

MICHIGAN DRY BEAN RESEARCH REPORT

2025



MSU Extension



**MICHIGAN BEAN
COMMISSION**

Production Research Advisory Board

2025

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A Systems Approach to Sustainable Dry Bean Production

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In 2024 the Michigan Bean Commission was awarded a grant from the Michigan Department of Agriculture and Rural Development through the USDA Specialty Crop Block Competitive Grant Program. This project was titled *A Systems Approach to Sustainable Dry Bean Production*. Throughout the duration of this project, the Michigan Bean Commission utilized a multidisciplinary approach to better understand the biology and ecology of dry bean production systems while addressing farmer-defined barriers to sustainable production systems in Michigan. Michigan dry beans have a storied reputation as the industry standard for premium quality in the marketplace. For Michigan bean producers to remain the leader in the industry, continued research is needed to address current barriers to production and test production methods for a new frontier in dry bean production that is more focused on the health and productivity of the system rather than any one particular crop. The Michigan dry bean industry, as a specialty crop, is dependent on a relatively limited number of major domestic end users and an extensive export market. The industry is continually challenged by niche market pricing and competition with alternative crops (e.g., corn, soy). Thus, the entire complex of bean growers, elevator operators, bean shippers, and end-users have demonstrated unity in assuring the economic and environmental sustainability of this important crop while improving the story of sustainability. Nutrient dense dry beans are increasingly popular with today's nutrition conscious consumers, who are increasingly aware of the environmental advantages of legume crops (dry beans) for soil enrichment and their direct contributions to dietary health. For these reasons it is important that Michigan dry beans continually progress towards increased sustainability and adapt to the needs of the land they are raised on, to do so continued extensive efforts are needed. Objectives of this project were to: **(1)** Develop and validation of a systems-based approach to improve dry bean production through alternative agronomic practices **(2)** Improve weed control strategies with an emphasis on adjustments to agronomic practices focused on planting dates and herbicide use strategies to manage weeds and altered production practices **(3)** Utilize multi-location testing protocols for screening genetic tolerance to biotic and abiotic stresses while optimizing best practices for crop protection programs **(4)** Implementation of grower educational activities to communicate research findings, intervention strategies, and economic options for improved production practices for premium quality Michigan dry beans.

Season Summary: Planting conditions for 2025 dry beans were average. When compared to 2024 the 2025 winter provided deep frost into the soil profile that improved soil conditions in the spring. The last Michigan Crop Weather data was issued on May 27, 2025, where topsoil moisture was categorized as: 0% short, 72% adequate, and 23% surplus. These conditions remained for much of the month of June and provided little issues or interruption to the planting season. As a whole very little waterlogging took place in 2025, those areas that were impacted were by and large in eastern Sanilac County. As July progressed into August, rainfall incidence diminished. Areas near the Saginaw Bay in Northwestern Tuscola County and Western Huron County South of M-142 entered a severe drought condition that did negatively impact dry bean yields especially on lighter soil types that are present intermittently throughout this region. Given the dryness through the reproductive stages of the crop white mold was not a major issue across most of the production area apart from those near Lake Huron. Overall warm and dry conditions led to an average harvest timing. Most of the crop matured as expected with some reports of sub-par dry down in small red beans. Rain was sparse through September and mid-October and led to only minor pauses in harvest progress. In general, dry bean yields were average with good quality. USDA has reported a state average yield for 2025 of 23.5 cwt/acre when averaged across all dry bean classes.

We would like to thank all the cooperators that hosted trials in 2025. Without their assistance, this research would not be possible.

Thank you,

Scott Bales

&

Joe Cramer

Field Trial Methods

Dry beans were seeded in four-row plots that measured 6.6' wide by 24' long, with 20" rows. Each entry was replicated four times. All trials were designed as randomized complete blocks (RCB). (RCB is a standard agricultural trial design in which entries are randomly assigned to groups or blocks, and the blocks are randomly repeated. The goal of the replication is to control for variables that might affect an entry's yield, such as soil nutrient levels [Table 2], pest loads, and variability in soil textures.)

Trials received industry standard seed treatments, fertilization, and weed control applications at labeled rates. Prior to harvest, plots were trimmed to 17' length. Yield data was obtained by direct harvesting the center two rows for small- and medium-seeded beans. Large-seeded beans were pulled by a two-row Pickett bean puller and then mechanically threshed to prevent harvest loss. Following harvest, samples were cleaned, weighed, and moisture tested.

Table 2. Soil test information from the 2025 trial locations, including the percentage of organic matter, soil type, soil pH, and soil cation exchange capacity (CEC). All macro- and micronutrients were sufficient for dry bean production.

Location	Percentage of organic matter	Soil type	Soil pH	Soil CEC
Bay	2.7	Sandy clay loam	7.0	12.3
Huron	2.0	Sandy clay loam	7.8	12.0
Montcalm	1.5	Loamy sand	7.3	5.1
Sanilac	2.0	Sandy clay loam	7.7	8.6
Tuscola (Zwerk and Sons)	2.7	Clay loam	7.9	15.5
Tuscola (SVREC)	2.2	Sandy clay loam	7.8	15.1

Yield Trial Results

Tables 5 through 15 provide each entry's yield results in pounds per acre (Lbs./A) adjusted to 18% moisture. This is presented as the combined average yield for each entry across all sites in 2025. (**Note:** If an entry was grown under different production systems [irrigated versus dry land] at different sites, the combined yield was not calculated.) When possible, two- and three-year average yields were also calculated across locations. For example, the three-year average yield of a navy bean entry (Table 5) includes data from 2023, 2024, and 2025 at four locations per year (12 site-years).

The last three rows of the agronomic and yield results tables list the trial average (mean), least significant difference (LSD), and coefficient of variation (CV), respectively, for the data in each column.

The entry with the **highest** value in each yield column is followed by two asterisks (**). Any yields listed in the same column that are not significantly different from the highest yield are noted with one asterisk (*). This means that if two entries in the same column are followed by either one or two asterisks, the difference in values between the entries is not statistically significant.

Table 16 lists the sources of dry bean varieties tested in 2025. The entries are organized by bean market class.

Canning Methods

183 lines were sampled and tested for canning quality. For mesoamerican germplasm (black, navy, s. red, etc.), samples were taken from Bay and Huron trial locations, andean germplasm (kidney, cranberry, etc.) was sampled from the Montcalm and Tuscola trial locations. Samples were processed utilizing the following methods: Each can was filled with 90 grams of dry matter for all mesoamerican market classes. Cans for andean beans were filled with 85 grams of dry matter. Moisture levels prior to soaking ranged from 9.7-13.6%, averaging 11.8% across all cultivars tested. Following subsampling, dry beans were transferred to the Food Processing and Innovation Center (FPIC), an MSU facility in Okemos, MI. At FPIC, two days of sample processing took place in 2026. Dry beans were soaked and blanched by market class according to the protocol in Table 3. Water for soaking included 125ppm of CaCl₂ for Andean beans. Immediately following blanching, samples were transferred to individually identifiable cans (size 307x407) and filled with 190°F brine. Brine is a mixture of tap water, 1.5% sucrose (sugar), 1.2% sodium chloride (salt), and 100ppm of CaCl₂. Colored beans had the additional component of disodium EDTA added at a ratio of 0.02%. Cans were then seamed and individually inspected to ensure seam quality prior to thermal processing. Cans were loaded in 552 can batches and transferred to an ‘Allpax’ retort. Thermal processing parameters were set for a 19-minute cook cycle at 250°F. Following cool down samples were stored for approximately 4 weeks prior to opening and evaluations to allow for equilibration.

Table 3. Dry Bean Brine, Soaking, Blanching and Thermal Processing by market class

Class	Brine				Rehydration		Thermal Processing
	Salt	Sugar	CaCl ₂	EDTA	Hot Soak	Blanch	
Navy	1.2%	1.5%	100 ppm	-	30 min (125°F)	5 min (190°F)	19min/250°F
Black	1.2%	1.5%	100 ppm	-	-	90 sec (190°F)	19min/250°F
Great Northern	1.2%	1.5%	100 ppm	-	30 min (125°F)	15 min (190°F)	19min/250°F
Pinto	1.2%	1.5%	100 ppm	0.02%	2 hr (130°F)	5 min (190°F)	19min/250°F
Small Red	1.2%	1.5%	100 ppm	0.02%	50 min (125°F)	15 min (190°F)	19min/250°F
Pink	1.2%	1.5%	100 ppm	0.02%	30 min (125°F)	15 min (190°F)	19min/250°F
Dark Red Kidney	1.2%	1.5%	100 ppm	0.02%	2 hr (130°F)	5 min (190°F)	19min/250°F
Light Red Kidney	1.2%	1.5%	100 ppm	0.02%	2 hr (130°F)	5 min (190°F)	19min/250°F
White Kidney	1.2%	1.5%	100 ppm	-	30 min (125°F)	5 min (190°F)	19min/250°F
Cranberry	1.2%	1.5%	100 ppm	0.02%	2 hr (130°F)	5 min (190°F)	19min/250°F
Yellow	1.2%	1.5%	100 ppm	-	30 min (125°F)	5 min (200°F)	19min/250°F

Evaluations: On February 4, 2026, a public meeting was held for the evaluation of all lines tested. Cans were opened and scored by a 19-member panel of trained evaluators. Trained evaluators scored all market classes visually on a scale from 1-5. This scoring system has been created and validated by USDA researchers located at MSU who are also involved in the training of evaluators. Table 4 documents this established scoring system based on physical characteristics of the processed sample for all market classes besides black beans. Black beans were

scored similarly, but color was evaluated on a 1-5 scale independently from general appearance as this is a unique trait of economic interest in black beans.

Table 4. General appearance scale used for scoring all market classes except for black beans.

Category	Score	Bean Splitting	Brine Clarity	Free Starch/Clumps	Color
<i>Excellent Appearance</i>	5	None (90% intact)	Very Clear	Very Little Starch/Clumps	Excellent color (exceeds industry standard)
<i>Very Good Appearance</i>	4	Moderately Intact (70-89% intact)	Moderately Clear	Moderately little starch/clumps	Very good color (meets industry standard)
<i>Average Appearance</i>	3	Average (60-69% intact)	Neither Clear or Cloudy	Neither Little or Much	Average Color
<i>Poor Appearance</i>	2	Moderately Broken (badly split but holding together)	Moderately Cloudy	Moderately Many/Big Starch/clumps	Poor color (a little darker or lighter than industry standard)
<i>Unacceptable Appearance</i>	1	Severe (Seeds blown apart)	Very Cloudy	Very Big Starch/Clumps	Unacceptable color (a lot darker or lighter than industry standard)



Images from 2026 Can Opening Meeting at Saginaw Valley Research and Extension Center

Table 5. Navy bean yield and quality results.

Navy bean entry	1-year avg. (Lbs./A)	2-year avg. (Lbs./A)	3-year avg. (Lbs./A)	Seed Size (Seeds/lb.)	Bay (1-5)	Huron (1-5)	1-year avg. (1-5)	2-year avg. (1-5)	3-year avg. (1-5)
14092	2,874 ^a	3,011	NA	1,966	2.6	2.9	2.7	2.7	NA
21102	2,608	2,497	NA	2,068	2.7	2.3	2.5	2.4	NA
21106	2,899	NA	NA	2,035	3.5	3.1	3.3	NA	NA
21108	2,692	2,679	NA	2,171	2.9	2.8	2.8	3.2	NA
Argosy	3,295	3,204	3,120*	1,722	3.1	2.3	2.7	2.7	2.3
Armada	3,227	3,041	3,207**	1,805	3.1	2.7	2.9	3.0	2.9
AuSable	2,893	2,821	2,770	1,935	2.9	2.7	2.8	2.9	2.8
Blast	3,381	3,076	NA	2,032	2.9	2.7	2.8	2.8	NA
Blizzard	3,252	2,984	3,156*	1,977	3.3	2.3	2.8	2.9	2.8
EX2111-N	3,104	2,963	2,846	2,081	3.3	3.1	3.2	3.0	2.7
EX-712302	2,900	NA	NA	1,986	2.4	2.6	2.5	NA	NA
EX-712310	2,881	NA	NA	1,971	3.4	3.1	3.3	NA	NA
EX-712315	2,455	NA	NA	1,941	3.3	2.9	3.1	NA	NA
EX-712316	2,993	NA	NA	1,927	3.1	2.5	2.8	NA	NA
EX-712317	3,016	NA	NA	1,933	3.0	2.8	2.9	NA	NA
HMS Bounty	2,656	2,507	2,821	2,345	3.1	3.1	3.1	3.1	2.9
HMS Medalist	2,883	2,900	3,137*	2,034	3.3	3.2	3.3	3.2	3.4
Liberty	2,775	2,742	2,932*	1,990	3.1	2.8	3.0	3.3	3.3
N22610	3,510*	NA	NA	1,856	3.8	3.5	3.7	NA	NA
N22616	3,618*	3,179	3,150*	2,012	2.2	2.3	2.3	2.5	2.4
N22622	3,557*	3,453*	NA	1,776	2.5	1.5	2.0	2.3	NA
N22623	3,529*	3,124	NA	1,978	3.4	2.9	3.2	3.2	NA
N23706	3,805**	3,296*	NA	1,950	3.4	2.6	3.0	3.0	NA
N23717	3,514*	NA	NA	2,091	2.3	2.6	2.5	NA	NA
N24847	3,509*	NA	NA	1,910	2.4	1.7	2.0	NA	NA
N24851	3,542*	NA	NA	2,024	3.0	2.3	2.7	NA	NA
Nautica	3,063	2,986	2,951*	2,032	3.6	3.4	3.5	3.0	2.7
ND Polar	3,355	2,807	2,751	1,785	3.4	3.3	3.4	3.3	3.2
OAC Charm	3,204	2,951	NA	1,857	3.3	3.3	3.3	3.1	NA
Steam	3,692*	3,647**	NA	1,794	3.4	2.8	3.1	2.9	NA
T9905	2,436	2,610	2,854	1,786	2.3	2.2	2.3	2.6	2.4
Valiant	2,883	2,725	2,997*	1,971	3.0	3.7	3.4	3.5	3.5
Victory	3,069	2,993	3,205*	1,884	2.8	2.6	2.7	2.7	2.8
MEAN	3,123	2,967	2,993	1,958	3.0	2.8	2.9	2.9	2.8
LSD_(0.05)	356	397	295	NA	NA	NA	NA	NA	NA
CV	16.9%	26.8%	23.6%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

^a Due to poor trial quality this season, Sanilac County yield averages were not included in the one-year average.

Table 6. Black bean yield and quality results.

Black bean entry	1-year avg. (Lbs./A)	2-year avg. (Lbs./A)	3-year avg. (Lbs./A)	Seed Size (Seeds/lb.)	Bay (1-5)	Huron (1-5)	1-year avg. (1-5)	2-year avg. (1-5)	3-year avg. (1-5)
13505	3,250 ^a	NA	NA	1,968	2.9(3.3) ^b	3.4(3.5)	3.2(3.4)	NA	NA
16598	3,206	NA	NA	2,090	2.5(2.5)	2.1(2.2)	2.3(2.3)	NA	NA
17746	3,398	3,220	NA	2,024	2.0(2.8)	2.3(2.8)	2.1(2.8)	2.5(2.8)	NA
17751	3,742*	3,358*	3,281	1,836	2.9(1.8)	3.4(1.9)	3.1(1.9)	2.9(1.9)	3.2(1.7)
17764	3,542	NA	NA	1,798	1.7(2.2)	1.5(2.0)	1.6(2.1)	NA	NA
21650	3,362	3,137	NA	1,708	2.1(2.6)	2.9(3.1)	2.5(2.8)	2.7(2.9)	NA
21702	3,806*	3,578*	NA	1,674	2.5(3.2)	2.4(3.1)	2.4(3.2)	2.7(3.1)	NA
21703	3,497	NA	NA	1,684	2.7(2.2)	2.6(2.3)	2.6(2.2)	NA	NA
21723	3,317	3,142	NA	1,782	3.6(3.9)	3.7(3.9)	3.7(3.9)	3.7(3.8)	NA
B2002-1-3	3,266	3,285*	NA	2,008	3.0(3.2)	2.8(3.1)	2.9(3.1)	3.1(3.3)	NA
B22041	3,490	3,381*	3,491*	2,020	3.4(3.0)	3.4(3.6)	3.4(3.3)	3.4(3.6)	3.6(3.5)
B22042	3,062	3,365*	NA	1,916	2.6(3.9)	2.8(3.9)	2.7(3.9)	3.1(4.0)	NA
B22062	3,549	3,433*	NA	1,712	2.7(3.0)	2.2(2.8)	2.5(2.9)	2.6(2.9)	NA
B22854	3,481	3,446*	3,358*	1,725	2.8(3.0)	2.7(3.2)	2.8(3.1)	2.8(3.0)	3.2(3.1)
B23911	3,389	3,343*	NA	1,842	3.4(3.6)	3.4(3.7)	3.4(3.6)	3.4(3.7)	NA
B23949	3,134	3,179	NA	1,880	3.2(2.5)	3.1(2.4)	3.2(2.5)	2.9(2.6)	NA
B24120	3,560	NA	NA	1,829	2.4(3.2)	1.9(3.6)	2.2(3.4)	NA	NA
B24122	3,403	NA	NA	1,966	1.8(3.4)	1.8(3.5)	1.8(3.5)	NA	NA
B24180	3,616*	NA	NA	1,783	3.3(3.8)	3.1(3.8)	3.2(3.8)	NA	NA
B24212	3,397	NA	NA	1,595	2.7(3.1)	3.3(3.4)	3.0(3.2)	NA	NA
B7071259	3,417	3,317*	3,478*	1,753	3.4(2.2)	2.8(2.4)	3.1(2.3)	2.9(2.4)	3.3(2.6)
B7072252	3,632*	3,202	3,336*	1,838	3.5(3.7)	3.1(3.7)	3.3(3.7)	3.4(4.0)	3.4(3.8)
B7072269	3,659*	3,185	3,273	1,856	2.9(3.8)	3.1(4.0)	3.0(3.9)	3.1(3.8)	3.3(4.0)
B18094173	3,213	3,016	3,167	1,761	3.1(3.7)	3.1(3.8)	3.1(3.7)	3.2(3.8)	3.3(3.9)
Black Bear	3,328	3,041	3,134	2,085	2.3(1.9)	2.4(2.1)	2.3(2.0)	2.3(2.0)	2.4(2.1)
Black Pearl	3,424	3,277*	3,144	1,882	1.7(4.6)	1.9(4.3)	1.8(4.5)	2.3(4.3)	2.6(4.5)
Black Tails	3,084	3,003	2,930	1,892	2.8(2.5)	3.2(2.9)	3.0(2.7)	3.0(3.1)	2.9(3.1)
BlackBeard	3,195	3,081	3,247	1,712	4.0(3.5)	3.9(3.8)	4.0(3.7)	3.8(3.8)	3.9(3.9)
Kona	3,876**	3,695**	3,614**	1,778	2.9(3.2)	2.8(3.4)	2.9(3.3)	3.0(3.3)	3.2(3.3)
ND Galaxy	3,056	NA	NA	2,008	1.9(2.1)	2.5(2.6)	2.2(2.3)	NA	NA
Nimbus	3,604*	3,288*	3,289*	1,773	2.8(2.2)	2.6(2.2)	2.7(2.2)	2.7(2.4)	2.9(2.2)
Slate	3,249	NA	NA	1,948	3.1(3.6)	3.2(3.8)	3.1(3.7)	NA	NA
Spectre	3,215	3,014	3,092	1,822	2.9(2.5)	2.8(2.3)	2.9(2.4)	2.7(2.6)	2.8(2.7)
Umbra	3,600*	3,422*	3,359*	1,766	2.3(2.8)	2.8(3.1)	2.5(2.9)	2.6(3.0)	2.8(3.1)
Zenith	3,165	3,211	3,096	1,760	3.3(4.1)	3.6(3.9)	3.5(4.0)	3.8(4.3)	3.7(4.2)
MEAN	3,405	3,266	3,269	1,842	2.8(3.0)	2.8(3.1)	2.8(3.1)	3.0(3.2)	3.1(3.2)
LSD(0.05)	300	418	326	NA	NA	NA	NA	NA	NA
CV	15.1%	28.2%	26.2%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

^a Due to poor trial quality this season, Sanilac County yield averages were not included in the one-year average.

^b Canning scores for black beans are notated as general appearance scores followed by color. Example: appearance(color).

Table 7. Small red and pink bean yield and quality results.

Small red & pink bean entry	Yield (Lbs./A)			Seed Size (Seeds/lb.)	Canning Score (1-5)		Canning Score (1-5)		
	1-year avg. (Lbs./A)	2-year avg. (Lbs./A)	3-year avg. (Lbs./A)		Bay (1-5)	Huron (1-5)	1-year avg. (1-5)	2-year avg. (1-5)	3-year avg. (1-5)
16686	3,634 ^a	3,281*	3,323*	1,171	2.4	2.4	2.4	2.6	2.6
17822	3,824*	3,360*	3,321*	1,255	2.4	2.7	2.5	2.7	2.8
17837	3,567	3,279*	3,345*	1,292	1.7	1.8	1.8	2.1	2.3
17848	3,835*	3,347*	NA	1,099	2.5	2.6	2.6	3.0	NA
17851	3,962*	3,233*	NA	1,122	2.3	2.4	2.4	2.5	NA
19837	3,160	3,120*	3,139*	1,161	1.8	2.4	2.1	2.1	2.1
Coral ^b	3,602	3,341*	3,056*	1,039	2.1	1.7	1.9	2.6	2.5
ND Rosalind ^b	4,000**	3,455**	NA	1,200	2.4	2.5	2.4	2.3	NA
ND151006-2	3,443	NA	NA	1,212	1.5	1.8	1.6	NA	NA
OAC Rosito	3,012	NA	NA	1,712	2.6	2.3	2.4	NA	NA
R22703	3,414	3,297*	NA	1,172	2.5	2.6	2.6	2.9	NA
R22710	3,822*	3,423*	NA	1,159	2.4	2.9	2.7	3.1	NA
R22714	3,724*	NA	NA	1,044	2.0	2.4	2.2	NA	NA
R23804	3,951*	NA	NA	1,212	2.4	2.7	2.5	NA	NA
USDA Lava	2,847	NA	NA	1,306	3.2	2.8	3.0	NA	NA
Viper	3,792*	3,347*	3,346**	1,735	1.7	1.9	1.8	2.4	2.5
MEAN	3,599	3,317	3,256	1,243	2.2	2.4	2.3	2.6	2.5
LSD_(0.05)	293	412	332	NA	NA	NA	NA	NA	NA
CV	12.0%	24.3%	24.7%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

^a Due to poor trial quality this season, Sanilac County yield averages were not included in the one-year average. ^b Pink bean variety.

Table 8. Conventional and slow darkening pinto bean yield and quality results.

