

2016 Dry Bean Research Report

**Dry Bean Yield Constraints Associated with
High Performance 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 “Dry Bean Yield Constraints Associated with High Performance Production Systems”. Main areas of study were White Mold and Root Rot Disease Control, Dry Bean Variety and Dry Bean Desiccants and Harvest Aids.

Expected outcomes from this project are:

1. Assessment of impact of suitable strategies 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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Photos

Front Cover: Planting Dry Bean Variety Trial in Sanilac County.
 Top Back Cover: Severe White Mold Yield Loss in Huron County. Bottom Back Cover: Severe Fusarium Root Rot in Montcalm County.

**2016 White Mold Fungicide Trial
Giles Farm, Wheeler, Michigan**

Treatment	Application		Incidence	Severity	%Pick	YIELD
	Code	Rate	% infection	%severity		
Untreated Check			86	69	3.3	2365
Propulse	8 oz	AB	48	36	2	3257
Propulse	10.3 oz	AB	46	37	1.6	3569
Propulse	8 oz	A	55	40	2.5	3256
Omega	8 oz	B				
Propulse	8 oz	C				
Omega	8 oz	AB	64	52	2.3	3333
Omega	8 oz	A	80	66	3.7	2386
Edura	8 oz	AB	52	39	1.7	3606
Edura	8 oz	A	69	54	2.3	2960
Edura+Omega	6+6 oz	A	69	54	3	2645
Edura+Omega	6+6 oz	AB	56	43	1.9	3455
Propulse+Omega	6+6 oz	A	68	52	3	2912
Propulse+Omega	6+6 oz	AB	42	29	1.5	3906
Approach	12 oz	AB	79	66	3.5	2465
		LSD .05 =	9.7	8.3	1.0	710
		C. V. =	10.90%	11.90%	27.70%	16.10%

Located at Varner Farm, Midland County

Application Code:A=100% or first bloom, B=10 days after 100% bloom, C=16 after 100% bloom

Rating Date: % infection "rating" on September 25, % Incidence, % Severity

Viper Small Red Beans planted in 20" rows. Population of 115,680. 5 Irrigations of one inch per week.

Planted:June 7 Harvested: October 11

First Spray: July 23, Second Spray: August 1, Third Spray: August 8

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.

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. Viper small red beans were planted. The white mold trial had twelve treatments and one non-sprayed control with four replications of each treatment. Four fungicides were used, either by itself or in combination with another fungicide.

Common Root Rot Pathogens of Dry Bean in Michigan

Martin Chilvers and Janette Jacobs

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It was no surprise that the results from a dry bean root rot survey supported by funds received from MSU Project GREEN and the USDA-Specialty Crop Block grant by way of Michigan Bean Commission across Michigan from 2014-2016, found that *Fusarium* spp., *Pythium* spp., and *Rhizoctonia solani* were all associated with roots exhibiting rot symptoms. These organisms are all known to be the big players when it comes to causing seed rot, damping-off and root rot. We conducted the survey to gain information on which species within *Pythium* and *Fusarium* and what anastomosis group of *Rhizoctonia solani* are actually the big hitters. We need to know what pathogens are capable of causing reduced stand, which can result in replant expenses and which pathogens impact root vigor and overall plant growth to decrease yield potential.

The survey included sampling of 26 field locations across seven counties. We isolated organisms from 600 plants and recovered 240 *Pythium* spp., 550 *Fusarium* spp., 202 *Rhizoctonia solani* and 17 *Macrophomina phaseolina* isolates from symptomatic dry beans. We commonly isolated all three pathogens from a single root. We are working through the identification of all these isolates and screening them for pathogenicity and virulence on red kidney and black bean. In addition, we are evaluating representative *Pythium* and *Fusarium* spp. isolates for sensitivity to fungicides in poison plate assays.

In general thus far, we have confirmed that *Rhizoctonia solani* anastomosis group AG2-2 is the predominant *Rhizoctonia* pathogen associated with dry bean. This pathogen aggressively causes seed rot, and pre and post-emergence damping-off. We also commonly isolated it from plants with infections running up the lower stem. We have identified over 25 different *Pythium* spp. to date, and these species vary greatly in regard to pathogenicity. Some species are not pathogenic at all and others such as, *Pythium ultimum* are very aggressive. Although *Fusarium oxysporum* was recovered at the highest incidence among *Fusarium* spp., it does not mean that this species is the predominant pathogen of dry bean. We have realized through this study that it is the closely related group of *Fusarium cuneirostrum*, *Fusarium phaseoli*, and *Fusarium brasiliense* that are consistently found colonizing and rotting the tap roots of dry beans. These pathogens greatly impact root vigor and overall plant growth.

With our increased knowledge about the key disease organisms we are able to collaborate and conduct additional research at the lab, growth chamber, greenhouse and field levels. We have performed field screening of dry bean breeding germplasm against specific disease organisms for the past three years with funds from a USDA-NIFA grant. We are also testing different fungicides for efficacy against these pathogens. In addition, we are working on determining quantification of these pathogens on roots, which will aid in selecting resistant germplasm and evaluating fungicide efficacy. We would like to thank the growers that allowed us to sample in their fields. Without your participation, we would not have been able to conduct this survey.

Oomycete Summary 2014 and 2015

- 20 *Pythium*, 1 *Phytophthora* and 1 *Phytophthium* species were identified
- *Pythium sylvaticum* was the most abundant species isolated both years
- 11 *Pythium spp.* were found to be associated with diseased dry bean roots that had not been previously reported.
- In a seedling pathogenicity assay, isolates of *Pythium ultimum*, *Pythium myriotylum*, and *Phytophthium aff. vexans* significantly reduced emergence in both red kidney and black bean
- New dry bean associated species, *Pythium attrantheridium*, *Pythium coloratum*, and *Pythium heterothallicum* caused a significant reduction in root dry weight in red kidney bean, but not in black bean

Fusarium Summary 2014 and 2015

- 9 *Fusarium* species or species complexes were identified
- *Fusarium oxysporum* species complex was the most abundant in both years
- In 2015, a higher percentage of common bean root pathogens (*Fusarium solani* species complex) were isolated due to improved technique
- *Fusarium* appeared to have the biggest impact in 2015, based on the number of isolates recovered, but also on the symptoms observed in the field

Rhizoctonia Summary 2014 and 2015

- In 2014, *Rhizoctonia* accounted for 42% of the organisms recovered from symptomatic roots and was the dominant pathogen in sampled fields
- In 2015, *Rhizoctonia* only accounted for 24% of the organisms recovered and had a significant presence in just 5/14 fields sampled
- *Rhizoctonia* isolates were characterized into anastomosis groups (AG):
AG2-2, AG2-3, AG4, AG5, and AG11
- Approximately 70% of the *Rhizoctonia solani* isolated were identified as AG2-2
- In pathogenicity screening on dry bean, AG2-2 and AG 4 isolates were the most aggressive, while AG 11 was found to be the least pathogenic
- In a seed rot assay, AG2-2 isolates caused complete seed rot or reduced germination

Dry Bean Root Rot Resistance Screening

Martin Chilvers, Adam Byrne, Janette Jacobs, Evan Wright, Jim Kelly

We have been conducting field trials to examine dry bean varieties for root rot resistance. In 2016, 51 dry bean varieties were challenged with either *Rhizoctonia solani* or *Fusarium brasiliense* and compared to plots that had no pathogen inoculum. These two pathogens were selected as we have found them to be commonly associated with root rot in Michigan. The trials are giving us a good sense of which lines show promise for root rot resistance, and these resistant lines can then be used in future breeding efforts. Data will be presented at the upcoming Bean and Beet Day and future dry bean meetings.

Dry Bean Fungicide In-Furrow Root Rot Field Trial

In 2016 graduate student Kjersten Swenson collaborated with Greg Varner to evaluate in-furrow fungicide treatments, the studies will be continued and results from 2016 will be presented at upcoming meetings.

Results from a dry bean root rot survey supported by Project GREEN across Michigan from 2014-2016 found that *Fusarium* spp., *Pythium* spp., and *Rhizoctonia solani* are all commonly associated with roots exhibiting root rot symptoms. It was not uncommon to isolate all three pathogens from a single root. However, in general seed rot and reduced stand are more often associated with specific *Pythium* spp. and *R. solani*, whereas plant stunting, yellowing of lower leaves and rotting of the tap root are symptoms of *Fusarium* root rot. Root rot diseases reduce stand, nitrogen fixation, root vigor and can affect pod set and yield.

Current management focuses on crop rotation, use of more tolerant varieties, and fungicide seed treatments. Seed treatments have been shown to alleviate the severity of root rot. There is little known about the effectiveness of using fungicide in-furrow for dry beans, specifically to control root rot. These trials focused on the efficacy of several fungicides and a nematicide for controlling the species that cause root rot and cyst nematodes and lessening the severity of root rot.

