

2018 Dry Bean Research Report

**Assessment of Diseases, Nitrogen Fertility and Cover
Crops in Sustainable Dry Bean Production Systems**



**Michigan Dry Edible Bean Production
Research Advisory Board**

The Michigan Bean Commission was awarded a grant from the MDARD Specialty Crop Block Grant Program-Farm Bill.

The title of this project is “Assessment of Diseases, Nitrogen Fertility and Cover Crops in Sustainable Dry Bean Production Systems”. Main areas of study were White Mold and Root Rot Disease Control, Dry Bean Variety, Nitrogen, Cover Crops and Dry Bean Desiccants and Harvest Aids.

Expected outcomes from this project are:

1. Assessment of impact of nitrogen, tile spacing and cover crops for dry beans that undergo acute losses from White Mold and Root Rots.
2. Development of tolerant cultivars and breeding lines for white mold and root rot disease conditions within diverse production regions in Michigan.
3. Assessments of dry bean disease control strategies aligned with IPM standards including varietal tolerance, biological and chemical pesticides.
4. Maximizing of yield through optimization of harvest aid applications.
5. Implementation of grower educational activities to communicate intervention strategies and economic options used for production of dry beans.

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Front Cover: Planting Dry Beans in Sanilac County.

Top Back Cover: Close-up of Severe White Mold Seed Damage.

Bottom Back Cover: Navy Beans Planted in a Cover Crop.

**2018 White Mold Fungicide Trial-Merrill
Giles Farm, Wheeler, Michigan**

Treatment	Rate	Application Code	(1-9) Visual Rating	Incidence % Infection	Yield Pounds/Acre
UTC			4	38	3096
Propulse	10.3 oz	AB	2	14	4100
Endura	8 oz	AB	2	15	3897
Omega	8 oz	AB	2	13	3688
Heads Up	Rec.	Seed Treatment	4	41	3154
Endura+Priaxor	8+4 oz	AB	2	16	4106
Endura+Serifel	8+4 oz	AB	2	16	3610
Propulse	8 oz	A	2	18	3775
Endura	8 oz	A	2	15	3682
Omega	8 oz	A	2	19	3592
Omega+Endura	8+8 oz	A+B	2	17	3950
Aproach+Endura	12+8 oz	A+B	2	16	3968
Omega+Propulse	8+8 oz	A+B	2	15	3924
		LSD=.05	0.99	11.66	639
		CV=	28.23%	39.96%	12.50%

Located at Varner Farm, Midland County

Application Code:A=100% or first bloom, B=10 days after 100% bloom

Black Bear Black Beans planted in 20" rows. Population of 130,680.

Planted: June 10 Harvested: October 17

First Spray: July 26, Second Spray: August 7

Visual Rating on August 27, 1 being 0-10% and 9 being 90-100%.

Rating Date: Incidence % infection "rating" on September 18,

Sprayed with 4 row bicycle-wheel CO2 sprayer using 30 gpa at 65 psi.

Twin-Jet nozzle placed directly over the row. Plot size sprayed was 4 rows by 30 feet.

7 Irrigations of one half inch per week between July 4 and August 15 as rainfall dictated.

Harvest area was middle 2 rows by 15 feet.

A field trial was conducted to determine the efficacy of various fungicide applications on controlling white mold in Midland County. The white mold trial had eleven treatments, a Heads Up seed treatment and one non-sprayed control with four replications of each treatment.

White mold apothecia were observed on August 14.

Field History: 2017-Cucumbers, Cover crop of Ryegrass. Sprayed Roundup to burn down

in early May. Field Cultivator Tillage on May 15. Sprayed 1.3 pints Dual and 1.6 pints Prowl H2O on May 24.

Fertilization consisted of 75 pounds of actual nitrogen from Urea. Applied on June 15.

**2018 White Mold Fungicide Trial
Montcalm Research Center, Lakeview, Michigan**

Treatment	Rate	Application Code	(1-9) Visual Rating	% Infection	Yield Pounds/Acre
UTC			4	48	2728
Propulse	10.3 oz	AB	2	23	3035
Endura	8 oz	AB	3	29	2937
Omega	8 oz	AB	2	23	2893
Endura+Priaxor	8+4 oz	AB	2	25	2880
Endura+Serifel	8+4 oz	AB	2	22	3300
Propulse	8 oz	A	3	25	3079
Endura	8 oz	A	2	20	2976
Omega	8 oz	A	3	26	2778
Omega+Endura	8+8 oz	A+B	2	21	3252
Aproach+Endura	12+8 oz	A+B	2	24	3431
Omega+Propulse	8+8 oz	A+B	2	21	3420
		LSD=.05	1.2	13	607
		CV=	31.40%	30.57%	14.56%

Application Code:A=100% or first bloom, B=10 days after 100% bloom.
 Black Bear Black Beans planted in 20" rows. Population of 130,680.
 Planted: June 12 Harvested: September 28.
 First Spray: July 27, Second Spray: August 8.
 Visual Rating on August 27, 1 being 0-10% and 9 being 90-100%.
 Rating Date: Incidence % infection "rating" on September 18,
 Sprayed with 4 row bicycle-wheel CO2 sprayer using 30 gpa at 65 psi.
 Twin-Jet nozzle placed directly over the row. Plot size sprayed was 4 rows by 30 feet.
 7 Irrigations of one half inch per week between July 4 and August 15 as rainfall dictated.
 Harvest area was middle 2 rows by 15 feet. Irrigated during bloom, pod setting and pod fill period.
 A field trial was conducted to determine the efficacy of various fungicide applications on
 controlling white mold in Montcalm County. The white mold trial had eleven treatments
 and one non-sprayed control with four replications of each treatment.
 White mold apothecia were observed on August 18.

2018 BASF Anthracnose Fungicide Trial-Merrill, Michigan

Giles Farms, Wheeler, Michigan

Treatment	Applications	Rate	28 DAT(1-9) Visual Rating	% Infection	Moisture%	Yield Pounds/Acre
UTC	1		9.0	100	28.48	1718
PRIAXOR	1	4 oz.	2.5	23	23.18	2810
		CV=	11.78%	14.92%	4.78%	10.77%
		LSD=.05	0.77	10.6	1.97	434

Zorro Black Beans planted in 20" rows. Population of 130,680.
 Date Planted: June 10, Date Sprayed: July 26, Date Harvested: October 9
 Inoculated with Race 73 spores on evening of first spray.
 Visual Rating on August 23, 1 being 0-10% and 9 being 90-100%.
 Rating Date: Incidence % infection "rating" on September 6.
 CO2 sprayer using Twin-Jet nozzles at 65 psi and 30 gpa. Plot size was 4 rows by 25 feet.

DRY BEAN (*Phaseolus vulgaris* “Red Hawk” and “Zorro”)
 Fusarium Root Rot; *Fusarium brasiliense*
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Evaluation of in-furrow Propulse® application for Fusarium root rot control in dry beans in Michigan, 2018

The field experiment was conducted at the Montcalm Research Center in Montcalm county, Michigan where *F. brasiliense* has been isolated in high abundance from previous dry bean and soybean crops. The previous crop was dry bean and soil type a Montcalm sandy loam. Dry beans were planted on 15 Jun 18 in 30-in. rows at a rate of 80,000 seeds/A. Plots were 17.5 ft. long. Seeds were treated by BASF with EverGol Energy, Allegiance-FL, Gaucho 600-FS, Precise S Finisher 1010, and red colorant. An in-furrow application was made at 9.59 G/A volume of Propulse at a 6 fl oz/A rate with furrow jet nozzles attached to the four-row seed cone planter. The experimental design was a complete randomized block design with two treatments and six replications. Stand counts were taken on 9 Jul on the center two harvest rows at the V2 growth stage. At the V2 (9 Jul), R2 (25 Jul), and R6 (22 Aug) growth stages, 5 plants from both outer rows were collected from each plot, for a total of 10 plants. Root rot ratings were taken on 5 random roots per plot using a 1-7 scale described in Kelly and Schneider (2000) where 1 describes a healthy, non-rotted root and 7 describes a dead root. Root rot ratings were converted into a continuous disease severity index (DIX) using a formula described in Li et al (2014). Plants were washed under tap water and dried in a drying oven for 3 d at 145°F for dry plant measurements. Dried taproots were ground in 15 mL vials with two 4 mm stainless steel balls in a GenoGrinder for 2 min at 1500 rpm. DNA was extracted from a 30-mg aliquot of ground, homogenized roots using a Mag-Bind Plant DNA DS Kit M1130 on the KingFisher™ Flex Purification System (ThermoFisher Scientific). DNA concentration was calculated using the Quant-IT dsDNA broad range kit (Invitrogen) in a 96-well SAFIRE microplate reader (Tecan). *F. brasiliense* DNA in taproots was quantified using a specific qPCR assay (Roth and Chilvers, unpublished). Yield was calculated by hand-harvesting 10 bed ft. of the center two rows, combining, weighing the seed, and adjusting to 18% moisture. Data were analyzed using PROC GLIMMIX in SAS. Cultivar and treatment were treated as classification variables while replication was used a random factor with multiple comparisons using the Tukey-Kramer adjustment (SAS Institute, Cary, NC).

The stand of Zorro dry beans was significantly lower with an in-furrow application of Propulse compared with the non-treated, while the stand counts of Red Hawk were not significantly different. Plant mass at the V2 growth stage was significantly lower for Zorro plants treated with Propulse, but not Red Hawk, perhaps suggesting early season phytotoxicity. At the R2 growth stage, the DIX was significantly decreased for Red Hawk plants treated with Propulse. The DIX was significantly diminished for Zorro plants treated with Propulse compared to the non-treated at the R6 stage. The quantity of *F. brasiliense* DNA in the taproot was significantly lower for both Red Hawk and Zorro plants treated with Propulse at the V2 growth stage. However, at the R2 growth stage, the Red Hawk and Zorro plants treated with Propulse had significantly higher quantities of *F. brasiliense* in the taproot. Yield was not significantly different for Red Hawk nor Zorro. Although Propulse is not currently registered for use as an in-furrow treatment for dry bean root rot, this study demonstrates that Propulse may aid in the reduction of root rot and root infection by *F. brasiliense*.