Pinto bean entry	Yield (Lbs./A)			Seed Size (Seeds/lb.)	Canning Score		Canning Score		
	1-year avg.	2-year avg.	3-year avg.		Bay (1-5)	Huron (1-5)	1-year avg.	2-year avg.	3-year avg.
Bronco ^a	2,318 ^b	2,527	NA	1,021	2.2	1.7	2.0	2.3	NA
Cancun	3,352	2,881	NA	981	2.2	1.7	2.0	2.6	NA
Charro	3,772**	3,483**	3,603**	1,036	3.4	3.5	3.5	3.2	3.7
Cowboy	3,118	3,023	NA	1,112	1.8	2.0	1.9	2.1	NA
Diamondback ^a	2,693	2,818	2,714	1,119	2.6	2.8	2.7	2.5	2.9
Eternal ^a	3,670*	3,122*	NA	1,163	2.9	2.8	2.9	3.1	NA
Gleam ^a	3,540*	3,029	3,033	1,115	2.2	2.1	2.1	2.4	2.7
Mystic ^a	3,007	2,936	2,976	1,061	1.2	1.6	1.4	1.3	1.3
ND Falcon	3,376	3,029	2,885	1,142	2.3	1.9	2.1	2.2	2.7
ND Rodeo ^a	3,103	3,259*	3,309*	1,064	3.0	2.9	3.0	2.6	2.8
P22103	3,347	NA	NA	1,111	3.1	2.7	2.9	NA	NA
P22204	3,496*	NA	NA	1,126	3.5	3.6	3.6	NA	NA
P23311	3,534*	3,350*	NA	1,164	2.9	3.4	3.2	2.8	NA
P24402	3,541*	NA	NA	1,081	2.6	3.5	3.0	NA	NA
Rattler	3,085	2,950	3,011	1,019	1.4	2.3	1.8	2.4	2.6
Shine ^a	3,063	3,080*	NA	1,143	2.2	2.9	2.5	2.3	NA
SV6139GR	2,865	2,715	2,834	1,200	2.0	2.2	2.1	2.4	2.7
Toast	3,340	NA	NA	1,120	1.4	1.6	1.5	NA	NA
USDA Cody	2,994	NA	NA	1,116	1.7	2.1	1.9	NA	NA
Vibrant ^a	3,104	3,036	3,072	1,199	1.5	2.2	1.9	1.6	1.9
MEAN	3,216	3,018	3,048	1,100	2.3	2.5	2.4	2.4	2.6
LSD_(0.05)	388	430	323	NA	NA	NA	NA	NA	NA
CV	17.8%	28.3%	25.3%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture. ^a Slow darkening pinto variety. ^b Due to poor trial quality this season, Sanilac County yield averages were not included in the one-year average.

Table 9. Great northern bean yield and quality results.

Great northern bean entry	Yield (Lbs./A)			Seed Size (Seeds/lb.)	Canning Score (1-5)		Canning Score (1-5)		
	1-year avg. (Lbs./A)	2-year avg. (Lbs./A)	3-year avg. (Lbs./A)		Bay (1-5)	Huron (1-5)	1-year avg. (1-5)	2-year avg. (1-5)	3-year avg. (1-5)
Eiger	3,500 ^a	3,127*	3,224**	1,172	2.4	2.2	2.3	2.6	2.4
G22004	3,878**	3,526**	NA	1,230	2.8	2.2	2.5	2.5	NA
G23108	3,386	NA	NA	1,203	2.9	2.8	2.9	NA	NA
ND Pegasus	3,057	3,039	2,971*	1,108	2.4	2.4	2.4	2.6	2.4
Powderhorn	2,550	2,506	2,437	1,196	2.6	3.4	3.0	2.9	3.1
MEAN	3,274	3,073	2,890	1,182	2.6	2.6	2.6	2.6	2.6
LSD_(0.05)	318	480	341	NA	NA	NA	NA	NA	NA
CV	14.2%	29.4%	27.7%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

^a Due to poor trial quality this season, Sanilac County yield averages were not included in the one-year average.

Table 10. Cranberry bean yield and quality results.

Cranberry bean entry	Yield (Lbs./A)		Irrigated (Lbs./A)		Dry land (Lbs./A)		Seed Size (Seeds/lb.)	Quality (1-5)		Quality (1-5)		
	Montcalm	Tuscola	2-year avg.	3-year avg.	2-year avg.	3-year avg.		Tuscola	Montcalm	1-year avg.	2-year avg.	3-year avg.
16756	2,002	2,306	2,668	2,936*	2,489	2,535	1,120	3.8	4.0	3.9	3.5	3.8
16758	1,862	1,878	2,312	2,668	1,857	2,015	975	3.9	4.0	3.9	3.4	3.6
16775	1,807	1,851	2,579	2,490	2,276	2,441	901	3.7	3.3	3.5	3.3	3.3
16816	1,938	2,239	2,764	2,833	2,242	2,240	889	2.8	2.9	2.9	2.4	2.8
151093	2,387*	3,032*	3,315**	3,249**	3,084**	3,246**	902	3.0	2.8	2.9	2.4	2.8
Amaranto	1,753	1,892	2,521	2,672	2,172	2,352	786	1.9	2.4	2.2	2.0	2.1
C24104	2,199	2,112	NA	NA	NA	NA	894	1.5	1.5	1.5	NA	NA
C24114	2,306	1,744	NA	NA	NA	NA	807	2.4	2.8	2.6	NA	NA
CR25-1	904	1,428	NA	NA	NA	NA	960	2.9	2.9	2.9	NA	NA
CR25-2	1,097	1,770	NA	NA	NA	NA	769	2.8	2.6	2.7	NA	NA
CR25-3	985	1,534	NA	NA	NA	NA	711	3.3	3.1	3.2	NA	NA
CR2283-8	1,762	1,877	NA	NA	NA	NA	740	3.4	3.5	3.4	NA	NA
CR22109-6	1,715	2,114	NA	NA	NA	NA	793	3.1	2.7	2.9	NA	NA
Etna	2,310	2,256	2,692	2,864	2,317	2,050	824	2.1	2.4	2.3	2.0	2.0
Jester	2,250	2,354	3,233*	2,758	2,660	3,016*	783	2.3	1.7	2.0	1.9	2.0
OAC Firestripe	2,377*	2,347	2,993*	3,106*	2,468	2,560	680	3.3	3.2	3.2	2.7	2.7
OAC Navabi	2,670**	2,752*	2,870	2,771	2,573	2,443	866	2.1	1.8	2.0	2.0	1.8
MEAN	1,851	2,038	2,795	2,831	2,414	2,528	847	2.8	2.8	2.8	2.5	2.7
LSD_(0.05)	298	427	360	314	351	425	NA	NA	NA	NA	NA	NA
CV	13.6%	17.7%	12.9%	13.3%	14.5%	19.1%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

Table 12. Light red kidney bean yield and quality results.

Light red kidney bean entry	Yield (Lbs./A)		Irrigated Yield (Lbs./A)		Dry land Yield (Lbs./A)		Seed Size (Seeds/lb.)	Canning Score (1-5)		Canning Score (1-5)		
	Montcalm	Tuscola	2-year avg.	3-year avg.	2-year avg.	3-year avg.		Tuscola	Montcalm	1-year avg.	2-year avg.	3-year avg.
15916	3,215*	2,783*	3,293*	3,132	2,698*	2,926*	841	1.8	2.0	1.9	2.0	2.2
15923	2,873	2,211	3,197*	3,284*	2,422	2,376	745	2.3	2.4	2.4	2.4	2.6
20870	2,669	2,676*	2,927	NA	3,053**	NA	764	3.3	2.4	2.9	2.8	NA
20909	2,140	2,806**	2,813	NA	2,842*	NA	796	3.3	1.9	2.6	2.6	NA
161055	1,952	2,832*	3,051	NA	3,011*	NA	772	2.8	2.2	2.5	2.5	NA
161082	2,383	2,578*	2,936	2,819	2,459	2,974*	912	3.0	2.5	2.8	2.5	2.5
Big Red	2,645	2,183	3,022	2,951	2,265	2,300	793	2.7	2.4	2.6	2.3	2.3
CELRK	2,569	2,205	3,084	2,911	2,299	2,358	799	1.8	2.0	1.9	2.0	2.0
K22601	2,766	2,810*	3,105*	NA	2,841*	NA	848	3.3	2.4	2.8	2.5	NA
K22604	3,238**	2,803*	3,668**	3,624**	2,902*	3,195**	888	3.8	2.5	3.1	2.6	2.5
K23702	2,668	2,657*	NA	NA	NA	NA	811	4.3	2.8	3.6	NA	NA
Pink Panther	2,416	2,444*	2,992	3,009	2,535	2,490	738	2.3	3	2.5	2.4	2.4
Ronnie's Red	1,706	2,756*	2,718	2,714	2,795*	2,751	799	2.7	2.1	2.4	2.4	2.3
Rosie	1,745	2,571*	2,573	NA	2,341	NA	871	2.9	2.3	2.6	2.5	NA
MEAN	2,499	2,594	3,030	3,057	2,655	2,681	813	2.9	2.3	2.6	2.4	2.3
LSD_(0.05)	350	378	584	409	362	338	NA	NA	NA	NA	NA	NA
CV	11.7%	12.2%	17.5%	16.0%	13.6%	14.6%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

Table 13. Dark red kidney bean yield and quality results.

Dark red kidney bean entry	Yield (Lbs./A)		Irrigated (Lbs./A)		Dry land (Lbs./A)		Seed Size (Seeds/lb.)	Quality (1-5)		Quality (1-5)		
	Montcalm	Tuscola	2-year avg.	3-year avg.	2-year avg.	3-year avg.		Tuscola	Montcalm	1-year avg.	2-year avg.	3-year avg.
15977	2,158	3,018*	2,881	2,503	2,871*	2,541	823	2.5	2.4	2.4	2.2	2.6
161156	3,070**	2,859*	3,846**	3,468**	2,845*	2,795*	1,067	3.3	2.8	3.1	2.6	2.7
161165	2,840*	2,861*	3,471*	3,210*	2,933*	3,109*	878	3.1	2.9	3.0	2.8	2.8
181017	2,765*	3,074**	3,689*	3,354*	3,124**	3,197**	823	3.3	3.4	3.4	2.8	3.2
181021	2,838*	2,546	3,546*	3,296*	2,461	2,191	831	3.5	2.7	3.1	2.7	2.8
Dynasty	2,666	2,880*	3,672*	3,226*	3,045*	2,868*	822	3.4	2.1	2.8	2.3	2.3
Epic	2,728	2,818*	3,564*	3,391*	2,783	2,644	857	2.8	2.6	2.7	2.4	2.4
Gallantry	2,897*	2,715	3,555*	3,335*	2,839*	2,569	885	3.6	3.4	3.5	3.1	3.4
K1920-2-3	2,094	1,857	3,023	NA	1,931	NA	999	3.9	4.1	4.0	3.4	NA
K23212	2,374	2,598	3,401*	NA	2,729	NA	860	3.6	2.7	3.2	2.7	NA
Montcalm	2,685	2,464	3,390*	3,232*	2,335	2,320	763	3.1	2.5	2.8	2.5	2.8
ND Redbarn	2,341	2,324	2,885	2,665	2,283	1,957	942	3.4	3.0	3.2	2.7	2.9
Rampart	2,353	2,323	3,315	3,141*	2,444	2,475	971	3.9	3.6	3.8	3.1	3.2
Red Hawk	2,511	1,972	3,148	2,843	2,114	1,980	958	3.6	3.3	3.4	3.3	3.4
Seattle	2,762*	2,814*	3,363*	3,094*	2,703	2,760*	1,082	3.7	3.1	3.4	3.1	3.2
MEAN	2,605	2,608	3,381	3,135	2,624	2,570	904	3.4	3.0	3.2	2.8	2.9
LSD_(0.05)	329	288	522	414	305	475	NA	NA	NA	NA	NA	NA
CV	10.6%	9.2%	15.5%	16.3%	11.7%	22.8%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

Table 14. White kidney bean yield and quality results.

White kidney bean entry	Yield (Lbs./A)		Irrigated (Lbs./A)		Dry land (Lbs./A)		Seed Size (Seeds/lb.)	Canning (1-5)		Quality (1-5)		
	Montcalm	Tuscola	2-year avg.	3-year avg.	2-year avg.	3-year avg.		Tuscola	Montcalm	1-year avg.	2-year avg.	3-year avg.
201016	1,886	2,627**	NA	NA	NA	NA	856	2.5	2.0	2.3	NA	NA
201020	2,130	2,406*	NA	NA	NA	NA	797	1.5	1.7	1.6	NA	NA
201030	1,864	2,312	NA	NA	NA	NA	951	2.1	2.3	2.2	NA	NA
231228	1,018	1,736	NA	NA	NA	NA	792	1.9	2.4	2.1	NA	NA
231229	966	1,753	NA	NA	NA	NA	804	1.9	2.2	2.1	NA	NA
231230	1,050	1,716	NA	NA	NA	NA	762	1.7	2.1	1.9	NA	NA
231231	1,168	2,088	NA	NA	NA	NA	853	2.3	2.1	2.2	NA	NA
231232	1,383	2,058	NA	NA	NA	NA	872	2.0	2.3	2.1	NA	NA
231233	1,666	1,990	NA	NA	NA	NA	930	2.6	2.2	2.4	NA	NA
Beluga	2,192	1,985	2,914	2,698	2,416*	2,660*	915	2.4	2.7	2.5	2.5	2.7
Denali	2,309	2,191	3,301*	3,214*	2,545*	2,634*	860	2.8	2.7	2.8	2.6	2.3
K22801	2,001	2,258	3,123*	NA	2,627**	NA	880	2.9	2.6	2.8	2.5	NA
K23908	2,097	2,546*	NA	NA	NA	NA	737	2.7	2.4	2.6	NA	NA
ND Whitetail	2,284	2,453*	3,076*	2,806	2,450*	2,655*	978	2.5	2.2	2.3	2.2	2.2
Snowdon	2,358*	2,270	3,007*	2,754	2,457*	2,415*	760	1.9	2.5	2.2	2.1	1.9
WK1601-1	2,652**	1,987	3,549**	3,459**	2,440*	2,789**	969	3.4	3.0	3.2	2.8	3.2
Yeti	1,873	2,311	NA	NA	NA	NA	938	2.8	2.1	2.5	NA	NA
MEAN	1,648	2,158	3,156	2,979	2,486	2,630	862	2.3	2.3	2.3	2.4	2.4
LSD_(0.05)	336	284	574	456	285	398	NA	NA	NA	NA	NA	NA
CV	17.2%	11.1%	17.0%	18.1%	11.1%	18.3*%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

Table 15. Yellow bean yield and quality results.

Yellow bean entry	Yield (Lbs./A)		Irrigated (Lbs./A)		Dry land (Lbs./A)		Seed Size (Seeds/lb.)	Canning Score (1-5)		Canning Score (1-5)		
	Montcalm	Tuscola	2-year avg.	3-year avg.	2-year avg.	3-year avg.		Tuscola	Montcalm	1-year avg.	2-year avg.	3-year avg.
Claim Jumper	2,261*	2,880*	3,358**	2,993**	2,742**	2,923**	1,228	3.6	2.9	3.3	3.3	3.4
DBY230-2	1,863	2,395	NA	NA	NA	NA	1,038	2.7	2.3	2.5	NA	NA
DBY231-2	1,694	2,755*	NA	NA	NA	NA	1,197	2.7	3.2	2.9	NA	NA
Honeycomb	2,079*	2,239	3,087*	2,904*	2,347	2,401	1,078	4.3	3.8	4.1	2.9	2.9
Motherlode	1,128	1,994	2,680	2,496	2,106	2,352	1,137	3.1	2.2	2.6	3.0	3.4
Y1803-5-3	1,740	2,973**	NA	NA	NA	NA	1,154	3.1	2.4	2.7	NA	NA
Y2115-3	1,459	1,578	NA	NA	NA	NA	1,202	2.3	2.5	2.4	NA	NA
Y2033307	1,836	2,421	NA	NA	NA	NA	1,058	3.9	3.2	3.6	NA	NA
Yellowstone	1,563	2,191	2,843*	2,848*	2,201	2,268	1,271	3.8	2.9	3.4	3.2	3.3
Yukon Gold	1,414	1,853	2,988*	2,927*	2,023	2,419	1,225	3.6	2.1	2.8	3.0	2.9
YW25-1	2,143*	2,879*	NA	NA	NA	NA	949	3.3	2.6	2.9	NA	NA
MEAN	1,842	2,315	2,997	2,835	2,284	2,474	1,140	3.3	2.7	3.0	3.1	3.2
LSD_(0.05)	412	341	658	435	279	383	NA	NA	NA	NA	NA	NA
CV	18.7%	12.3%	18.3%	17.0%	11.9%	18.6%	NA	NA	NA	NA	NA	NA

Note. The **highest** yield in each column is marked with two asterisks. Any values in a column that are not statistically different from the column's two-asterisk entry are marked with one asterisk. NA = Not available. Lbs./A = Pounds per acre. Canning is Scored from 1 (Poor) to 5 (Excellent). All yield and seed size measurements adjusted to 18% moisture.

2025 Sourcing Information

Table 16. Sources of dry bean entries tested in the 2025 performance trials, organized alphabetically by market class.

Entry	Market class	Source
13505	Black	ProVita
16598	Black	ProVita
17746	Black	ProVita
17751	Black	ProVita
17764	Black	ProVita
21650	Black	ProVita
21702	Black	ProVita
21703	Black	ProVita
21723	Black	ProVita
B2002-1-3	Black	USDA EL ^a
B22041	Black	MSU ^b
B22042	Black	MSU
B22062	Black	MSU
B22854	Black	MSU
B23911	Black	MSU
B23949	Black	MSU
B24120	Black	MSU
B24122	Black	MSU
B24180	Black	MSU
B24212	Black	MSU
B7071259	Black	ADM ^c
B7072252	Black	ADM
B7072269	Black	ADM
B18094173	Black	ADM
Black Bear	Black	ProVita
Black Pearl	Black	MSU
Black Tails	Black	ProVita
BlackBeard	Black	ProVita
Kona	Black	MSU
ND Galaxy	Black	NDSU ^d
Nimbus	Black	ProVita
Slate	Black	ADM
Spectre	Black	ProVita
Umbra	Black	Gentec
Zenith	Black	MSU
16756	Cranberry	ProVita
16758	Cranberry	ProVita
16775	Cranberry	ProVita
16816	Cranberry	ProVita
151093	Cranberry	ProVita
Amaranto	Cranberry	Bayer
C24104	Cranberry	MSU
C24114	Cranberry	MSU
CR25-1	Cranberry	USDA WA ^e
CR25-2	Cranberry	USDA WA
CR25-3	Cranberry	USDA WA
CR2283-8	Cranberry	USDA EL
CR22109-6	Cranberry	USDA EL
Etna	Cranberry	Bayer

Entry	Market class	Source
Jester	Cranberry	ProVita
OAC Firestripe	Cranberry	TVS ^f
OAC Navabi	Cranberry	TVS
15977	Dark red kidney	ProVita
161156	Dark red kidney	ProVita
161165	Dark red kidney	ProVita
181017	Dark red kidney	ProVita
181021	Dark red kidney	ProVita
Dynasty	Dark red kidney	Gentec
Epic	Dark red kidney	ProVita
Gallantry	Dark red kidney	Gentec
K1920-2-3	Dark red kidney	USDA EL
K23212	Dark red kidney	MSU
Montcalm	Dark red kidney	MSU
ND Redbarn	Dark red kidney	NDSU
Rampart	Dark red kidney	ProVita
Red Hawk	Dark red kidney	MSU
Seattle	Dark red kidney	ProVita
Eiger	Great northern	MSU
G22004	Great northern	MSU
G23108	Great northern	MSU
ND Pegasus	Great northern	NDSU
Powderhorn	Great northern	MSU
15916	Light red kidney	ProVita
15923	Light red kidney	ProVita
20870	Light red kidney	ProVita
20909	Light red kidney	ProVita
161055	Light red kidney	ProVita
161082	Light red kidney	ProVita
Big Red	Light red kidney	ProVita
CELRK	Light red kidney	UC Davis ^g
K22601	Light red kidney	MSU
K22604	Light red kidney	MSU
K23702	Light red kidney	MSU
Pink Panther	Light red kidney	Bayer
Ronnie's Red	Light red kidney	ProVita
Rosie	Light red kidney	NDSU
14092	Navy	ProVita
21102	Navy	ProVita
21106	Navy	ProVita
21108	Navy	ProVita
Argosy	Navy	Gentec
Armada	Navy	ProVita
AuSable	Navy	MSU
Blast	Navy	Gentec
Blizzard	Navy	ProVita
EX2111-N	Navy	TVS
EX-712302	Navy	TVS
EX-712310	Navy	TVS



Entry	Market class	Source
EX-712315	Navy	TVS
EX-712316	Navy	TVS
EX-712317	Navy	TVS
HMS Bounty	Navy	ProVita
HMS Medalist	Navy	ProVita
Liberty	Navy	ProVita
N22610	Navy	MSU
N22616	Navy	MSU
N22622	Navy	MSU
N22623	Navy	MSU
N23706	Navy	MSU
N23717	Navy	MSU
N24847	Navy	MSU
N24851	Navy	MSU
Nautica	Navy	Gentec
ND Polar	Navy	NDSU
OAC Charm	Navy	TVS
Steam	Navy	Gentec
T9905	Navy	TVS
Valiant	Navy	ProVita
Victory	Navy	ProVita
Coral	Pink	MSU
ND Rosalind	Pink	NDSU
Cancun	Pinto	ProVita
Charro	Pinto	MSU
Cowboy	Pinto	ProVita
ND Falcon	Pinto	NDSU
P22103	Pinto	MSU
P22204	Pinto	MSU
P23311	Pinto	MSU
P24402	Pinto	MSU
Rattler	Pinto	Kelley Bean
SV6139GR	Pinto	Bayer
Toast	Pinto	Gentec
USDA Cody	Pinto	Central Bean
Bronco	Slow darkening pinto	TVS
Diamondback	Slow darkening pinto	Kelley Bean
Eternal	Slow darkening pinto	Hensall
Gleam	Slow darkening pinto	ProVita
Mystic	Slow darkening pinto	ProVita
ND Rodeo	Slow darkening pinto	NDSU
Shine	Slow darkening pinto	ProVita
Vibrant	Slow darkening pinto	ProVita
16686	Small red	ProVita
17822	Small red	ProVita
17837	Small red	ProVita
17848	Small red	ProVita
17851	Small red	ProVita
19837	Small red	ProVita
ND151006-2	Small red	NDSU
OAC Rosito	Small red	Gentec

Entry	Market class	Source
R22703	Small red	MSU
R22710	Small red	MSU
R22714	Small red	MSU
R23804	Small red	MSU
USDA Lava	Small red	Central Bean
Viper	Small red	ProVita
201016	White kidney	ProVita
201020	White kidney	ProVita
201030	White kidney	ProVita
231228	White kidney	ProVita
231229	White kidney	ProVita
231230	White kidney	ProVita
231231	White kidney	ProVita
231232	White kidney	ProVita
231233	White kidney	ProVita
Beluga	White kidney	ADM
Denali	White kidney	MSU
K22801	White kidney	MSU
K23908	White kidney	MSU
ND Whitetail	White kidney	NDSU
Snowdon	White kidney	MSU
WK1601-1	White kidney	USDA EL
Yeti	White kidney	Gentec
Claim Jumper	Yellow	ProVita
DBY230-2	Yellow	OSU ^h
DBY231-2	Yellow	OSU
Honeycomb	Yellow	USDA EL
Motherlode	Yellow	ProVita
Y1803-5-3	Yellow	USDA EL
Y2115-3	Yellow	USDA EL
Y2033307	Yellow	ADM
Yellowstone	Yellow	MSU
Yukon Gold	Yellow	MSU
YW25-1	Yellow	USDA WA

- a USDA-EL = U.S. Dept. of Agriculture—Agricultural Research Service, East Lansing, Michigan, site
- b MSU = Michigan State University
- c ADM = Archer-Daniels-Midland
- d NDSU = North Dakota State University
- e USDA WA = U.S. Dept. of Agriculture—Agricultural Research Service, Washington State site
- f TVS = Treasure Valley Seed
- g UC Davis = University of California, Davis
- h OSU = Oregon State University

Fungicide Evaluation for White Mold Control of Zorina in Small Red Beans

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Locations: Gentner-Bischer Farms (Harbor Beach, MI)	GPA: 20
Planting Date: May 31, 2025	PSI: 30
Replicated: 8 times	Nozzle: XR8002
Design: RCBD	Timing: R1 (A) & R3 (B)
Variety: Viper Small Red Beans	Row width: 22-inch
Population: 110,000 seeds/A	Treated Plot Size: 6.6' x 20'
Harvest Date: September 14, 2025	Application date: July 21 (A) & July 31 (B)

Table 1. Dry bean fungicide treatments, application timing, disease severity index, percent infection and dry bean yield.