A field trial was conducted to determine the efficacy of in-furrow fungicide in Midland County, Viper small red beans were planted in two trials. Trial 1 had ten fungicide applications, that were sprayed in the seed furrow at time of planting, with four replications. Trial 2 had eight fungicides and a nematicide applications, that were sprayed in the seed furrow at the time of planting, as well as foliar fungicide sprays later in the season; also with four replications. The in-furrow fungicides were prepared by adding the dosage to two gallons of water.

In early July and early August, ten plant samples were collected from each plot in both trials. The plant samples were separated by roots and shoots, dried, and measured for their dry weights. Plant samples were also collected from the untreated control plots to isolate the fungal species present. In August, root samples were taken from each plot to isolate root lesion nematodes and cyst nematodes. Currently, the fungal species are being genetically sequenced to determine which species were present in the roots.

There were no differences between the root weights between any fungicide treatments for Trial 1 or Trial 2, in July or August. However, while the root weights were very similar in July for all the treatments for both Trial 1 and Trial 2, in August, there was some variation between some of the treatments.

There were no root lesion nematodes found in any of the root samples from either Trial 2. There were juvenile and male soybean cyst nematodes found, however the distributions between the different treatments were not significantly different. Cyst nematodes were found to a greater extent in Trial 1.

Overall, these trials did not reveal significant results but they give us a direction in which to look for further research. For future trials, focusing on best fungicides and different dosages appears to hold the most promise. In addition, future trials should take more comprehensive data. We were unable to take data on stand counts or disease severity this season, which would be beneficial to understanding if these fungicides really protect against root rot.

Effect of Nitrogen X Cultivar on White Mold

Kjersten Swenson, Martin Chilvers, Jim Kelly

Kjersten also began a study in collaboration with Dr. Jim Kelly to examine the impact of nitrogen levels on white mold development, which complements our soybean white mold risk modelling studies.

White mold, caused by *Sclerotinia sclerotiorum*, resulted in an estimated economic damage in dry beans of \$46 million. There is a complex relationship between plant canopy, the microclimate, and the incidence of white mold. Research has shown that dry bean cultivars with denser canopies lead to greater prevalence of white mold in part because of the cooler and wetter conditions under denser canopies. Because leaf production and shoot growth increases with higher levels of nitrogen fertilization, our research aims to look at two dry bean cultivars with different plant architecture and two levels of nitrogen to determine if the nitrogen fertilization will lead to different disease levels under the cultivars.

In Montcalm county, two dry bean cultivars were planted, Zenith, an upright, determinate black bean and Viper, a vining, indeterminate small red bean. Twenty-four plots were randomly assigned to one of the cultivars, and one of the nitrogen levels, 20 lbs/acre and 80 lbs/acre. Urea was applied once for the 20 lbs/acre treatment and while the 80 lbs/acre treatment was split into two 40 lbs/acre applications. The first application took place right after planting in June and the second application occurred in July, right before flowering. Every week, the pictures of the plant canopy were taken, as well as measurements for canopy height, soil temperature, and soil conductivity. When flowering began, every 3-4 days the number of blossoms and senesced blossoms were counted on five plants per plot. Following flowering, disease incidence and severity was calculated by rating plants in each plot on a 0-3 scale, where 0 indicated no white mold and 3 indicated white mold causing poor pod fill and/or death.

This season was fortunate for growers and unfortunately for researchers, a season marked by low incidence of white mold. Apothecia, the fruiting body of *Sclerotinia sclerotiorum*, which release spores that infect plants, were not found in research plots. Typically, we would have expected to see apothecia when the canopy closed, which was between July 28 and August 11, however the weather conditions may have not been ideal for apothecia formation. Because there was no apothecia formation, there was a very low white mold incidence. White mold disease was scouted on August 18 on one or two plants and disease rating began on August 25 and continued for three weeks. After three weeks, the beans were senesced to the point of disease rating being too difficult.

There was no significant difference between the disease incidence or severity of the four treatments, probably due to the low disease pressure. However, by the final disease rating, both of the high nitrogen treatments had the greatest incidence of white mold. Higher incidence did not translate into higher severity however. During the season, there was a significant difference in height between the treatments. Canopy closure was most closely correlated to fertility level suggesting that the height is influenced by the interaction of the cultivar and nitrogen level while canopy closure is more influenced by fertility level.

While this trial did not give us significant data regarding white mold, it did show us that nitrogen level and cultivar influence architectural aspects of the canopy. Perhaps in future trials we will have conditions more conducive to white mold and will be able to discern if the architectural aspects translate into different disease levels.



2016 MICHIGAN DRY BEAN TRIALS

Compiled by Gregory V. Varner, Dry Bean Research Director

COUNTY & COOPERATOR: Bay: *Frank Farms* Montcalm: *Ek Farms*
 Gratiot: *Hrabal Farms* Sanilac: *Keinath Farms*
 Huron: *Gruehn Farms* Tuscola: *VanHoost Farms*

2016 PLANTING DATES: 6/2 6/17 5/31 6/14 6/3 6/11

NAVY	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA	2016 AVE	Lodging	White Mold
									6-4 LOC	Rating	Ratings 3 years 2013-14-15-Ave.
HMS MEDALIST	95-100	COOP/ADM	1625	3043	828	3894	3748	1209	2391-1853	2	2.3-3.0-1.8-2.4
MERLIN	95-102	COOP/ADM	2425	3374	1157	4027	3768	1589	2723-2235	2.5	1.9-3.0-2.2-2.4
T9905	94-99	TVS	2002	3006	720	3936	4065	1483	2535-2068	2.5	2.1-3.6-2.8-2.8
INDI	92-95	ADM	1805	3081	557	3595	3677	1210	2321-1812	2	2.1-2.5-2.2-2.3
ALPENA	94-100	MSU	2005	3313	889	3583	3758	1833	2564-2121	2.5	3.5-3.1-2.7-3.1
GTS OB-1723-03	97-103	GTS	1947	3292	801	3367	3671	1368	2408-1947	3	0.0-3.1-2.5-2.8
DS105WO	95-101	TVS	1717	3326	784	3607	3748	1537	2453-1947	3.5	new in 2016
VIGILANT	91-99	PROVITA	2467		707		3585	1866	2156	1.5	2.8-4.0-2.8-3.2
REXETER	92-101	OAC-HDC	2532		659		4195	1421	2202	2.5	2.4-3.5-2.2-2.7
NAUTICA	94-99	OAC-HDC	1877		851		3802	1508	2010	3	1.8-3.0-1.8-2.2
MIST	93-104	OAC-HDC	2169		670		4120	1253	2053	2.5	1.6-1.9-1.7-1.7
FATHOM	92-100	OAC-HDC	1734		985		3408	1275	1851	2.5	0.0-4.3-4.0-4.2
PROVITA 06063	92-97	PROVITA	2227		843		3933	1818	2205	2.5	3.5-3.3-2.8-3.2
PROVITA 08070	90-99	PROVITA	1984		818		3989	1614	2101	2.5	2.5-3.3-2.3-2.7
PROVITA 08072	94-101	PROVITA	1981		894		3676	1446	1999	2.5	2.9-3.0-2.2-2.7
PROVITA 12039	92-97	PROVITA	2178		860		3673	1929	2160	3	0.0-3.0-3.0-3.0
PROVITA 12047	91-94	PROVITA	2281		1181		3065	1569	2024	2	0.0-2.4-2.3-2.4
PROVITA 12051	90-96	PROVITA	1987		608		2468	1380	1611	3.5	0.0-4.1-4.0-4.1
PROVITA 12062	92-100	PROVITA	2030		1077		3602	1538	2062	2.5	new in 2016
PROVITA 12063	92-103	PROVITA	1790		1009		3373	1655	1957	2.5	0.0-0.0-2.8-2.8
PROVITA 12064	95-102	PROVITA	1665		801		3782	2096	2086	2	0.0-0.0-2.0-2.0
PROVITA 13049	92-101	PROVITA	2375		861		3589	1486	2078	2.5	new in 2016
PROVITA 13066	94-99	PROVITA	1725		869		3670	1658	1981	1.5	0.0-0.0-2.0-2.0
PROVITA 13068	94-102	PROVITA	1608		821		4338	1437	2051	2	new in 2016
MSU N14218	95-99	MSU	2149		954		3555	2009	2167	3.5	new in 2016
MSU N14229	93-96	MSU	2139		1170		3321	1870	2125	3.5	new in 2016
MSU N15341	91-94	MSU	2134		836		3138	1880	1998	2.5	new in 2016
MSU N15345	96-98	MSU	1538		1031		3006	1676	1813	3	new in 2016
SV 1893GH	93-101	SEMINIS			759		2788	1845		3	new in 2016
			lsd=514	lsd=783	lsd=197	lsd=615	lsd=563	lsd=425			
			cv-18.3%	cv-16.4%	cv-16.2%	cv-11.2%	cv-10.0%	cv-11.1%			