Cultivar	Treatment	V2 Stand Count (plants/A)	V2 Plant Mass (g/10 plants)	R2 DIX	R6 DIX	V2 <i>F. brasiliense</i> Quantity (Log(fg of <i>F. brasiliense</i> DNA/ng of taproot DNA))	R2 <i>F. brasiliense</i> Quantity (Log(fg of <i>F. brasiliense</i> DNA/ng of taproot DNA))	Yield (cwt)
Red Hawk	Non-treated	58,743	20.05	82.4 a	86.6	8.3 a	7.2 b	12.07
	Propulse	52,272	18.9	72.3 b	80.4	6.2 b	8.5 a	9.34
	<i>p-value</i>	<i>0.1817</i>	<i>0.4845</i>	<i>0.0305</i>	<i>0.2213</i>	<i>0.0444</i>	<i>0.0143</i>	<i>0.2962</i>
Zorro	Non-treated	59,325 a	12.9 a	59.5	55.7 a	5.0 a	8.3 b	17.97
	Propulse	49,782 b	10.4 b	48.6	45.7 b	1.08 b	11.7 a	16.85
	<i>p-value</i>	<i>0.006</i>	<i>0.0209</i>	<i>0.0788</i>	<i>0.0167</i>	<i>0.0184</i>	<i>0.0069</i>	<i>0.6561</i>

Column numbers followed by different letters are significantly different at p=0.05 within cultivar, as determined by least square means comparison

Evaluation of Quadris® In-furrow application and fungicide seed treatments for dry beans, 2017 and 2018 in Michigan

In 2017 and 2018, field experiments were completed in the same field at the Montcalm Research Center in Montcalm County, Michigan. The soil was a Montcalm sandy loam and the field had a high natural inoculum pressure of *F. brasiliense*, a newly-identified soybean sudden death syndrome (SDS) and dry bean root rot pathogen in Michigan, though previously known soybean SDS pathogen in South America. Prior to the 2017 crop, soybeans were grown. The trial was planted on 14 Jun 2017 and 15 Jun 2018, planted at a seeding rate of 80,000 seeds/A. Plots were four rows with 30-inch spacing between each row and were 17.5 ft. long. The plots were set up in a complete randomized block design with three treatments (non-treated, base seed treatment plus Quadris, and base + ILeVO seed treatment plus Quadris) and four replications in 2017 and six replications in 2018. In 2017, Quadris in-furrow was applied at a rate of 10 fl oz/A in 15 G/A spray volume of water using a hand-held spray boom pressurized with CO₂ at 40 psi. In 2018 Quadris was applied in the planting furrow at a rate of 8.7 fl oz/A at 9.5 G/A spray volume of water using furrow jet nozzles attached a four-row cone seed planter. The base seed treatment contained EverGol Energy, Allegiance-FL, Gaucho 600-FS, Precise S Finisher 1010, and red colorant at standard rates. The beans with base seed treatment plus ILeVO were treated with 0.15 mg ai/seed of ILeVO at 600 g ai/L in addition to the base seed treatment for both cultivars. At the V2 growth stage (6 Jul 17 and 9 Jul 18), plant stand was measured by counting plants in the center two rows. Ten plants, five plants from either outer row in a plot, were collected at the V2, R2 (2 Aug 17, 25 Jul 18), and R6 (28 Aug 17, 22 Aug 18) growth stages. Five random roots per plot were used to take root rot ratings using a 1-7 scale from Kelly and Schneider (2000) where roots are progressively more rotted with each subsequent number. Using a method described by Li et al (2014), root rot ratings were converted to a continuous disease severity index (DIX). After being washed under tap water, plants were dried at 145°F for three d in a drying oven prior to collecting dry plant mass measurements. 10 bed feet of the center two rows were hand-harvested, combined, weighed, and adjusted for 18% moisture to calculate yield. Data analysis was conducted using PROC MIXED in SAS (SAS Institute, Cary, NC).

Plots were flooded shortly after 2017 planting, leaving only three replications of each treatment in 2017. Poor germination of Zorro plants was observed in 2017 due to seed originating from a poor-quality seed lot. Due to the small sample size and reduced stand of Zorro plants, there is no significance in either cultivar for any variable tested in 2017. The 10 oz/A of Quadris used led to observed phytotoxicity foliar symptoms in both Red Hawk and Zorro plants. The reduced rate of 8.7 oz/A of Quadris in 2018 did not lead to any observed phytotoxicity symptoms. In 2018, The Red Hawk and Zorro plants treated with the base seed treatment and Quadris had significantly increased stands compared to plants treated with Quadris and the base + ILeVO seed treatment. Red Hawk plants treated with base + ILeVO and Quadris had significantly decreased dry plant mass at the V2 stage compared to the non-treated and base seed treatment. However, at the R2 growth stage, Red Hawk plants treated with base + ILeVO and Quadris had a significantly lower DIX than the non-treated or base seed treatment with Quadris beans. In the Zorro beans, the base seed treatment with Quadris also in addition to the base + ILeVO with Quadris had significantly decreased DIX compared to the non-treated Zorro beans. In both years, yield was not significantly different between treatments for either cultivar. This study demonstrates that at a rate of 8.7 fl oz/A, Quadris in-furrow applications and a base + ILeVO seed treatment may reduce root rot infection by *F. brasiliense*.

Cultivar	Treatment	2018 Stand Count (plants/A)	2018 V2 Dry Plant Mass (g/10 plants)	2018 R2 DIX	2018 R6 DIX	2017 Yield (Cwt)	2018 Yield (Cwt)
Red Hawk	Non-treated	39,328 b	17.8 ab	85.2 a	88.5	7.64	10.8
	Base + Quadris	56,254 a	20.7 a	81.4 a	86.6	10.2	8.78
	Base + ILeVO + Quadris	41,319 b	14.6 b	70.4 b	81.9	8.4	9.61
	<i>p-value</i>	0.0275	0.0142	0.0013	0.5331	0.5122	0.3791
Zorro	Non-treated	54,761 a	8.4	70.9 a	64.7 a	6.11	11.07
	Base + Quadris	56,752 a	9.9	60.9 b	55.2 ab	7.78	11.05
	Base + ILeVO + Quadris	48,787 b	8.6	53.3 c	44.7 b	8.17	10.9
	<i>p-value</i>	<0.0001	0.3268	<0.0001	0.0124	0.8172	0.9947

Column numbers followed by different letters are significantly different within cultivar at p=0.05, determined by least squares mean comparison

2018 Results from root or stem isolations from the seven field locations in Presque Isle and Alcona Counties.

Field Identification	County	Dry bean (class, variety)	Number of Plants Diagnosed	Number of Oomycetes Isolates Recovered	Number of Rhizoctonia Isolates Recovered	Number of Fusarium Isolates Recovered	Number of Fusarium solani, clade 2 Isolates Recovered
Rhode Farm - #1	Presque Isle	Red Kidney, Red Cedar	9	3	8*	19	12*
Rhode Farm -#2	Presque Isle	Red Kidney, Montcalm	3	2*	0	14	8*
Rhode Farm-#3 (western seed)	Presque Isle	Red Kidney, Montcalm	6	0	3*	20	7*
Scike Farm-#4	Presque Isle	Red Kidney, Montcalm	7	3*	0	24	5
Dellar-#5 (Home Place)	Alcona	Black, Zenith	1	0	0	2	1*
Dellar-#6	Alcona	Black, Zorro	6	6*	4*	25	11*
Across Lyndseys Produce-#7	Alcona	Black	3	1*	3*	5	0
TOTAL			35	15	18	109	44

***highlighted numbers are pathogens in higher abundance in field. Summary of Results:** The main take away message is that root rot pathogens are a constant presence in fields where dry bean production has occurred for repeated years. Each field has its own unique composition of organisms, and dependent on weather conditions, and bean variety grown will result in some level of root rot present. Pathogens such as, Rhizoctonia and Oomycetes are generally more of an issue during stand establishment, causing seed rot and damping off symptoms, resulting in stand loss. Fusarium has a wide range of species that are associated with the roots of dry beans; however, it is the *Fusarium solani*, clade 2 species that tend to cause the greatest amount of root rot of dry beans. *Fusarium oxysporum* is generally associated with leaf yellowing and wilt symptoms. Not all *Rhizoctonia solani*, *Fusarium* species, or *Pythium* species isolated from the roots of dry beans are pathogens. Based on results from our pathogenicity screening, we know *Rhizoctonia solani* AG2-2, causes the most damage in Michigan. Many of the Rhizoctonia isolates recovered from these fields did not have the typical morphology of AG2-2. We will perform further testing to determine which AG these isolates are. As mentioned above, it is the *Fusarium solani*, clade 2 organisms that provide constant pressure on dry beans, resulting in the loss of the tap root and induction of lateral root formation for plant recovery.

We have isolated over 30 different species of *Pythium* associated with dry bean roots over the years. Again, not all of these are pathogens, however, many do cause seed rot, damping-off, or root nibbling.



2018 MICHIGAN DRY BEAN TRIALS

COUNTY & COOPERATOR:	Bay: <i>Kevin & Lyle Wackerle Farm</i> Gratiot: <i>Hoard Farms</i> Huron: <i>Gentner-Bischer Farms</i>	Montcalm: Sanilac: Tuscola:	<i>Grassley Farms</i> <i>Wadsworth Farms</i> <i>Bednarski Farms</i>
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PLANTING DATES:			6/8	6/1	6/7	6/6	6/11	6/14		2018 AVE	WM	Lodge
<u>NAVY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>AVG-4 BHST</u>	<u>Rating</u>	<u>Rating</u>	
HMS MEDALIST	102-110	COOP/ADM	1997	2721	3123	2724	2223	3505	2716-2641	2.1	2.5	
MERLIN	104-110	COOP/ADM	2401	3276	3521	2840	2865	3405	3051-3009	2.0	2.0	
T9905	99-108	TVS	1621	2498	3554	2334	2513	4021	2757-2502	2.7	3.0	
EX 1703	98-106	TVS	1917	2409	3652	2376			2588	3.2	3.5	
ALPENA	98-100	MSU					2593	3291		3.0	2.0	
DS105WO	99-106	TVS	2411	2787	3352	2023	2293	2611	2580-2643	3.0	3.0	
INDI	96-98	ADM	2242	2964	2632	2729			2642	1.8	1.5	
REXETER	99-105	OAC-HDC	2013	2817	3071	2251			2538	3.1	2.5	
NAUTICA	102-108	OAC-HDC	1990	2132	3205	2056			2345	1.8	2.0	
MIST	102-108	OAC-HDC	2024	2756	2819	2888			2622	1.5	2.5	
ARGOSY	102-106	OAC-HDC	2312	2906	3295	2725			2810	2.2	2.5	
BLIZZARD	103-110	PROVITA	2256	2809	3258	2571			2723	2.3	1.5	
APEX	103-107	TVS	2501	2670	3518	3144			2958	1.8	2.0	
EX 1701	98-104	TVS	2485	2589	3411	2739			2806	2.6	2.5	
EX 1702	99-105	TVS	2761	2910	3358	2950			2995	2.3	2.5	
PROVITA 12039	99-105	PROVITA	2553	3115	3470	3027			3041	2.6	2.5	
PROVITA 12047	101-108	PROVITA	3199	3605	3419	3353			3394	1.3	1.5	
PROVITA 12062	100-107	PROVITA	1840	3232	3581	3238			2973	2.8	2.5	
PROVITA 12063	98-104	PROVITA	2479	3308	3115	3198			3025	2.2	1.5	
PROVITA 12064	100-106	PROVITA	2597	2980	3233	2362			2793	1.6	2.0	
PROVITA 13058	97-104	PROVITA	1144	2914	2671	2760			2372	3.1	2.0	
PROVITA 13066	100-106	PROVITA	1915	3403	3428	2779			2881	2.0	2.0	
PROVITA 13068	100-108	PROVITA	2137	3433	3682	2945			3049	2.0	2.0	
PROVITA 14068	101-108	PROVITA	1613	2897	3918	2599			2757	3.0	2.0	
PROVITA 14069	101-107	PROVITA	2364	3004	3464	2560			2848	3.0	3.5	
PROVITA 14078	102-109	PROVITA	1934	2562	3521	2733			2688	2.9	2.5	
PROVITA 14081	100-106	PROVITA	2262	2843	2835	2855			2699	1.8	2.5	
PROVITA 14084	96-104	PROVITA	2346	3413	3348	2749			2964	3.1	2.0	
PROVITA 15094	96-103	PROVITA	2441	3653	3284	2989			3092	2.1	2.5	
PROVITA 15095	102-108	PROVITA	2489	3126	4111	2799			3131	3.2	3.0	
MSU N14229	99-106	MSU	1544	2622	3536	2067			2442	3.5	2.0	
MSU N17504	100-106	MSU	2158	2375	3396	2148			2519	2.5	2.0	
MSU N17506	100-106	MSU	1680	1726	3577	1877			2215	3.5	1.5	
SV1893GH	104-108	SEMINIS	2225	3090	3272	2652			2810	2.0	2.5	
MEAN			2177	2895	3352	2668	2497	3366	2773			
LSD(.05)			585	535	349	366	516	437	233			
CV%			22.9	15.7	8.9	11.7	16.4	10.3	14.4			