#	Treatments	Application Timing	Disease Severity Index ^{ab}	Percent Infection	Yield ^c
1	Untreated	-	50 ab	70 a	3329 b
2	Zorina (20 fl oz)	AB	31 c	48 bc	4272 ab
3	Endura (6 oz)	AB	24 c	42 c	4386 a
4	Zorina (20 fl oz)	A	38 bc	60 ab	4336 a
	Zorina (20 fl oz) + Priaxor (4 fl oz)	B			
5	Endura (6 oz)	A	59 a	75 a	4027 ab
	Endura (6 oz) + Priaxor (4 fl oz)	B			
Mean:			40	59	4070
LSD:			14	15	945
Cv:			23.7%	16.3%	22.6%

^aMeans within the same column with different letters are not significantly different from each other ($\alpha \leq 0.05$).

^bDisease severity index is calculated utilizing the formula provided below, combining percent infection and disease severity.

^cYield is in pounds per acres obtained by direct harvest, adjusted to 18% moisture.

Summary: A white mold trial was established at Gentner- Bischer Farms in a field near Harbor Beach, Michigan. This field had been planted to ‘Viper’ Small Red Beans on May 31, 2025. Disease pressure averaged 59% across all treatments, with an average severity of 1.9 (0-3 scale, data not presented). A Disease Severity Index was calculated on a scale of 0-100 by utilizing the following formula:

$$\frac{(0 \times \# \text{ of plants rated}) + (1 \times \# \text{ of plants rated}) + (2 \times \# \text{ of plants rated}) + (3 \times \# \text{ of plants rated})}{\# \text{ of score levels} \times \text{total} \# \text{ of plants rated}} * 100 .$$

Treatments were made at two separate timings: (A) R1 and (B) 10 days after R1. Yield was significantly improved in two treatments when compared to the untreated control. Numerical yield response ranged from the lowest of 698 lbs./A to the highest of 1,057 lbs./A. Percent infection was numerically decreased by all fungicide treatments except for Endura Fb Endura plus Priaxor. In 2025 the highest overall performance came from a standard application of Endura applied twice at a 6 ounce per acre rate. Disease pressure was high in 2025 with less than ideal uniformity. Strong experimental designs, such as this (8 replications) are a minimum requirement to produce usable data for decision making. Fungicide trials will be continued in 2026 to build a stronger data set for crop protection decisions. We would like to thank BASF and the Michigan Bean Commission for supporting this research.

Evaluation of Standard Products, Timing, and Rates for White Mold Management

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Locations: Montcalm Research Center	GPA: 20
Planting Date: June 6, 2025	PSI: 30
Replicated: 8 times	Nozzle: XR8002
Design: RCBD	Timing: R1 (A) & R3 (B)
Variety: Viper Small Red Beans	Row width: 20-inch
Population: 130,000 seeds/A	Treated Plot Size: 6.6' x 20'
Harvest Date: October 1, 2025	Application date: August 1 (A) & August 10 (B)

Table 1. Dry bean fungicide treatments, application timing, disease severity index, percent infection and dry bean yield.

#	Treatments	Application Timing	Disease Severity Index ^{ab}	Percent Infection	Yield ^c
1	Untreated	-	67	77	4074 bc
2	Propulse (8 fl. oz.)	A	54	71	4242 b
3	Propulse (8 fl. oz.)	AB	52	79	5015 a
4	Propulse (10 fl. oz.)	A	67	89	4576 b
5	Propulse (10 fl. oz.)	AB	52	77	4896 ab
6	Endura (6 oz)	A	66	77	4367 b
7	Endura (6 oz)	AB	48	75	4831 ab
8	Endura (8 oz)	A	59	81	4148 b
9	Endura (8 oz)	AB	56	82	4608 ab
10	Topsin M (30 fl. oz.)	A	43	69	4658 ab
11	Topsin M (30 fl. oz.)	AB	41	72	5459 a
12	Zorina (20 fl oz)	A	51	85	4471 b
	Endura (8 oz)	AB			
	Priaxor (4 fl oz)	B			
13	Zorina (20 fl oz) Priaxor (4 fl oz)	AB	62	69	4520 b
14	Priaxor (4 fl oz)	AB	54	75	4430 b
15	Priaxor (4 fl oz)	B	55	81	4227 b
Mean:			55	77	4568
LSD:			NS	NS	621
Cv:			33.4%	24.5%	13.7%

^aMeans within the same column with different letters are not significantly different from each other ($\alpha \leq 0.05$).

^bDisease severity index is calculated utilizing the formula provided below, combining percent infection and disease severity.

^cYield is in pounds per acres obtained by direct harvest, adjusted to 18% moisture.

Summary: A white mold trial was established at the Montcalm Research Center near Entrican, MI. This field had been planted to ‘Viper’ Small Red Beans on June 6, 2025. This trial location has a history of heavy disease pressure, irrigation and high levels of soil fertility. Disease pressure averaged 77% across all treatments. A Disease Severity Index was calculated on a scale of 0-100 by utilizing the following formula:

$$\frac{(0*\# \text{ of plants rated})+(1*\# \text{ of plants rated})+(2*\# \text{ of plants rated})+(3*\# \text{ of plants rated})}{\# \text{ of score levels } * \text{ total } \# \text{ of plants rated}} * 100 .$$

Treatments were made at two separate timings: (A) R1 and (B) 10 days after R1. Yield was significantly improved by two treatments when compared to the untreated control. Numerical yield response ranged from the lowest of 74 lbs./A to the highest of 1,384 lbs./A. We would like to thank the Michigan Bean Commission for supporting this research.



Seed Treatments of Rhizobium, Azospirillum, and Harpin Proteins Alone and In Combination With Plant Nutritionals

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Locations: Tuscola County, MI	Population: 130,000 seeds/A
Planting Date: June 11, 2025	Row width: 20-inch
Replicated: 6 times	Treated Plot Size: 6.6' x 135'
Design: RCBD	Seed Treater: Seedburo Batch Lab Seed Treater
Variety: Black Beard Black Beans	

Table 1. 2025 Analysis of final plant stands and yield when applications

#	Treatments	Application Method	Stand Count		Yield ^c
			June 20	September 23	
1	Untreated (Talc)	Dry Planter Box	77,166	79,578	2,250
2	MicroSURGE*	Dry Planter Box	72,603	83,742	2,294
3	MicroSURGE + Inceptive*	Dry Planter Box	73,017	76,802	2,181
4	SeedFlow Nutria + MicroSURGE + Inceptive*	Dry Planter Box	72,188	80,504	2,282
5	Tripidity ST **	Liquid Seed Treatment	72,499	80,506	2,277
Mean:			73,495	80,226	2,257
LSD:			NS	NS	NS
Cv:			7.5%	5.9%	9.9%

*Rate applied was 4 ounces of product per unit of seed

**Rate applied was 1.2 fluid ounces per hundredweight of seed

^a Means within the same column with different letters are not significantly different from each other ($\alpha \leq 0.05$).

^b Yield is in pounds per acres obtained by direct harvest, adjusted to 18% moisture.

Summary: In 2025 three dry planted box treatments were sourced from Talc USA and trialed in comparison to an untreated control of standard Talc. Two biological components were included. #1: ‘MicroSURGE’, a biological treatment containing: rhizobium etli, rhizobium tropici and azospirillum brasilense. #2 ‘Inceptive’: dry based harpin protein produced commercially. Harpin proteins were originally documented as a byproduct of Erwinia amylovora (Fire Blight in fruit crops) and known to stimulate systemic acquired resistance (SAR) in host plants. Documentation of nematode and root rot suppression by these organisms/method of actions is found in the literature but can be pest and host plant specific, as well as dependent on ambient temperatures (Navarro-Acevedo 2016). In addition, two nutritional products were added to testing including a dry product of SeedFlow Nutria (Talc USA) and a liquid Tripidity ST (Rosens Inc.). In 2025 field testing no significant results were documented in stand or harvestable yield. These results were also documented in 2024 with a smaller subset of treatments. Further research should be done in dry beans analyzing the potential benefits from harpin proteins in inoculated testing focusing in both soil-borne pathogens and potential nematode suppression. This research question would benefit from testing in a controlled environment. We would like to thank Talc USA, Rosins Inc, and the Michigan Bean Commission for supporting this work.



Early Planting of Michigan Dry Beans

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Introduction:

In the last decade the varietal landscape of Michigan dry beans has transformed rapidly. We have documented high levels of variety improvement and adoption in both black and navy beans. This accounts for over 80% of total Michigan acres. With this transition we have also observed a few trends: 1.) longer average maturities are providing additional yield potential and are being accepted by growers; 2.) improved plant vigor with newly adopted varieties; 3.) higher levels of fungicide use in the crop; and 4.) more focus on winter wheat planting dates. These trends it has provided the opportunity to reanalyze the traditional dry bean production system. Growers have responded to trend #1 and have adopted varieties that have long term average maturities that are longer than 100 days, a historical upper limit. While this has provided yield to offset the opportunity cost of delayed harvest it has also pushed back wheat planting dates in the fall. In the past this was not a major concern unless fall weather became inclement. However, recent MSU research documented a yield loss of 0.6 bushel per day for seedings planted after October 1 in Michigan (Pennington & Singh 2022) and has driven trend #4. This direct economic cost is in addition to the unquantifiable quality risk of harvesting dry beans in October rather than September. The risk of late harvest has appeared to be greater in the last decade with variable rainfall and temperature patterns, and also helped growers understand trend #2. With early season waterlogging (wet feet) becoming commonplace it has become clear that modern dry bean varieties are much more tolerant of this type of stress than previous generations. Anecdotally, areas of water damage would get larger over time in the field after the initial wet period. However, it has been much more common for these areas to shrink as beans on the margins are able to recover from injury and provide a harvestable yield by the end of the season. This overall improvement in the system has increased total yield potential and made room in the balance sheet for a higher management system that includes inputs such as fungicide during the reproduction stages of development. Survey data from Michigan producers estimated more than 80% of all acres receive at least one fungicide application (2026 PRAB Survey). While this has documented a positive return on investment for growers, it can contribute to even longer maturities as leaf retention and ‘green stem’ can be more likely to persist after fungicide applications. With these challenges come opportunities and growers have adapted. It has become more commonplace to plant dry beans earlier in the spring than was traditionally the norm. In recent years (weather allowing) more beans will be planted in the third week of May than the third week of June. Historically this was not true. Questions arise about what pressures do we put on the system as we look at adjusting this planting date. To research this question multiple projects were implemented in 2024 and 2025, including a variety trial with the added factor of planting date that is the focus of this report.

Table 1. Varieties tested, market class, and average maturity over 2024 and 2025 cropping seasons.

Variety	Market Class	Maturity
Black Beard	Black	97*
Kona	Black	96
Spectre	Black	100
HMS Bounty	Navy	97
AuSable	Navy	92
Viper	Small Red	98

*Rated in days from planting to harvest averaged across all planting dates

Methods:

In both seasons dry beans were seeded in four-row plots that measured 6.6' wide by 25' long, with 20" rows at five separate timings. The goal was to plant once per week starting in early May if weather and field conditions allowed. Actual planting dates for 2024 were: May 6th, 13th, 20th, 27th and June 13th. In 2025 actual planting dates were as follows: May 12th, May 16th, May 26th, May 31st and June 12th. For the remainder of this report planting dates 1-5 will be referred to as: (1) ultra early, (2) early, (3) mid, (4) standard, (5) traditional. Planting population was 130,000 seeds per acre for all entries. Entries included three black beans, two navy beans and one small red (Table 1.). In 2024, 60 lb. of nitrogen was applied at planting utilizing 2x2 placement of 28-0-0 fertilizer. In 2025 20 gallons per acre of 17-4-4 + Mn +Zn was applied utilizing a 2x2 placement at the time of planting (~40 lbs./A Nitrogen). The trial was designed as a Split-Plot design. Main plot effect was planting date with **four replications** per planting date. Subplot effect was variety with four replications per planting date. Care was taken to select commercial varieties at each end of the maturity spectrum when possible (short vs. long) (Figure 1). Trials received industry standard seed treatments, fertilization, and weed control applications at labeled rates. PPI herbicide treatments and tillage were applied directly ahead of planting for each planting date. Yield data was obtained by direct harvest. Following harvest, samples were cleaned, weighed, and moisture tested. All yield data is adjusted to a standard 18% moisture for standardization. In 2025 following cleaning samples were processed for canning quality at the Food Processing and Innovation Center utilizing a standard protocol described in the 2025 Michigan Dry Bean Canning Report (Michiganbeans.com). All market classes were stored for 4 weeks after canning to allow for equilibration. Samples were then opened and evaluated by a panel of trained evaluators on a scale of 1-5 for appearance. For black beans specifically the same scale was also applied to color, both scoring rubrics are available in the 2025 Michigan Dry Bean Canning Report (Michiganbeans.com).

Results:

Overall, trial quality was poor in 2024. Heavy and repeated early-season rainfall followed by a relatively dry reproductive period led to areas of waterlogging and low overall dry bean yields regardless of planting date or variety. Trial conditions were much better in 2025. Moisture was available through the first two thirds of the growing season, becoming slightly dry in the last third of the season. All agronomic data was combined over years as yield stability is a desired outcome of this testing protocol. Canning was not performed in 2024 thus only available for 2025. When yield data was combined over years the main plot effect of planting date was not significant. The subplot effect of variety was significant in this testing. There was not a significant interaction between factors.

Planting Date: When averaged across all entries the mean results from planting dates ranged from 18.8 cwt.- 21.9 cwt./acre (Table 2.). The numerical depression of planting date (3) Mid was the result of more than 2 inches of rainfall that was received on the freshly planted beans in 2024. This greatly impacted early season root health in that season. This yield depression was considered non-significant when averaged over years without these large rainfall events.

Variety: When averaged across all planting dates entries yielded from 18.2 cwt.- 23.9 cwt./acre (Table 3.). Black Beard, Viper and Kona significantly outyielded all other entries ($Pr > F = 0.000$) when averaged across all planting dates.

Table 2. Dry bean response to planting date averaged over varieties tested (Main plot)

Planting Date	Yield ^{ab}
(1) Ultra Early	2,145 a
(2) Early	2,142 a
(3) Mid	1,881 a
(4) Standard	2,197 a
(5) Traditional	2,192 a

Table 3. Dry bean yield by variety averaged over planting dates (Sub plot)

Variety	Yield ^{ab}
Black Beard	2,393 a
Viper	2,383 a
Kona	2,313 a
Spectre	1,910 b
AuSable	1,842 b
HMS Bounty	1,828 b

^a Yields followed by the same letter are not considered to be different $P < 0.05$.

^b Yield is in pounds per acre obtained by direct harvest, adjusted to 18% moisture.

Canning Quality: Appearance scores were impacted by the interaction of the main plot effect (planting date) and the sub plot (variety) ($P = 0.008$). As a general trend appearance score increased as planting time was delayed until the traditional planting time was reached. After this the scores decline again. Overall appearance scores ranged from 1.9-3.6 on a scale of 1-5. Highest appearance scores were achieved by HMS Bounty and Black Beard. When evaluating black bean color, the main effect of planting date was not significant but variety entered was ($P < 0.001$). Black Beard canned darkest (3.4), followed by Kona (2.8) and Spectre (2.3). There was no interaction between factors that impacted the canning color of black beans.

Table 4. The interaction between planting date and variety planting on appearance of canned bean samples

Variety	Appearance*					Mean:
	Ultra Early	Early	Mid	Standard	Traditional	
AuSable	2.9 ae	2.5 be	2.9 ae	3.0 ae	2.4 be	2.7
Black Beard	3.1 ad	3.1 ad	2.8 ae	3.6 a	2.8 ae	3.1
HMS Bounty	2.8 ae	3.1 ac	3.3 ab	3.6 a	2.7 ae	3.1
Kona	2.6 ae	2.6 ae	2.8 ae	2.7 ae	2.2 be	2.6
Spectre	1.9 e	2.5 be	2.7 ae	2.9 ae	2.5 be	2.5
Viper	2.1 ce	2.0 de	2.1 ce	2.1 ce	2.5 be	2.2
Mean:	2.6	2.6	2.8	3.0	2.5	2.7

*Appearance of canned beans is scored from 1 (Poor) to 5 (Excellent).

Discussion:

When interpreting yield and quality data no significant interactions exist that suggest a producer may want to alter variety selection based on planting date. When digesting yield information, the entries that perform well do so across all planting dates. The non-significant impact of planting date is the most thought provoking result and speaks to the flexibility that may exist in the dry bean planting window. Similar to yield, the canning color of black beans followed what was expected from the genetics included and was not impacted by alterations in planting date. When interpreting appearance scores the interaction between factors is not as clear. As a reminder this is how well the beans hold together after

cooking. Given the interaction between factors (planting date * variety) not all varieties responded to planting date the same way. Initial interpretations of the data may suggest that some varieties are less responsive to changes in appearance based on planting date. It has been well documented that canning quality is influenced heavily by environment and by planting at five separate timings we artificially created differing environments for each of those entries progressing through developmental stages at different timings in the same location (timing of heat, timing of rainfall, etc.). To truly understand a varieties sensitivity to environment, or stability, more years and locations should be included in testing. To confirm yield results testing needs repetition over years that are conducive for dry bean planting (2025), as well as years that are not (2024). Stability in variety yield and quality is the desired outcome when looking to hedge risk to production. The development of a viable data set on a complex trait such as response to planting date will take years of continued trialing to grasp the scale of which genetics x environment x management= yield and quality. We would like to thank the Michigan Bean Commission for supporting this work in 2025.

Table 5. Black bean canning color when averaged across all planting dates.

Variety	Color
Black Beard	3.4 a
Kona	2.8 b
Spectre	2.3 c

*Appearance of canned beans is scored from 1 (Poor) to 5 (Excellent).



Figure 1. Two rows of AuSable navy beans ripening on August 11, 2025, from ultra early seeding on May 12, 2025. Individual yield for this variety in 2025 (not averaged with 2024) was 25.8 cwt./acre when planted ultra early.

Cover Crop Integration into Dry Bean and Sugarbeet Systems

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Locations: Richmond Brothers Farms	Previous Crop: Wheat	
Planting Date: August 15, 2024	Fertility: Liquid Dairy Manure (July 2024)	
Replicated: 3 times	Seeding Method: High Speed Disk	
Design: RCBD	Following Crop:	Sugarbeets (2025)
Plot size: 2.5 acres (7.5 acres per treatment)		Dry Beans (2026)

Table 1. Fall 2024 Cover Crop Data Including Species, Seeding Rates, Percent Ground Cover, Below Ground Biomass, Above Ground Biomass, Total Biomass, and Rotational Crops.

#	Treatments	Percent Ground Cover ^{ab}	Biomass (lbs./Acre)			Yield	
			Below Ground	Above Ground	Total	Sugarbeets	Dry Beans
1	Radish (5 lbs./A) + Oats (35 lbs./A)	100 a	754 a	2,614 a	3,368 a	Fall 2025	Fall 2026
2	Sorghum Sudan Grass (40 lbs./A)	100 a	1,124 a	2,382 a	3,507 a	-	-
3	Annual Rye Grass (25 lbs./A) + Radish (2 lbs./A)	100 a	1,081 a	2,374 a	3,456 a	-	-
4	Untreated Check	11 b	NA	NA	NA	-	-
	Mean:	77	986	2,457	3,444		
	LSD:	10	NS	NS	NS		
	Cv:	7.1%	34%	22.9%	16.5%		

^a Ground cover measured on a percentage basis of exposed soil within each replicate. Untreated ground cover was provided by volunteer wheat.

^b Means within the same column with different letters are not significantly different from each other ($\alpha \leq 0.05$).

^c Biomass samples were dug or cut from the field, sieved in water to remove any attached soil and dried for 5 days in a forced air dryer to provide an accurate estimation of dry biomass produced by each treatment.

^d Non-significant

Cover Crop Summary: In 2024 a trial was established on Richmond Brothers Farms in Pigeon Michigan. This trial was implemented based on past experience with cover crop integration into the dry bean and sugarbeet system after wheat harvest. It was hypothesized that specific cover crop species had been successful for the mitigation of compaction, providing ground cover into the fall, and building soil tilth eventually resulting in higher yields throughout the rotation. To test this hypothesis a four-treatment trial was designed and planted by a high-speed disk on August 15th, 2024. This trial was allowed to grow well into the fall and was sampled right ahead of a predicted killing frost. Biomass samples were taken from both above and below ground (roots). Overall biomass production was lower than expected due to little precipitation in the fall of 2024. The MSU Enviroweather network reported 3.07” of rain from August 1, 2024, through October 1, 2024 which is under 50% of the 5-year average (6.5”). Despite the lack of growth this trial will continue to be monitored by both the research team at PRAB and SBA taking yield and quality estimated on the rotational crops. However, if conclusions are to be drawn from this type of research multiple years and locations are needed.