										White Mold
										- Lodging
<u>SMALL RED</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>3 LOC</u>	<u>Rating</u>
MERLOT	90-94	USDAMSU	2391		1457		3801		2550	3-3.5
VIPER SR 09303	90-98	PROVITA	3119		1529		4445		3031	3.5-3.8
RUBY SR 09304	90-98	PROVITA	2723		1885		4149		2919	3-4.0
SR 11511	90-99	PROVITA	1009		1390		4332		2244	2-3.0
MSU R12844	93-96	MSU	2294		1298		4839		2810	2-2.5
MSU R13752	90-94	MSU	2374		1215		4188		2592	2-2.8
<u>PINK-ROSETTA</u>	94-95	MSU	2889							2.5-2.5
			lsd=664		lsd=405		lsd=811			
			cv-17.7%		cv-18.2%		cv-12.5%			

											White Mold
											Ratings 3 years
<u>BLACK</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>6-4 LOC</u>	<u>Rating</u>	<u>2013-14-15-Ave.</u>
ZORRO	92-103	MSU	2211	3505	744	4197	3305	1668	2605-1982	2.5	2.3-3.1-1.8-2.4
ZENITH	92-103	MSU	2293	4022	842	4059	3506	2281	2834-2231	2.5	2.6-3.3-2.7-2.9
LORETO	92-102	COOP-PRO	2192	2997	646		3182	1805	1956	3	2.3-3.5-2.7-2.8
SHANIA	94-103	ADM	1895	3443	640		3354	1543	1858	3	3.0-3.3-2.2-2.8
ECLIPSE	88-94	NDSU	1964		583		3790	1552	1972	2.5	2.4-3.1-2.2-2.6
BLACK CAT	92-98	PROVITA	2336		912		3408	2069	2181	3.5	3.8-3.8-3.0-3.5
BLACK BEAR 12576	93-102	PROVITA	2568		1079		4147	1953	2437	2.5	0.0-4.0-2.5-3.3
BL 13489	90-99	PROVITA	2171		647		4152	1750	2180	2.5	0.0-4.4-0.0-4.4
BL 13490	92-103	PROVITA	1820		1235		3657	1524	2059	2	0.0-0.0-2.5-2.5
BL 13496	89-102	PROVITA	2256		843		3679	1619	2099	2.5	new in 2016
BL 14497	91-102	PROVITA	2952		1173		4149	2270	2636	2	new in 2016
BL 14504	94-99	PROVITA	2265		1246		3528	1919	2240	2.5	0.0-0.0-2.2-2.2
BL 14506	91-101	PROVITA	2075		1181		3624	1699	2145	2	0.0-0.0-2.8-2.8
BL 14510	92-102	PROVITA	1309		442		3592	1513	1714	2.5	0.0-0.0-2.8-2.8
BL 14522	91-100	PROVITA	2168		727		3435	2000	2083	2	new in 2016
MSU B15408	91-96	MSU	2651		742		3637	1931	2240	3	new in 2016
MSU B15418	94-103	MSU	2098		835		3721	1759	2103	2.5	new in 2016
MSU B15430	91-98	MSU	2394		1043		3819	2131	2347	2.5	new in 2016
MSU B15434	91-103	MSU	2215		720		3703	1821	2115	2.5	new in 2016
MSU B15451	92-100	MSU	2460		765		3546	2049	2205	1.5	new in 2016
ADM B8006282	90-99	ADM	2521				3464	1459		2.5	0.0-3.4-2.5-3.0
ADM B0040316	91-100	ADM	2196				3885	1646		1.5	0.0-0.0-2.5-2.5
ADM B1048276	90-103	ADM	2077				3655	1494		2.5	new in 2016
ADM B1048280	90-103	ADM	2025				4184	1789		2.5	new in 2016
SV6894GB	93-100	SEMINIS			755		3849	1821		1.5	new in 2016
			lsd=719	lsd=776	lsd=215		lsd=648	lsd=518			
			cv-23.0%	cv-13.9%	cv-18.6%		cv-12.5%	cv-20.5%			

											White Mold
											- Lodging
<u>PINTO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>4 LOC</u>	<u>Rating</u>	
ELDORADO	92-103	MSU	2278	3435		3651	4010		3344	2-2.0	
LA PAZ	88-93	PROVITA	2097	3593		3430	3897		3254	3.5-2	
MSU P14815	90-94	MSU	1916	3181		3491	3205		2948	2-2.0	
EL DIABLO	87-93	GTS	1912	2898		3522	3106		2860	2-2.5	
SV6533GR	85-88	SEMINIS	2440	2272						2.5	
SV6139GR	85-88	SEMINIS	2288	2906						2.5	

PALOMINO	91-99	NDSU	1910	2743					3.5
CO SD 44	89-94	CSU	2464	2971					2.5
			lsd=277	lsd=582		lsd=1096	lsd=781		
			cv-8.5%	cv-12.9%		cv-19.4%	cv-13.7%		

**White Mold
- Lodging**

<u>GREAT NORTHERN</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>3 LOC</u>	<u>Rating</u>
POWDERHORN	86-88	MSU	2763		421	4103			2429	3-3.0
MSU G13444	88-90	MSU	2854		771	4314			2646	2.5-2
MSU G14506	90-92	MSU	2962		1004	4629			2865	4-2.5
			lsd=413		lsd=130	lsd=976				
			cv-8.3%		cv-10.3%	cv-13.0%				

**White Mold
- Lodging**

<u>TEBO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>3 LOC</u>	<u>Rating</u>
FUJI	90-95	MSU	1858	1689		3648			2398	3-3.0
SAMURAI	92-100	MSU	2829	2849		4758			3479	3-2.5
MSU G14505	90-98	MSU	2454	3326		4761			3514	3-2.5
			lsd=426	lsd=456		lsd=1614				
			cv-10.3%	cv-10.1%		cv-21.3%				

ADZUKI

ERIMO	101-103	JAPAN		2028		2104				
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CRANBERRY

<u>CRANBERRY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
ETNA	90-92	SEMINIS	2382	4319
CHIANTI vine	98-100	SEMINIS	2489	3738
BELLAGIO vine	100-102	MSU	2937	3715
MSU C13413	91-93	MSU	2176	3864
KRIMSON	93-94	BASIN	2329	3871
			lsd=514	lsd=938
			cv-13.5%	cv-15.6%

LIGHT RED KIDNEY

<u>LIGHT RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
CALIF ELRK	90-93	CAL	2077	4004
CLOUSEAU	91-94	SEMINIS	2219	3975
INFERNO	110-114	OAC-HDC	3287	3265
MSU K15601	105-106	MSU	3441	4506
ROSIE ND 061106	102-105	NDSU	2650	2892
BIG RED 09351	91-94	PROVITA	2197	3806
LRK 06269	105-106	PROVITA	2795	3444
LRK 09378	91-93	PROVITA	2507	3825
			lsd=447	lsd=713
			cv-11.5%	cv-13.1%

<u>DARK RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
RED HAWK	94-99	MSU	1974	3560
MONTCALM	105-107	MSU	1735	3131
RED ROVER	92--97	SEMINIS	1955	3681
DYNASTY	102-106	OAC-HDC	2729	3905
MSU K11306	96-100	MSU	2003	3537
MSU K15302	100-103	MSU	3273	3212
GTS 104	102-106	GTS	2002	3755
TALON ND061210	97-103	NDSU	2354	3342
CHAPARRAL 09423	105-108	PROVITA	2554	3149
DRK 09424	105-107	PROVITA	2411	2422
DRK 09429	105-108	PROVITA	2264	2932
DRK 09430	103-105	PROVITA	2211	3176
DRK 09431	104-105	PROVITA	2601	2780
			lsd=402	lsd=684
			cv-12.1%	cv-14.6%

<u>ALUBIA-W. KID.</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
BELUGA	105-108	MSU	1805	3054
SNOWDON	90-94	MSU	1584	3417
YETI	105-107	OAC-HDC	2072	3737
MSU K14807	92-95	MSU	2014	2943
MSU K14814	92-96	MSU	2540	3707
COB-212-03	109-115	GTS	1908	2092
COB-228-03	92-96	GTS	1885	3202
			lsd=650	lsd=463
			cv-22.2%	cv-9.8%