<u>SMALL RED</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>AVG-4 BHST</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
MERLOT	94-103	USDA/MSU	2544	2765	3726	2332	2816		2842	3.5	3
VIPER	95-104	PROVITA	2894	3155	4685	2504	2776		3309	4	3
RUBY	94-103	PROVITA	2808	2790	4362	2104			3016	4	4
SR 11511	94-102	PROVITA	3124	3432	4005	2510			3267	2.5	3
CAYENNE	92-99	MSU	3450	3944	3807	2645	2998		3461	2	2
MSU R17603	95-104	MSU	3247	4354	4139	2907			3662	2	2.5
LSD(.05)			303	637	330	538	497		226		
CV%			8.1	15.1	6.5	17.4	12.6		11.7		

<u>BLACK</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>2018 AVE AVG-4 BHST</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
ZORRO	102-106	MSU	2492	2744	3804	1930	2710	4401	3014-2743	2.3	2.0
ZENITH	103-107	MSU	3068	2259	4027	2113	3085	4141	3116-2867	2.8	2.0
LORETO	104-109	COOP-PRO	2895	3177	3786	2181			3010	2.7	2.0
BLACK Cat	98-103	PROVITA	2312	2452	3975	2513			2813	3.6	2.0
BLACK Bear 12576	102-107	PROVITA	2669	2378	3958	1792			2699	3.3	2.0
BLACK Tails 13489	96-102	PROVITA	2739	2936	3701	2300			2919	3.8	1.5
BL 13505	97-103	PROVITA	2276	2374	4014	1903			2642	4.5	1.5
BL 14496	102-107	PROVITA	3455	3450	4394	2913			3553	2.8	2.0
BL 14497	102-108	PROVITA	3352	3507	4220	2683			3440	2.9	2.0
BL 14498	98-104	PROVITA	3138	3309	4129	2790			3341	2.2	2.0
BL 14500	99-104	PROVITA	3370	3655	4406	2771			3550	2.5	2.5
BL 14504	100-106	PROVITA	3340	3615	4200	3162			3579	2.7	2.0
BL 14505	101-106	PROVITA	2989	3350	4176	3235			3438	2.9	2.0
BL 14506	100-105	PROVITA	2972	3527	4358	2996			3463	2.8	2.0
BL 15610	101-106	PROVITA	2866	2317	3906	1979			2767	3.1	3.0
BL 15619	99-104	PROVITA	1835	2493	3977	2066			2593	4.3	2.5
MSU B16501	97-102	MSU	2448	3035	3729	2274			2872	2.6	2.0
MSU B16504	99-105	MSU	3066	3404	4199	2635			3326	3.0	2.0
MSU B17220	97-102	MSU	2363	3233	4091	2647			3084	2.5	2.0
MSU B17536	100-107	MSU	3154	2909	4105	2107			3069	3.2	2.0
MSU B17691	99-104	MSU	2410	2658	4166	2286			2880	3.0	2.0
MSU B17922	100-105	MSU	2742	3260	3929	2591			3130	3.3	2.0
USDA BL1401-15	99-104	USDA/MSU			4113	2708					2.0
ADM B8006282	96-100	ADM			3462	2569					2.0
ADM B1048276	96-101	ADM			3498	2630					2.0
ADM B3036368	96-99	ADM			3426	2936					2.0
ADM B5054341	97-102	ADM			3184	2366					2.0
ECLIPSE	96-100	NDSU			3227	2274					1.5
B18504	102-106	MSU	2641	3173	4781	2166			3190	3.3	2.0
HU Zenith	102-106	MSU	3062	2759	3948	1905			2918	3.0	2.0
MEAN			2819	2999	3963	2447	2897	4271	3205		
LSD(.05)			466	598	314	411	437	940	227		
CV%			14.0	16.9	6.7	14.3	9.1	13.2	12.7		

<u>PINTO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>AVG BHGM</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
ELDORADO	101-104	MSU	2786	3134			3146	4405	3368	2.0	2.5
LA PAZ	96-101	PROVITA	2642	2961			2945	4678	3306	4	2.5
MSU P16901	98-102	MSU	2942	3060			3180	4846	3507	2.5	2.0
MSU P17510	98-103	MSU	2761	3316			3162	4817	3514	2.5	2.0
PALOMINO	100	NDSU		2538						3.0	3.3
MONTERREY	96	PROVITA		3150						3.0	2.0
SANTA CRUZ	94	PROVITA		2297						4.0	2.0
SINALOA	95	PROVITA		2642						3.5	2.0
ISLAND	94	VITERRA		2334						4.0	3.0
WINDBREAKER	91	SEMINIS		2129						3.0	3.0
ROUGH RIDER	92	SEMINIS		1961						3.0	2.0
LSD(.05)			252	582			619	771	265		
CV%			7.0	17.5			15.4	12.7	13.0		
<u>GREAT NORTHERN</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>BST AVG</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
POWDERHORN	90-92	MSU	2578		3150	2564			2764	2.5	2.0
MSU G16351	95-97	MSU	2175		4182	2695			3017	3.0	2.0
MSU G17410	94-97	MSU	2529		3788	2937			3085	3.0	2.0
ARIES GN	90-93	PROVITA	1767		3469	2636			2624	3.5	2.0
LSD(.05)			428		374	708			281		
CV%			14.6		7.9	20.2			14.1		
<u>TEBO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>BT AVG</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
SAMURAI	103-105	MSU	2269			2217			2243	3.0	2.0
G17913	100-102	MSU	1731			1765			1748	3.5	3.0
LSD(.05)			513			751			375		
CV%			15.4			22.7			19.4		
<u>PINK</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>BST AVG</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
ROSETTA PINK	94-97	MSU	2838		3766	2703			3102	2.5	2.0
S17706	94-98	MSU	2279		3903	2149			2777	2.5	2.0
LSD(.05)			258		659	444			217		
CV%			6.1		10.3	11.0			9.9		
<u>CRANBERRY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>GM AVG</u>	<u>WM Rating</u>	<u>Lodge Rating</u>
ETNA	87-90	SEMINIS					2889	2915	2902		
CHIANTI vine	94-98	SEMINIS					2974	3432	3203		
BELLAGIO vine	97-100	MSU					3127	3749	3438		
VERO	88-90	ADM						3081			
CR 151084	101-103	PROVITA					2865	4040	3453		
CR 151085	101-104	PROVITA					3188	4231	3709		
CR 151093	101-103	PROVITA					3569	3358	3463		
CR 151106	92-94	PROVITA					2782	2979	2880		
CR 16760	90-91	PROVITA					3509	3124	3317		
CR 16761	90-92	PROVITA					3141	3576	3359		
CR 16764	93-94	PROVITA					3007	2267	2637		
CR 16766	93-94	PROVITA					3045	2398	2722		
USDA CR1502-3	102-104	USDA/MSU					2678	2962	2820		
USDA CR1503-1	103-104	USDA/MSU					2691	3024	2858		
USDA CR1506-1	104-105	USDA/MSU					2833	2750	2792		
LSD(.05)							344	679	377		
CV%							9.8	18.1	14.8		

<u>LIGHT RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>GM AVG</u>
CALIF ELRK	90-92	CAL	2137	2717	2427
CLOUSEAU	94-95	SEMINIS	2526	3403	2964
INFERNO	104-106	OAC-HDC	3208	4629	3919
MSU K15601	96-97	MSU	2449	4164	3306
MSU K16640	97-98	MSU	2410	4168	3289
MSU K17703	97-98	MSU	2782	4619	3700
ROSIE	98-100	NDSU	2301	3633	2967
BIG RED	90-92	PROVITA	2071	2864	2468
LRK 06269	98-99	PROVITA	2224	4377	3300
Ronnie's Red 09360	105-107	PROVITA	2756	4462	3609
LRK 09363	88-91	PROVITA	2212	3327	2770
LRK 15898	106-107	PROVITA	2576	3784	3180
LRK 15907	106-108	PROVITA	2699	3477	3088
LRK 15926	105-108	PROVITA	2490	3622	3056
LSD(.05)			388	512	323
CV%			13.1	11.6	12.4

<u>DARK RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>GM AVG</u>
RED HAWK	96-98	MSU	2405	3784	3095
MONTCALM	100-102	MSU	2129	3949	3039
RED ROVER	92-95	SEMINIS	2248	3374	2811
DYNASTY	100-102	OAC-HDC	2776	4321	3548
RED CEDAR	93-96	MSU	2428	3447	2937
MSU K16131	99-102	MSU	2403	3554	2978
MSU K16136	97-100	MSU	2699	3858	3279
MSU K17206	97-100	MSU	2136	2611	2374
GTS 104	98-103	GTS	2408	3759	3083
TALON	98-101	NDSU	2230	3480	2855
CHAPARRAL	102-105	PROVITA	2278	3965	3121
EPIC 09430	103-105	PROVITA	2512	3618	3065
DRK 09431	104-106	PROVITA	2514	4432	3473
DRK 09433	101-103	PROVITA	2441	3259	2850
RAMPART 09434	100-102	PROVITA	2521	3720	3120
DRK 11479	98-100	PROVITA	2823	3296	3059
DRK 15978	104-106	PROVITA	2602	4212	3407
DRK 15979	102-103	PROVITA	2153	4145	3149
DRK 15981	104-106	PROVITA	2826	3693	3259
DRK 151011	98-101	PROVITA	2754	3842	3298
DRK 151021	99-101	PROVITA	2726	3245	2986
LSD(.05)			297	478	279
CV%			10.2	10.9	10.9

<u>WHITE KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>GM AVG</u>
BELUGA	103-104	MSU	2385	3266	2825
SNOWDON	90-92	MSU	2754	2755	2754
MSU K15901	91-92	MSU	3053	3353	3203
MSU K16924	91-92	MSU	2589	3709	3149
MSU K16957	98-100	MSU	2810	3552	3181
MSU K17804	102-103	MSU	2734	3974	3354
COB-228-03	94-95	GTS	2698	3509	3103
YETI	103-105	HDC	2543	3798	3171
LSD(.05)			329	338	231
CV%			10.0	8.0	8.9

<u>YELLOW</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>GM AVG</u>
SVS 0863	104	SEMINIS	2811	2819	2815
Y16503	101	MSU	2951	3882	3417
LSD(.05)			519	1314	583
CV%			10.8	23.6	19.3

<u>ADZUKI</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>
ERIMO	102	JAPAN	1617