Table 2. Cover crop treatments and associated sugarbeet Measurables performed by Sugarbeet Advancement and Michigan Sugar Company including gross revenue per acre, raw white sugar per ton, raw white sugar per acre, tons per acre harvested, percent sugar, and percent clarified juice purity. Author for correspondence Dave Wishowski (wishowsk@msu.edu)

#	Treatments	Gross \$/A ^a	RWST ^b	RWSA ^c	Tons/Acre	% Sugar	% CJP ^d	Emergence	
								6 DAP ^e	31 DAP
1	Radish (5 lbs./A) + Oats (35 lbs./A)	\$2,750	341	11,655	34.1	18.8	97.2	62	177
2	Sorghum Sudan Grass (40 lbs./A)	\$2,989	354	12,223	34.5	19.1	97.1	47	203
3	Annual Rye Grass (25 lbs./A) + Radish (2 lbs./A)	\$2,799	341	11,874	34.8	18.8	96.7	38	193
4	Untreated Check	\$2,415	319	11,013	34.6	18.3	95.8	52	193
	Mean:	\$2,738	339	11,691	34.5	18.7	96.7	50	192
	LSD:	NS ^f	NS	NS	NS	NS	NS	NS	NS
	Cv:	9.0%	4.2%	5.0%	1.0%	2.2%	0.7%	21.0%	5.5%

^a Gross dollars per acre is calculated using the new Quality Payment System incorporating values from the post-harvest forecast. ^b Recoverable white sugar per ton. ^c Recoverable white sugar per acre. ^d Clarified juice purity. ^e Days after planting. ^f Non-significant

Sugarbeet Summary:

Fall 2024 was dry and led to limited cover crop growth (see dry matter results). Sugarbeets were planted on 04/23/2025 into good soil conditions. Emergence counts were taken (2 Rows x 50 feet = 100 foot of Row) at 6 and 31 days post planting. The sorghum sudan grass treatment did appear to have a slight visual advantage in crop size between the 6- and 31-day emergence counts, however no visual differences were observed between treatments from late spring through harvest. Cercospora leafspot and other foliar diseases were not an influence in this trial. Three subsamples in each of the three replications were taken from each treatment for sugar and purity data. Harvest data was measured from 8 rows and weighed utilizing dump cart with scales to establish yield estimates.

Michigan Dry Bean Grower Priorities Assessment
Findings from Regional Grower Breakout Sessions, December 2025
 Scott Bales, MSU & Joe Cramer, MBC

Objective:

The Michigan Bean Commission conducted a series of regional grower meetings in December 2025. In past years these meetings have been focused on production and marketing. New in 2025 breakout sessions were incorporated mid-program. The goal of this was to gather structured input from dry bean growers to help inform future Commission priorities. These meetings were designed to capture both qualitative perspectives (touch/feel) and quantitative guidance (numbers) directly from growers regarding long-term production challenges, desired allocation of Commission resources, and to solicit structured information on any unmet needs. Meetings were held in three regions across Michigan including: Bad Axe, Bay City and Greenville. In total 204 attendees participated in the activity. Groups were randomly assigned and consisted of 8-10 members each. When possible, agribusiness was consolidated into independent groups of like professionals. However, priorities of agribusiness groups were not statistically different than grower-based groups and were merged into the data set as a whole. This design was chosen to facilitate group discussions, encourage participation, and produce candid feedback. The results summarized below reflect patterns that emerged consistently across regions and groups, not broken out by location.



Methods

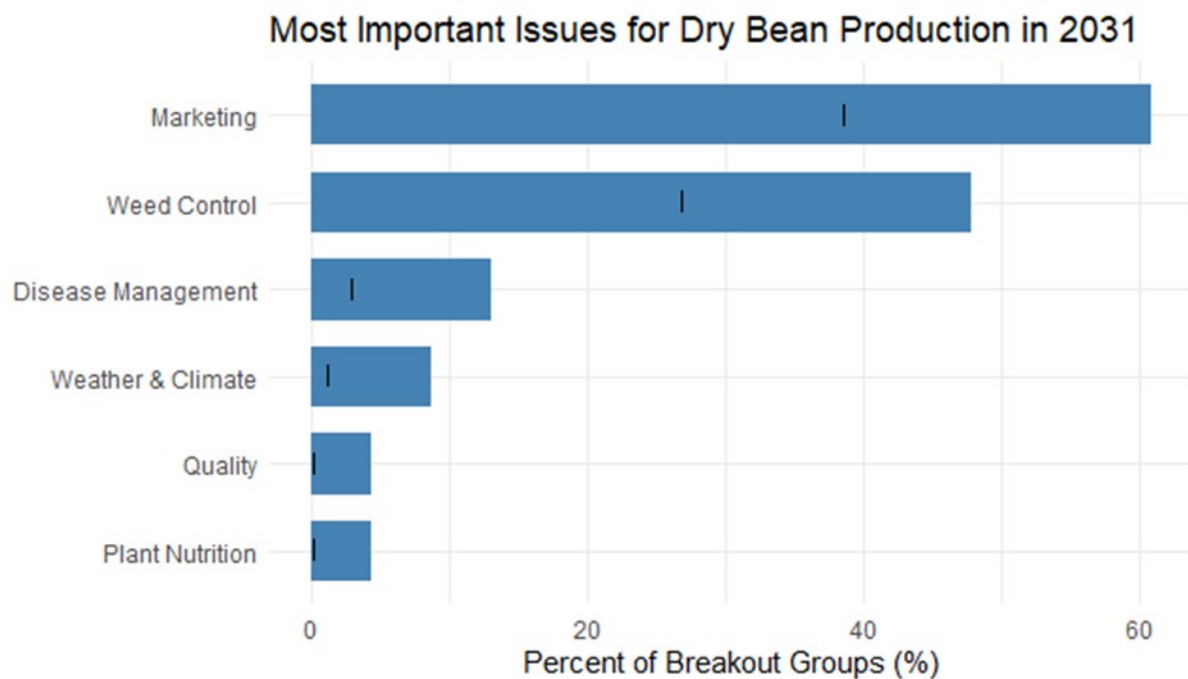
- Three regional meetings were held in December 2025. Within these meetings 40 minutes was utilized for ‘**Michigan Dry Bean Grower Priorities Assessment**’
- 23 separate groups provided feedback (average group size 8-10).
 1. 204 total participants
- Each breakout group responded to three structured questions exactly as follows:
 1. *What issue will be of most importance for dry bean production in 2031?*
 2. *In the groups opinion, how should you see your check off dollars spent?*
 - a. *Production Research* _____ %
 - b. *Promotion/ Market Access* _____ %
 - c. *Innovation (new food products)* _____ %
 - d. *Legislative Issues* _____ %
 - e. *Other (_____)* _____ %
 3. *What tools for dry bean production are you missing? (written materials, reports, marketing information, etc.)*
- All data was summarized utilizing RStudio 2025.09.2+418 "Cucumberleaf Sunflower"
 1. Qualitative responses from breakout group discussions were reviewed and coded into common thematic categories using structured content analysis. Coding was conducted to ensure consistency across regions and groups utilizing a binary system.
 2. Quantitative results are summarized as percentages of breakout groups

Key Findings

- **Weed control emerged as the most consistent long-term production concern**, often raw response included key words such as weed control, herbicide resistance, and chemistry availability. Desiccation was not mentioned.
- **Marketing, cost of production, and overall profitability were closely following weed control top issues for future production.** Keywords such as economics, price and markets trended as significant.
- **Balancing the assessment budget was the most challenging discussion across groups.** The majority favored a balanced/diversified approach that supports both production research and market development.
- **Unmet needs often related to marketing information, contracts, and geopolitical trends.** Key words included market reports, supply and demand, marketing.

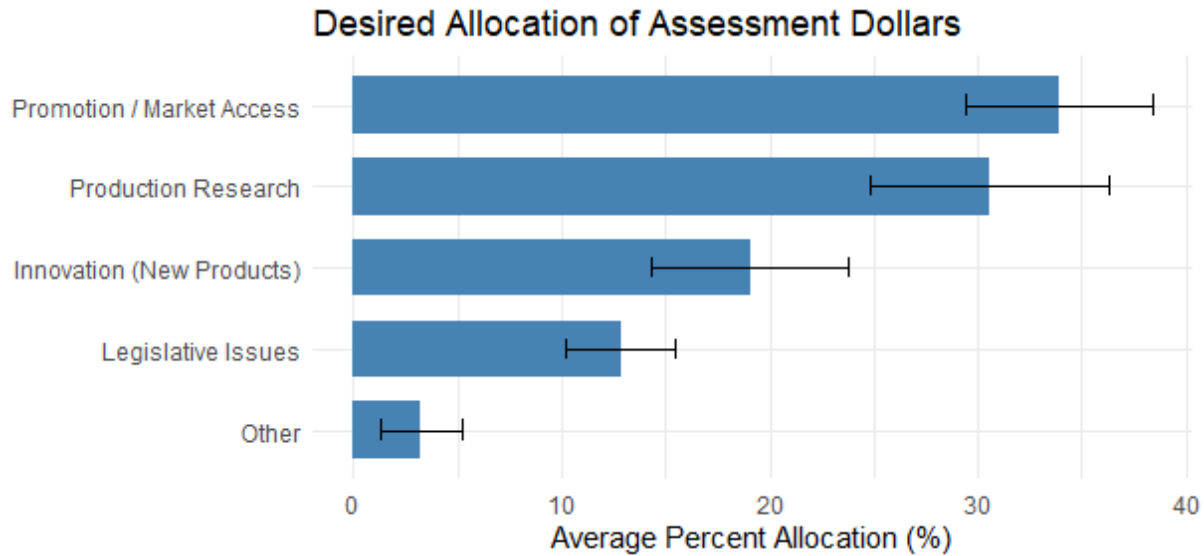
Results

Question 1: Most Important Issue for Dry Bean Production in 2031



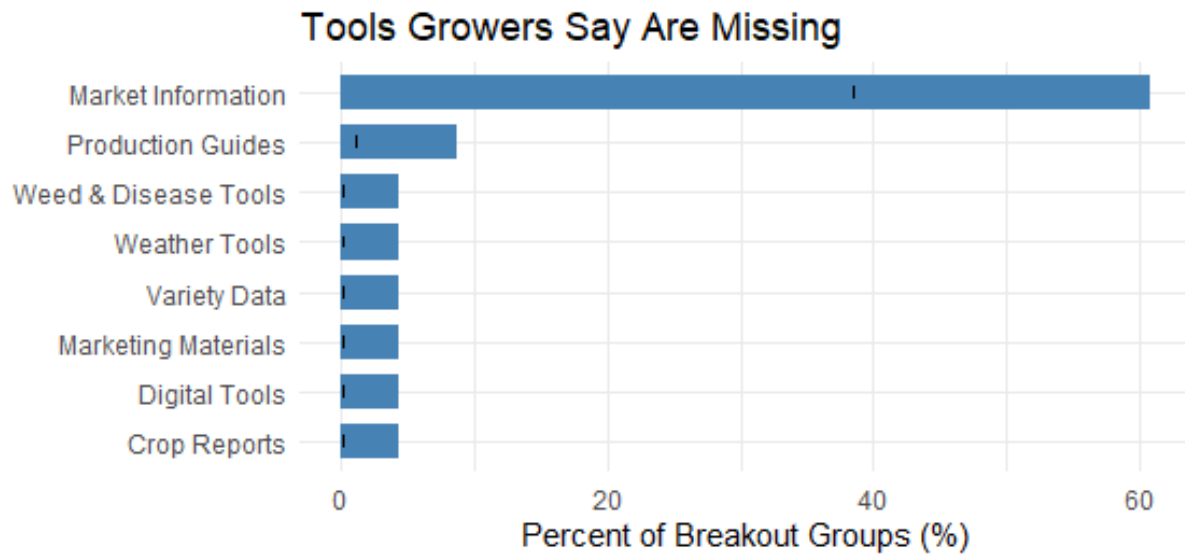
Across breakout groups, weed control was the most frequently identified issue affecting the long-term sustainability of dry bean production. Growers cited concerns related to resistant weeds, and limited chemistry options. Marketing and economic issues were also frequently raised, reflecting concerns about price volatility, market access, and long-term profitability. Disease management and weather-related risks were mentioned less frequently.

Question 2: Desired Allocation of Assessment Dollars



Breakout groups consistently supported a diversified approach resource investment. On average, the largest share of assessment dollars was recommended for promotion and market access activities, followed closely by production research. Innovation related to new products and uses for dry beans was viewed as an important supporting area, while legislative issues and regulation were generally assigned a smaller but meaningful portion of funding.

Question 3: Tools and Information Needs



Growers most frequently identified gaps in market-related information, including regional and international market reports, supply and demand data, and pricing insights. Regular crop progress and condition reports were also commonly requested. These needs align closely with the production and marketing concerns identified in Question 1.

Take Away Points

- Persistent weed control concerns suggest continued need for investment in both research and management guidance.
- Strong emphasis on marketing and economics supports maintaining or expanding efforts related to promotion, market access, and market communication.
- Grower interest in innovation indicates opportunity to support new products and uses that complement market development efforts to increase demand.
- Information delivery is as important as content; growers value tools that are timely, practical, and easy to access. Less focus on mailing lengthy dated information, more focus on short current updates that are relative to decision making.

Objective 3. Utilize multi-location testing protocols for screening genetic tolerance to biotic and abiotic stress while optimizing best practices for crop protection programs.

Evan Wright, Halima Awale, Madalyn Scanlan, and Valerio Hoyos-Villegas.

Plan of work:

Screening of Genetic Material for Biotic & Abiotic Stress Tolerance: Trials at the Saginaw Valley Research and Extension Center (SVREC) will be conducted by Mr. Evan Wright and the MSU Dry Bean Breeding and Genetics Program. Two additional locations in major dry bean production environments will be established in Huron and Montcalm Counties to evaluate field trials of advanced breeding lines under white mold disease pressure. White mold remains the number one yield limiting factor to Michigan producers and severity can be compounded with manure-based systems (often key in regenerative conservation tillage systems). Mr. Wright’s research team will use sites to develop a high throughput phenotyping pipeline using low-cost UAS-based RGB cameras to estimate dry bean tolerance/resistance to disease. Image data from the UAS will be collected across breeding populations and advanced breeding lines. Multiple UAS flights will be conducted across the phenological maturity phase to estimate the decay of canopy greenness following infection at the flowering stage. Results from this study will increase the accuracy of selection of more tolerant dry bean varieties that tolerate biotic and abiotic stress in the environment.

Multi-location trials for screening genetic variation in breeding program:

In 2025, dry bean genetics and breeding research was conducted by Michigan State University. The MSU dry bean breeding and genetics program conducted 27 field trials at five locations in ten market classes (navy, black, pinto, great northern, pink, red, dark red kidney, light red kidney, white kidney, and cranberry) and participated in the growing and evaluation of the Cooperative Dry Bean, Midwest Regional Performance, National Drought, and the National Sclerotinia (White Mold at MRC) Nurseries in Michigan and winter nursery in Puerto Rico. Bean yield trials were established at SVREC (Tuscola Co.) and MRC (Montcalm Co.) research farms, in addition to on-farm near Bay Port (Huron Co.) in 2025. In total, 25 yield trials in total were conducted to evaluate the yield potential, agronomic characteristics, white mold tolerance and maturity of 322 bean breeding lines and relevant commercial varieties as checks.

The 2025 season was characterized by favorable planting conditions followed by frequent rainfall, excessive at some locations. This resulted in rapid maturity (82-89 days) and an early harvest commencing on September 9.

The MSU program evaluated the following **Early Generation Breeding Material grown in Michigan in 2025:**

F3 through F5 lines

Navy and Black - 113 lines
Pinto - 275 lines
GN - 20 lines
Pinks and Reds - 14 lines
Kidneys (DR, LR, White) - 99 lines

F2 populations

Navy and Black -103 populations
Pinto - 28 populations
GN - 23 populations
Pinks and Reds - 25 populations
Kidneys (DR, LR, White) - 54 populations

Cranberry – 5 lines

F1 populations: 228 different crosses among ten contrasting seed types.

In total ~1,000 early generation breeding lines were produced.

Optimizing best practices and new testing protocols:

New tools for phenotyping for canning quality were developed using segmentation, and the deployment of UAS phenotyping platforms to estimate maturity, biological nitrogen fixation, as well as assessment of white mold disease severity via multispectral imaging. High-Throughput Phenotyping efforts in the development of improved canning quality (color and appearance) are underway, as part of a broader project in the validation of genomic selection for black beans.

MSU is leading the way with a Pan-Genomic Selection initiative to develop robust, accurate and durable genomic prediction models across multiple dry bean breeding programs. New efforts have been deployed to determine the feasibility of implementing genomic prediction in the MSU black bean breeding program. Genomewide association analyses have also been advanced for the identification of genomic signals for agronomic traits and drought tolerance

High throughput phenotyping (HTP) via Unoccupied Aerial System (UAS)-based RGB images was conducted at both SVREC and MRC sites during the growing season. Maturity notes were also collected visually by our team of experienced plant breeders to validate information collected by the drone imaging. Data analysis is currently ongoing, to automate estimation of maturity via modeling decay of canopy greenness, as well as conducting stand count-based yield corrections.

Development of Biotic Stress Tolerance:

Halo blight resistance was evaluated in kidney beans. As well, development of improved black and navy beans possessing Co-5 for more durable anthracnose resistance was carried out. Work was advanced in screening elite dry bean materials for *Fusarium oxysporum* and *Rhizoctonia solani* root rots. Genomewide association analyses have been advanced for the identification of genomic signals for white mold physiological tolerance. Other research involved the evaluation of aggressivity in common bean across a *Sclerotinia sclerotiorum* collection as part of a developing project in characterization of genomic diversity in the disease.

At the MRC location, experimental HTP via UAS-based multispectral (MS) imaging was conducted across flight dates with the goal of developing an image-based method for monitoring and evaluation of white mold disease development. The year 2025 marks the third and final season this method has been employed, and initial analysis suggests that the MS imaging may offer sufficient precision for accurately modeling white mold development, both spatially and temporally across the season. Notes collected by experienced staff using conventional ground based visual disease ratings will be used to assess how well the HTP method works. This effort is now in the final steps of modeling data from UAV imagery to model white mold disease using deep learning approaches, among others.

COMBINED STANDARD BLACK BEAN YIELD TRIAL-SVREC & HURON							Planted: 5/30 & 6/6/25		
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	
B20536	B15430/B16504, KONA	9	30.4	23.8	46.8	94.5	1.5	48.8	
B23925	B19309/B20591	7	28.5	24.2	45.0	91.5	1.5	45.0	
B24142	B20597/B20536	26	28.4	24.0	46.5	89.5	1.5	45.5	
B24122	B20536/B20617	23	28.0	22.0	44.5	88.0	1.8	48.3	
B23949	B20617/B19344	16	26.5	21.8	46.0	87.5	1.5	36.5	
B23909	B18201/B19309	4	26.2	22.7	46.0	94.0	1.5	45.3	
B24120	B20536/B20616	22	26.1	21.7	44.0	87.5	1.8	41.0	
B24102	B19309/B19344	33	25.8	21.1	44.3	89.0	1.5	45.5	
B24123	B20536/B20617	32	25.7	22.2	46.5	87.5	1.0	37.8	
B22854	B19309/B18222	6	25.7	23.7	46.5	88.5	1.5	42.3	
B24149	B20597/B20599	27	25.5	23.1	45.8	89.5	1.3	46.3	
B22042	B17536/B18504	18	24.5	19.9	46.0	87.5	1.3	40.0	
B24218	B19504/I95408	35	24.4	22.0	44.8	88.5	1.0	44.5	
B24180	B21710/B20527	21	24.2	22.2	45.8	89.0	1.3	42.8	
B23927	B19330/B19309	8	24.0	23.2	44.3	88.5	1.5	39.0	
B24109	B19344/B20599	31	23.7	21.7	45.0	88.5	1.3	40.8	
B24219	B19504/I95408	36	23.7	22.3	45.0	90.0	1.5	42.8	
B24101	B19309/B19344	34	23.5	21.5	45.0	88.0	1.3	35.5	
B23941	B20549/B20591	13	23.5	21.3	47.0	91.0	1.5	40.5	
B24213	N20395/B19344	30	23.2	22.0	45.3	88.0	1.5	45.5	
B22041	B17536/B18504	1	23.0	20.5	46.3	87.5	1.0	40.3	
B24212	B20547/B20597	24	22.7	25.0	45.5	88.5	1.5	41.3	
B24174	B20599/X21207	25	22.5	21.6	45.8	89.5	1.5	42.3	
B22031	B15434/B18204	2	22.5	22.6	44.0	88.5	1.0	38.8	
B23946	B20617/B19309	11	22.3	21.9	48.0	89.0	2.5	44.0	
B22033	B15434/B18204	12	22.2	22.0	45.5	89.5	1.0	42.5	
B23911	B18201/B19345	3	22.1	22.7	44.3	88.5	1.8	42.3	
B23922	B19309/B18201	10	21.9	21.6	45.8	89.0	1.0	40.3	

I19702	BL14497, SPECTRE	19	21.8	21.6	46.3	90.0	2.0	43.8
B19344	B16506/B16507, BLACK PEARL	15	21.7	21.1	44.8	87.5	1.3	40.3
B22062	B18231/B18233	5	21.7	22.6	46.3	88.5	1.3	44.5
B22035	B15434/B18504	14	21.4	21.2	45.5	90.0	1.5	46.3
B10244	B04644/ZORRO, ZENITH	17	21.0	21.3	45.8	88.5	1.0	36.5
I21901	BL14500, NIMBUS	20	20.1	22.9	48.5	91.5	1.0	43.5
B24112	B20527/B19344	29	19.9	21.7	45.8	90.0	1.0	39.5
B24111	B19344/B21717	28	19.0	20.3	44.8	88.0	1.0	37.8
MEAN (36)			23.8	22.1	45.6	89.2	1.4	42.1
LSD (0.05)			3.5	0.9	1.3	2.2	0.7	5.1
CV (%)			12.8	3.5	2.5	1.4	43.9	10.4