ORIGIN KEY

MSU - Michigan State University
GTS - Gen-Tec Seeds
SEMINIS - Seminis Seeds - Monsanto
ADM - Archer Daniels Midland-Seedwest
TVS-Treasure Valley Seed Company
COOP - Cooperative Elevator Company
CAL - University of California
USDA - US Department of Ag - ARS
NDSU - North Dakota State University
CSU - Colorado State University
OAC-HDC - University of Guelph-Hensall District Coop
PROVITA - Provita Seeds
BASIN-Basin Seed Company
JAPAN - Japan Foods - Purity Foods

Maturity days = planting until harvest in 2016
Direct Cut Lodging Ratings = 1-erect, 5-laying flat on ground
White Mold Rating = 1-10% mold, 5-100% mold
White Mold Ratings on medium size varieties from Montcalm County
Bay, Huron, Sanilac and Tuscola were direct harvested
Gratiot and Montcalm navies, blacks, pintos and sm. reds were direct
harvested and large colored beans were hand pulled and harvested
4 location average Thumb and Bay county



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DRY BEAN CHARACTERISTICS

Gregg Varner, Michigan Dry Edible Bean Production Research Advisory Board														
Variety	Class	Plant Type	Maturity	Origin	Anthracnose		Canning Quality	White Mold		Halo Blight	Common Blight	Rust	Air Pollution	Direct Cut-Rating
					BCMV	73		7	Quality					
Medalist	N	USV	F	COOP/ADM	R-1	S	R	3	2	R	S	T	T	2
Vigilant	N	USV	F	COOP/ADM	R-1	S	R	3	2	R	S	T	T	2
Hyland T9905	N	USV	M	HYLAND	R-1	S	R	2	2	R	S	T	T	2
Merlin	N	USV	M-F	COOP/ADM	R-1	S	R	3	2	R	S	T	T	2
Indi	N	USV	M-F	ADM	R-1	S	R	3	2	R	S	T	T	1
Alpena	N	USV	F	MSU	R-1	S	R	3	3	T	S	T	T	2
La Paz	P	USV	M	ADM	R	S	S	3	2	T	S	R	T	2
Lariat	P	USV	M	NDSU	R	S	S	3	3	T	S	R	T	3
Eldorado	P	USV	F	MSU	R	S	S	3	1	T	S	R	T	2
T-39	B	SV	F	UCD	R-1	S	S	3	3	R	S	T	T	4
Zenith	B	USV	F	MSU	R-1	R	R	5	3	R	S	T	T	2
Black Velvet	B	USV	F	SEMINIS	R-1	S	R	4	3	R	S	T	T	2
Zorro	B	USV	F	MSU	R-1	S	R	5	2	R	S	T	T	2
Eclipse	B	USV	M	NDSU	R-1	S	R	4	2	R	S	T	T	2
Black Bear 576	B	USV	F	COOP/ADM	R-1	S	R	3	4	R	S	T	T	2
Shania	B	USV	F	ADM	R-1	S	R	3	3	R	S	T	T	2
Loreto	B	USV	F	COOP/ADM	R-1	S	R	3	2	R	S	T	T	2
Chinook 2000	LRK	B	F	MSU	R-1	R	R	3	2	R	S	T	T	6
Calif. ELRK	LRK	B	E	UCD	R-1	R	R	3	2	S	S	T	T	6
Clouseau	LRK	B	M	SEMINIS	R-1	R	R	3	2	S	S	T	T	6
Pink Panther	LRK	B	M	SEMINIS	R-1	R	S	3	2	S	S	T	T	6
Montcalm	DRK	B	F	MSU	R-1	R	S	4	2	R	T	T	T	6
Red Hawk	DRK	B	F	MSU	R-1	R	R	4	2	T	S	T	T	6
Red Rover	DRK	B	F	SEMINIS	R-1	R	R	4	2	S	S	T	T	6
Etna	C	B	E	SEMINIS	R-1	R	S	2	2	S	S	T	T	6
Chianti	C	SV	M	SEMINIS	R-1	S	S	5	3	S	S	T	T	6
Bellagio	C	SV	F	MSU	R-1	R	S	5	3	S	S	T	T	6
Merlot	SR	USV	M	MSUSDA	R	S	S	4	3	R	S	T	T	3
Viper 09303	SR	USV	M	COOP/ADM	R	S	S	3	4	R	S	T	T	3
Rudy 09304	SR	USV	M	COOP/ADM	R	S	S	2	4	R	S	T	T	3
Rosetta	PK	USV	M	MSU	R-1	S	S	3	3	R	S	T	T	3
Samurai Tebo	W	USV	M	MSU	R-1	S	S	3	3	T	S	S	S	3
Fuji Tebo	W	B	M	MSU	R-1	S	S	3	3	T	S	S	S	4
Beluga	WK-AL	B	F	MSU	R-1	R	S	3	3	S	S	T	T	6
Snowdon	WK-AL	B	E	MSU	R-1	R	S	3	3	S	S	T	T	6
Aurora	SW	SV	M	CUNY	R-1	S	S	3	3	R	S	R	S	4

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

Disease -R=Resistant, S=Susceptible, T=Tolerant, R-I=I gene, VS=Very Susceptible

JAN-2017

EXPERIMENT 6101 STANDARD NAVY YIELD TRIAL

PLANTING DATE: 6/2/16

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

NAME	PEDIGREE	YIELD CWT	100 SEED	DAYS TO	DAYS TO	LODGING	HEIGHT	DES.	CBB
		/ACRE	WT. (g)	FLOWER	MATURITY	(1-5)	(cm)	SCORE	RATING
N14229	N11275/N11256	25.1	19.9	46.0	97	1.3	53.0	5.3	2.0
N14201	N11249/N11256	24.7	21.9	49.0	99	2.0	53.8	4.5	2.0
N15326	N12405/N12468	24.5	18.8	45.0	95	1.0	47.3	4.3	1.0
N14243	N11284/N11277	23.9	20.6	47.0	95	1.0	50.5	4.0	4.0
N15331	N12438/N12468	23.8	20.1	45.0	95	1.8	50.8	5.0	3.0
N15335	N12453/N11277	22.9	20.4	44.0	96	1.0	51.0	4.3	2.0
N15313	N11258/N11277	21.9	18.8	47.0	93	1.0	49.5	3.8	3.0
N14230	N11275/N11256	21.8	20.5	48.0	98	2.0	53.5	5.0	3.0
N13120	N08003/N05324	21.4	22.9	44.0	96	1.0	50.5	4.8	2.0
N16401	N09175/Alpena	21.4	22.1	44.0	94	1.0	48.3	4.0	1.0
N16405	N12466/N11264	21.4	18.1	46.0	95	1.8	51.3	5.3	2.0
N16404	N12454/N12440	21.2	21.3	44.0	96	1.5	47.0	3.8	2.0
N15339	N12468/N11292	21.0	18.5	48.0	99	1.8	53.0	4.8	2.0
N14210	N11256/N11262	21.0	24.3	47.0	97	1.5	48.8	3.5	2.0
N15337	N12466/N11258	20.3	20.6	46.0	96	1.5	51.8	4.8	2.0
N14218	N11256/N11298	19.9	19.6	47.0	96	1.0	52.3	5.5	3.0
N14205	N11256/N11258	19.7	22.2	49.0	98	1.3	53.8	5.0	3.0
N16406	Alpena//N11238/N09034	19.7	22.7	47.0	96	1.0	53.0	5.0	2.0
N15306	N11230/N11298	19.5	22.9	47.0	99	1.0	54.5	4.8	2.0
N15320	N11277/N11258	19.5	23.3	48.0	98	1.0	53.0	4.3	2.0
N14225	N11257/N11280	19.2	22.8	50.0	98	2.5	46.3	2.8	3.0
N15341	N12468/N12466	19.2	20.4	47.0	96	1.3	51.3	5.3	2.0
I10101	COOP 02084, Vigilant	19.1	22.0	47.0	96	1.0	52.0	3.8	5.0
N11283	MEDALIST/N08003, ALPENA	18.8	20.9	45.0	99	1.0	53.5	5.0	2.0
I11264	COOP 03019, MERLIN	18.8	19.7	45.0	97	1.0	51.0	3.8	3.0
N16407	Alpena//N11238/N09034	18.8	21.4	47.0	98	1.0	53.5	4.3	3.0
N14223	N11257/N11256	18.6	19.9	45.0	99	2.0	49.5	3.8	2.0
N14216	N11256/N11292	18.2	20.9	46.0	99	1.3	54.5	4.5	2.0
N13142	N08007/N09046	18.2	20.6	46.0	100	1.8	49.0	3.8	2.0
N15346	N09020/B09204//B10238/B11343	18.1	17.8	46.0	92	1.0	45.8	3.5	4.0
N15336	N12466/N11238	18.0	17.3	45.0	97	1.0	51.5	4.0	3.0
N14240	Alpena/N11264	17.8	22.5	47.0	96	1.5	50.8	4.0	3.0
N14206	N11256/N11258	17.7	21.7	48.0	99	1.0	52.8	4.3	2.0
N16402	N11231/Alpena	16.9	20.4	45.0	100	1.3	54.8	4.5	2.0
N15340	N12468/N11298	16.9	27.0	50.0	98	1.3	53.0	5.3	1.0
N15321	N11277/N11258	16.9	22.7	46.0	95	1.0	51.8	3.8	4.0
I15621	MIST	16.3	20.9	44.0	100	1.0	51.3	3.5	1.0
N15319	N11277/N09034	16.3	20.7	46.0	97	1.0	50.0	4.0	2.0
I08902	HYLAND T9905	15.5	24.0	47.0	100	1.5	51.8	3.8	2.0
I16725	08072, BLIZZARD	15.2	23.5	46.0	98	1.3	53.5	4.0	2.0
I08958	Mayflower/Avanti, MEDALIST	13.3	22.3	47.0	100	1.5	51.8	3.8	2.0
I15628	LIGHTHOUSE	12.1	21.3	45.0	101	1.0	50.0	3.8	1.0
MEAN (48)		18.9	21.2	46.1	97.0	1.3	51.3	4.3	2.4
LSD (.05)		2.9	0.9	1.1	1.2	0.4	1.2	0.7	(1 rep)
CV (%)		13.2	3.7	1.4	1.1	25.7	2.1	13.6	35.9