ORIGIN KEY

ADM - Archer Daniels Midland-Seedwest

CAL - University of California, Davis

COOP - Cooperative Elevator Company

GTS - Gen-Tec Seeds LTD

JAPAN - Japan Foods - Purity Foods

MSU - Michigan State University

NDSU - North Dakota State University

OAC-HDC - University of Guelph-Hensall Co-op

PROVITA - Provita Seeds

SEMINIS - Seminis Seeds - Monsanto

TVS - Treasure Valley Seed Company

USDA - US Department of Ag - ARS

VITERRA - Alberta/Manitoba Dry Bean Company

Maturity days = planting until harvest in 2018

Direct Cut Lodging Rating = 1-erect, 5-laying flat on ground

WM=White Mold Rating = 1-10% mold, 5-100% mold

White Mold Rating from Huron and Bay Counties

Black, Navy, Pinto and Small Red beans were direct harvested

Large seeded colored beans were hand pulled and harvested

Contact Information

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Greg Varner, Michigan Dry Edible Bean Production Research Advisory Board													
DRY BEAN CHARACTERISTICS													
Variety	Class	Plant Type	Maturity	Origin	BCMV	Anthracnose	Canning Quality	White Mold	Halo Blight	Common Blight	Rust	Air Pollution	Direct Cut-Rating
Medalist	N	USV	F	COOP/ADM	R-I	73	7	2	R	S	T	T	2
Merlin	N	USV	M-F	COOP/ADM	R-I	S	R	2	R	S	T	T	2
Vigilant	N	USV	F	COOP/ADM	R-I	S	R	2	R	S	T	T	2
Hyland 19905	N	USV	M	HYLAND	R-I	S	R	2	R	S	T	T	2
Indi	N	USV	M-F	ADM	R-I	S	R	2	R	S	T	T	1
Zorro	B	USV	F	MSU	R-I	S	R	2	R	S	T	T	2
Zenith	B	USV	F	MSU	R-I	R	R	3	R	S	T	T	2
Black Bear	B	USV	F	COOP/ADM	R-I	S	R	4	R	S	T	T	2
Eclipse	B	USV	M	NDSU	R-I	S	R	2	R	S	T	T	2
Cayenne	SR	USV	M	MSU	R	S	S	2	R	S	T	T	2
Merlot	SR	USV	M	MSU/USDA	R	S	S	3	R	S	T	T	3
Viper	SR	USV	M	COOP/ADM	R	S	S	4	R	S	T	T	3
Ruby	SR	USV	M	COOP/ADM	R	S	S	4	R	S	T	T	3
Calif. ELRK	LRK	B	E	UCD	R-I	R	S	2	S	S	T	T	6
Clouseau	LRK	B	M	SEMINIS	R-I	R	S	2	S	S	T	T	6
Pink Panther	LRK	B	M	SEMINIS	R-I	R	S	2	S	S	T	T	6
Montcalm	DRK	B	F	MSU	R-I	R	R	2	R	T	T	T	6
Red Hawk	DRK	B	F	MSU	R-I	R	R	2	T	S	T	T	6
Red Rover	DRK	B	F	SEMINIS	R-I	R	R	2	S	S	T	T	6
Etna	C	B	E	SEMINIS	R-I	R	S	2	S	S	T	T	6
Chianti	C	SV	M	SEMINIS	R-I	S	S	3	S	S	T	T	6
La Paz	P	USV	M	PROVITA	R	S	S	2	T	S	R	T	2
Lariat	P	USV	M	NDSU	R	S	S	3	T	S	R	T	3
Eldorado	P	USV	F	MSU	R	S	S	1	T	S	R	T	2
Rosetta	PK	USV	M	MSU	R-I	S	S	3	R	S	T	T	3
Samurai Tebo	W	USV	M	MSU	R-I	S	S	3	T	S	S	S	3
Fuji Tebo	W	B	M	MSU	R-I	S	S	3	T	S	S	S	4
Beluga	WK-AL	B	F	MSU	R-I	R	S	3	S	S	T	T	6
Snowdon	WK-AL	B	E	MSU	R-I	R	S	3	S	S	T	T	6

Plant Type: B=Bush, SV=Short Vine, USV=Upright Short Vine, V=Vine
Maturity: E=Early (less than 88 days), M=Mid-Season (89-95 days), F=Full Season (96-102 days), L=Late Full Season (greater than 102 days)
Canning Quality: 1=Poor, 2=Fair, 3=Good, 4=Above Average, 5=Excellent
White Mold: 1=Less than 10% Infection, 2=Less than 20% Infection, 3=20-40% Infection, 4=40-60% Infection, 5=Greater than 60% Infection
Direct Cut Rating: 1=Very erect, 2=lodging, pods off ground, 3=lodging, pods close to ground, 4=high yield loss, 5=severe yield loss, 6=not recommended

JAN-2019

EXPERIMENT 8102 STANDARD BLACK YIELD TRIAL

PLANTED: 6/1/18

Dr. James D. Kelly and Evan Wright, Plant, Soil, and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT 100 SEED		DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
		/ACRE	WT. (g)					
B18504	Zenith//Alpena*/B09197	44.5	23.3	48.0	102.0	1.0	52.0	6.0
B16504	Zenith//Alpena*/B09197	43.5	22.9	47.0	102.0	1.0	52.5	6.0
B15447	B11363/Zenith	43.3	25.0	48.0	102.0	1.0	52.0	5.0
B17315	B10244/B12724	43.0	22.9	49.0	101.0	1.5	51.5	5.0
B17271	B10244/B12724	42.0	25.5	47.0	99.0	1.5	50.0	4.5
B17293	B10244/B12724	41.7	25.0	47.0	99.0	2.0	50.0	4.5
B10244	B04644/ZORRO, ZENITH	41.5	26.2	47.0	102.0	1.0	52.5	5.0
B17207	B10244/B12724	41.3	23.4	48.0	99.0	1.0	52.5	5.0
B17286	B10244/B12724	41.2	25.1	47.0	99.0	1.0	49.0	4.0
B17265	B10244/B12724	41.0	24.4	48.0	99.0	1.0	51.5	4.5
B15427	Zenith/B11343	41.0	27.3	48.0	99.0	1.0	53.5	5.0
B17202	B10244/B12724	41.0	23.2	48.0	101.0	2.5	49.0	4.0
B16501	Zenith/B10215	41.0	25.4	48.0	100.0	1.0	52.0	5.0
B17260	B10244/B12724	40.4	24.4	47.0	101.0	2.0	49.5	4.0
B15430	Zenith/B12721	39.9	26.1	47.0	98.0	1.5	52.0	5.5
B17298	B10244/B12724	39.9	22.9	48.0	98.0	1.0	50.5	5.0
B17269	B10244/B12724	39.6	25.5	48.0	100.0	1.0	53.5	5.5
B15453	B11371/B11363	39.3	24.1	47.0	100.0	1.0	53.5	6.0
B17317	B10244/B12724	39.2	25.9	48.0	100.0	2.0	50.5	4.5
B17237	B10244/B12724	39.0	22.2	48.0	103.0	1.5	50.0	4.5
B17290	B10244/B12724	39.0	24.8	47.0	97.0	1.5	47.0	3.5
B17305	B10244/B12724	39.0	26.5	48.0	100.0	1.5	50.5	4.5
B17259	B10244/B12724	38.9	24.8	48.0	100.0	1.5	52.0	5.5
B16505	B11363//Alpena*/B09197	38.7	24.0	47.0	98.0	1.0	50.5	5.5
B15434	Zenith/B12721	38.6	24.5	48.0	100.0	1.0	55.0	6.0
B17214	B10244/B12724	38.6	26.6	48.0	100.0	2.0	49.5	4.0
B16503	Zenith/B12720	38.4	24.3	49.0	99.0	1.0	51.0	5.0
B17262	B10244/B12724	38.4	24.0	47.0	102.0	1.0	53.0	5.5
B15417	B10208/B09175	38.3	26.4	48.0	102.0	1.0	51.5	5.5
B15451	B11371/B11363	38.2	23.6	49.0	101.0	1.0	53.5	6.0
B17306	B10244/B12724	38.2	24.4	47.0	101.0	2.0	49.5	4.0
B17328	B10244/B12724	38.0	26.1	47.0	99.0	2.5	48.0	4.0
B17280	B10244/B12724	38.0	25.4	47.0	99.0	1.0	54.0	5.0
B17340	B10244/B12724	38.0	24.3	48.0	99.0	2.0	50.5	4.5
B17220	B10244/B12724	37.9	25.6	48.0	101.0	1.0	55.0	5.5
B17255	B10244/B12724	37.8	24.2	49.0	102.0	2.0	50.5	4.5
B17112	B14304/B10244	37.6	23.1	48.0	99.0	1.0	51.0	5.5
B15411	B09175/B11363	37.5	22.5	47.0	99.0	1.0	51.0	5.0
B17274	B10244/B12724	37.5	23.9	47.0	99.0	1.5	50.5	4.5
B17225	B10244/B12724	37.5	22.8	47.0	98.0	2.0	48.0	4.0
I17501	BL12576, BLACK BEAR	37.3	22.5	47.0	100.0	1.5	51.0	5.0
B15443	B11363/B09175	37.2	25.9	47.0	99.0	1.5	52.0	5.5
B17342	B10244/B12724	37.2	25.3	49.0	101.0	2.5	48.0	4.0
B16507	B12720/Zenith	36.5	27.9	48.0	102.0	1.0	53.5	6.0
B04554	B00103*/X00822, ZORRO	36.5	23.7	49.0	101.0	1.0	51.0	5.0
I18625	Black Tails	35.3	23.2	47.0	98.0	1.0	50.5	4.0
I17517	ACUG 15-B4	34.2	23.5	48.0	99.0	2.0	47.5	3.5
I03390	ND9902621-2, ECLIPSE	33.1	20.8	48.0	98.0	1.0	50.0	4.5
MEAN(54)		38.6	24.4	47.5	99.8	1.4	51.0	4.8
LSD(.05)		2.8	1.0	0.7	0.9	0.3	1.2	0.3
CV%		6.1	3.5	0.9	0.6	13.5	1.4	4.0

