeregence grass herbicide either 1 day before or 7 days after Reflex or Reflex tank-mixtures will prevent the antagonism.
- Reflex can be applied only in the Lower Peninsula of Michigan.
- DO NOT make more than one application of Reflex (1 pt/A) in consecutive years.
- Preharvest interval (PHI): 45 days
- Refer to Table 12 and the label for crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Select Max 0.97EC	clethodim	1	POST	9 fl oz + NIS 0.25% v/v	N

- Select Max provides postemergence grass and volunteer corn control. Refer to Table 5A for weed control and crop tolerance ratings.
- Select Max rates range from 9 to 16 fl oz/A for annual grass and 12 to 32 fl oz/A for perennial grass control. Application rates are based on weed size and sensitivity. Refer to Table 2E for maximum weed sizes.
- COC/MSO (1% v/v) can replace NIS for certain tank-mixtures (see label).
- The addition of AMS at 2.5 to 4 lb/A has been shown to improve control of difficult to control weeds, e.g., quackgrass, rhizome Johnsongrass, volunteer cereals, and volunteer corn.
- Apply 6 fl oz/A of Select Max for volunteer corn control up to 12 inches tall; 9 fl oz/A for corn up to 24 inches tall; and 12 fl oz/A for corn up to 36 inches tall. Select Max will control Enlist corn.
- For perennial grass control, higher rates (12 to 32 fl oz/A) and sequential applications may be needed.
- Tank-mixtures of Select Max with certain postemergence broadleaf herbicides (Group 6, 14 and certain Group 2 herbicides) can antagonize grass control.
- Applying Select Max either 1 day before or 7 days after the broadleaf herbicide will prevent the antagonism.
- Increasing the Select Max rate by 2 fl oz/A will also improve grass control in certain tank mixtures.
- DO NOT apply more than 32 fl oz/A per application and 64 fl oz/A/year.
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

Sequence 5.25EW	glyphosate + s-metolachlor	9 15	PP, PRE	3 pt + AMS 17 lb/100 gal	N

- Sequence at 3 pt/A contains 0.9 lb a.e./A of glyphosate and 1.2 pt/A of Dual Magnum.
- Sequence is best used to control existing vegetation prior to planting no-till dry beans with the residual control of s-metolachlor (Dual).
- Refer to Table 5A for residual weed control and crop tolerance ratings.
- DO NOT apply to emerged dry bean – severe injury will occur.
- DO NOT apply more than 3.5 pt/A on coarse textured soils or 4 pt/A on medium and fine textured soils.
- DO NOT exceed 1.91 lb ai/A/year of s-metolachlor.
- Make only one application per year.
- Preharvest interval (PHI): none listed
- Refer to Table 12 and the label for crop rotation restrictions.

Sonalan HFP 3EC	ethalfluralin	3	PPI only	2 pt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Incorporate Sonalan HFP in top 2 to 3 inches of soil within 2 days of application.
- Sonalan should be tank-mixed with Eptam. Other measures may need to be taken for additional broadleaf control.
- Sugarbeets may be planted 8 months after application only if the Sonalan is applied at 3 pt/A or less and the treated soil is moldboard-plowed to a depth of 12 inches. Refer to Table 12 and the label for additional crop rotation restrictions.

trifluralin 4EC (many)	trifluralin	3	PPI only	1 pt	N

- Refer to Table 5A for weed control and crop tolerance ratings.
- Incorporate trifluralin in the top 2 to 3 inches of soil within 24 hr after application.
- On sandy and sandy loam soils low in organic matter, use 0.5 lb ai/A (1 pt/A); on medium textured soils apply up to 1.5 pt/A; and on fine textured soil apply up to 2 pt/A.
- Trifluralin provides better pigweed control than Prowl or Sonalan.
- Trifluralin should be tank-mixed with Eptam. Other measures may need to be taken for additional broadleaf control.
- Sugarbeets may be planted 12 months after application. Moldboard plowing to a depth of 12 inches is recommended to reduce the risk of crop inury. Refer to Table 12 and the label for additional crop rotation restrictions.

TABLE 5B — Dry Edible Bean Herbicides - Remarks and Limitations

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Varisto 4.18SL	bentazon + imazamox	6 2	POST	21 fl oz + COC 1% v/v + AMS 2.5 lb	N

- Apply Varisto after the first trifoliate leaf of dry bean has fully expanded (V1) up to flowering (R1). Refer to Table 5A for weed control and crop tolerance ratings.
- Varisto can be applied at rates from 16 to 21 fl oz/A. Varisto at 21 fl oz/A is equivalent to Basagran at 21 fl oz (4L) or 16.8 fl oz (5L) and 4 fl oz/A of Raptor.
- Best when applied to weeds 2 inches tall or less.
- Delayed maturity may result from applications of Varisto. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity.
- DO NOT tank-mix with postemergence grass herbicides unless for volunteer corn – grass antagonism will occur.
- MSU research has shown significant dry bean injury from bentazon (Basagran) applications to Adzuki beans and does not recommend this application.
- DO NOT make more than one application of Varisto per season or apply more than 21 fl oz/A per season.
- Preharvest interval (PHI): 30 days
- Refer to Table 12 and the label for crop rotation restrictions.