COMBINED STANDARD NAVY BEAN YIELD TRIAL-SVREC & HURON						Planted: 5/30 & 6/6/25		
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)
N24848	X21102/N21510	23	30.0	19.6	44.0	88.5	1.5	43.0
N24834	N21510/N19253	20	28.9	20.5	46.8	89.5	1.8	44.0
N21510	N15306/N14229	6	28.2	19.4	45.5	89.0	1.8	49.3
N24847	X21102/N21510	22	27.6	18.8	43.0	88.0	1.5	42.5
N23717	N19226/B19309	1	27.5	20.9	47.5	96.5	1.5	41.5
N22616	N19216/N17505	2	27.1	21.1	44.0	88.0	2.0	44.5
N22610	N18122/N19253	3	26.7	23.3	46.8	93.5	1.5	52.0
N24844	X21102/N19253	19	26.2	21.9	45.8	92.5	1.0	44.3
N23706	N18128/N19253	9	26.2	21.7	49.3	94.0	1.3	48.3
N24803	N18105/N20388	24	26.1	24.5	48.3	100.0	1.8	52.8
N24826	N20401/N19277	30	26.1	20.6	49.5	99.0	1.8	46.8
N22623	N19241/N18103	7	25.6	22.8	45.3	88.0	1.8	43.0
N23716	N19226/B19309	4	24.8	22.5	48.8	89.5	1.8	45.0
N24816	N20317/N18122	29	24.7	23.2	47.0	92.0	1.8	48.8
N24805	N19246/N20401	28	24.7	20.3	46.5	89.5	1.5	38.8
N22605	N17505/B18224	14	24.5	21.6	48.0	88.0	1.5	49.3
N24842	X21101/N20401	27	23.9	19.2	47.5	88.5	1.5	41.0
N22622	N19216/B18224	5	23.8	21.4	45.0	91.5	1.5	41.0
N18103	N13120/PR00806-81, AuSable	15	22.9	21.3	45.3	87.5	1.8	42.3
N24828	N20401/N20317	26	22.8	19.2	48.5	97.0	1.0	42.0
N21511	N15306/N15337	13	22.6	21.2	45.8	90.0	1.8	42.8
N23721	N19253/N18122	10	22.5	21.7	46.0	95.0	1.5	45.0
N22602	N17505/N18122	8	22.3	22.0	47.3	90.0	1.3	45.5
N24811	N19253/N18105	25	22.3	20.2	46.0	89.5	1.3	41.3
N11283	MEDALIST/N08003, ALPENA	16	21.9	20.4	45.0	88.5	2.3	46.0
N24801	N18105/N19246	18	21.7	21.1	47.0	89.0	1.5	46.5
N24851	B19309/N21510	21	21.2	21.5	44.0	94.0	1.5	45.0
N22005	N15306/B17023	12	21.0	18.9	45.5	92.0	1.3	46.8
I22001	LIBERTY	11	20.2	20.6	44.8	93.0	1.8	40.5
I21920	HMS BOUNTY	17	17.8	17.0	43.5	89.5	1.3	40.3
MEAN (30)			24.4	21.0	46.2	91.4	1.6	44.6
LSD (0.05)			3.5	0.8	1.6	2.6	0.5	5.3
CV (%)			12.4	4.0	2.5	1.4	23.6	8.3

COMBINED STANDARD KIDNEY BEAN YIELD TRIAL-MRC & MONTCALM						Planted: 6/5 & 6/10/25		
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)
K23707	K15601/K19605	5	30.2	57.0	42.8	104.3	4.0	36.3
K23702	K16981/K16962	40	26.9	64.2	45.5	107.8	3.8	37.5
I07104	K17703/K19610	2	26.9	62.3	44.8	105.5	3.8	35.0
I17507	K19831/K19830	22	26.4	63.3	46.0	107.8	2.3	42.5
K22604	K19610/K17703	19	26.1	59.4	46.0	105.5	4.5	35.0
K22601	K17702/K20745	30	25.8	60.4	44.3	103.8	4.0	33.8
K90101	K20212/K20745	29	25.7	57.1	43.5	102.0	3.3	37.5
I15622	K16638/K16980	13	25.7	62.8	45.0	106.0	3.0	43.8
K23705	K15601/K17703	6	25.6	55.8	43.5	102.0	6.5	32.5
K23210	K19610/K19830	1	25.6	66.0	46.5	105.5	3.0	41.3
K90902	K19610/K19120	9	25.5	55.1	43.8	103.3	3.0	38.8
K16924	K19111/K16924	10	25.3	59.3	45.5	106.0	2.0	35.0
K19830	K19831/K18312	16	25.1	62.3	43.8	103.8	2.5	40.0
K22605	K17201/K19817	37	25.1	58.2	45.3	104.3	2.8	42.5
K23703	K18912/K15601	23	24.0	56.1	43.3	104.3	2.8	38.8
K23912	K19120/K17703	18	24.0	57.3	44.8	106.0	2.3	38.8
K15601	ND Redbarn	21	22.9	53.5	42.8	98.0	1.5	40.0
K23212	BEA/50B1807//LASSEN, BELUGA	11	22.2	56.2	45.3	106.0	3.0	36.3
K23710	Pink Panther//ZAA/Montcalm, CLOUSEAU	20	21.8	57.9	37.3	96.3	3.0	38.8
I11201	K04604/USDK-CBB-15, SNOWDON	24	21.6	61.2	35.0	98.0	1.0	35.0
I23002	K17201/K20212	31	21.5	57.7	42.3	102.0	3.3	35.0
K23908	K11917/SNOWDON, DENALI	12	21.4	55.2	37.5	98.0	1.0	40.0
K22801	K17703/15Mbeya_55	14	21.3	57.8	45.0	107.3	2.8	42.5
K08961	Chardonnay/CELRK, PINK PANTHER	3	21.3	59.4	36.8	98.0	1.8	36.3
K74002	ND122386, ND WHITETAIL	4	21.2	53.3	44.0	103.8	4.5	31.3
K11306	RED CEDAR/K11916, COHO	17	21.0	52.3	44.0	105.5	1.3	40.0
I90013	K20212/K20221	32	20.8	57.0	46.5	102.0	5.0	27.5
K24321	DYNASTY	8	20.8	55.3	42.0	105.5	3.0	40.0
K24504	K17201/K20235	34	20.7	56.9	42.8	102.0	2.8	36.3
K24502	MDRK/CN(3)-HBR(NEB#1), MONTCALM	25	20.7	55.8	41.5	106.0	2.8	35.0
K24322	K18312/K17703	15	20.5	60.5	45.0	106.0	3.0	37.5
K24309	K20234/K20217	38	20.4	57.9	43.5	99.8	1.0	42.5
K24310	K06621/USDK-CBB-15, RED CEDAR	26	20.2	54.3	42.5	99.8	2.5	35.0
K24302	K20212/K20221	33	20.0	56.4	44.8	99.8	5.3	25.0
K24323	CHAR/2*MONT, RED HAWK	7	19.7	52.5	41.3	98.0	2.8	36.3
K24301	K17201/K17702	35	19.3	58.1	42.5	102.0	3.0	33.8
K24501	CELRK	27	18.3	56.8	35.0	94.5	1.5	33.8
K24316	K20235/K20217	36	17.2	55.2	42.5	98.0	2.3	32.5
K24306	K20745/K20234	28	17.0	51.7	41.3	98.0	1.5	33.8
K19832	K20212/K17201	39	16.2	58.0	42.3	99.8	3.5	35.0
MEAN (40)			22.6	57.7	42.9	102.5	2.9	36.7
LSD (0.05)			4.2	2.6	1.3	4.1	1.6	8.0
CV (%)			16.5	3.9	2.2	2.9	38.7	15.5

2025 PRAB Progress Research Report

Navy Bean Canning Quality

Sharon Hooper, Karen Cichy, Mark Uebersax, Scott Bales

Background/Statement of Problem

Recently (2023 and 2024 crops) within the MSU Dry Bean Performance trials and the Dry Bean breeding nurseries, some navy beans have been exhibiting a canning quality concern that can be described as gelling of the brine. In this case, the brine is highly viscous, with a jelly-like consistency. Interestingly, it does not necessarily appear to be caused by broken beans or starch leaching from the beans into the brine. In many cases, with gelling of the brine, the brine is not cloudy, but relatively clear, and the canned bean samples are fully intact and there is no sign of starch leaching. There is no clear current explanation of what is causing the observed gelling. While it is known that during thermal processing free starch swells and thickens, proteins undergo denaturation and gelation, and various hydrocolloids (pectin and soluble fiber) can serve as a matrix for this gel structure. It is noted that excessive starch or pectin/hydrocolloids leaching through intact seedcoats have not previously been observed. Thus, there is a need for directed studies and objective brine viscosity measurements and compositional analyses to better understand the nature of the problem and potential causes.

Objectives: (1) To determine the impact of cultivar, production environment, and post-harvest handling on specific canning quality concerns such as brine gelling. (2) To identify physicochemical properties and physiological components of the dry bean contributing to brine gelling.

Approach: (1) Conduct preliminary canning trials on navy bean 2023 (Reese and Olivia location) and 2024 (6- genotypes grown in 4 locations- Tuscola, Bay, Huron and Sanilac) crops. (2) Assess viscosity of navy bean brine via unheated viscometer. (3) Determine navy bean flour pasting viscosity using a heated rotational Rapid Visco Analyzer (RVA). (4) Identify microbes that could cause the production of exopolysaccharides resulting in brine gelling.

Progress

(1) Storage duration of navy bean seeds can influence brine viscosity/gel formation. Canning results show that navy bean seeds (previously exhibited gelled brine) canned after 1 year of storage showed clear brine with no gelling. However, storage after 2 months did not reduce gelling. (2) Brine gelling was impacted by location/environment. Brine gelling was predominately observed in dry beans grown in Huron. (3) Viscosity and low temperature RVA measurements did not correlate with observed brine gelling. (4) The microbe *Xanthomonas campestris* was observed growing on Lima bean agar plates containing extracts obtained from bean seeds that exhibited brine gelling after canning. *Xanthomonas sp* produces the exopolysaccharide xanthan gum which is used in the food industry as a thickener and a gelling agent in gluten free products. Flours from such seeds could be used to make food products without the added burden of including the additive xanthan gum.

Next Steps: (1) Identify/quantify components including exopolysaccharides present in both gelled and non-gelled brine. (2) Determine flour pasting properties with high temperature RVA. (3) Continue to monitor the occurrence of the problem in 2025 at canning evaluations.

Improved Methods of Integrated Weed Management in Dry Edible Beans

Jacob Felsman, Ph.D. Student, Michigan State University

Christy Sprague, Professor and Weed Extension Specialist, Michigan State University

The 2025 growing season included three key field experiments at the Michigan State University Agronomy Farm (East Lansing, MI) and Saginaw Valley Research and Extension Center (Richville, MI). These experiments focused on early planting of dry beans under various herbicide programs, the impact of cover crop termination techniques, and the integration of an oat or cereal rye cover crop in strip-till on weed management for dry bean production systems. This research relates to **objectives 1, 2, and 4** of the Specialty Crop Block Grant awarded to Michigan Bean Commission.

The first experiment aimed to determine the pressure points on current herbicide practices and programs and explore how earlier planting of dry bean affects weed management and production. Three planting dates were targeted: ultra early (first week of May), early (third week of May), and normal (first week of June). In addition to the East Lansing and Richville locations, this experiment was also conducted on-farm at a waterhemp-infested site in Morrice, MI. Weed species evaluated included common lambsquarters, common ragweed, and herbicide-resistant waterhemp (Morrice). Results from the six site-years of data show that planting date had little effect on weed control. Trends in herbicide programs averaged across planting dates were also consistent, showing benefit for preplant incorporated (PPI) application and the addition of a residual herbicide in the postemergence (POST) herbicide application for extended weed control. Existing recommendations for herbicide programs remain effective when following a two-pass program with a PPI and POST containing overlapping residual controls weeds regardless of planting date. There were no clear trends in planting date for dry bean yield. This was likely due to differences in weather among the five site-years that yield was measured. In two years there was an advantage to early planting, in two years there was no difference between planting dates, and in one year the normal planting yielded higher than the ultra early and early planting dates. Earlier planting dates warrant further investigation.

The second experiment was designed to quantify the weed-suppression capabilities of an oat cover crop with different termination timings and tillage scenarios. An oat cover crop was seeded in mid-April, and dry beans mid-June to the first of April with two termination timings: early termination (two weeks before planting) and termination at dry bean planting. The termination techniques were paired with tillage (control with no cover crop), no-till, and strip-till practices. A third subsequent study evaluated the adoption of either an oat or cereal rye cover crop into integrated weed management approaches. Yield in the termination timing study did not differ between early termination and termination at dry bean planting, although terminating the oats at planting suppressed more weed biomass in all tillage methods. Comparing the impacts of an oat and cereal rye cover crop in dry bean, equal weed control was observed amongst strip-tillage treatments, and including a residual herbicide protected yield potential under both cover crop scenarios.

These results were shared with over 250 Michigan dry bean growers through extension events as well as other scientists at academic meetings and conferences.

Significant impacts from these projects:

1. Climate-focused Management

- a. Adapt weed management approaches to account for increasing growing degree days earlier in the season and drastic shifts in weather events.

2. Herbicide Evaluation and Resistance Mitigation

- a. Evaluate current dry bean herbicide programs for weaknesses and potential resistance evolution.

3. Integrating Cultural Weed Management

- a. Further integrate cultural practices to diversify weed management options for dry bean producers proactively.

4. Cover Crop Adoption into Dry Bean Systems for Weed Management

- a. Explore the adoption of cover crops in dry beans for weed control and agronomic potential.

Relevant outcomes from the 2025 research

• **Extension presentations**

- Saginaw Valley Research and Extension Center Field Day – 150 attendees (8.19.2025)
- 2025 Regional Dry Bean Outlook and Production Meetings – Bay City (12.8.25) – 90 attendees, Greenville (12.10.25) – 30 attendees, Bad Axe (12.11.25) – 80 attendees
- Michigan Bean Commission - Beans at Brody (1.4.2026) – 15 attendees

• **Academic presentations**

- North Central Weed Science Society – 2025 Annual Meeting – Grand Rapids, MI (12.15.2025)
 - “Does Cereal Rye and Reduced Tillage Influence Weed Management in Dry Edible Beans?” | Jacob H. Felsman*, Brian J. Stiles II, Christy L. Sprague
 - “Planting Date Effects on Waterhemp (*Amaranthus tuberculatus*) Management in Dry Edible Beans” | Jacob H. Felsman*, Brian J. Stiles II, Christy L. Sprague
- Weed Science Society of America – 2026 Annual Meeting – Raleigh, NC (2.9.2026)
 - “Time as a Tool: Does Planting Date Impact Weed Management in Dry Beans?” | Jacob H. Felsman*, Brian J. Stiles II, Christy L. Sprague

Overlapping residuals for waterhemp control in dry edible beans

Christy Sprague and Brian Stiles, Michigan State University

Location:	Shiawassee County	Tillage:	Conventional
Replicated:	4 times	Row width:	30-inch
Planting Date:	June 3, 2025	Population:	109,000 seeds/A
Variety:	‘Black Beard’ black beans	PRE application:	June, 3 2025
		POST application:	30 d after planting (V3)

Table 1. Waterhemp control from various treatments comparing applications timings of the Group 15 residual herbicides, Outlook and Dual Magnum.

Herbicide treatments		Waterhemp control		
		At POST ^a	21 d after POST	At harvest
PREs	POST ^b	%		
None	Varisto (21 fl oz)	0 b ^c	18 e	3 e
None	Reflex (1 pt)	0 b	73 d	61 d
None	Reflex (1 pt) + Varisto (21 fl oz)	0 b	78 cd	53 d
None	Outlook (14 fl oz) + Reflex (1 pt)	0 b	81 cd	61 d
None	Dual Mag. (1.33 pt) + Reflex (1 pt)	0 b	84 bc	78 bc
Outlook (14 fl oz)	Varisto (21 fl oz)	98 a	92 ab	84 b
Dual Magnum (1.33 pt)	Varisto (21 fl oz)	99 a	95 a	85 b
Outlook (11 fl oz)	Outlook (10 fl oz) + Varisto (21 fl oz)	96 a	95 a	93 ab
Dual Magnum (1 pt)	Dual Magnum (1 pt) + Varisto (21 fl oz)	100 a	100 a	100 a
Outlook (11 fl oz)	Outlook (10 fl oz) + Reflex (1 pt) + Varisto (21 fl oz)	96 a	100 a	96 a
Dual Magnum (1 pt)	Dual Magnum (1 pt) + Reflex (1 pt) + Varisto (21 fl oz)	97 a	100 a	100 a

^a The at POST evaluation was ~30 DAP.

^b All treatments were applied with crop oil concentrate (COC) (1% v/v) + AMS (2.5 lb).

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

Summary: Herbicide-resistant waterhemp is problem for Michigan dry bean growers. Even though glyphosate is not a major component for weed control in dry bean, ALS-resistant waterhemp is wide spread. Additionally, a few populations have also been found to be resistant to the Group 14 herbicides (Reflex) limiting potential options for waterhemp control in dry bean. Overlapping residual herbicide programs may be one potential way to effectively control glyphosate-resistant waterhemp. Outlook and Dual Magnum/Dual II Magnum are residual (Group 15) herbicides labeled postemergence (POST) applications after dry beans reach the 1st trifoliolate stage (V1). The total maximum use rates per season for dry beans are 21 fl oz/A for Outlook and 2 pt/A for Dual Magnum. There is a 70 d preharvest interval (PHI) for Outlook and a 50 d PHI for Dual Magnum. In 2025, we conducted a field study to

examine various treatments and treatment timings for control of glyphosate- and ALS-resistant waterhemp in dry beans. We compared standard-use rate applications (PRE or EPOS) and split-applications (PRE followed by POST) of the Group 15 herbicides Outlook and Dual Magnum with and without Reflex. Reflex was included to control emerged waterhemp. This is effective on waterhemp populations that are not yet resistant to the Group 14 herbicides, as in this study. However, in certain fields in the state where Group 14 resistance is present the POST application of Reflex would not be effective.

This year immediately after planting there was 1.11-inches of rainfall within one week of application. This rainfall provided good incorporation of the PRE herbicide applications. Applying 1 to 1.33 pt/A of Dual Magnum or applying 11 to 14 fl oz/A of Outlook PRE provided similar waterhemp control at the time of POST (~30 DAP). Varisto did not adequately control waterhemp and POST applications Reflex were needed to control emerged waterhemp. Waterhemp control at harvest indicated that split applications with Outlook or Dual Magnum in combination of Reflex and Varisto POST provided the greatest control. Overall, these results show that if a grower has or is concerned about waterhemp in their dry beans a program they should consider applying is a split-application of Outlook or Dual Magnum, PRE followed by EPOS/POST, especially if Reflex is in the POST application.

Recommendations for waterhemp control in dry bean:

- Start out with a soil-applied application of Outlook or Dual Magnum.
 - Use the appropriate rate for the soil type.
 - Preplant incorporated applications will improve crop safety.
- Split-applications (overlapping) of Outlook or Dual Magnum will provide extended waterhemp control. Apply the POST application prior to new waterhemp emergence. Tank-mixing these applications with Reflex will control emerged waterhemp if they are not resistant to the Group 14 herbicides.
 - Outlook 11 fl oz/A (PPI) followed by 10 fl oz/A (POST)
 - Dual Magnum 1 pt/A (PPI/PRE) followed by 1 pt/A (POST)

Weed control and dry bean tolerance with various PPI treatments

Christy Sprague and Brian Stiles, Michigan State University

Location: Ingham County	Tillage: Conventional
Planting Date: June 9, 2025	Row width: 30-inch
Replicated: 4 times	Population: 109,000 seeds/A
Variety: 'Black Beard' black beans	PPI/PRE applications: June 9, 2025 POST application: 23 d after planting (V3)

Table 1. Weed control from various herbicide treatments at POST and harvest and dry bean yield.

PPI Treatments	At POST		At Harvest (96 d after POST)		Yield (cwt/A)
	annual grass	c. lambs ^a	annual grass	c. lambs.	
	% control				
Prowl H2O (2 pt) + Outlook (11 fl oz) ^b	87 ab	99 a	88 a	100 a	17.1 a
Pendalin H2O (2 pt) + Outlook (11 fl oz) ^b	81 b	91 b	84 a	99 a	17.4 a
Satellite HydroCap (2 pt) + Outlook (11 fl oz) ^b	82 b	94 ab	87 a	100 a	16.4 a
Eptam (3 pt) + Outlook (11 fl oz) ^b	93 a	99 a	90 a	96 a	16.7 a
Eptam (3 pt) + Prowl H2O (2 pt) ^b	88 a	100 a	89 a	100 a	15.7 a
Sonolan HFP (2.5 pt) + Eptam (3 pt) ^c	90 a	99 a	70 b	100 a	15.6 a
Sonolan HFP (2.5 pt) + Eptam (3 pt) + Permit (0.67 oz) (PPI only)	91 a	100 a	72 b	95 a	13.7 b
<i>Untreated</i>	0 c	0 c	0 c	0 b	4.0 c

^a Common lambsquarters

^b A POST herbicide treatment of Varisto (21 fl oz) + Outlook (10 fl oz) + crop oil concentrate (1% v/v) + AMS (2.5 lb) was applied when dry beans were at the V3 stage and weeds were 2-inches tall.

^c A POST herbicide treatment of Permit (0.67 oz) + NIS was applied.

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

Summary: The objectives of this research were to compare weed control and dry bean tolerance from various PPI treatments used in a complete weed control program. Various pendimethalin herbicides (Prowl H2O, Pendalin, and Sattelite HydroCap) were also compared to see if there are any differences in weed control. There was 0.31-inches of rainfall after dry bean planting. Overall PPI applications were safe to dry beans. At the time of POST herbicide application (~4 weeks after planting), there were some minor differences in grass control with grass control ranging from 81-93%, with a slight advantage in control when Eptam was in the mixture. Common lambsquarters control was also very similar amongst PPI treatments (91-100%). All treatments that received a POST application of Varisto + Outlook provided good control of annual grasses and excellent control of common lambsquarters at harvest. Overall dry bean yield was lower than normal due to the drier season (only 6.53-inches of rain). However, yield was not affected and was similar when a 2-pass PRE followed by POST program was applied. When there was no POST herbicide application, yields were reduced by as much as 21% when only a PPI herbicide application was made and reduced 77% if no herbicide was applied. This research shows the benefits of a two-pass program for effective weed control and preserving dry bean yield.

Defol 5 dry bean desiccation and residue analysis

Christy Sprague and Brian Stiles, Michigan State University

Location:	Tuscola County (SVREC)	Tillage:	Conventional
Planting Date:	June 13, 2025	Row width:	30-inch
Replicated:	4 times	Population:	109,000 seeds/A
Varieties:	‘Viper’ small red beans	Desiccation date:	Aug. 29, 2025

Table 1. Preharvest treatments on ‘Viper’ small red beans overall desiccation (%) 3, 7, 10, and 17 days after treatment (DAT) and dry bean yield.

Treatments ^a	Overall desiccation (%)				Moisture (%)	Yield (cwt/A)
	3 DAT	7 DAT	10 DAT	17 DAT		
Defol 5 (2.4 qt) + Hot MES	66 b	84 c	88 b	100 a	15.5 a	22.6 b
Defol 5 (4.8 qt) + Hot MES	76 a	89 b	89 b	100 a	15.1 a	22.1 b
Defol 5 (9.6 qt) + Hot MES	78 a	93 a	95 a	100 a	14.6 b	22.6 b
<i>Nontreated</i>	60 c	63 c	65 c	88 b	16.1 a	26.3 a

^a Hot MES is a surfactant + MSO blend applied at 16 fl oz/A.