EXPERIMENT 8101 STANDARD NAVY YIELD TRIAL

PLANTED: 6/1/18

Dr. James D. Kelly and Evan Wright, Plant, Soil, and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT 100 SEED		DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
		/ACRE	WT. (g)					
N18116	N14201/N15334	37.1	20.8	52.0	102.0	2.0	52.5	5.0
N18126	N15335/N14238	37.0	21.0	49.0	100.0	1.0	53.5	6.0
N18117	N14201/N15334	36.3	19.6	51.0	103.0	1.5	54.0	5.5
N18112	N13131/B14302	36.2	22.9	49.0	100.0	1.0	50.5	5.0
N18102	N13120/I15617	36.0	22.5	48.0	100.0	1.5	51.5	6.0
N11283	MEDALIST/N08003, ALPENA	35.5	22.1	47.0	103.0	2.0	49.0	4.0
I18630	NA 14068	35.5	26.6	47.0	104.0	2.0	55.0	4.5
N17506	N14230/N12447	35.4	21.7	48.0	100.0	1.0	52.5	5.5
N18127	N14201/N13131	35.0	19.2	47.0	99.0	1.0	51.5	5.0
N15337	N12466/N11258	34.7	20.3	49.0	99.0	1.5	50.5	5.0
N18119	N14218/N15341	34.6	20.0	50.0	100.0	1.5	52.5	5.0
N18118	N14201/N15334	34.6	20.2	51.0	102.0	1.5	53.0	6.0
N18104	N13131/N14201	34.4	21.8	48.0	101.0	2.0	52.0	5.0
N18109	N13131/B14302	34.4	23.2	47.0	101.0	1.0	51.5	5.5
N17505	N14230/N12447	34.3	22.3	48.0	99.0	1.0	53.0	6.0
N15306	N11230/N11298	34.2	20.8	47.0	101.0	2.0	50.0	5.0
N18122	N15334/N15335	34.0	23.0	48.0	101.0	1.0	55.0	6.5
N18113	N13131/B14302	33.8	22.2	49.0	100.0	1.0	52.0	5.5
N18128	N15341/N14238	33.8	23.4	48.0	99.0	1.0	54.0	6.0
N18105	N13131/N14201	33.7	20.6	49.0	100.0	1.5	51.5	5.0
I10101	COOP 02084, VIGILANT	33.3	23.3	47.0	100.0	1.0	53.0	5.0
N14230	N11275/N11256	33.3	18.7	48.0	99.0	1.5	52.5	5.5
I11264	COOP 03019, MERLIN	33.1	21.7	48.0	105.0	2.0	48.5	4.0
N18130	N15341/N14238	33.1	22.0	50.0	98.0	1.5	53.5	5.5
N18110	N13131/B14302	33.0	23.8	48.0	100.0	1.0	50.0	5.0
N18115	N13142/B14302	33.0	19.5	50.0	99.0	2.5	47.0	3.5
N18125	N15335/N14218	32.9	20.0	49.0	97.0	1.0	51.0	5.0
N18103	N13120/I15617	32.8	23.7	47.0	99.0	1.0	51.5	5.5
N18101	N13120/I15617	32.7	24.0	47.0	97.0	1.5	49.5	4.5
N18131	N15335/N13142	32.6	19.3	49.0	97.0	1.5	51.0	5.0
N18129	N15341/N14238	32.5	21.2	48.0	98.0	1.0	48.5	4.5
N17504	N14206/N14229	32.4	20.3	48.0	98.0	1.5	51.0	5.5
N18108	N13131/B14302	32.2	21.8	48.0	99.0	1.0	52.5	5.5
N14201	N11249/N11256	32.1	20.6	49.0	99.0	1.0	51.5	5.5
N18120	N14238/N14229	32.1	20.7	48.0	99.0	1.0	51.0	5.0
N18121	N14238/N14230	32.0	19.4	48.0	101.0	1.5	54.0	4.5
N18106	N13131/N14238	31.7	22.3	48.0	98.0	1.5	50.0	5.0
N18114	N13142/N13120	31.6	23.1	48.0	100.0	1.5	49.5	5.0
N14229	N11275/N11256	31.3	18.2	51.0	98.0	1.5	52.0	5.0
N18111	N13131/B14302	31.3	20.9	49.0	97.0	2.0	49.5	5.0
N18107	N13131/N14238	30.8	22.1	47.0	99.0	1.0	50.0	5.0
N18124	N15335/N14201	30.3	19.5	48.0	97.0	1.0	49.0	4.5
N14218	N11256/N11298	30.3	20.3	50.0	100.0	1.5	50.0	5.0
N17508	Alpena/N14229	29.8	19.1	48.0	98.0	1.0	52.0	6.0
N16405	N12466/N11264	29.4	24.7	48.0	98.0	1.5	48.5	4.0
N15313	N11258/N11277	28.4	19.4	47.0	97.0	2.0	48.0	4.0
N18123	N15335/N14201	27.9	19.0	48.0	98.0	1.0	51.0	5.0
I08958	Mayflower/Avanti, MEDALIST	27.8	22.0	47.0	105.0	2.5	50.0	4.0
MEAN(48)		33.0	21.3	48.2	99.5	1.4	51.3	5.1
LSD(.05)		3.5	1.0	1.1	1.7	0.7	1.7	0.7
CV%		8.9	4.0	1.3	1.0	28.1	2.0	8.0

EXPERIMENT 8218 NATIONAL WHITE MOLD YIELD TRIAL

PLANTED: 6/13/18

Dr. James D. Kelly and Evan Wright, Plant, Soil, and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT 100 SEED		DAYS TO FLOWER	DAYS TO MATURITY	LODGING HEIGHT (1-5)	LODGING HEIGHT (cm)	DES. SCORE	WM (1-9)	WM %
		/ACRE	WT. (g)							
R17604	R12859/R12844	36.1	34.7	45.0	94.0	1.5	54.0	6.0	2.7	29.6
P16901	Eldorado/P11519	35.8	40.2	47.0	96.0	2.5	52.5	5.7	2.7	29.6
B17691	B14311/B12724	35.2	22.5	44.0	96.0	1.0	55.0	5.0	4.0	44.4
P16905	P11519/P12610	35.1	39.7	45.0	96.0	2.0	53.5	5.7	3.7	40.7
R17603	R12859/R12844	34.7	35.4	44.0	94.0	1.0	55.0	6.0	3.3	37.0
I13401	SR 09303, VIPER	32.9	29.7	43.0	93.0	2.5	50.5	4.0	7.0	77.8
N14229	N11275/N11256	32.4	18.2	45.0	98.0	2.0	53.5	5.7	3.0	33.3
B16504	Zenith//Alpena*/B09197	30.6	20.5	43.0	96.0	2.0	51.5	4.7	5.7	63.0
G17410	G13467/G13479	30.5	35.7	41.0	97.0	1.0	52.0	6.0	3.0	33.3
G16351	Eldorado/G13467	29.4	37.4	43.0	97.0	1.5	52.5	5.7	3.7	40.7
B15430	Zenith/B12721	29.3	26.1	41.0	97.0	1.0	52.5	5.0	3.7	40.7
R12844	SR9-5/R09508, CAYENNE	29.0	34.8	42.0	94.0	1.5	53.0	5.0	5.7	63.0
B10244	B04644/ZORRO, ZENITH	28.9	23.4	43.0	97.0	2.0	52.0	5.3	5.3	59.3
I18618	PT11-13B	27.2	38.9	44.0	93.0	2.5	50.5	4.3	5.3	59.3
B18504	Zenith//Alpena*/B09197	27.0	20.5	43.0	92.0	2.0	50.5	5.0	6.3	70.4
I11264	COOP 03019, MERLIN	25.8	19.7	44.0	98.0	1.5	54.5	5.0	2.0	22.2
N17504	N14206/N14229	25.7	19.3	45.0	98.0	2.0	54.0	5.3	3.0	33.3
N17506	N14230/N12447	25.1	19.9	44.0	97.0	1.0	53.5	6.0	3.3	37.0
N11283	MEDALIST/N08003, ALPENA	24.8	19.0	44.0	97.0	1.0	54.0	4.7	6.0	66.7
I15652	ND121630	23.9	35.8	42.0	93.0	2.5	50.5	3.7	7.0	77.8
I18629	PRP-153	23.8	37.2	43.0	99.0	3.0	44.5	3.3	6.0	66.7
B17536	B14311/B10244	22.4	18.8	42.0	96.0	1.0	50.0	4.3	4.3	48.2
B04554	B00103*/X00822, ZORRO	22.0	23.1	42.0	98.0	2.0	53.5	5.7	3.3	37.0
B17220	B10244/B12724	18.4	23.5	44.0	94.0	1.0	52.5	5.3	3.3	37.0
I17551	SR16-5	17.6	39.5	39.0	91.0	1.0	49.0	3.0	6.0	66.7
B16501	Zenith/B10215	17.3	18.8	44.0	93.0	1.0	51.0	4.3	5.7	63.0
I17550	NDZ14083	16.4	37.1	39.0	92.0	3.0	44.5	3.3	6.0	66.7
I18628	VCP-13	11.8	37.9	46.0	103.0	3.5	45.0	3.0	2.0	22.2
I81010	JAPON3/MAGDALENE, Bunsi	11.1	19.2	39.0	97.0	3.0	45.5	3.3	7.0	77.8
I96417	G122	10.6	40.5	40.0	103.0	2.0	45.5	2.7	3.7	40.7
I89011	RB, BERYL	7.4	30.2	39.0	90.0	4.0	40.0	3.0	8.7	96.3
I16705	ND121448	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN(32)		25.1	28.9	42.6	95.6	1.9	50.8	4.7	4.6	51.0
LSD(.05)		4.4	1.7	2.2	2.9	0.6	4.3	0.9	1.8	20.5
CV%		12.8	4.3	3.0	1.8	20.2	5.0	14.5	29.4	29.4

EXPERIMENT 8420 YDI YIELD TRIAL-WITH/WITH OUT N FERTILIZER/NON-INOCULATED

PLANTED: 6/26/18

Dr. James D. Kelly and Evan Wright, Plant, Soil, and Microbial Sciences, Michigan State University

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NAME	PEDIGREE	YIELD CWT		YIELD DIFF Fert-NoFert	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	DAYS TO LODGING (1-5)	HEIGHT (cm)	DES. SCORE
		/ACRE	/ACRE							
B16501	Zenith/B10215	38.3	26.4	11.9	22.4	42.0	101.0	1.0	52.0	6.0
B18504	Zenith//Alpena*/B09197	41.4	31.7	9.8	23.0	42.0	101.0	1.0	52.5	5.5
B11611	I82054/B07554	37.7	28.4	9.2	23.2	42.0	103.0	2.0	47.5	3.0
B11530	I82054/B07554	37.3	28.7	8.7	24.3	41.0	103.0	2.0	50.5	3.5
B11588	I82054/B07554	40.4	32.9	7.5	25.8	42.0	104.0	2.0	47.5	3.0
B17220	B10244/B12724	37.8	30.4	7.5	22.6	42.0	99.0	1.5	50.5	5.0
B11552	I82054/B07554	37.8	30.4	7.4	23.5	43.0	108.0	3.0	47.5	3.0
B11617	I82054/B07554	37.1	29.8	7.3	23.0	42.0	102.0	1.0	47.5	3.5
B11521	I82054/B07554	32.4	25.2	7.2	23.4	42.0	109.0	4.0	45.5	2.5
B10244	B04644/ZORRO, ZENITH	39.2	32.8	6.4	22.8	42.0	100.0	1.5	50.0	5.5
B11602	I82054/B07554	39.8	33.6	6.2	27.4	42.0	103.0	2.5	47.0	3.0
B04554	B00103*/X00822, ZORRO	39.7	33.7	6.1	22.9	42.0	101.0	2.0	50.0	4.0
I11264	COOP 03019, MERLIN	35.0	29.3	5.8	21.2	41.0	104.0	1.5	52.0	4.5
B11519	I82054/B07554	41.0	35.2	5.7	23.0	46.0	102.0	2.5	49.0	4.0
B11555	I82054/B07554	34.6	29.7	4.9	23.8	41.0	107.0	3.0	45.5	2.5
B16504	Zenith//Alpena*/B09197	43.2	39.0	4.2	23.3	42.0	101.0	2.5	49.0	4.5
B11536	I82054/B07554	37.0	33.4	3.7	25.1	42.0	101.0	3.5	45.5	3.0
N17504	N14206/N14229	31.6	28.5	3.1	18.9	42.0	100.0	1.0	52.0	5.0
N14229	N11275/N11256	31.8	30.0	1.9	18.3	43.0	98.0	1.0	53.0	6.0
B11567	I82054/B07554	36.1	34.5	1.6	24.8	43.0	102.0	3.0	44.5	3.0
B11594	I82054/B07554	34.0	33.3	0.7	24.7	42.0	101.0	2.5	46.0	3.0
B11582	I82054/B07554	32.2	32.6	-0.4	20.3	43.0	102.0	1.5	50.0	4.0
B11586	I82054/B07554	34.1	34.7	-0.6	24.0	42.0	102.0	1.5	50.5	4.0
N17506	N14230/N12447	33.2	34.0	-0.7	20.9	46.0	99.0	1.0	53.0	6.0
B11571	I82054/B07554	33.3	34.8	-1.6	22.6	44.0	105.0	1.5	50.5	3.5
B11580	I82054/B07554	29.9	31.8	-1.9	23.7	45.0	107.0	2.5	47.5	3.0
MEAN(26)		36.4	36.4	0.0	23.0	42.3	102.3	2.0	49.1	4.0
LSD(.05)		4.7	4.7	0.0	1.2	1.6	2.7	0.9	3.0	1.1
CV%		7.5	7.5	0.0	3.0	2.2	1.6	26.6	3.5	16.1

Timing of glyphosate and preharvest treatment effects on two classes of dry beans

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location:	Richville (SVREC)	Tillage:	Conventional
Planting Date:	June 19, 2018	Row width:	30-inch
Replicated:	4 times	Soil Type:	Sandy clay loam, 2.5% OM, pH 7.7
Varieties:	‘Zenith’ black beans	Populations:	109,000 seeds/A
	‘Merlin’ navy beans		109,000 seeds/A

Table 1. Preharvest treatments on leaf and stem desiccation (%) 4, 8, 14 days after treatment (DAT).