EXPERIMENT 6102 STANDARD BLACK YIELD TRIAL PLANTING DATE: 6/2/16

Dr. James D. Kelly and Evan Wright, Crops and Soil 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	CBB RATING
		/ACRE	WT. (g)						
B16504	Zenith//Alpena*/B09197	28.9	23.6	46.0	98	1.5	53.8	4.5	2.0
B16506	B11363//Alpena*/B09197	28.6	22.5	44.0	94	1.0	48.8	4.0	3.0
B16507	B12720/Zenith	27.3	27.5	46.0	96	1.0	52.8	4.8	2.0
B16501	Zenith/B10215	27.2	24.1	45.0	93	1.0	49.8	4.3	2.0
B15417	B10208/B09175	27.1	25.0	46.0	99	1.0	52.8	4.8	1.0
B15442	B11363/B09175	26.6	27.2	46.0	99	1.0	52.3	4.0	3.0
B15408	B09175/B10215	26.5	24.4	44.0	96	1.3	49.3	3.8	4.0
B16511	B13204//Alpena*/B09197	26.2	25.6	45.0	96	1.0	50.3	4.3	2.0
B15416	B10208/B09175	26.1	30.2	47.0	99	1.5	50.5	3.8	2.0
B15414	B09175/B11611	25.9	29.3	45.0	99	1.8	50.3	4.0	2.0
B16512	B13204//Alpena*/B09197	25.8	24.8	45.0	96	1.0	51.3	4.0	4.0
B15418	B10208/B09175	25.3	27.0	45.0	98	1.0	51.8	4.8	4.0
B15432	Zenith/B12721	25.2	26.9	46.0	97	1.0	53.3	4.3	4.0
B10244	B04644/ZORRO, ZENITH	25.1	26.0	46.0	99	1.0	52.8	4.3	3.0
B16505	B11363//Alpena*/B09197	24.9	23.5	44.0	92	1.0	49.0	4.5	2.0
B15451	B11371/B11363	24.8	22.4	47.0	97	1.0	53.3	4.8	2.0
B15427	Zenith/B11343	24.6	25.0	44.0	93	1.0	49.5	4.3	3.0
B15430	Zenith/B12721	24.4	25.6	44.0	95	1.3	51.3	4.5	4.0
B15464	B12709/B12721	24.4	27.6	46.0	98	1.0	54.3	6.0	2.0
B16508	B12720/Zenith	24.4	29.4	45.0	98	1.0	52.3	4.3	2.0
B15443	B11363/B09175	24.2	27.4	46.0	98	1.0	49.8	4.0	2.0
B15453	B11371/B11363	24.0	24.4	46.0	95	1.3	52.3	5.5	1.0
B16503	Zenith/B12720	23.7	27.6	47.0	97	1.3	52.3	4.5	1.0
B15434	Zenith/B12721	23.6	25.9	46.0	98	1.3	53.8	4.8	2.0
B15447	B11363/Zenith	23.4	25.7	45.0	97	1.0	52.3	4.3	3.0
B16510	B12720/B11363	23.1	22.9	46.0	98	1.5	51.8	4.5	2.0
B15438	B11334/Zenith	23.1	22.4	44.0	97	1.3	50.8	4.0	2.0
B15411	B09175/B11363	22.7	21.6	46.0	97	1.0	49.3	4.0	2.0
B16502	Zenith/B12710	22.6	24.0	45.0	98	1.0	52.8	4.0	2.0
B15421	B10208/B11611	22.5	23.4	44.0	96	1.0	49.8	3.8	2.0
I03390	ND9902621-2, ECLIPSE	22.5	23.1	44.0	93	1.0	49.0	3.8	2.0
B15439	B11334/Zenith	22.4	21.9	46.0	97	1.0	53.0	4.5	2.0
B15419	B10208/B09175	22.4	27.6	46.0	99	1.5	51.3	4.3	2.0
B16509	B12720/B11363	22.4	21.5	44.0	96	1.0	50.0	4.0	3.0
B15433	Zenith/B12721	22.3	25.6	46.0	98	1.0	54.5	4.5	3.0
B15441	B11343/B10213	22.3	22.0	43.0	93	1.0	47.8	3.8	2.0
B15407	B09175/B10215	22.2	26.4	47.0	99	1.8	50.8	4.0	2.0
B15431	Zenith/B12721	22.0	25.0	44.0	96	1.0	51.3	3.8	3.0
B15410	B09175/B11343	22.0	22.1	45.0	97	1.0	53.3	4.8	2.0
B15435	Zenith/B12721	22.0	26.3	46.0	99	1.0	52.3	4.3	3.0
B16513	Alpena*/B09197//B12720	21.6	23.8	46.0	99	1.3	51.0	4.5	2.0
B04554	B00103*/X00822, ZORRO	16.0	20.9	45.0	99	1.0	52.3	4.0	2.0
MEAN (48)		23.3	24.8	45.1	96.6	1.1	51.2	4.2	2.5
LSD (.05)		3.4	1.0	0.7	1.6	0.4	1.9	0.7	0.0
CV (%)		12.4	3.5	0.9	1.4	27.1	3.1	13.3	35.6