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

Summary: The objective of this research was to examine increasing rates of Defol 5 as a dry bean desiccant. Defol 5 (42.3% sodium chlorate) is a product that has been used for seed corn defoliation for several years. Defol 5 has a dry bean label with a 0 d preharvest interval. This is the third year examining Defol 5 as a dry bean desiccant. Preharvest treatments were applied at 19 gallons per acre when dry bean pods were at 70% yellow and 60% of leaves were green. This year conditions were ideal (warm and dry) at application improving the effectiveness of preharvest treatments. At 3 DAT, the higher rates of Defol 5 (4.8 and 9.6 qt/A) provided greater overall desiccation (76-78%) than the 2.4 qt/A rate (66%). By 7 DAT, all the Defol 5 rates separated out with the highest rate providing the greatest desiccation and only the highest rate was greater than 90% desiccation by 7 DAT. However, all were over 20% points higher than the nontreated control. Dry bean yield for all rates of DeFol 5 was similar, however none were as high as the nontreated control. Indicating that desiccation treatments were effective at stopping growth of the dry bean plants equally after application. Delaying applications would have allowed for similar yields. From this research there are some promising results for Defol 5 as a dry bean desiccant, however additional studies should be conducted under less favorable conditions to evaluate its consistency, as well as effectiveness in desiccating different weed species that may be present at dry bean harvest.

Comparison of preharvest treatments for dry bean desiccation

Christy Sprague and Brian Stiles, Michigan State University

Location: Tuscola County (SVREC)	Tillage: Conventional
Planting Date: June 13, 2025	Row width: 30-inch
Replicated: 4 times	Population: 109,000 seeds/A
Varieties: ‘Viper’ small red beans	Desiccation date: Sept. 2, 2025

Table 1. Preharvest treatments on ‘Viper’ small red beans overall desiccation (%) 3, 7, 13 days after treatment (DAT) and dry bean yield.

Treatments ^a	Overall desiccation (%)			Moisture (%)	Yield (cwt/A)
	3 DAT	7 DAT	13 DAT		
Reviton (1 fl oz) + MSO + AMS	73 bc ^b	78 abcd	100 a	15.1 bcd	21.9 e
Reviton (1.5 fl oz) + MSO + AMS	71 bc	76 bcd	100 a	14.5 de	21.7 e
Reviton (2 fl oz) + MSO + AMS	72 bc	79 abcd	100 a	14.5 de	22.4 cde
Sharpen (1 fl oz) + MSO + AMS	74 b	78 abcd	98 a	15.6 ac	24.7 abc
Sharpen (1.5 fl oz) + MSO + AMS	72 bc	75 cd	100 a	15.0 bcd	22.1 de
Sharpen (2 fl oz) + MSO + AMS	78 a	83 ab	100 a	13.8 e	23.6 b-e
Helmquat (12.8 fl oz) + NIS + AMS (3 lb/100 gal)	65 d	66 e	97 b	16.3 a	24.3 abc
Helmquat (20.8 fl oz) + NIS + AMS (3 lb/100 gal)	69 cd	73 d	98 a	15.9 abc	25.1 ab
Valor SX (3 oz) + MSO + AMS	68 cd	72 d	100 a	15.6 abc	25.2 ab
Sharpen (1 fl oz) + Helmquat (21 fl oz) + NIS + AMS	81 a	84 a	98 a	14.9 cd	22.5 cde
Defol 5 (2.4 qt) + MSO	76 ab	79 ab	98 a	16.4 a	25.2 ab
<i>Nontreated</i>	56 e	61 e	95 b	16.5 a	26.3 a

^a MSO was applied at 1% V/V. AMS was applied at 8.5 lb/100 gal unless otherwise noted. NIS = nonionic surfactant was applied at 0.25% V/V

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

Summary: The objective of this research was to examine Reviton (tiafenacil) as a dry bean desiccant and compare it with current standard desiccation treatments. Reviton is a Group 14 herbicide that is in the same site of action group as Sharpen. Desiccation treatments were applied when 70% of the pods were yellow. ‘Viper’ small reds are known to have pods mature prior to leaves yellowing. This year conditions were ideal (warm and dry) at application improving the effectiveness of preharvest treatments. At 3 DAT, Sharpen + Helmquat (paraquat) provided the highest level of desiccation (81%). Sharpen (2 fl oz) and Defol 5 (2.4 qt) provided similar desiccation. By 7 DAT, these Sharpen at 1 fl oz/A and several of the Reviton treatments provided similar levels of desiccation, but none were over 90%. It took until 13 DAT for treatments to reach 100% overall desiccation and all but two were greater than the nontreated control. Treatments that had the highest levels of desiccation 3 DAT resulted in slightly less yields than the untreated control, with the exception Defol 5. From this research there are some promising results for Reviton as a dry bean desiccant, however it does not appear to be as active as the combination of Sharpen + Helmquat or the highest rate of Sharpen.

Reviton use rates and adjuvant systems for dry bean desiccation

Christy Sprague and Brian Stiles, Michigan State University

Location: Tuscola County (SVREC)	Tillage: Conventional
Planting Date: June 13, 2025	Row width: 30-inch
Replicated: 4 times	Population: 109,000 seeds/A
Varieties: ‘Viper’ small red beans	Desiccation date: Sept. 2, 2025

Table 1. Preharvest treatments on ‘Viper’ small red bean overall desiccation (%) 3, 7, 13 days after treatment (DAT) and dry bean yield.

Reviton treatments ^a	Overall desiccation (%)			Moisture (%)	Yield (cwt/A)
	3 DAT	7 DAT	13 DAT		
Reviton (0.5 fl oz) + MSO + AMS	75 ab	77 ab	100 a	14.7 a	25.6 a
Reviton (0.75 fl oz) + MSO + AMS	73 ab	76 ab	100 a	14.4 a	25.6 a
Reviton (1 fl oz) + MSO + AMS	78 a	80 ab	100 a	14.5 a	25.6 a
Reviton (1.25 fl oz) + MSO + AMS	80 a	83 a	100 a	13.9 a	24.6 a
Reviton (1.5 fl oz) + MSO + AMS	78 a	81 a	100 a	14.6 a	25.8 a
Reviton (2 fl oz) + MSO + AMS	77 ab	79 ab	100 a	14.6 a	24.1 a
Reviton (0.5 fl oz) + COC + AMS	76 ab	80 ab	100 a	14.1 a	23.2 a
Reviton (0.75 fl oz) + COC + AMS	74 ab	77 ab	100 a	14.5 a	24.8 a
Reviton (1 fl oz) + COC + AMS	73 ab	77 ab	100 a	14.6 a	25.9 a
Reviton (1.25 fl oz) + COC + AMS	73 ab	79 ab	100 a	14.7 a	26.1 a
Reviton (1.5 fl oz) + COC + AMS	72 ab	75 ab	100 a	14.6 a	24.5 a
Reviton (2 fl oz) + COC + AMS	76 ab	80 ab	100 a	13.9 a	25.6 a
Reviton (0.5 fl oz) + NIS + AMS	73 ab	76 ab	100 a	14.6 a	25.8 a
Reviton (0.75 fl oz) + NIS + AMS	70 b	73 b	100 a	14.1 a	26.3 a
Reviton (1 fl oz) + NIS + AMS	74 ab	76 ab	100 a	14.4 a	25.6 a
Reviton (1.25 fl oz) + NIS + AMS	77 ab	80 ab	100 a	14.7 a	26.2 a
Reviton (1.5 fl oz) + NIS + AMS	72 ab	75 ab	100 a	14.2 a	25.4 a
Reviton (2 fl oz) + NIS + AMS	77 ab	79 ab	100 a	14.5 a	24.4 a
<i>Nontreated</i>	60 c	60 c	75 b	14.4 a	25.4 a

^a Helm methylated seed oil MSO and Helm crop oil concentrate (COC) were both applied at 1% V/V. Helm nonionic surfactant (NIS) was applied at 0.25% V/V. AMS was applied at 8.5 lb/100 gal.

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

Summary: The objective of this research was to examine various Reviton rates and adjuvant systems for dry bean desiccant. Reviton is a Group 14 herbicide that is in the same site of action group as Sharpen. Desiccation treatments were applied when 70% of the pods were yellow. ‘Viper’ small reds are known to have pods mature prior to leaves yellowing. Across the three evaluation timings there were very few differences in dry bean desiccation based on Reviton rate or adjuvant selection. On average Reviton treated dry bean desiccation ranged from 10 to 25% higher than the non-treated control. There was also no difference in harvest moisture or yield with any of the treatments. From this trial it appears that use rate and adjuvant system had little effect on dry bean desiccation with Reviton. This is only one year of research and additional years under different conditions should continue to be examined.

Integrating Cover Crops and Strip-tillage into Dry Bean Weed Management

Jacob Felsman, Christy Sprague, and Brian Stiles, Michigan State University

Location:	MSU	SVREC	Tillage:	Conventional, Strip-Till
Oat Termination:	6/5/2025	5/27/2025	Row width:	30-inch
Cereal Rye Termination:	5/24/2025	5/27/2025	Population:	109,000 seeds/A
Planting Date:	6/11/2025	6/12/2025	Cultivar:	'BlackBeard' Black Beans

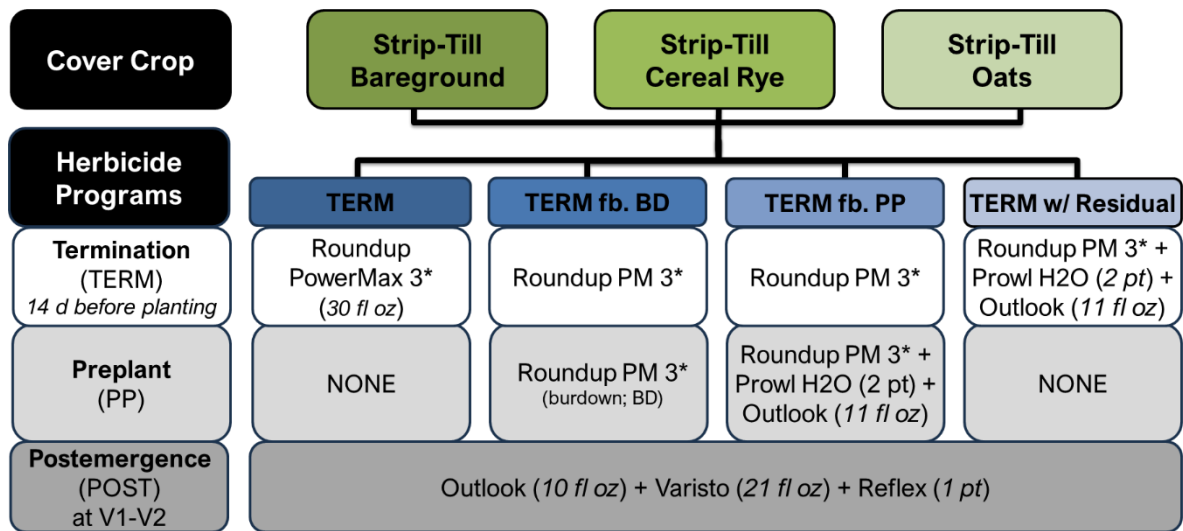


Figure 1. Experimental design including strip-tillage cover crop treatments and herbicide programs.

Summary: Historically, dry bean production has been a tillage-intensive system, justified as the first and primary approach to weed management. The objective of this research was to evaluate weed management strategies for dry beans that integrate cover crops and strip tillage approaches for weed control. A field experiment was established in 2025 at two locations: Michigan State University Agronomy Farm (MSU; East Lansing, MI) and Saginaw Valley Research and Extension Center (SVREC; Richville, MI). The experiment was designed as a split-plot randomized complete block design with cover crop as the main-plot (strip-till bareground, strip-till oats, and strip-till cereal rye), and herbicide program as the sub-plot factor (Figure 1). All treatments received a burndown application 15 days prior to planting with Roundup PM 3, with one treatment including the addition of Prowl H₂O + Outlook. Cover crop dry biomass at termination was 1,421 and 9,936 lbs ac⁻¹ for oats and cereal rye at MSU and 2,102 and 6,328 lbs ac⁻¹ at SVREC, respectively. Strip-tillage and planting occurred immediately after preplant herbicide applications, followed by a POST application. The main effect of cover crop did not affect dry bean stands at SVREC; however, at MSU, stands were the highest in the bareground plots (18.9 plants m⁻¹), followed by oats (18.3 plants m⁻¹), and cereal rye (17.6 plants m⁻¹). Weeds were counted and biomass was harvested in-row (IR; strip-tilled area) and between rows (BR; undisturbed soil between tillage strips) prior to POST application. No differences in weed counts or biomass were present at MSU or SVREC. At MSU, dry bean yield was highest with an oat cover crop,

while bareground and cereal rye treatments resulted in an 11% reduction. The highest yields at SVREC were bareground, followed by oats and cereal rye with 7% and 15% reductions, respectively. Initial results from year one indicate that combination of strip-till cover crops and herbicide programs had no effect on weed counts or biomass and show potential for little to no yield reductions. This study will be repeated in 2026.

Figure 2. Main effects of cover crop^a and herbicide program^b for 2025 MSU dry bean yields.

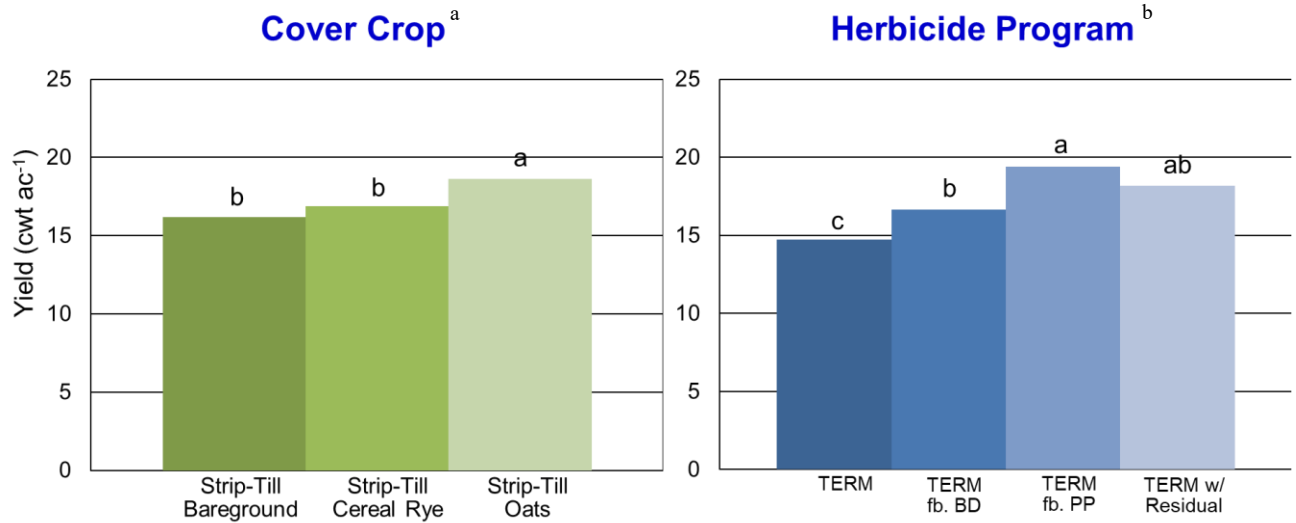
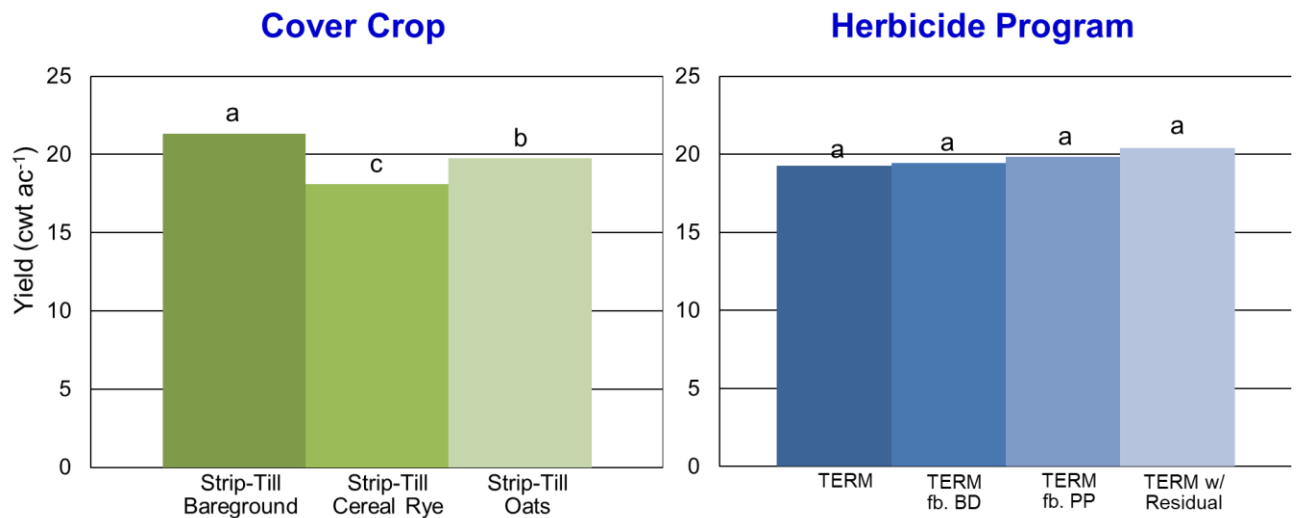


Figure 3. Main effects of cover crop and herbicide program for 2025 SVREC dry bean yields.



^a Cover crop is analyzed as a main effect combined over all herbicide programs.

^b Herbicide programs is analyzed as a main effect combined over all cover crops.

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

Comparison of weed control systems in early planted dry bean

Jacob Felsman, Christy Sprague, and Brian Stiles, Michigan State University

Location: Ingham and Tuscola Counties				Tillage: Conventional	
Replicates: 4				Row width: 30-inch	
Site-Year	Ultra-Early Planting:	Early Planting:	Normal Planting:	Variety: ‘Zenith’ black beans (2024) ‘Black Beard’ black beans (2025)	
MSU-24	May 6	May 20	June 4	POST application: ~28 d after planting	LPOST application: ~5 d after POST
MSU-25	May 12	May 20	June 9		
SVREC-25	May 13	May 27	June 12		

Summary: The objective of this research was to compare weed management systems and yield in ‘ultra-early’ and ‘early’ planted black beans with a ‘normal’ planting date. A field experiment was established in 2024 & 2025 at Michigan State University Agronomy Farm (MSU; East Lansing, MI) and Saginaw Valley Research and Extension Center (SVREC; Richville, MI). The experiment was setup with three planting dates and four weed control programs. The three planting dates included: ‘ultra-early’ (targeting the 1st week of May), ‘early’ (3rd week of May) and ‘normal’ (1st week of June). Weed management systems included: (1) preplant incorporated (PPI) Prowl H₂O (2 pt) + Outlook (11 fl oz), (2) the PPI treatment followed by (fb.) POST Varisto (21 fl oz) + COC + AMS, (3) PPI treatment fb. POST Varisto + Outlook (10 fl oz) + COC + AMS, (4) PPI treatment fb. POST Varisto + Outlook fb. late postemergence (LPOS) of Reflex (1 pt) + COC 5 d after POST. Weeds at MSU-24 consisted of common ragweed, common lambsquarters, and annual grasses (giant foxtail and barnyardgrass); whereas, MSU-25 consisted of annual grasses (giant foxtail, barnyardgrass) predominately. Common lambsquarters, common ragweed, and Powell amaranth were present at SVREC-25, but at extremely low population levels (data not shown). Weed biomass at MSU was collected at harvest and was combined over the two MSU-site years. Regardless of planting date, applying a PPI alone or a PPI fb. POST reduced MSU weed biomass by 37 and 95% compared with the nontreated control, respectively (Figure 1). A 15% reduction in MSU-24 dry bean stands was observed for the nontreated control plots across all planting dates (data not shown). At MSU-25, dry bean stands were 12% lower for the ‘ultra-early’ planting compared with the ‘early’ and ‘normal’ planting dates, and herbicide programs did not affect stand. The highest yielding herbicide treatments at MSU-24 across all three planting dates included PPI fb. POST programs, but application of at least a PPI resulted in the highest yields at MSU-25. Planting ‘ultra-early’ or ‘early’ at MSU-24 resulted 31 and 13% lower yields compared with the normal planting, mostly due to higher rainfall and cooler temperatures; however, no yield was note affected by planting date at MSU-25. At SVREC-25, higher yields were observed with the ‘ultra-early’ and ‘early’ planting dates compared with the ‘normal’ planting (23% higher). Overall, the success of planting dry beans early is likely going be weather-dependent and weed control across planting dates should be similar with a 2-pass (PPI followed by POST program). We will be continuing this research during the 2026 growing season.

Figure 1. Main effect of herbicide program^a for MSU 2024/2025 (combined) weed biomass at harvest. There was no differences between planting dates.

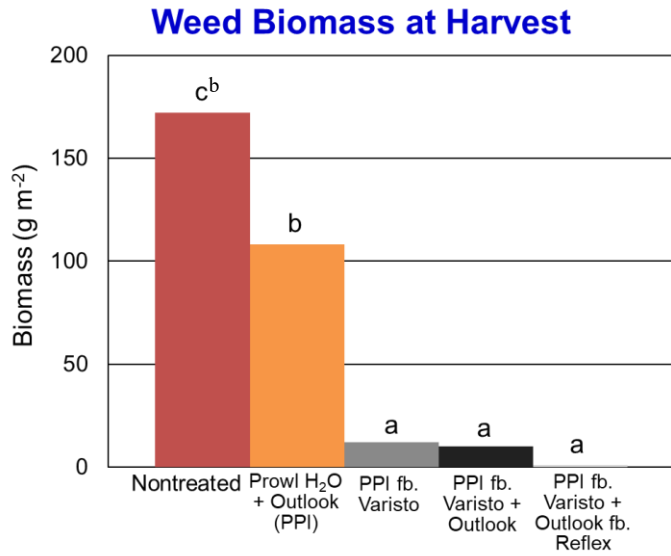
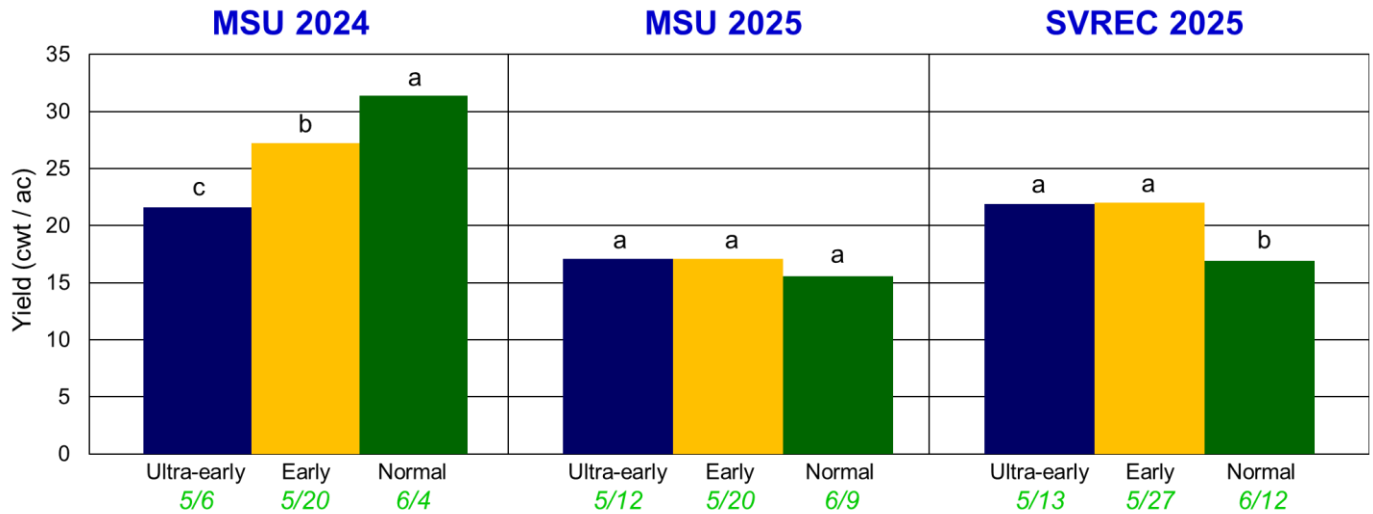


Figure 2. Main effect of planting date^c on black bean yield (MSU-24, MSU-25, SVREC-25). Planting dates area listed below each bar.