Treatments	Zenith					Merlin				
	4 DAT	8 DAT		14 DAT		4 DAT	8 DAT		14 DAT	
		leaf	stem	leaf	stem		leaf	stem	leaf	stem
Sharpen (1 fl oz) + MSO + AMS	100 a ^a	100 a	100 a	100 a	100 a	100 a	100 a	96 a	100 a	99 a
Sharpen (2 fl oz) + MSO + AMS	100 a	100 a	100 a	100 a	100 a	99 a	100 a	98 a	100 a	100 a
Gramoxone (2 pt) + NIS	99 a	100 a	99 a	100 a	100 a	95 a	99 a	84 b	100 a	95 b
Sharpen (1 fl oz) + Gramox.+ MSO + AMS	99 a	100 a	98 a	100 a	100 a	98 a	100 a	91 a	100 a	97 ab
Roundup (22 fl oz) + AMS	95 a	100 a	100 a	100 a	100 a	87 b	100 a	84 b	100 a	100 a
Untreated	75 b	78 b	81 b	95 b	92 b	68 c	80 b	58 c	89 b	73 c

^a Means within a column with different letters are significantly different from each other.

Summary: There were two objectives to this study this year using two dry bean classes, ‘Zenith’ black bean (uniform dry down) and ‘Merlin’ navy bean (green stem). The first objective was to evaluate the effect of glyphosate application timing on glyphosate residues remaining in harvested seed. Due to the overall concerns from dry bean buyers on the use of glyphosate, this objective was conducted to provide some actual data on the potential for glyphosate residues. Preharvest applications of glyphosate were made at five different dry bean stages ranging from 30% to >95% yellow pods. Dry beans were sampled and are currently being analyzed for residues. The second objective was to evaluate the effects of the most popular preharvest treatments on dry bean leaf and stem desiccation. Treatments were applied when ~70% of the pods were yellow. There were no differences in the desiccation treatments for Zenith black beans at any of the evaluation timings (Table 1). Differences were detected for desiccation of Merlin navy beans. Desiccation with glyphosate (Roundup), which is currently not recommended due to dry bean buyer concerns with residues, was slower than the other treatments for maximum desiccation. Additionally, stem desiccation with Gramoxone alone was not as effective as some of the other treatments, but was still 95%. This combined with previous research trials, show some general trends. Sharpen applied at 1 fl oz/A is similar 2 fl oz/A rate, regardless of variety. The speed of effectiveness on desiccation is dependent on the year, but over four years, Sharpen or Sharpen tank-mixtures provide the most consistent bean desiccation 7 DAT, followed by Gramoxone. The biggest concern is with yield, when quick acting herbicides are applied prior to 80% of the pods being yellow, we do see reductions in yield. This label recommendation must always be followed. Overall, many of the treatments provided good bean desiccation. This research was supported by the Michigan Dry Bean Commission through the Michigan Department of Agriculture Specialty Crops grant.

Harvest aid effects on common lambsquarters and dry bean desiccation

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location: Richville (SVREC)	Tillage: Conventional
Planting Date: June 19, 2018	Row width: 30-inch
Replicated: 4 times	Soil Type: Sandy clay loam, 2.5% OM, pH 7.7
Varieties: ‘Merlin’ navy beans	Date Treated: Sept. 27 & Oct. 3, 2018

Table 1. Effect of preharvest treatments on common lambsquarters and dry bean desiccation.

Treatments	C. lambsquarters		‘Merlin’ navy bean	
	6 DAT	12 DAT	6 DAT	12 DAT
Sharpen (1 fl oz) + MSO + AMS	61 de ^a	70 d-f	100 a	100 a
Sharpen (2 fl oz) + MSO + AMS	71 de	73 c-e	100 a	100 a
Gramoxone (2 pt) + NIS	91 ab	91 a-c	96 ab	100 a
Valor (1.5 oz) + MSO	68 de	77 c-e	100 a	100 a
Roundup (22 fl oz) + AMS	75 b-e	85 a-c	92 b	100 a
Aim (2 fl oz) + MSO	61 de	58 g	99 a	100 a
Sharpen (1 oz) + Roundup + MSO +AMS	90 a-c	84 a-c	100 a	100 a
Sharpen (1 oz) + Gramox. + MSO + AMS	90 a-c	98 a	100 a	100 a
Valor (1.5 oz) + Roundup + MSO +AMS	78 b-d	82 b-d	100 a	100 a
Valor (1.5 oz) + Gramox. + MSO + AMS	96 a	97 a	99 a	100 a
Aim (2 fl oz) + Roundup + MSO +AMS	76 b-d	80 cd	100 a	100 a
Aim (2 fl oz) + Gramox. + MSO + AMS	93 ab	96 ab	100 a	100 a
Sharpen (1 fl oz) + MSO + AMS fb. Sharpen (1 fl oz) + MSO + AMS	73 c-e	84 a-c	100 a	100 a
Gramoxone (2 pt) + NIS fb. Sharpen (1 fl oz) + MSO + AMS	93 ab	95 ab	94 ab	100 a
Roundup (22 fl oz) + AMS fb. Sharpen (1 fl oz) + MSO + AMS	58 e	65 f	83 b	100 a
Untreated	39 f	40 h	80 b	76 b

^a Means within a column with different letters are significantly different from each other

Summary: This study was conducted to evaluate the effects of preharvest herbicide treatments on weed and bean desiccation. We have been looking at common lambsquarters desiccation and have evaluated Powell amaranth desiccation previously. This year we also included three sequential applications timed six days apart. In the past, Gramoxone, Roundup (glyphosate) or combinations with these herbicides have provided the greatest common lambsquarters desiccation. This year Gramoxone alone, Gramoxone combinations or sequential applications with Gramoxone were the most consistent for common lambsquarters desiccation. Sequential applications did not improve common lambsquarters desiccation. Over the years if you are trying desiccate weeds, including Gramoxone in preharvest treatment has been the most consistent. In this trial dry beans were further along >90% yellow pods, so most all treatments were excellent in dry bean desiccation. Please refer to the 2019 MSU Weed Control Guide (E-434) for recommendations for the different preharvest herbicide treatments available in dry bean. This research was supported by the Michigan Dry Bean Commission through the Michigan Department of Agriculture Specialty Crops grant.

Sensitivity of two classes of dry beans to plant growth regulator herbicides

Scott Bales and Christy Sprague, Michigan State University

Location:	Richville (SVREC)	Tillage:	Conventional
Planting Date:	June 19, 2018	Row width:	30-inch
Replicated:	4 times	Soil Type:	Sandy Clay loam, 2.5% OM, pH 7.7
Varieties:	‘Zenith’ black beans	Populations:	109,000 seeds/A
	‘Merlin’ navy beans		109,000 seeds/A

Table 1. Sub-lethal rates of plant growth regulator herbicides effects on dry bean injury 28 days after treatment (DAT), maturity and yield.

Herbicide	Rate ^a	Injury ^b		Delayed maturity ^c		Yield ^b	
		V2	V8	V2	V8	V2	V8
Dicamba	0.1	0 a ^c	6 c	0 a	0 a	33.0 c-e	34.8 a-d
	1.0	4 b	12 d	6 b	9 b	32.5 d-f	29.9 f
	10	27 e	58 f	16 c	20 c	22.6 g	16.3 h
2,4-D Choline	0.1	0 a	0 a	0 A	0 A	36.9 a	35.7 a-c
	1.0	0 a	0 a	0 A	2 B	34.7 a-d	36.6 a
	10	1 a	4 b	4 C	11 C	36.0 ab	30.8 ef
Untreated	-	-	-	-	-	33.5 b-e	35.4 a-d

^a Rate is a % of 0.5 lb ae/A of dicamba and 1.0 lb ae/A of 2,4-D.

^b Injury, maturity and yield are combined over dry bean class.

^c Means within each outlined area with different letters are significantly different from each other.

^d Days past the untreated control to reach 50% maturity. The larger the number the greater delay in maturity.

^e Yield is in cwt/A obtained by direct harvest and adjusted to 18% moisture.

Summary: With the recent commercialization of soybean resistant to dicamba (Xtend soybean) and the upcoming release of soybean resistant to 2,4-D (Enlist soybean) a study was conducted to investigate the effects of off-target exposure of dicamba and 2,4-D on two classes of dry edible bean. The objective of this research was to gain a better understanding of how dry edible beans respond to sub-lethal doses of these PGR herbicides. ‘Zenith’ black bean and ‘Merlin’ navy bean were exposed to the PGR herbicides at the V2 and preflower (V8) stages. Dry bean varieties responded similarly to exposure of dicamba and 2,4-D. Exposure to dicamba always caused more injury and caused greater delays in dry bean maturity. Even with delays in maturity dry bean yield was only lower compared with the untreated when beans were exposed to 1% dicamba treatments at V8 stages, and 10% dicamba treatments at both timings. We have conducted this study in three other environments. Plant injury was similar between all locations. In 2018 untreated control treatments at SVREC yielded 39% more than other locations. However, 10% dicamba treatments reduced yield 37% more at SVREC in 2018 than other locations. The delays in harvest also may greatly effect yield of other treatments in the future. We are currently looking at the effects of this injury on different aspects of the progeny seed (seed size and germination).

TABLE 5B –Dry Edible Bean Herbicides – Remarks and Limitations

Dry Edible Beans – Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	EPTC (<i>Eptam</i>)	2.25	1.25 qt 7EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Eptam</i> suppresses common ragweed and wild mustard. • Prowl (pendimethalin), trifluralin, or Sonalan should be tank mixed with <i>Eptam</i> for additional broadleaf control, including lambsquarters. • <i>Pursuit</i> (2 oz) can be added to tank mixes with <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i> for nightshade control. • <i>Pursuit</i> (2 oz) may also be applied preemergence after preplant incorporated applications of <i>Eptam</i> tank mixed with <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i>. See remarks for <i>Pursuit</i>. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i> or <i>Raptor</i> may be necessary for additional broadleaf control. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses Annual broadleaves	pendimethalin (<i>Prowl</i>) OR (<i>Prowl H₂O</i>)	0.75	1.8 pt 3.3EC OR 1.6 pt 3.8CS	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Prowl</i> provides better velvetleaf control than <i>trifluralin</i> or <i>Sonalan</i>. • Prowl should be tank mixed with <i>Eptam</i>. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin (<i>Sonalan</i>)	0.75	2 pt 3EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • Sonalan should be tank mixed with <i>Eptam</i>. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	trifluralin (<i>many</i>)	0.5	1 pt 4EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Trifluralin</i> provides better pigweed control than <i>Prowl</i> or <i>Sonalan</i>. • Trifluralin should be tank mixed with <i>Eptam</i>. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.