TABLE 5C — Dry Edible Bean — Preharvest Applications

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Aim 2EC	carfentrazone	14	Preharvest	2 fl oz + MSO 1% v/v	N

- Apply when crop is mature – at least 80% of the pods are yellow or buck skin in color and only 30% of green leaves remain on the plant.
- AMS (2.5 lb/A) in addition to MSO may enhance performance.
- Aim alone is not as effective as Sharpen, glyphosate, Gramoxone or Valor for dry bean desiccation.
- Tank-mixtures with Gramoxone or glyphosate will improve dry bean desiccation and is needed to improve the spectrum of weed desiccation.
- Aim at 1 fl oz/A can be applied with glyphosate or Gramoxone to broaden the spectrum of weed control over Aim alone.
- It generally takes 7-10 days to reach maximum desiccation.
- Spray coverage is important - apply in a minimum of 10 gallons of water per acre (20 gal/A is recommended) - sequential applications may be needed.
- DO NOT apply more than 6.1 fl oz/A of Aim per season.
- Preharvest interval (PHI): 0 days

glyphosate (see Table 10)	glyphosate	9	Preharvest	0.75 lb ae (see Table 10) + AMS 17 lb/100 gal	N

- Glyphosate should only be used for weed desiccation and not dry bean desiccation. Glyphosate residues have been found in harvested beans if applications are made too early. Consequently, some dry bean purchasers will not accept beans treated with glyphosate, consult you buyer prior to using glyphosate as a preharvest treatment.
- See Table 10 for a list of glyphosate products, formulations, and rates. Not all glyphosate products are labeled as a preharvest treatment in dry beans - consult specific labels for legal applications. Roundup branded products are currently labeled.
- Apply when beans are in the hard dough stage (30% moisture or less).
- It generally takes 10-14 days to reach maximum weed desiccation.
- Spray coverage is important - apply in a minimum of 10 gallons of water per acre (20 gal/A is recommended).
- DO NOT apply glyphosate to beans grown for seed.
- Only one preharvest application of glyphosate can be made per year.
- Preharvest intervals (PHI): 7 days

Gramoxone SL 3.0L	paraquat	22	Preharvest	1.3 pt + NIS 0.25% v/v	N

- **Gramoxone is a restricted-use pesticide.** Certified applicators are required to complete a paraquat specific training prior to use of Gramoxone. The paraquat training course can be found at: **www.epa.gov/pesticide-worker-safety/paraquat-dichloride-training-certified-applicators**.
- Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% of the leaves are still green.
- Always add NIS at 0.25% v/v or COC at 1% v/v.
- If growth is lush and vigorous, make either a single application of 1.3 pt/A of Gramoxone SL; or split applications at 0.65 pt/A each. Split applications may improve vine coverage.
- Gramoxone is effective at desiccating glyphosate-resistant weeds and common lambsquarters.
- Gramoxone tank-mixtures with Sharpen at 1 fl oz/A are the most consistent and effective treatment for dry bean and weed desiccation.
- It generally takes 7-10 days to reach maximum desiccation.
- Spray coverage is important - apply in a minimum of 20 gallons of water per acre.
- DO NOT exceed 1.3 pt/A of Gramoxone SL 3.0 per year.
- Preharvest interval (PHI): 7 days

Sharpen 2.85SC	saflufenacil	14	Preharvest	1 fl oz + MSO 1% v/v + AMS 8.5 lb/100 gal	N

- Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% of the leaves are still green.
- Sharpen can be applied at rates up to 2 fl oz/A.
- Sharpen is effective at desiccating glyphosate-resistant broadleaf weeds.
- Sharpen (1 fl oz/A) tank-mixtures with Gramoxone are the most consistent and effective treatment for dry bean and weed desiccation.
- It generally takes 7-10 days to reach maximum desiccation.
- Spray coverage is important - apply in a minimum of 10 gallons of water per acre (20 gal/A is recommended).
- DO NOT apply to beans grown for seed.
- DO NOT apply more than 2 fl oz/A/year of Sharpen for desiccation purposes.
- Preharvest interval (PHI): 2 days
- Refer to Table 12 and the label for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

TABLE 5C — Dry Edible Bean — Preharvest Applications

Herbicide	Common Name	Site of Action Number	Application Timing	Rate/A	Trait
Valor EZ 4SC	flumioxazin	14	Preharvest	1.5 fl oz + MSO 1 qt	N
Valor SX 51WDG	flumioxazin	14	Preharvest	1.5 oz + MSO 1 qt	N

- Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% of the leaves are still green.
- Valor EZ and Valor SX can be applied at rates up to 3 fl oz/A and 3 oz/A, respectively.
- AMS (2.5 lb/A) in addition to MSO may enhance performance.
- Dry bean desiccation from Valor is similar to that from Gramoxone and glyphosate; however, the spectrum of weed control is not as broad.
- It generally takes 7-10 days to reach maximum desiccation.
- Spray coverage is important – apply in a minimum of 15 gallons of water per acre (20 gal/A is recommended).
- Valor provides residual activity that may reduce winter annual growth.
- Follow sprayer clean-up instructions – residues of Valor can be trapped in poly tanks and hoses if not adequately cleaned.
- Preharvest interval (PHI): 5 days
- Crop rotation restrictions are dependent on rainfall, use rate, and tillage. Rotation restrictions for 2 oz or less of Valor/Valor EZ are 1 month with 1 inch of rain for corn and winter wheat. Dry bean and barley may be planted after 3 months, and alfalfa, oats and sugarbeets may be planted after 4 months if the ground is tilled prior to planting or 8 months if no tillage is performed. Note: In Michigan research trials, planting sugarbeet no-till the spring following a Valor preharvest treatment resulted in major sugarbeet stand reduction. Tillage reduced the effect of Valor on sugarbeet; however, slight injury may occur on sandier soils. Refer to Table 12 and the label for additional crop rotation restrictions.