^a Herbicide is analyzed as a main effect combined over all planting dates.

^b Columns within a graph with different letters are significantly different from each other.

^c Planting date is analyzed as a main effect combined over all herbicide programs.

Termination Strategies of an Oat Cover Crop in Dry Bean Production Systems

Jacob Felsman, Christy Sprague, and Brian Stiles, Michigan State University

Location:	Shiawassee County		Tillage:	Conventional, No-Till, Strip-Till
Replications:	4		Row width:	30-inch
Year:	2024	2025	Population:	109,000 seeds/A
Varieties:	‘Zenith’	‘BlackBeard’	Early Cover Crop Termination:	14 DBP
Planting Date:	July 3	June 10	At-Plant Cover Crop Termination:	At-planting

Table 1. Oat cover crop termination treatments in black and dry bean yield.

Treatment	Treatment Factors		
	Oat Termination*	Tillage	POST
1) Tilled	Bareground	Tilled	-
2) Tilled with POST	Bareground	Tilled	Yes
3) ET+NT	Early	No-Till	-
4) ET+NT w/ POST	Early	No-Till	Yes
5) ET+ST	Early	Strip-Till	-
6) ET+ST w/ POST	Early	Strip-Till	Yes
7) AP+ET	At-Plant	No-Till	-
8) AP+ET w/ POST	At-Plant	No-Till	Yes
9) AP+ST	At-Plant	Strip-Till	-
10) AP+ST w/ POST	At-Plant	Strip-Till	Yes

Table 2. Weed biomass at harvest by the main effects of Oat Termination and POST Herbicide

Weed Biomass at Harvest (g m ⁻²) 2024 & 2025	
Oat Termination ^a	
Bareground	115.8 b
Early Term	129.4 b
At-Plant Term	54.3 a
POST Herbicide	
No	129.1 b
Yes	70.5 a

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

Summary: The objective of this research was to compare weed control and the agronomic benefits of various management strategies using a spring-seeded oat cover crop in a dry bean production system. A field experiment was conducted in 2024 and 2025 at Michigan State University Agronomy Farm (MSU; East Lansing, MI). The experiment was set up with four replications looking at soil management, including conventional tillage as the control, and four cover crop treatments: early termination (ET) + no-till (NT), ET + strip-till (ST), at-plant termination (AP) + NT, and AP + ST (Table 1). All cover crops were terminated chemically with Roundup PowerMax 3 (30 fl oz) + AMS, which was applied either 14 days prior to planting for ET or at dry bean planting for AP. The sub-plot factor was the exclusion or inclusion of a POST herbicide with Varisto (21 fl oz) + Outlook (10 fl oz) + COC + AMS. Oat cover crop dry matter biomass in 2024 was 3,480 and 5,138 lbs ac⁻¹; 1356 and 2391 lbs ac⁻¹ in 2025 at ET and AP termination times, respectively. Weed pressure was primarily horseweed and annual grasses in 2024 but was predominantly annual grasses and common ragweed in 2025. At the POST herbicide application, total weed suppression was similar between at-plant oat termination and conventional tillage (data not shown). At harvest, the AP-terminated oats suppressed weed biomass 58% greater than the ET oats across both years (Table 2). Application of a POST herbicide reduced weed biomass by 44% regardless of soil management. Yield was similar for all management strategies in 2024 and 2025. POST herbicide applications protected yields on average across all management strategies by

20% in 2024 (Figure 1) and 28% in 2025 (Figure 2). Two years of data show that implementing oats as a spring cover crop can help suppress weeds in a dry bean system without negatively affecting yield compared with standard conventional tillage treatments. Further research is needed to determine the how much cover crop biomass can be accumulated without reducing yields in dry beans.

Figure 1. Main effects of POST herbicide application^b and soil management^c on dry bean yields in 2024.

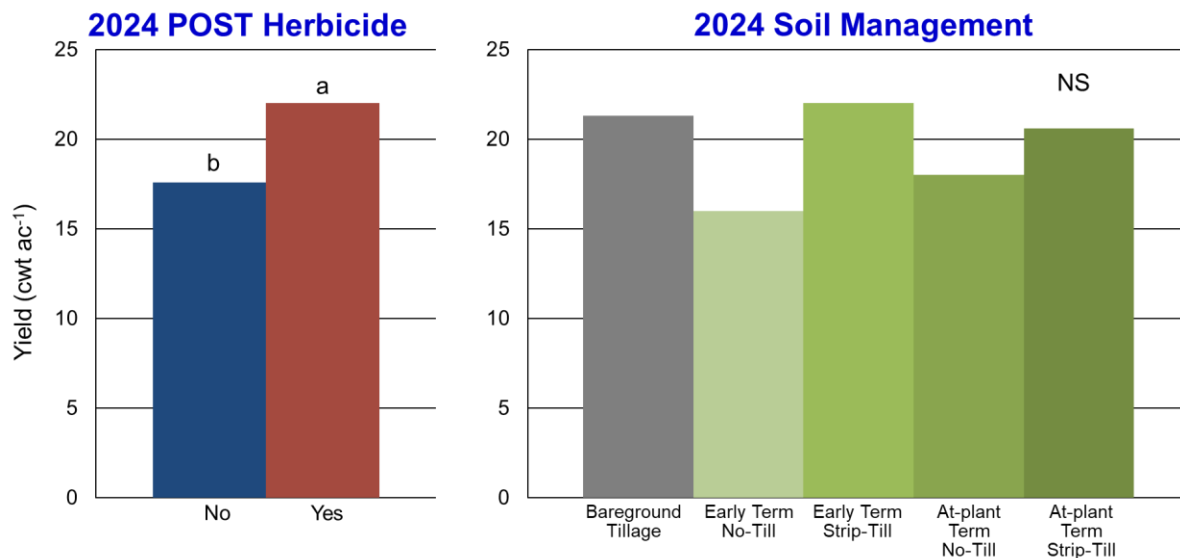
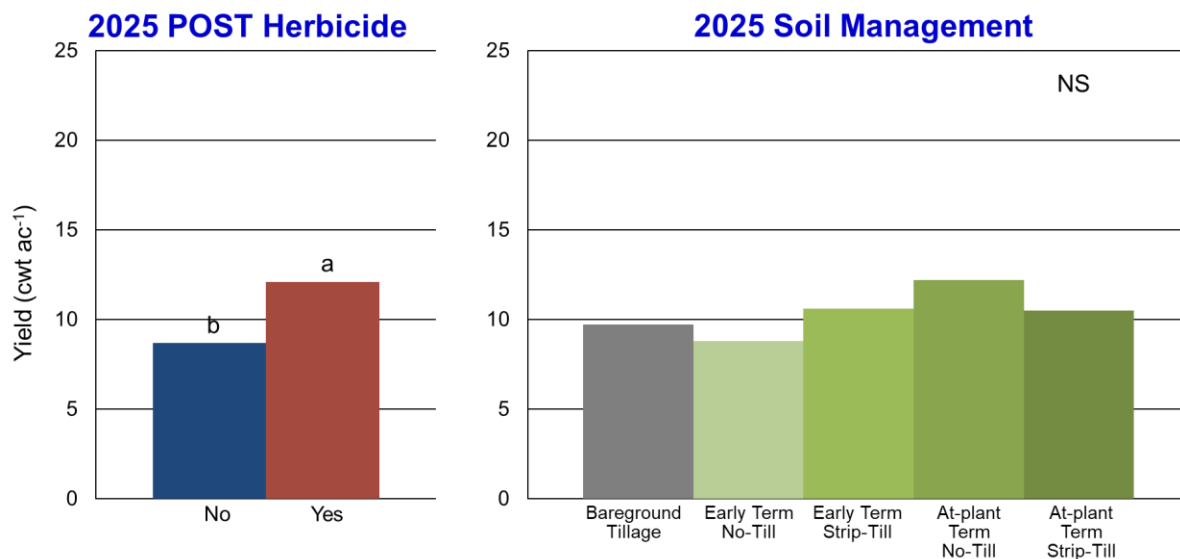


Figure 2. Main effects of POST herbicide application and soil management on dry bean yields in 2025.



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

^b POST herbicide is analyzed as a main effect combined over all soil management.

^c Soil management is analyzed as a main effect combined over all POST herbicide.

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.
	dimethenamid-P (<i>Outlook</i>)	0.66	14 oz 6L	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • <i>Outlook</i> may be applied early postemergence. Refer to the postemergence section for more information. • Reduce the <i>Outlook</i> rate to 12 oz/A on coarse-textured soil with low organic matter. • Navy and black beans are more sensitive to <i>Outlook</i> applications than <i>Dual Magnum</i>. • <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 weed 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.
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.
	ethalfuralin (<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.

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Dry Edible Beans – Preplant Incorporated Only (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual grasses Annual broadleaves	trifluralin (many)	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 (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.
	metolachlor (Parallel PCS)	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.

(Continued on next page)

Dry Edible Beans – Soil Applied (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual grasses	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.
	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.

Dry Edible Beans – Soil Applied (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	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.
	fluzifop-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.

(Continued on next page)

Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Grasses	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 I 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 + ammonium sulfate		+ 1 qt + 2.5 lb	
	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	+ 1% OR	
	+ surfactant + ammonium sulfate		+ 0.25% + 2.5 lb	
Residual annual grass control	dimethenamid-P (<i>Outlook</i>)	0.47	10 oz 6L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • <i>Outlook</i> may be applied from the first to the third trifoliate stage. • <i>Outlook</i> will not control emerged weeds but will provide residual control of annual grasses and some broadleaf weeds, including waterhemp. • Postemergence applications may result in temporary spotting or browning of dry bean leaves and stunting. • Tank mixtures with other postemergence herbicides may result in increased dry bean injury. • DO NOT exceed a total of 21 oz/A of <i>Outlook</i> per season. • 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.

Dry Edible Beans – Postemergence (*continued*)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	bentazon (<i>Basagran</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.
	halosulfuron (<i>Permit</i>) + surfactant		0.023	

(Continued on next page)

Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	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.
	imazamox <i>(Raptor)</i> + bentazon <i>(Basagran)</i> + crop oil concentrate + ammonium sulfate	0.032 0.25	4 oz 1L + 8 oz 4L OR 6.4 oz 5L + 1% + 2.5 lb	<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.

(Continued on next page)

Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	fomesafen (<i>Reflex</i>) + surfactant	0.25	1 pt 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; 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.
	basagran + imazamox (<i>Varisto</i>) + crop oil concentrate + ammonium sulfate	0.68	21 oz 4.18L + 1% + 2.5 lb	<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.

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>) OR (<i>Gramoxone SL 3.0</i>) + surfactant	0.3-0.5	1.2–2 pt 2SL OR 0.8-1.33 pt 3SL + 0.25%	<ul style="list-style-type: none"> • Gramoxone is a restricted-use pesticide. Certified applicators are now required to complete a paraquat specific training prior to use of <i>Gramoxone</i>. The paraquat training course can be found online at: www.epa.gov/pesticide-worker-safety/paraquat-dichloride-training-certified-applicators. • Apply when crop is mature, at least 80% of the pods are yellowing and mostly ripe and no more than 40% (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</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> or 1.33 pt/A of <i>Gramoxone SL 3.0</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"> • Parazone is a restricted-use pesticide. Certified applicators are now required to complete a paraquat specific training prior to use of <i>Parazone</i>. The paraquat training course can be found online at: www.epa.gov/pesticide-worker-safety/paraquat-dichloride-training-certified-applicators. • <i>Parazone</i> contains the same active ingredient as <i>Gramoxone SL</i> (paraquat). • See the Remarks and Limitation section for <i>Gramoxone SL 3.0</i>.

(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	saflufenacil <i>(Sharpen)</i>	0.023	1 oz 2.85L	<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.
	+		+	
	methylated seed oil		1%	
+	+			
	ammonium sulfate		17 lb/100 gal	
	flumioxazin <i>(Valor)</i>	0.05	1.5 oz 51WG	<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.
OR	OR		OR	
<i>(Valor EZ)</i>			1.5 oz 4L	
+	+	+		
	methylated seed oil		1 qt	
	carfentrazone <i>(Aim)</i>	0.03	2 oz 2EC	<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.
+	+		+	
	methylated seed oil		1% v/v	

Nutrient Recommendations for Field Crops in Michigan

Table 16. Potassium recommendations for selected yields of corn (mineral soils).

Soil test	CEC	140 bu/a				180 bu/a			
		4	8	12	16	4	8	12	16
ppm		— lb K ₂ O/a —				— lb K ₂ O/a —			
40		92	115	142	173	103	126	153	184
80		44	59	78	101	55	70	89	112
85		38	52	70	92	49	63	81	103
95		38	38	54	74	49	49	65	85
105		38	38	38	56	49	49	49	67
115		38	38	38	38	49	49	49	49
125		19	38	38	38	25	49	49	49
135		0	19	38	38	0	25	49	49

Numbers highlighted are maintenance amounts.

Table 17. Potassium recommendations for selected yields of corn silage (mineral soils).

Soil test	CEC	20 t/a				30 t/a			
		4	8	12	16	4	8	12	16
ppm		— lb K ₂ O/a —				— lb K ₂ O/a —			
40		214	237	264	295	294	300	300	300
80		166	181	200	223	246	261	280	300
85		160	174	192	214	240	254	272	294
95		160	160	176	196	240	240	256	276
105		160	160	160	178	240	240	240	258
115		160	160	160	160	240	240	240	240
125		80	160	160	160	120	240	240	240
135		0	80	160	160	0	120	240	240

Numbers highlighted are maintenance amounts.

Maximum annual recommendation is 300 lb K₂O/a.

Where soybeans have not been grown recently, inoculation of the soybean seed with soybean-specific Bradyrhizobia strains is essential for effective nitrogen fixation.

Soybeans are more sensitive to fertilizer placement and rate than corn. Starter fertilizer placed 2 inches to the side and 2 inches below the seed can contain up to 100 pounds of phosphate (P₂O₅) and 60 pounds of potash (K₂O) per acre. Placement of fertilizer with the seed may cause serious injury and reduced plant stands. When soybeans are drilled (7- to 10-inch spacing), broadcast and incorporate all the P₂O₅ and K₂O before plant-

Table 18. Phosphorus recommendations for selected yields of soybean (mineral soils).

Soil test	Yield (bu/a)	
	40	60
ppm	— lb P ₂ O ₅ /a —	
5	82	98
10	57	73
15-30	32	48
35	16	24
40	0	0

ing. The P₂O₅ and K₂O required for soybeans may also be broadcast prior to the previous corn crop. For no-till soybeans, use a band-placed starter fertilizer or broadcast the required fertilizer before planting. On lake-bed soils and dark-colored soils where the soil pH is above 6.5, Mn application will usually improve soybean growth and yields. Include 2 lb Mn/a (or the recommended amount based on a soil test) in the starter fertilizer, or apply one or two applications of 1 to 2 lb Mn/a to the foliage. Broadcast applications made to the soil are not effective.

Dry Edible (Field) Beans

Phosphorus and K recommendations are given in Tables 20 and 21.

Dry beans, like soybeans, are legumes and can fix N. Nitrogen fixation in dry bean can be unreliable, however, because of environmental conditions and variability among varieties. Therefore, applying 40 to 60 lb N/a is recommended to achieve maximum yield. Apply 60 lb N/a for beans grown in narrow rows (less than 23 inches) and for colored beans grown under irrigation. For beans grown with less intense management systems, apply 40 lb N/a. Applying ex-

Nutrient Recommendations for Field Crops in Michigan

Table 19. Potassium recommendations for selected yields of soybean.

Soil test	CEC	40 bu/a				60 bu/a			
		4	8	12	16	4	8	12	16
ppm		— lb K ₂ O/a —				— lb K ₂ O/a —			
40		110	133	160	191	138	161	188	219
80		62	77	96	119	90	105	124	147
85		56	70	88	110	84	98	116	138
95		56	56	72	92	84	84	100	120
105		56	56	56	74	84	84	84	102
115		56	56	56	56	84	84	84	84
125		28	56	56	56	42	84	84	84
135		0	28	56	56	0	42	84	84

Numbers highlighted are maintenance amounts.

Table 21. Potassium recommendations for selected yields of dry beans (mineral soils).

Soil test	CEC	20 cwt/a				30 cwt/a			
		4	8	12	16	4	8	12	16
ppm		— lb K ₂ O/a —				— lb K ₂ O/a —			
40		86	109	136	167	102	125	152	183
80		38	53	72	95	54	69	88	111
85		32	46	64	86	48	62	80	102
95		32	32	48	68	48	48	64	84
105		32	32	32	50	48	48	48	66
115		32	32	32	32	48	48	48	48
125		16	32	32	32	24	48	48	48
135		0	16	32	32	0	24	48	48

Numbers highlighted are maintenance amounts.

cess N can delay bean maturity and may increase potential for white mold if the crop canopy is dense.

Dry beans are sensitive to low levels of available Zn. Providing adequate amounts of Zn fertilizer, if needed, is important because even mild Zn deficiency can delay maturity. Use a soil test to determine available Zn levels, and calculate the amount to apply from the equation on page 27. In the absence of a soil test, apply 1 lb Zn/a if the previous crop was sugar beets or if the soil pH is above 6.5.

Table 20. Phosphorus recommendations for selected yields of dry edible beans (mineral soils).

Soil test	Yield (cwt/a)	
	20	30
ppm	— lb P ₂ O ₅ /a —	
5	74	86
10	49	61
15-40	24	36
45	12	18
50	0	0

Dry beans do not tolerate fertilizer applied with the seed. Up to 40 lb N/a, all of the P₂O₅ and 60 lb of K₂O/a may be included in a starter fertilizer placed in a band 2 inches to the side and 2 inches below the seed. Before planting, broadcast and incorporate any additional fertilizer that is needed. Additional N may also be sidedressed two weeks after planting.

Bean yield may be affected by nutrient management and cropping systems. Dry beans grown after sugar beets often experience Zn deficiency, which results in delayed maturity and reduced yield. Dry beans rely on a symbiotic relationship with mycorrhizal fungi to assist the plant in taking up nutrients. Sugar beets do not host these fungi. Reduced numbers of mycorrhizae after sugar beets result in Zn deficiency because the bean plant can not take up enough Zn on its own.

Dry beans are also more sensitive to soil compaction than some other crops, particularly soybean. So take care to avoid soil compaction after primary tillage.

Introduction Figure 1: How to read the insecticide tables in this bulletin – a made-up example!

Active ingredients (AI) are listed alphabetically.
Insecticides are listed by Trade Name under each AI to allow for comparison or substitution of products.

See Table 1 to cross reference active ingredients x insecticide.

A letter under an insect indicates it is on the label
• The specific letter corresponds to use rates in column 2.

Compare PHIs between products

A few of the important statements on the label

Active ingredient Trade names	Labeled rate per acre	caterpillars	cutworm	grasshopper	spider mite	stink bugs	Pre-harvest Interval (PHI) in days	Precautions and Remarks
abamectin Big-Ten SC	(a) 1.7 - 3.5 oz				a		28	<ul style="list-style-type: none"> Apply when spider mites are first observed
An AI with one trade name with a single rate (a) for one pest, spider mite								
bifenthrin Brutus Buckeye	(a) 3.5 - 5.0 oz (a) 7.0 - 10 oz	a	a	a		a	18	<ul style="list-style-type: none"> Do not make applications less than 30 days apart
An AI with two trade names, each with its own single rate (a) for multiple insects • For example, for cutworm the rate per acre is 3.5-5.0 oz of Brutus and 7.0-10 oz of Buckeye								
chlorantraniliprole O-Hi Advanced	(a) 14 oz (b) 20 oz	a		b			1	<ul style="list-style-type: none"> Must be applied before insects reach damaging levels
An AI with one trade name but different use rates, (a) and (b), for different pests • For example, the rate per acre is (a) 14 oz for caterpillars and (b) 20 oz for grasshoppers								
cyhalothrin (lambda) Izzo AG Green-UP WDG Lansing LV Scarlet 4F Spartan Izzo Extra Spartan Maxx	(a) 3 oz (b) 6 oz (a) 1 oz (b) 2 oz	a	a	b		b	30	<ul style="list-style-type: none"> Do not graze or harvest vines as forage or hay
An AI with many trade names, grouped by use rates; products in a group are similar and interchangeable • For example, for cutworm use (a) 3 oz of Izzo Ag or 1 oz of Izzo Extra. Use the higher rate (b) for hoppers • If you can't find Izzo Extra, Spartan Maxx is a similar product								

Management of Insect Pests of Dry Beans in Michigan

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How to Use this Guide

This publication is set up as a series of stand-alone tables with information on insect biology, damage, management recommendations, and insecticides registered in Michigan on **dry beans**. Pesticide names and rates are current as of the date at the top of the page.

- ✓ **Table 1** shows the timing of common insect pests in the crop, from early to late season.
- ✓ **Table 2** is a checklist of damage symptoms from these insects to aid in field scouting.
- ✓ **Table 3** has information on the life cycle of each insect, plus a detailed description of its damage and the conditions that may lead to or favor infestations. A rating of pest status (and thus damage potential) is given based on experience in the state. Most insect pests are uncommon or do not increase to damaging levels in a typical year.
- ✓ **Table 4** has information on management of each pest. Most insects are kept in check by natural enemies (biological control) or by adverse environmental conditions. Some pest problems can be reduced by simply changing or avoiding certain agronomic practices. Table 4 also gives scouting and threshold recommendations. Note that these recommendations vary in quality. Key pests tend to have research-based scouting methods and thresholds. But many insects are not at damaging levels often enough to generate good information; sampling recommendations and thresholds for these species are based on observations, experience, or a best guess. This is noted in the table.
- ✓ Insecticides registered in Michigan on the crop are listed in **Table 5** (at planting) and **Table 6** (foliar sprays). Active ingredients (AI) are listed alphabetically in column 1. All products with the same active ingredient are grouped together under each AI for easy comparison or substitution of one product for another. Label rates and pests are listed in columns 2 and 3. A letter under a pest indicates that a particular insect is on the label (i.e., the label claims control of that insect). The letter corresponds to an application rate in column 2. Some insecticides are applied at a single rate for all insects ('a'), while others vary ('a', 'b', 'c'). The final columns in the table list the preharvest interval (PHI) in days and notes on application - for example bee toxicity warnings, minimum recommended spray volumes, or other restrictions.