Dry Edible Beans – Soil Applied

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	s-metolachlor (Dual Magnum, EverpreX) OR (Dual II Magnum, Cinch)	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED <i>Dual Magnum</i> minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce <i>Dual Magnum</i> rate to 1 pt/A on coarse-textured soils with low organic matter. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • <i>Dual Magnum</i> provides better yellow nutsedge control than <i>Outlook</i>. • <i>Prowl</i>, <i>trifluralin</i> or <i>Sonalan</i> can be tank mixed preplant incorporated for lambsquarters control. • <i>Pursuit</i> (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i> or <i>Raptor</i> may be necessary for additional broadleaf control. • DO NOT apply <i>Dual Magnum</i> within 60 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P (Outlook)	0.66	14 oz 6L	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED Outlook minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce <i>Outlook</i> rate to 12 oz/A on coarse-textured soils with low organic matter. • Navy and black beans are more sensitive to <i>Outlook</i> applications than to <i>Dual Magnum</i>. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • <i>Outlook</i> provides better pigweed and nightshade control than <i>Dual Magnum</i>. • <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i> can be tank mixed preplant incorporated for lambsquarters control. • <i>Pursuit</i> (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i>, or <i>Raptor</i> may be necessary for additional broadleaf control. • DO NOT apply <i>Outlook</i> within 70 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans – Soil Applied (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual grasses	metolachlor (<i>Parallel PCS</i>)	1.3	1.33 pt 8EC	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • <i>Parallel PCS</i> is a mix of the R and S-isomers of metolachlor. Limited research has shown that 1.33 pt/A of these products provide similar activity to s-metolachlor products at 1.33 pt/A. However, <i>Parallel PCS</i> may not provide the consistency, length of control or performance on more difficult to control weeds. Rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) in the 1.33 pt/A rate of <i>Dual Magnum/ Dual II Magnum/Cinch</i> (s-metolachlor). • Refer to Table 5A for weed control and crop tolerance ratings. • See remarks and limitations for <i>Dual Magnum</i>. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor (<i>Sequence</i>) + ammonium sulfate	1.64	3 pt 2.25L + 17 lb/100 gal	<ul style="list-style-type: none"> • May be applied preplant or preemergence. • <i>Sequence</i> contains 0.9 lb a.e./A of glyphosate and 1.2 pt/A of <i>Dual Magnum</i>. • <i>Sequence</i> is best used to control existing vegetation prior to planting no-till dry beans with the residual control of <i>Dual Magnum</i>. • 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. • Apply only one application per crop year. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves	halosulfuron (<i>Permit/Sandea</i>)	0.023	0.67 oz 75DG	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • Reduce the rate of <i>Permit/Sandea</i> to 0.5 oz/A on lighter textured soils with low organic matter. • <i>Permit/Sandea</i> can cause injury under cool and wet growing conditions. • Delayed maturity may result from applications of <i>Permit/Sandea</i>. • Dry bean varieties and classes vary in their tolerance to <i>Permit/Sandea</i>. From MSU research, CAUTION should be taken when applying <i>Permit/Sandea</i> to kidney and black beans. • <i>Permit/Sandea</i> can be tank mixed with <i>Eptam</i> for grass and additional lambsquarters control. • <i>Permit/Sandea</i> can be tank mixed with metolachlor products or <i>Outlook</i> for annual grass control. • <i>Permit/Sandea</i> will not control ALS-resistant weed species. • DO NOT plant SUGAR BEETS within 21 months of a <i>Permit/Sandea</i> application. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans – Soil Applied *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	imazethapyr <i>(Pursuit)</i>	0.031	2 oz 2L	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT apply <i>Pursuit</i> if cold and/or wet conditions are present or predicted to occur within 1 week of application. • Delayed maturity may result from applications of <i>Pursuit</i>. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • On heavy soils with greater than 2% organic matter and heavy weed pressure, 3 oz of <i>Pursuit</i> may be applied. • <i>Pursuit</i> can be tank mixed and applied preplant incorporated with <i>Eptam</i> plus <i>trifluralin</i>; <i>Prowl</i> or <i>Sonalan</i>; or <i>Dual Magnum</i> or <i>Outlook</i>; or preemergence with <i>Dual Magnum</i> or <i>Outlook</i>. <i>Pursuit</i> in these mixes will control eastern black nightshade. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • <i>Pursuit</i> will NOT control common ragweed. • Dry bean varieties vary in their sensitivity to <i>Pursuit</i>. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if SUGAR BEETS, CUCUMBERS, CANOLA or TOMATOES are in the rotation; requires 40 months and a soil bioassay. • Refer to label and Table 12 for crop rotation restrictions.
	fomesafen <i>(Reflex)</i>	0.25	1 pt 2L	<ul style="list-style-type: none"> • May be applied preplant surface or preemergence. • Refer to Table 5C for weed control and crop tolerance ratings. • <i>Reflex</i> 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. • <i>Reflex</i> can be applied only in the Lower Peninsula of Michigan. • DO NOT apply <i>Reflex</i> or other fomesafen products to the same field in CONSECUTIVE years. • The maximum use rate of <i>Reflex</i> per field is 1 pint per acre. • Refer to Table 12 for crop rotation restrictions.

Dry Edible Beans — Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Grasses	quizalofop-P-ethyl (<i>Assure II/Targa</i>)	0.044	7 oz 0.88L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Treat actively growing grasses (annual grasses up to 4 inches). • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between <i>Assure II/Targa</i> application and dry bean harvest. • <i>Assure II/Targa</i> can be tank mixed with <i>Basagran</i> for foxtails and barnyardgrass. Increase the <i>Assure II/Targa</i> rate by 2 oz. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • <i>Assure II/Targa</i> (10 oz/A) plus crop oil concentrate (1% v/v) or nonionic surfactant (0.25% v/v) will control quackgrass 6-10 inches tall. A sequential application of 7 oz/A may be needed 14-21 days later. • Refer to label and Table 12 for crop rotation restrictions.
	+		+	
	crop oil concentrate OR surfactant		1% OR 0.25%	
	fluzifop-P-butyl (<i>Fusilade DX</i>)	0.188	12 oz 2L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Apply 6 oz/A of <i>Fusilade DX</i> to control volunteer corn. • Allow 60 days between <i>Fusilade DX</i> application and dry bean harvest. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • DO NOT apply more than 48 oz/A of <i>Fusilade DX</i> per season. • Refer to label and Table 12 for crop rotation restrictions.
	+		+	
	crop oil concentrate		1 qt	
	+		+	
	ammonium sulfate		2.5 lb	
	sethoxydim (<i>Poast</i>)	0.19	1 pt 1.5SC	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of <i>Poast</i> (12 oz/A) may be used when barnyardgrass, green and giant foxtail, and fall panicum are less than 4 inches tall and the target species. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between <i>Poast</i> application and dry bean harvest. • <i>Poast</i> is generally less effective than other postemergence grass herbicides for perennial grass control. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • Refer to label and Table 12 for crop rotation restrictions.
	+		+	
	crop oil concentrate		1 qt	
	+		+	

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Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Grasses	clethodim (<i>Select/Arrow</i>)	0.094	6 oz 2EC	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of <i>Select/Arrow</i> (4-5 oz/A) or <i>Select Max</i> (6-8 oz/A) may be used when some grass species are small. • The addition of ammonium sulfate 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. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 7 days prior to and 7 days following application. • Allow 30 days between application and dry bean harvest. • <i>Select/Arrow</i> or <i>Select Max</i> can be tank mixed with <i>Basagran</i>. Increase the <i>Select/Arrow</i> rate to 8-10 oz/A and the <i>Select Max</i> rate to 12 oz/A and apply with crop oil concentrate (1% v/v). • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • <i>Select/Arrow</i> (8-16 oz/A) plus crop oil concentrate (1% v/v) plus ammonium sulfate (2.5 lb/A) will control quackgrass 4-12 inches tall. A sequential application of 8 oz/A may be needed 14-21 days later. Sequential applications of <i>Select Max</i> (12 + 12 oz/A) are needed to control 4 to 12 inch quackgrass. • Refer to label and Table 12 for crop rotation restrictions.
	+ crop oil concentrate OR (<i>Select Max</i>) + surfactant + ammonium sulfate	0.068	9 oz 0.97EC + 0.25% + 2.5 lb	
Annual broadleaves	bentazon (<i>Basagran/Broadloom</i>) OR <i>Basagran 5L</i> + crop oil concentrate	0.75	1.5 pt 4L OR 1.2 pt 5L + 1 qt	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds. Check dry bean label for specific rate and proper weed growth stage. • Beans MUST HAVE one fully expanded trifoliolate before application. • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if dry beans are under stress from herbicide injury, cold or dry weather, or hail damage. • For improved velvetleaf control 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) can be used INSTEAD OF crop oil concentrate. However, if common ragweed and common lambsquarters are present, a crop oil concentrate must also be included. • Split applications of 1 pt + 1 pt (4L) or 0.8 pt + 0.8 pt (5L) plus crop oil concentrate (1 pt + 1 pt) can be used for more consistent common ragweed and 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 crop oil concentrate (1 qt + 1 qt) when Canada thistle is 6-8 inches tall and yellow nutsedge is 4-6 inches. Make second application 7-10 days later. • Allow 30 days between application and dry bean harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	halosulfuron <i>(Permit)</i> + surfactant	0.023	0.67 oz 75WG + 0.25%	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Apply when beans have 1-3 trifoliolate leaves. • DO NOT apply if dry beans have begun to flower. • <i>Permit</i> can be tank-mixed with other herbicides for additional broadleaf and grass control. • Dry bean varieties and classes vary in their tolerance to <i>Permit</i>. 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 plant SUGARBEETS within 21 months of <i>Permit</i> application. • Refer to Table 12 for crop rotation restrictions.
	imazethapyr <i>(Pursuit)</i> + surfactant	0.031	2 oz 2L + 0.25%	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliolate before application. • DO NOT apply if dry beans have begun to flower. • Apply <i>Pursuit</i> with non-ionic surfactant (0.25% v/v). • DO NOT add 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (2.5 lb/A) unless at least 8 oz of <i>Basagran</i> 4L is added to “safen” this application. • Increase the rate of <i>Basagran</i> 4L to 16 fl oz (4L) or 12.8 fl oz (5L) when tank mixed with <i>Pursuit</i> to control common cocklebur and jimsonweed. • Delayed maturity may result from applications of <i>Pursuit</i>. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • DO NOT tank mix with postemergence grass herbicides – grass antagonism will occur. • Dry bean varieties vary in their sensitivity to <i>Pursuit</i>. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if sugar beets, cucumbers, canola or tomatoes are in the rotation; requires 40 months and a soil bioassay. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	imazamox (<i>Raptor</i>)	0.032	4 oz 1L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliolate before application. • DO NOT apply if dry beans have begun to flower. • DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • Apply <i>Raptor</i> with crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v). • At least 8 fl oz of <i>Basagran</i> 4L or 6.4 fl oz (5L) must be tank mixed with <i>Raptor</i>, if ammonium sulfate (12-15 lb/100 gal) or 28% liquid nitrogen (2.5% v/v) are added. <i>Basagran</i> “safens” this application. • Increase the rate of <i>Basagran</i> to the 16 fl oz (4L) or 12.8 fl oz (5L) when tank mixed with <i>Raptor</i> to control common cocklebur and jimsonweed, and to provide good control of common lambsquarters (less than 2 inch tall). • DO NOT tank mix with postemergence grass herbicides – grass antagonism will occur. • DO NOT apply within 60 days of harvest. • DO NOT use the combination of <i>Raptor</i> + <i>Basagran</i> on adzuki beans. <i>Basagran</i> causes significant injury to adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	+	0.25	8 oz 4L OR 6.4 oz 5L	
	bentazon (<i>Basagran</i>)		+	
	+		+	
	crop oil concentrate		1%	
	+		+	
	ammonium sulfate		2.5 lb	
	fomesafen (<i>Reflex</i>)	0.25	1 pt 2L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds; common ragweed 4-inches or less and eastern black nightshade 2-inches or less. • Common ragweed less than 4-inches will be controlled with 0.5 pt/A of <i>Reflex</i>. • Beans MUST HAVE one fully expanded trifoliolate before application. • A non-ionic surfactant at 0.25-0.5% v/v or a crop oil concentrate at 0.5-1.0% v/v must be included for effective control. • <i>Reflex</i> can be tank-mixed with <i>Basagran</i>, <i>Raptor</i>, or <i>Pursuit</i>. Include a COC when tank-mixing <i>Reflex</i> + <i>Basagran</i>. ONLY include a non-ionic surfactant when tank-mixing with <i>Raptor</i> or <i>Pursuit</i>. DO NOT add AMS or 28%N. • <i>Reflex</i> can be applied only in the Lower Peninsula of Michigan. • DO NOT apply <i>Reflex</i> or other fomesafen containing products to the same field in CONSECUTIVE years. • DO NOT apply within 45 days of harvest. • Refer to Table 12 for crop rotation restrictions.
	+		+	
	surfactant		0.25%	
	basagran + imazamox (<i>Varisto</i>)	0.68	21 oz 4.18L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • <i>Varisto</i> at 21 fl oz/A is equivalent to 21 fl oz (4L) or 16.8 fl oz (5L) of <i>Basagran</i> and 4 fl oz/A of <i>Raptor</i>. • Most effective on small weeds (less than 2 inches). • Beans must have one fully expanded trifoliolate before application. • DO NOT apply if dry beans have begun to flower. • DO NOT tank-mix with postemergence grass herbicides – grass antagonism will occur. • DO NOT apply within 30 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	+		+	
	crop oil concentrate		1%	
	+		+	
	ammonium sulfate		2.5 lb	