EXPERIMENT 5210 NATIONAL WHITE MOLD YIELD TRIAL

PLANTED: 6/10/15

NAME	PEDIGREE	YIELD CWT 100 ACRE	SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LOGGING HEIGHT (1-5)	DES. (cm)	WM SCORE (1-5)	WM %	STAND	
P07863	AN-37/P02630, ELDORADO	34.7	45.7	48.0	110	1.0	52.3	5.0	2.0	22.2	4.0
B10244	B04644/ZORRO, ZENITH	30.7	23.7	50.0	109	1.0	50.0	5.7	1.3	14.8	4.3
I13446	SR 09304, RUBY	30.5	34.4	49.0	105	2.0	48.7	3.3	2.7	29.6	4.3
B14307	B11271/B11343	30.4	19.8	51.0	109	1.0	52.3	5.0	2.3	25.9	4.7
I13401	SR 09303, VIPER	30.4	33.1	48.0	108	1.3	49.0	4.0	1.7	18.5	4.7
G14506	G11469/G11417	29.9	33.8	49.0	104	1.3	49.7	5.3	2.0	22.2	3.7
B13204	B09174/CW54-1	29.5	28.1	47.0	108	1.0	50.3	5.3	1.7	18.5	4.3
B13218	B09175/I09215	29.3	30.2	48.0	108	1.0	49.3	5.3	1.0	11.1	4.7
N13142	N08007/N09046	28.8	23.0	48.0	105	1.0	49.3	5.7	1.3	14.8	5.0
B14311	B11338/B10241	28.4	24.7	50.0	109	1.0	50.0	5.7	1.0	11.1	5.0
G14530	P11518/G11405	28.2	41.3	49.0	108	1.7	52.7	5.7	1.3	14.8	4.3
R13752	Merlot/SER48	28.1	42.1	48.0	106	1.3	49.3	4.3	1.3	14.8	3.7
I13445	039-A-5	27.6	41.1	48.0	107	1.0	49.3	4.3	1.3	14.8	3.0
B14308	B11301/B10222	27.5	22.8	51.0	106	1.0	48.7	5.3	1.0	11.1	4.7
N14229	N11275/N11256	26.2	20.6	50.0	105	1.0	49.3	5.3	1.3	14.8	5.0
G14507	G09329/G10412	26.0	34.9	48.0	105	1.3	48.0	5.3	2.3	25.9	4.0
G12901	G07321/Fuji, SAMURAI	26.0	29.6	49.0	108	1.0	50.3	5.3	3.0	33.3	4.7
B14309	B11338/B10222	25.9	22.3	49.0	106	1.0	48.7	5.7	1.0	11.1	5.0
N14202	N11249/N11256	25.4	24.9	49.0	108	1.7	52.7	5.3	1.3	14.8	3.7
N14218	N11256/N11298	25.4	21.0	50.0	108	1.0	48.7	5.3	1.3	14.8	4.7
N12457	B09174/N09056	25.3	22.1	48.0	105	1.0	48.3	5.0	1.3	14.8	5.0
G14509	G11404/Eldorado	24.7	44.4	48.0	107	2.0	50.3	4.3	3.3	37.0	4.7
I15628	LIGHTHOUSE	24.4	24.8	49.0	110	1.0	48.0	4.7	1.0	11.1	4.3
N12447	B09174/N09056	23.9	24.9	49.0	105	1.0	49.0	5.3	2.3	25.9	4.7
G13444	G07302//G08274/P08410	23.9	33.9	48.0	103	1.0	48.3	5.3	1.0	11.1	3.3
N14201	N11249/N11256	23.7	22.2	51.0	109	1.0	50.0	5.7	1.0	11.1	4.7
S14708	Rosetta/S11707	23.4	44.7	50.0	107	1.0	49.0	4.0	1.3	14.8	2.0
N14230	N11275/N11256	23.3	21.8	49.0	107	1.3	50.3	5.3	1.3	14.8	4.7
S08418	S02754/S04503, ROSETTA	23.2	41.2	50.0	109	1.7	50.0	3.7	1.0	11.1	2.3
R12845	SR9-5/R09508	22.9	38.9	47.0	103	1.0	48.7	4.7	1.7	18.5	4.3
P14811	P08403/G11405	22.7	38.8	47.0	103	1.3	49.3	4.3	1.7	18.5	4.7
N13131	N09175/N08007	22.6	23.5	49.0	105	1.0	47.7	5.3	1.3	14.8	4.7
B04554	B00103*/X00822, ZORRO	22.4	26.1	49.0	109	1.0	49.0	5.0	1.7	18.5	4.0
N14231	N11275/N11264	22.3	24.3	50.0	107	2.0	50.0	4.3	1.3	14.8	4.0
I08933	37-2, USPT-WM-12	22.2	42.1	49.0	105	1.0	49.0	4.0	2.0	22.2	2.0
N13140	N05324/MEDALIST	22.2	21.7	48.0	106	1.0	49.0	5.7	1.0	11.1	5.0
B13220	B09175/TARS-MST1	22.1	25.1	49.0	103	1.0	47.0	5.7	1.3	14.8	5.0
G14505	G11429/P08175	22.0	29.3	47.0	103	1.0	47.7	4.3	1.3	14.8	4.7
N11283	MEDALIST/N08003, ALPENA	21.8	22.1	48.0	104	1.0	49.3	6.0	2.0	22.2	4.3
P14815	P08522/LONG'S PEAK	21.8	38.5	49.0	101	1.0	48.0	5.0	1.3	14.8	3.3
I15621	MIST	20.0	24.3	48.0	110	1.0	47.7	4.7	1.0	11.1	4.0
R98026	R94037/R94161, MERLOT	19.4	40.5	49.0	106	2.0	48.3	4.0	2.0	22.2	4.0
B14310	B11338/B10241	19.3	23.2	50.0	104	1.0	43.7	4.7	1.0	11.1	5.0
B12724	B09184/B09135	18.7	24.9	50.0	105	1.0	47.0	5.0	1.3	14.8	4.7
I81010	JAPON3/MAGDALENE, BUNSI	18.6	22.9	47.0	108	1.7	46.7	3.7	1.7	18.5	4.0
R12844	SR9-5/R09508	18.4	38.1	47.0	102	1.3	48.0	4.7	1.3	14.8	3.7
I11264	COOP 03019, MERLIN	17.9	21.5	49.0	108	1.0	49.3	4.7	1.3	14.8	4.0
G08254	G04514/Matterhorn, POWDERHORN	16.8	41.9	48.0	102	1.0	47.0	4.7	1.0	11.1	3.7
I89011	RB, BERYL	16.5	36.1	46.0	101	2.7	43.0	3.0	2.7	29.6	4.3
I96417	G122	8.6	46.5	43.0	109	1.3	44.3	3.0	2.0	22.2	5.0
MEAN (64)		22.9	30.5	48.4	105.9	1.2	48.6	4.8	1.6	17.3	4.2
LSD (.05)		4.6	1.7	1.9	2.4	0.4	2.1	0.8	0.9	9.7	1.0
CV (%)		14.7	4.2	2.4	1.7	25.3	3.3	12.6	41.4	41.4	16.8

EXPERIMENT 4219 NATIONAL WHITE MOLD YIELD TRIAL PLANTED: 6/13/14

NAME	PEDIGREE	YIELD CWT 100 SEED		DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	WM (1-9)	WM %
Dr..	James Kelly and Evan Wright	/ACRE	WT. (g)	FLOWER	MATURITY	(1-5)	(cm)	SCORE	(1-9)	%
P07863	AN-37/P02630, ELDORADO	33.8	43.6	44.0	101.0	2.0	52.3	5.0	6.0	66.7
I14520	SF103-8	31.8	43.6	45.0	104.0	2.0	50.3	5.0	4.0	44.4
R12832	SR9-5/Merlot	31.0	37.1	43.0	98.0	1.7	53.3	4.3	4.0	44.4
G08254	G04514/Matterhorn, POWDERHORN	30.1	43.6	44.0	97.0	1.3	48.3	5.3	2.5	27.8
G13438	G09330//G09308/X09107	28.4	37.0	44.0	100.0	1.3	51.3	4.7	4.0	44.4
R12844	SR9-5/R09508	27.9	37.8	47.0	99.0	1.3	50.7	4.7	2.5	27.8
G13467	Matterhorn/P05436//Eldorado	27.2	39.2	44.0	99.0	2.0	55.0	4.3	5.0	55.6
I08933	37-2, USPT-WM-12	27.0	45.7	44.0	98.0	1.7	47.7	5.3	2.0	22.2
S08418	S02754/S04503, ROSETTA	26.8	39.5	45.0	102.0	1.3	49.3	5.0	3.0	33.3
I13444	O31-A-11	26.8	43.9	42.0	104.0	2.0	49.7	4.3	3.0	33.3
B10244	B04644/ZORRO, ZENITH	26.5	23.3	45.0	98.0	1.0	49.3	5.3	3.5	38.9
B12724	B09184/B09135	26.4	25.2	44.0	100.0	1.0	48.0	5.0	3.5	38.9
P13701	G09305/ELDORADO	26.4	41.1	44.0	96.0	1.0	49.3	5.3	4.0	44.4
G12901	G07321/Fuji	26.3	31.3	44.0	100.0	1.0	52.0	5.0	4.5	50.0
B04554	B00103*/X00822, ZORRO	25.5	24.1	44.0	100.0	1.0	51.0	5.3	2.0	22.2
B12710	B07554/Jaguar/B07554	25.2	24.7	44.0	99.0	1.0	48.0	4.3	4.0	44.4
R13771	R98026/I11207	24.7	34.0	44.0	99.0	2.0	51.0	3.7	7.5	83.3
B11555	I82054/B07554	24.5	27.5	45.0	103.0	1.3	51.3	4.0	6.5	72.2
B12720	B09175/Eclipse	24.2	26.1	45.0	98.0	1.0	49.0	4.3	7.5	83.3
R13609	I11210/R98026	23.7	32.8	50.0	99.0	2.0	49.3	3.3	7.0	77.8
N12454	B09174/N09056	23.6	22.2	44.0	100.0	1.0	50.3	5.3	2.0	22.2
R98026	R94037/R94161, MERLOT	23.6	37.4	48.0	103.0	1.7	53.7	4.0	4.5	50.0
P12606	P07406/P08401	23.4	39.8	45.0	98.0	1.3	50.3	4.3	4.0	44.4
N12440	N09056/N09175	23.3	21.4	44.0	99.0	1.0	50.3	5.3	2.5	27.8
R13752	R98026/I11207	22.9	40.0	45.0	99.0	1.3	52.0	5.0	3.5	38.9
P11519	SANTA FE/P07806	22.4	41.1	50.0	104.0	2.0	57.0	4.3	6.5	72.2
R13526	X10308/R08514	21.8	39.5	50.0	100.0	1.0	55.0	4.7	5.5	61.1
N13140	N05324/MEDALIST	21.7	22.5	46.0	101.0	1.0	51.0	5.7	2.5	27.8
BC373	UCD 9634	21.0	38.7	44.0	102.0	2.3	49.7	3.3	4.5	50.0
B11363	B04644/B07554	21.0	24.8	46.0	99.0	1.0	48.7	5.0	1.0	11.1
G93414	MATTERHORN	20.9	38.5	43.0	95.0	1.7	48.0	4.0	6.5	72.2
G13424	Powderhorn//Eldorado/G09312	20.3	41.4	44.0	100.0	1.3	50.0	4.3	5.0	55.6
I13401	SR 09303	20.2	29.8	48.0	99.0	1.3	51.0	3.3	8.5	94.4
N13124	N08007/N05324	20.1	20.1	45.0	98.0	1.0	51.0	5.7	3.5	38.9
P12609	P08362/P08401	19.9	41.2	45.0	98.0	1.3	48.0	4.3	6.5	72.2
I81010	JAPON3/MAGDALENE, BUNSI	19.9	24.9	39.0	105.0	2.7	43.3	4.0	2.0	22.2
S12906	Rosetta/NDZ06209	19.8	38.9	45.0	102.0	1.7	49.3	4.3	5.5	61.1
N12467	N08010/N08007	19.6	20.9	45.0	99.0	1.3	51.7	4.7	5.0	55.6
N13131	N09175/N08007	19.4	21.6	45.0	98.0	1.0	49.0	4.7	5.5	61.1
B12721	B09175/Eclipse	19.4	26.8	45.0	98.0	1.0	48.7	4.3	3.5	38.9
B11548	I82054/B07554	18.8	23.9	48.0	103.0	1.7	51.0	4.7	4.5	50.0
N12466	N08010/N08007	17.9	19.6	48.0	100.0	1.3	51.0	4.3	6.5	72.2
N11257	N07009/MEDALIST	17.7	21.0	48.0	100.0	1.0	49.7	4.7	3.5	38.9
I14519	23ST-27	17.6	40.7	44.0	95.0	2.3	47.3	3.0	9.0	100.0
I89011	BERYL	17.3	35.9	43.0	95.0	3.7	38.0	2.0	9.0	100.0
I11264	COOP 03019, MERLIN	17.2	23.0	44.0	102.0	1.0	50.0	4.3	2.0	22.2
N11283	MEDALIST/N08003, ALPENA	15.9	21.1	44.0	98.0	1.0	48.7	4.3	4.0	44.4
K11306	K06621/USDK-CBB-15	14.8	63.8	41.0	102.0	1.3	47.7	5.3	2.5	27.8
K08961	K04604/USDK-CBB-15, SNOWDON	12.4	77.1	37.0	96.0	1.0	45.0	4.3	2.0	22.2
I96417	G122	10.5	45.4	40.0	104.0	2.0	48.7	3.7	4.0	44.4
MEAN (64)		20.6	36.2	44.0	99.8	1.5	49.1	4.3	4.4	48.6
LSD (.05)		4.6	2.0	2.1	2.4	0.5	2.9	0.9	1.7	18.5
CV (%)		16.5	4.0	2.9	1.8	23.9	4.3	15.9	22.7	22.7