Table 5C – Preharvest Treatments in Dry Edible Beans

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preharvest	glyphosate (<i>many</i>) + ammonium sulfate	0.75 lb a.e.	See Table 10 + 17 lb/100gal	<ul style="list-style-type: none"> • Glyphosate should ONLY be used to control weeds that hinder harvest. • Not all glyphosate products are labeled for Preharvest application in dry edible beans. Consult product labels for legal applications. Roundup branded products, <i>Duramax</i>, <i>Durango DMA</i>, <i>Touchdown Total</i> and <i>Traxion</i> are some glyphosate products that are currently labeled. • DO NOT use glyphosate for vine desiccation — residues of glyphosate have been found in harvested beans if applications are made too early. • Glyphosate should be applied when beans are in the hard dough stage (30% moisture or less). • Some buyers will not purchase beans treated with glyphosate, consult your buyer prior to using glyphosate as a preharvest herbicide treatment. • Glyphosate applications should be made at least 7 days before harvest. • ONLY one application should be made per year. • DO NOT apply glyphosate to beans grown for seed. • DO NOT feed treated vines and hay from these crops to livestock.
	paraquat (<i>Gramoxone SL 2.0</i>) + surfactant	0.3-0.5	1.2–2 pt 2SL + 0.25%	<ul style="list-style-type: none"> • <i>Gramoxone SL 2.0</i> is a restricted-use pesticide. • Apply when crop is mature, at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • Always add a non-ionic surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v. • Apply by air in 5 gal water/A or by ground in 20-40 gal of water/A. • If growth is lush and vigorous, make either a single application of the higher rate of <i>Gramoxone SL 2.0</i>; or split applications at the lower rates. Split applications may improve vine coverage. DO NOT exceed 2.0 pt/A of <i>Gramoxone SL 2.0</i>. • Do not harvest within 7 days of application.
	paraquat (<i>Parazone</i>) + surfactant	0.5	1.33 pt 3SL + 0.25%	<ul style="list-style-type: none"> • <i>Parazone</i> is a restricted-use pesticide. • <i>Parazone</i> contains the same active ingredient as <i>Gramoxone SL 2.0</i> (paraquat), but is at a different concentration. • See the Remarks and Limitation section for <i>Gramoxone SL 2.0</i>.
	saflufenacil (<i>Sharpen</i>) + methylated seed oil + ammonium sulfate	0.023	1 oz 2.85L + 1% + 17 lb/100 gal	<ul style="list-style-type: none"> • Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type) beans of the leaves are still green. • <i>Sharpen</i> can be applied at rates up to 2 oz/A. • Dry beans can be harvested 2 days after application. However, it generally takes 7 days to reach maximum desiccation activity. • <i>Sharpen</i> is an effective desiccant. • DO NOT apply to beans grown for seed. • DO NOT graze or feed desiccation-treated hay or straw to livestock. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

(Continued on next page)

Preharvest Treatments in Dry Edible Beans (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Preharvest	flumioxazin <i>(Valor)</i> OR <i>(Valor EZ)</i> + methylated seed oil	0.05	1.5 oz 51WG OR 1.5 oz 4L + 1 qt	<ul style="list-style-type: none"> • Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • <i>Valor/Valor EZ</i> can be applied at rates up to 2 oz/A. • Dry beans can be harvested 5 days after <i>Valor</i> application. However, it generally takes 7 to 14 days to reach maximum desiccation activity. • Dry bean desiccation is similar to that from <i>Gramoxone</i> and glyphosate; however, the spectrum of weed control is not as broad. • <i>Valor</i> provides residual activity that may reduce winter annual growth. • Follow sprayer clean-up instructions — residues of <i>Valor</i> can be trapped in poly-tanks and hoses if not adequately cleaned. • Crop rotation restrictions are dependent on rainfall, <i>Valor</i> use rate and tillage. • Rotation restrictions for 2 oz or less of <i>Valor/Valor EZ</i> 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 sugar beets 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 sugar beet no-till the spring following a <i>Valor</i> preharvest treatment resulted in major sugar beet stand reduction. Tillage reduced the effect of <i>Valor</i> on sugar beet; however, slight injury may occur on sandier soils. • Refer to label and Table 12 for crop rotation restrictions.
	carfentrazone <i>(Aim)</i> + methylated seed oil	0.03	2 oz 2EC + 1% v/v	<ul style="list-style-type: none"> • Apply when crop is mature – at least 80% of the pods are yellowing and most ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • <i>Aim</i> alone is not as effective as <i>Sharpen</i>, glyphosate, <i>Gramoxone</i>, or <i>Valor</i> for dry bean desiccation. • Tank mixtures with <i>Gramoxone</i> or glyphosate will improve dry bean desiccation and is needed to improve the spectrum of weed desiccation. • Thorough spray coverage is required – sequential applications may be needed. • The preharvest interval is 0 days for <i>Aim</i> alone.

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

	SITE OF ACTION	CROP TOLERANCE**	ANNUAL BROADLEAVES									ANNUAL GRASSES							PERENNIALS					
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																								
DUAL MAGNUM/PARALLEL	15	2	N	N	P	F	G	P	P	N	P	E	E	E	E	E	G	G	F	N	N	N	N	G
EPTAM	8	2	P	P	G	F	F	F	F	F	F	E	E	E	E	E	E	E	G	N	N	N	F	F
OUTLOOK	15	3 ^a	N	N	P	G	G	P	P	N	P	E	E	E	E	E	G	G	P	N	N	N	N	F
PROWL H ₂ O/PROWL	3	1	N	N	G	P	F	P	P	F	P	E	E	E	E	E	E	E	G	N	N	N	N	N
PURSUIT	2	3	F	F	P	E	E	P	F	F	G	P	P	F	F	F	P	P	P	N	N	N	N	F
SONALAN	3	1	N	N	G	F	G	P	P	N	P	E	E	E	E	E	E	E	G	N	N	N	N	N
TRIFLURALIN	3	1	N	N	G	N	G	N	P	N	P	E	E	E	E	E	E	E	G	N	N	N	N	N
Preemergence																								
DUAL MAGNUM/PARALLEL	15	2	N	N	P	F	G	P	P	N	P	E	E	E	E	E	G	G	F	N	N	N	N	F
OUTLOOK	15	3 ^a	N	N	P	G	G	P	P	N	P	E	E	E	E	E	G	G	P	N	N	N	N	F
PERMIT/SANDEA	2	3	F	F	F	P	E	G	P	G	E	N	N	N	N	N	N	N	N	N	N	N	N	F
PURSUIT	2	3	P	P	P	E	E	P	F	P	G	P	P	F	F	F	P	P	P	N	N	P	N	F
REFLEX	14	2	P	P	G	E	E	G	G	P	E	N	N	N	N	N	N	N	N	N	N	N	N	N
SEQUENCE ^b	9/15	2	N	N	P	F	G	P	P	N	P	E	E	E	E	E	G	G	F	N	N	N	N	F
Postemergence																								
ASSURE II/TARGA	1	1	N	N	N	N	N	N	N	N	N	G	G	E	E	G	E	E	E	N	N	N	E	N
BASAGRAN/BROADLOOM ^c	6	2	E	G	F	P	P	F	E	G	E	N	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	E	G	E	E	E	E	E	E	N	N	N	G	N
PERMIT	2	3	E	G	N	P	E	G	F	G	E	N	N	N	N	N	N	N	P	P	P	N	E	
POAST	1	1	N	N	N	N	N	N	N	N	N	E	G	E	E	E	E	E	E	N	N	N	F	N
PURSUIT ^d	2	3	F	P	P	E	E	P	F	F	E	P	P	F	P	P	P	P	P	N	N	P	N	F
PURSUIT ^d + BASAGRAN	2/6	2	E	G	F	E	E	F	G	G	E	P	P	F	P	P	P	P	P	N	N	G	N	G
RAPTOR ^d	2	3	F	F	F	E	E	P	F	G	E	F	P	F	P	P	P	P	P	N	N	P	N	P
RAPTOR ^d + BASAGRAN 8 oz (4L) or 6.4 oz (5L)	2/6	2	G	F	F/ G	E	E	F	G	G	E	F	P	F	P	P	P	P	P	N	N	F	N	F
RAPTOR ^{de} + BASAGRAN 16 oz (4L) or 12.8 oz (5L)	2/6	2	E	G	G	E	E	F	E	G	E	P	P	F	P	P	P	P	P	N	N	G	N	F
REFLEX	14	2	P	F	P	G	G	E	P	P	E	N	N	N	N	N	N	N	N	N	N	N	N	N
REFLEX + BASAGRAN	6/14	2	E	G	F/ G	G	G	E	E	G	E	N	N	N	N	N	N	N	N	N	N	F	N	G
REFLEX + RAPTOR ^e	2/14	3	F	F	F	E	E	E	F	G	E	F	P	F	P	P	P	N	N	N	N	P	N	P
SELECT/SELECT MAX/ARROW	1	1	N	N	N	N	N	N	N	N	N	E	G	E	E	E	E	E	E	N	N	N	G	N
VARISTO	2/6	2	E	G	G	E	E	F	E	G	E	P	P	F	P	P	P	P	P	N	N	G	N	F

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

*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 (soil applied — cold, wet; foliar applied — hot, humid); 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 Crop tolerance for navy and black beans = 3. For other bean classes, crop tolerance = 2. Preplant incorporation will increase tolerance of navy and black beans to *Outlook*.

^b Sequence is a premixture of *Dual Magnum* and glyphosate and should be used to control existing vegetation prior to planting dry beans. See Remarks and Limitations section.

^c Control of **hairy nightshade** is good.

^d Control of **hairy nightshade** with *Pursuit* and *Raptor* is excellent.

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