Harvest aid effects on three classes of dry beans

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

Location:	Richville (SVREC)	Tillage:	Conventional
Planting Date:	June 14, 2016	Row width:	22-inch
Replicated:	4 times	Soil Type:	Sandy clay loam, 2.3% OM, pH 7.8
Varieties:	‘Zorro’ black beans	Populations:	109,000 seeds/A
	‘Merlin’ navy beans		109,000 seeds/A
	‘El Dorado’ pinto beans		100,000 seeds/A

Table 1. Preharvest treatments on bean desiccation (%) 3 & 7 days after treatment (DAT) and yield.

Treatments	Zorro			Merlin			El Dorado		
	3 DAT	7 DAT	Yield ^a	3 DAT	7 DAT	Yield	3 DAT	7 DAT	Yield
Sharpen (1 fl oz) + MSO + AMS	77 bc ^b	97 ab	21.3 e	77 b	96 bc	20.9 cd	79 a	100 a	23.2 a
Gramoxone (2 pt) + NIS	87 a	94 b	23.0 b-e	86 a	94 cd	21.2 cd	69 cd	86 c	23.3 a
Valor (1.5 oz) + MSO	72 cd	95 b	24.4 a-d	76 b	92 d	22.1 bcd	78 ab	96 a	24.2 a
Roundup (22 fl oz) + AMS	57 e	88 c	25.6 ab	64 c	87 e	23.9 ab	61 e	89 bc	22.4 a
Aim (2 fl oz) + MSO	69 d	76 d	24.7 abc	66 c	74 f	22.6 abc	71 bc	91 b	24.5 a
Sharpen (2 fl oz) + MSO + AMS	80 b	100 a	23.5 a-e	76 b	100 a	20.8 cd	80 a	100 a	22.3 a
Sharpen (1 fl oz) + Roundup + MSO + AMS	77 bc	100 a	21.9 cde	76 b	98 ab	20.9 cd	83 a	100 a	23.2 a
Sharpen (1 fl oz) + Gramox.+ MSO + AMS	92 a	99 a	21.7 de	87 a	98 ab	20.3 d	82 a	100 a	24.1 a
Untreated	53 e	62 e	25.8 a	52 d	60 g	24.6 a	63 de	77 d	24.3 a

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

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

Summary: This study was conducted to evaluate the effects of preharvest treatments on desiccation and yield of three classes of dry beans with differing speeds of dry down, ‘Zorro’ black bean (uniform dry down), ‘Merlin’ navy bean (green stem), and ‘El Dorado’ pinto bean (green stem). Preharvest applications were made when 75, 60, and 75% of the pods were yellow for ‘Zorro’, ‘Merlin’, and ‘El Dorado’ beans, respectively. There were some differences in the speed and effectiveness of the treatments between varieties. However, there were some general trends that were similar among the three varieties. For example, Sharpen + Gramoxone always provided the quickest speed of activity 3 DAT. By 7 DAT, most treatments provided greater than 90% desiccation, with the exception of Roundup and Aim; and Gramoxone alone in 2 of 3 varieties. By 14 DAT, Aim applied to ‘Merlin’ navy beans was the only treatment that did not reach 90% desiccation. Yield was slightly affected by products that provided quicker desiccation for the ‘Zorro’ and ‘Merlin’ beans, due to early application (60-75% yellow pod) instead of 80% yellow pod. 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, Powell amaranth, and dry bean desiccation

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

Location: Shiawassee County	Tillage: Conventional
Planting Date: June 7, 2016	Row width: 20-inch
Replicated: 4 times	Population: 106,000 seeds/A
Varieties: 'Zenith' black beans	Date Treated: September 9, 2016

Table 1. Effect of preharvest treatment on common lambsquarters and bean desiccation 7 and 14 days after treatment (DAT) and yield.

Treatments	C. lambsquarters		Powell amaranth		'Zenith' black bean	
	7 DAT	14 DAT	7 DAT	14 DAT	7 DAT	14 DAT
Sharpen (1 fl oz) + MSO + AMS	0 d ^a	0 c	77 de	97 ab	87 ab	85 b
Sharpen (2 fl oz) + MSO + AMS	9 cd	0 c	82 bcd	92 bc	93 a	98 a
Gramoxone (2 pt) + NIS	88 a	99 ab	92 abc	100 a	83 a-d	86 b
Valor (1.5 oz) + MSO	0 d	0 c	60 fgh	87 c	82 a-d	90 ab
Roundup (22 fl oz) + AMS	10 cd	90 ab	63 efg	94 abc	85 a-d	90 ab
Aim (2 fl oz) + MSO	4 cd	5 c	45 h	45 d	66 d	69 c
Sharpen (1 oz) +Roundup+ MSO +AMS	10 cd	90 b	73 def	100 a	94 a	94 ab
Sharpen (1 oz) +Gramox.+ MSO + AMS	93 a	95 ab	95 a	99 ab	89 a	93 ab
Valor (1.5 oz) +Roundup+ MSO +AMS	36 b	95 ab	71 d-g	96 ab	90 a	94 ab
Valor (1.5 oz) +Gramox.+ MSO + AMS	91 a	94 ab	90 abc	95 abc	85 a-c	91 ab
Aim (2 fl oz) +Roundup+ MSO +AMS	25 bc	95 ab	70 d-g	99 ab	90 a	96 a
Aim (2 fl oz) +Gramox.+ MSO + AMS	83 a	91 b	91 abc	100 a	86 ab	91 ab
Untreated	0 d	0 c	0 i	0 e	40 e	44 d

^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. Gramoxone or combinations with Gramoxone provided the greatest desiccation of common lambsquarters (88% or greater) and Powell amaranth (90% or greater), 7 DAT. These treatment also provided good desiccation of black beans, 7 DAT. By 14 DAT, Gramoxone, Roundup (glyphosate) or combinations with these herbicides were needed for common lambsquarters desiccation. These treatments also provided good control of Powell amaranth, 14 DAT. Sharpen alone at the 1 or 2 fl oz/A rate also provided good desiccation of Powell amaranth. All treatments provided greater than 90% black bean desiccation 14 DAT, except Sharpen at 1 fl oz/A alone, Gramoxone alone, and Aim alone. Desiccation of these treatments were 85, 86, and 69%, respectively. While we have several years data comparing preharvest treatments, our recommendation if a grower decides to use Sharpen is to use 1 fl oz/A rate, this also reduces the rotation restriction for following crops, such as sugarbeet. In many cases there were no detriments for applying tank-mixtures of the preharvest herbicides. However, Gramoxone or Roundup were in many cases needed to help with weed desiccation. Please refer to the 2017 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.

Preharvest herbicide applications are an important part of direct-harvest dry bean production

Christy Sprague, Michigan State University Extension, Department of Plant, Soil and Microbial Sciences

Function, timing and rotation restrictions are important to consider when selecting a preharvest herbicide treatment for dry beans. Preharvest herbicides, also known as “harvest aids,” are used to desiccate or dry down “green” stem and leaf tissue that can hinder dry bean harvest. The main intention of preharvest herbicide applications is to desiccate weeds; however, many growers use these herbicide applications to hurry along or even out the maturing process of dry beans. While there are several products that growers can use for dry bean desiccation, glyphosate is one product that growers need to take special precautions when using to ensure a quality bean product at harvest.

Glyphosate (Roundup PowerMax and several other formulations) provides the most consistent and effective weed control of the preharvest herbicides labeled for use in dry beans. However, glyphosate is the one product that if not used properly can lead to illegal residues in the marketed product and has led to buyers rejecting “**(Canadian)**” dry bean exports. To avoid illegal residues, glyphosate applications need to be made to dry beans after they are in the **hard dough stage (30 percent seed moisture or less)**. Additionally, in MSU trials we have also observed a loss of black color in canned black beans if preharvest applications of glyphosate are made too early “**(Off Label)**”. While the intentions of most growers are to make these applications according to the label, the unevenness in dry bean maturity of some varieties makes it difficult to have an entire field all at the same stage for preharvest herbicide applications. In these cases, growers should either wait until the entire field of dry beans is in the hard dough stage (**30 percent moisture or less**) or they should consider using a different product. The maximum use rate of glyphosate as a preharvest treatment is **0.75 pounds acid equivalent (a.e.) per acre** – equivalent to 22 fluid ounces per acre of Roundup PowerMax. Not all glyphosate products are registered for preharvest use in dry beans, so it is important to consult product labels for legal applications. We recommend to always include 17 pounds of ammonium sulfate (AMS) per 100 gallons of spray solution for applications of glyphosate. Remember there is also a **seven-day preharvest** interval for glyphosate. Glyphosate provides the slowest activity of all the preharvest herbicides labeled and it generally takes seven to 14 days after treatment for complete weed and dry bean desiccation. There are no crop rotation restrictions with glyphosate.

For additional preharvest herbicide product recommendations for use in dry beans, please consult the dry bean section of the 2017 MSU Weed Control Guide (E-434).

Dr. Chris Difonzo, Field Crops Entomologist & Undergrad Advisor, Michigan State University

Brand new Cheat sheet for spider mite spraying in Michigan field crops, posted at msuent.com

August is the timeframe in drought years when spider mites increase in Michigan and spray decisions have to be made. Hot, dry conditions obviously favor mites. Rain and irrigation can help to reduce populations, but only if humidity remains high under the canopy for an extended period (48 hours) so that mite pathogens can take hold. In the last widespread drought year, 2012, the highest mite infestations were actually in irrigated fields. This is because frequent watering kept plants juicy, but the foliage dried off quickly once the irrigation stopped. In addition to dry weather, the other way to generate a rip-roaring mite infestation is to spray a pyrethroid. With the exception of bifenthrin, other pyrethroids flare mites by killing beneficials but leaving mites unharmed. When using pyrethroids, check for mites before application, and be smart about product choice to avoid flaring populations.

Tips for spraying mites

*Good coverage is critical for control. Use the highest gallons per acre practical; more water is better. Ground is usually better than air.

*Read the label to understand how the chemical acts on mites and what to expect after application. Some products kill mites but not their eggs. Unless there is residual, newly-hatched mites can recolonize plants quickly. Some of the mite growth regulators kill eggs and nymphs, but not adults. They reduce the population, but act slowly.

*In Michigan, I do not recommend spraying for mites more than once in a season. If you choose to spray twice, never apply the same product, or one in a similar group, again. Switch modes of action to avoid resistance.

*Selective miticides usually have low impact on beneficials. However, the insecticides bifenthrin and dimethoate, which double as miticides, are hard on beneficial insects and honey bees. For example, during the 2012 drought, there were several bee kills attributed to dimethoate use in soybean. To avoid such a situation, check the label before using a product. Most labels recently were updated with specific warnings and guidelines about application to crops in bloom. Know the neighborhood and talk to beekeepers in the area. They may be able to cover or move hives. Spray in the evening versus during the day to avoid exposing foraging bees. The Drift Watch web site (<https://mi.driftwatch.org/map>) lists the location of some apiaries in the state, however it is not complete since beekeepers are not required to post.

*Note that preharvest intervals range from 0 – 60 days depending on the crop x insecticide.

DRY BEAN ONLY

Trade	common	company	RUP	Signal	REI	Group
Bifen 2 Ag Gold	bifenthrin	Direct Ag Source	y	warning	12	3A
Bifenthrin 2EC	bifenthrin	Aceto Ag Chem Corp	y	warning	12	3A
Bifenture EC	bifenthrin	United Phosphorus	y	warning	12	3A
Brigade 2EC	bifenthrin	FMC Corp	y	warning	12	3A
Fanfare 2EC	bifenthrin	Makhteshim Agan	y	warning	12	3A
Fanfare EC, ES	bifenthrin	Makhteshim Agan	y	warning	12	3A
Sniper	bifenthrin	Loveland	y	warning	12	3A
Tailgunner	bifenthrin	Makhteshim Agan	y	warning	12	3A
Tundra EC	bifenthrin	Winfield Solutions	y	warning	12	3A
Hero, Hero EW	bifenthrin cypermethrin	FMC	y	caution	12	3A
Steed	bifenthrin cypermethrin	FMC	y	warning	12	3A
Dimate 4E	dimethoate	Winfield Solutions	n	warning	*	1B
Dimethoate 400	dimethoate	Loveland	n	warning	*	1B
Dimethoate 4E	dimethoate	Cheminova	n	warning	*	1B
Dimethoate 4EC	dimethoate	Drexel	n	warning	*	1B

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. • <i>Prowl</i> (pendimethalin), <i>trifluralin</i>, or <i>Sonalan</i> 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>. • <i>Prowl</i> 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. • <i>Sonalan</i> 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>. • <i>Trifluralin</i> 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 (<i>Dual Magnum</i>) OR (<i>Dual II Magnum</i> , <i>Cinch</i>)	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 (<i>Outlook</i>)	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 <i>Outlook</i> 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. • Sequence 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>) + crop oil concentrate OR surfactant	0.044	7 oz 0.88L + 1% OR 0.25%	<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.
	fluzafop-P-butyl (<i>Fusilade DX</i>) + crop oil concentrate	0.188	12 oz 2L + 1%	<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.
	sethoxydim (<i>Poast</i>) + crop oil concentrate + ammonium sulfate	0.19	1 pt 1.5SC + 1 qt + 2.5 lb	<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.

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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>	0.068	9 oz 0.97EC		
+ surfactant		0.25%			
+ ammonium sulfate		2.5 lb			
Annual Broadleaves	bentazon <i>(Basagran/Broadloom)</i>	0.75	1.25 pt 4L		<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) 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) 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.
+ 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>				
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> is added to “safen” this application. • Increase the rate of <i>Basagran</i> (16 oz) 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> 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> (16 oz) 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.
	+ bentazon (<i>Basagran</i>)	0.25	8 oz 4L	
	+ 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/A of <i>Basagran</i> 4L 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). • 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>) + methylated seed oil	0.05	1.5 oz 51WG + 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</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</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	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)	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)	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	N	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.