Table 1. Timing of damage from insect pests of dry beans in Michigan
Pests are listed from early to late-season. Key species are highlighted in bold text.

Common name	Overwintering stage, location	May	June	July	August	September
seedcorn maggot	pupae, in soil	larvae (maggots) feed on seeds and scar cotyledons				
slugs & snails	both eggs and adults, in field	juveniles and adults feed on seedlings				
white grubs	larvae (grubs), underground	larvae (grubs) feed on roots				
aphids (usually black bean & cotton aphids)				nymphs and adults pierce leaves, feed on plant sap		
grasshoppers (multiple species)	egg clusters, underground			nymphs and adults feed on leaves		
green cloverworm	Southern USA, migrate north			larvae (caterpillars) feed on leaves and pods		
Mexican bean beetle	adults, in protected areas			larvae and adults skeletonize leaves		
potato leafhopper	Southern USA, migrate north			nymphs and adults suck plant sap		
spider mite	adult females, at the base of hosts			nymphs and adults pierce plant cells, suck plant sap		
Lygus or tarnished plant bug	adults, in protected areas			nymphs and adults suck plant sap		
thrips	depends on species			nymphs and adults 'punch' individual cells, suck plant sap		
western bean cutworm	prepupae, underground			larvae (caterpillars) feed on blossoms and developing pods, then chew into beans		
European corn borer	larvae, in corn residue				second generation larvae bore stems & chew into pods, beans	
stink bug	adults, in & around fields				nymphs and adults suck plant sap, pierce developing pods	

Table 2: Damage checklist to aid in scouting for insect pests of dry beans in Michigan

Plant part or timing Type of damage or injury	aphids	European corn borer	grasshoppers	green cloverworm	Mexican bean beetle	plant bug	potato leafhopper	seedcorn maggot	slugs & snails	spider mite	stink bugs	thrips	western bean cutworm	white grubs
<u>Stand (emergence)</u>														
seeds fed-on								x	x					x
gaps in row								x	x					x
wilted or cut plants														x
<u>Leaves</u>														
slimy or shiny trails									x					
scraping of leaf surface					x				x					
skeletonizing between veins					x									
irregular leaf feeding			x	x										
severe defoliation			x	x	x									
generalized leaf yellowing	x					x				x				
yellow leaf margins (hopperburn)							x							
tiny yellow spots (stippling)										x		x		
leaves cupped, crinkled	x					x	x			x		x		
sticky leaves or sooty mold	x													
fine webbing										x				
leaf drop, death							x			x		x		
<u>Stems</u>														
boring into stem		x												
powdery frass		x												
<u>Roots</u>														
root hairs missing														x
pruning of whole roots														x
<u>Pods and beans</u>														
large holes chewed into pod		x	x										x	
small holes chewed into pod		x		x									x	
beans fed on in pod		x	x										x	
shriveled, aborted beans						x					x			
<u>Other</u>														
virus transmission	x													

Table 3: Life cycle, damage, and pest status of insect pests of dry beans in Michigan

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare:** Unusual, typically goes unnoticed. May not even be present
- **Uncommon:** Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional:** Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important:** Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized:** Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan
aphids	Summer population is all female. Females give birth to live young and do not mate to reproduce (parthenogenesis). Multiple overlapping generations	<ul style="list-style-type: none"> • All stages suck plant sap from leaves • Heavy infestation may lead to stunting, curling of leaves, weakening of plants • Aphids also transmit plant viruses 	<ul style="list-style-type: none"> • Drought stress may be made worse by aphids removing plant sap 	Uncommon Usually present, but numbers not enough to cause damage
bean leaf beetle	Adults overwinter in leaf litter and wooded field margins. Become active in spring; move into alfalfa, then migrate into beans after first alfalfa cutting. Larvae feed underground on roots. 1-2 generations per year	<ul style="list-style-type: none"> • Adults defoliate younger plants, leaving small round holes between major leaf veins • Adults feed on and scar developing pods, reducing yield and seed quality 	<ul style="list-style-type: none"> • Adults may move into dry beans, if adjacent soybean fields were infested in the previous or current season 	Uncommon Usually present, but numbers rarely high enough to cause damage
European corn borer (ECB)	Mature larvae overwinter in corn residue and pupate in late spring. Moths emerge in late May-early June and lay eggs in corn and other crops. Two generations in south & central Michigan, the first in June & the second in late July/ early August. One generation in the UP and northern Michigan.	<ul style="list-style-type: none"> • Older larvae bore into stem, disrupt water flow, weaken stem • Larvae also bore into pods, consume seeds, and contaminate harvested beans 	<ul style="list-style-type: none"> • Nearby non-Bt corn production probably increases local ECB risk 	Uncommon Populations suppressed by widespread use of Bt GMO corn
grasshoppers <i>multiple species</i>	Eggs overwinter in soil. Nymphs emerge in June. Amount of feeding increases with size. Females lay groups of eggs in the undisturbed soil in late summer. 1 generation per year	<ul style="list-style-type: none"> • All stages chew on leaves; feeding has a ragged appearance 	<ul style="list-style-type: none"> • Fallow areas and pasture are preferred egg-laying sites • A hot dry summer & fall can lead to a high population the next year 	Uncommon Outbreaks rare, usually after a dry season
green cloverworm	Adults lay eggs singly on the undersides of leaves. Larvae feed on foliage.	<ul style="list-style-type: none"> • Small caterpillars scrape leaf tissue while older larvae defoliate plants. 		Uncommon Usually present, but numbers rarely high enough to cause damage

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan
Mexican bean beetle	Adults overwinter in crop debris, woodlots, etc. Adults move into dry beans in early summer and lay eggs. Larvae mature in 3-4 weeks, pupating on leaf surface. Adults emerge in late July into August, lay eggs for a second generation. Second generation larvae feed, pupate in late August, and new adults overwinter.	<ul style="list-style-type: none"> • Larvae and adults strip the leaf surface between the veins on the underside of leaves, resulting in windowpane damage or a skeletonized (lacy) appearance. Time frame: mid-July into August. • Pod feeding is rare 	<ul style="list-style-type: none"> • A mild winter increases survival • Planting adjacent to fields with high populations the previous year • Early-planting (adults attracted to these fields) 	Uncommon and Localized
potato leafhopper (PLH)	Adults are carried into Michigan from the south on weather fronts in May/early June. Females lay eggs inside stems. Nymphs hatch in 7-10 days, begin feeding immediately, and reach adult stage in 2-3 weeks. Multiple overlapping generations	<ul style="list-style-type: none"> • Adults and nymphs lacerate and suck on leaves and stems, damaging cells and blocking vascular tissue; the classic symptom of feeding is tip yellowing or 'hopper burn' • Other symptoms include stunting and curling of leaves and poor pod fill 	<ul style="list-style-type: none"> • PLH damage is worse under dry conditions, and leafhopper survival is probably better too 	Sporadic <i>later in season:</i> Important, if populations become well-established
seedcorn maggot (SCM)	SCM overwinters as pupae in the soil. Adult flies emerge in early spring and are attracted to lay eggs in disturbed soil with decaying organic matter. Multiple generations	<ul style="list-style-type: none"> • Tiny larvae (maggots) feed on germinating seed. May cause variable emergence, stand loss, and delayed development. 	<ul style="list-style-type: none"> • Cool wet conditions which delay germination • Tillage of fields with high organic matter from a decaying green cover crop, or weeds, or fresh manure 	Sporadic and Localized Depends on presence of fresh organic matter and cool, wet conditions
slugs & snails	Slugs overwinter as both eggs & adults; females deposit eggs in soil; these hatch in about one month. Multiple overlapping generations	<ul style="list-style-type: none"> • Feeding on cotyledons & lower leaves; feeding usually occurs at night • Substantial defoliation can be tolerated in pre-bloom dry beans, but if the growing point is killed, stands can be significantly reduced 	<ul style="list-style-type: none"> • Planting into heavy crop residue • Cool, wet soils which delay germination • Poorly closed furrows give access to seed 	Localized Depends on residue and cool conditions. Dry beans are usually planted after slug risk is past.
spider mite	Adult females overwinter in field borders and sheltered areas. In spring, they move to new growth, and lay eggs. Mites spread from field to field by crawling or blowing in the wind. Multiple overlapping generations	<ul style="list-style-type: none"> • Adults & nymphs pierce individual plant cells, resulting in tiny yellow spots called stippling • Webbing is a sign of heavy infestation • Severe damage results in leaf yellowing, death, water loss 	<ul style="list-style-type: none"> • Prolonged hot, dry weather favors an outbreak and enhances the impact of feeding • Infestations often start on dusty edges of fields 	Sporadic Outbreaks occur in hot, dry seasons
stink bug <i>several species including green, one-spotted, & the brown marmorated</i>	Adults overwinter in protected areas. Weeds and early crops like wheat are fed on and colonized first. Stink bug eggs, laid in small clusters, often sport a small 'crown'. Nymphs and adults live and feed in the crop together. Note - some stink bug species are beneficial predators of other insects like caterpillars	<ul style="list-style-type: none"> • Adults and nymphs feed by injecting salivary enzymes into plants and sucking up plant juices • Feeding on pods can result in aborted or shriveled beans 	<ul style="list-style-type: none"> • May move into dry beans as adjacent wheat fields dry down 	Uncommon Numbers rarely high enough to cause damage
tarnished plant bug (TPB)	Adults overwinter in residue and on field edges. Weeds and early crops like alfalfa are fed on and colonized first.	<ul style="list-style-type: none"> • Adults and nymphs suck plant sap. Tarnished plant bug injects a toxic saliva during feeding. • Feeding on pods can result in aborted or shriveled beans 	<ul style="list-style-type: none"> • May move into dry beans from adjacent alfalfa fields that were recently cut 	Uncommon Numbers rarely high enough to cause damage

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan
thrips	<p>Adults and nymphs overwinter in residue. Populations initially build up on grasses and in wheat.</p> <p>Note that thrips are an important food source for some of the beneficial insects, such as pirate bugs, that control other pests.</p>	<ul style="list-style-type: none"> • Nymphs and adults feed with a single mandible, using it to puncture plant cells and slurp up the liquid inside • Punctured cells dry up, resulting in areas of dead cells; under heavy infestation, leaves dry up, curl, or die 	<ul style="list-style-type: none"> • Dry conditions in early summer • May move into dry beans from adjacent wheat fields or grassy borders that are drying down 	<p>Uncommon</p> <p>Usually present, but numbers rarely high enough to cause damage</p>
western bean cutworm (WBC)	<p>Overwinter in pre-pupal stage. Adults emerge in mid-late July; females lay eggs in pre-tassel corn and switch to dry beans as corn matures. Larvae feed on pods at night. In early September, they drop & burrow into soil to over-winter. Areas with sandy soil appear to have deeper and better overwintering.</p> <p>1 generation per year</p>	<ul style="list-style-type: none"> • Tiny larvae feed on leaves and then inside blossoms • Larger larvae drop to the ground & stay under residue or in cracks during the day. They climb into the canopy to feed on pods at night 	<ul style="list-style-type: none"> • Areas with sandy soil, where overwintering survival is higher • Adjacent corn which is no longer attractive for egg laying (past the pretassel stage) 	<p>Occasional - Important</p> <p>Montcalm and surrounding counties + the UP are historic hot spots for WBC</p>
white grubs <i>multiple species</i>	<p>Mature grubs overwinter underground. Adults emerge May-July, depending on species. Eggs laid in soil in the summer. Grubs feed on roots, then move down in soil profile in late fall to overwinter. In spring, grubs feed for a period, then pupate.</p> <p>1 generation per year except June beetle, which has a 2-3 year life cycle</p>	<ul style="list-style-type: none"> • Larvae (grubs) prune root hairs and sometimes whole roots, causing wilting, water and nutrient deficiency, or plant death 	<ul style="list-style-type: none"> • Planting into fallow fields or pasture • Fields near home lawns or pasture • Fields or parts of fields with sandy soil type 	<p>Uncommon</p>

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of dry bean in Michigan

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
aphids	<ul style="list-style-type: none"> • Biological: Predators (such as ladybugs, lacewings, parasitoids) keep populations in check. Under humid conditions, entomopathogenic fungi infect aphids. • Environmental: Heavy rainfall and irrigation can wash off aphids. Adequate moisture reduces feeding stress and increases humidity for infection by pathogens. 	Check 100 plants (20 plants x 5 sets)	<p>General guideline: One or more aphid colony (a group of about 30) per plant</p> <p>Rarely justified</p>
bean leaf beetle	<ul style="list-style-type: none"> • Environment: Extended periods of cold winter temperatures may increase kill of overwintering beetles. 	Check 100 plants (20 plants x 5 sets)	<p>General guideline: More than 10% of the pods damaged</p> <p>Rarely justified</p>
European corn borer (ECB)	<ul style="list-style-type: none"> • Biological: Numerous natural enemies kill ECB eggs and larvae. Predators, egg and larval parasitoids, and pathogens are common • Agronomic: The widespread planting of Bt corn has greatly reduced the European corn borer population in the landscape 	<p>No specific recommendation</p> <p>Note: Trapping can detect large corn borer flights. Michigan moths respond to Z (Iowa) strain pheromone</p>	None
grasshoppers	<ul style="list-style-type: none"> • Biological: Blister beetle larvae and other insects prey on eggs. Insects, birds, and mammals eat nymphs & adults. Fungal pathogens kill eggs and nymphs under wet spring conditions • Agronomic: Tillage reduces survival of eggs and newly hatched nymphs • Insecticide: May be able to limit sprayed area if hoppers invade from a neighboring field or grassy border 	<p>No specific recommendation</p> <p>Have never seen populations high enough to treat in Michigan</p>	<p>General guideline: During flowering & pod fill, 15% overall defoliation by leaf-feeding insects, including hoppers</p>
green cloverworm	<ul style="list-style-type: none"> • Biological: Many natural enemies keep cloverworm in check. 	<p>No specific recommendation</p> <p>Cloverworm can be detected by sweeping or beating plants over a cloth laid between rows</p>	<p>General guideline: During flowering & pod fill, 15% overall defoliation by leaf-feeding insects, including cloverworm</p>
Mexican bean beetle (MBB)	<ul style="list-style-type: none"> • Biological: Predators feed on eggs and larvae. • Agronomic: Avoid early planting, as overwintered adults colonize these fields first. • Environmental: Hot, dry weather and heavy rainfall are both cited as reducing populations. 	<p>Early to mid July: Scout for # egg masses per meter. Take multiple samples across the field</p> <p>During flowering & pod fill: estimate defoliation</p>	<p>General guideline – 0.5 egg masses per meter/yard or 15% overall defoliation by leaf-feeding insects, including MBB</p>
potato leafhopper (PLH)	<ul style="list-style-type: none"> • Biological: A naturally occurring fungal pathogen reduces PLH numbers under favorable conditions, usually later in the year • Insecticides: Resistance is not an issue with PLH 	<p>Check 100 trifoliates from different plants (20 leaves x 5 sets)</p> <p>Count both adults and nymphs</p>	<p>Unifoliolate stage: > 0.5 leafhopper <u>per plant</u></p> <p>Otherwise: > 1 leafhopper per trifoliolate leaf</p>
seedcorn maggot (SCM)	<ul style="list-style-type: none"> • Agronomic: Potential for injury increases in wet, cool springs when seed germinates slower, or when seed is planted into tilled fields where fresh green material (cover crops or weeds) have been worked in. Risk drops after organic matter breaks down. Risk is very low in no-till fields. • Insecticide: Management is preventative, using a seed treatment in tilled fields where weeds and cover crop were recently killed or manure applied. 	No specific recommendation	No rescue treatment is available. Consider replanting fields or areas with significant stand loss

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
slugs & snails	<ul style="list-style-type: none"> Biological: Some ground beetle species consume slugs. Agronomic: Tillage and crop rotation reduce corn residue (slug habitat). Avoid planting in wet conditions, as open furrows act as slug highways Insecticide: Slugs are not insects, thus soil insecticides and seed treatments have no impact on them. Some studies suggest that seed treatments actually exacerbate slug populations by killing their ground beetle predators 	<p>No specific recommendation</p> <p>Walk fields at night or early morning, turning over residue and looking for slime trails</p>	<p>None established</p> <p>A guess: Consider applying a molluscicide (slug bait) if stand is reduced by 5%</p>
spider mite	<ul style="list-style-type: none"> Biological: Under humid conditions, a natural fungal pathogen can infect and wipe out mite populations in a matter of days. Some natural enemies eat mites Agronomic: Irrigation mitigates the impact of spider mite feeding and increases humidity for fungal biocontrol, but during a drought, even irrigation isn't enough Environmental: Rainfall has a similar effect as irrigation Insecticide: Insecticide resistance is common in mites. Some insecticides (including most pyrethroids) flare mite populations by killing off natural enemies. Likewise, fungicide applications may disrupt fungal pathogens of mites. Insurance applications of both are discouraged; be cautious about pesticide applications in dry years 	<p>Infestations often start on field edges</p> <p>Look for mites on the undersides of leaves using hand lens, or tap leaves over a black piece of paper</p> <p>Webbing is present when populations are high</p>	<p>A guess: Treat when mites appear on >25% of the plants and yellowing is first seen</p> <p>Mites are difficult to control. Spraying is often a losing proposition</p>
stink bugs	<ul style="list-style-type: none"> Biological: Several parasitoids attack egg masses or bugs 	<p>No specific recommendation</p>	<p>None established</p>
tarnished plant bug	<ul style="list-style-type: none"> Agronomic: Good weed control reduces alternate hosts for plant bugs 	<p>No specific recommendation</p>	<p>General guideline: One bug or more per plant at first flower to green pod stage</p>
thrips	<ul style="list-style-type: none"> Biological: Generally kept in check by predators. Environmental: Rainfall or irrigation reduces populations. Insecticides: Onion thrips are killed better by pyrethroids than OPs/ carbamates <p>A caution about spraying: Thrips can be viewed as semi-beneficial, because they are predators of spider mite eggs. Spraying for thrips may contribute to a spider mite outbreak in the future, especially under dry conditions</p>	<p>Infestations often start on field edges</p> <p>Look for thrips on the undersides of leaves using hand lens. Or tap leaves over a white piece of paper or a paper plate</p>	<p>Threshold used in the High Plains: >15 thrips per plant and leaf cupping is present</p> <p>(this threshold has not been tested in MI or OH)</p>
western bean cutworm	<ul style="list-style-type: none"> Biological: Many predators consume eggs and larvae; tiny Trichogramma wasps have been seen in the field in Michigan parasitizing egg masses 	<p>Sampling beans directly for WBC eggs of larvae is difficult</p> <p>Use bucket-type pheromone traps to detect flight, starting at the end of June. At a cumulative catch of 100-120 moths, scout fields for pod feeding</p>	<p>Action threshold developed in the Great Lakes Region:</p> <p>Treat when >10% of pods are fed on by WBC larvae</p>
white grubs	<ul style="list-style-type: none"> Biological: Some species are attacked by pathogens. Agronomic: If practical, fall plowing of long-standing fallow fields & pasture prior to planting is recommended. Tillage also exposes grubs to mammals and birds. <p>Note: It is important to identify grubs to species distinguish annual species from multi-year species of June beetles</p>	<p>No specific recommendation</p> <p>Grubs tend to be patchy, and in sandy parts of fields</p> <p>Grubs are sometimes detected when plowing in the fall or spring</p>	<p>None established</p>

Table 5: Soil/at-plant insecticides to manage insect pests of dry beans in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the use rate from column two.
- Note that insecticide rates per 1000 feet of row are based on a **30-inch row spacing**. See label for specific per-acre rate and gauge-setting charts for narrower row spacing.

Active ingredient Trade Names	Labelled rate(s) per 1000 feet of row or per acre	seedcorn maggot	slugs & snails	white grubs	Precautions and Remarks
bifenthrin Xpedient Plus V Bifender FC Capture 3RIVE3D Bifenture LFC Capture LFR Nirvana RTU Sniper LFR	(a) 0.15 – 0.30 oz per 1000 ft (= 2.56 - 5.12 oz per acre) (a) 0.17 - 0.34 oz per 1000 ft (= 3.0 - 5.9 oz per acre) (a) 0.19 – 0.46 oz per 1000 ft (= 3.2 - 8 oz per acre) (a) 0.2 - 0.39 oz per 1000 ft (= 3.4 - 6.8 oz per acre)	a		a	<ul style="list-style-type: none"> • Apply as a band over row on soil surface, T-banded over an open furrow, or in-furrow; see label for PRE and PPI instructions • Many are formulated to mix directly w/ fertilizer or PRE herbicide applications Note: Many of these can be broadcast on the soil surface to control cutworm and armyworm .
bifenthrin + biofungicide Ethos XB Ethos Elite LFR	(a) 0.2 - 0.49 oz per 1000 ft (= 3.4 - 8.5 oz per acre)	a		a	<ul style="list-style-type: none"> • Similar to bifenthrin alone, but contains a biological fungicide for suppression of early season root diseases: XB: <i>Bacillus amyloliquefaciens</i> Elite: <i>Bacillus velezensis</i> & <i>subtilis</i> strains • Apply T-band or in-furrow; see label for PRE and PPI instructions and for other row spacings
cypermethrin (zeta) Mustang Mustang Maxx	(a) 0.247 oz per 1000 ft (= 4.3 oz per acre) (a) 0.23 oz per 1000 ft (= 4 oz per acre)			a	<ul style="list-style-type: none"> • Apply T band or in-furrow in a minimum of 2-7 gal per acre
iron phosphate Ferroxx AQ Sluggo	(a) 4.0 – 15.0 lbs per acre (a) 20 - 44 lbs per acre		a		<ul style="list-style-type: none"> • Broadcast using a spreader • Apply bait in evening when slugs feed; product works best when the soil is moist
sodium ferric EDTA Ferroxx Slug & Snail Bait	(a) 5 – 20 lbs/acre		a		<ul style="list-style-type: none"> • Broadcast uniformly using a spreader • Apply higher rate if infestation is severe • Non-toxic to pets and wildlife

Table 6: Foliar Insecticides to manage insect pests of dry beans in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two

Active ingredient Trade Names	Labelled rate per acre (unless stated)	aphids	bean leaf beetle	Euro corn borer	grasshopper	green cloverworm	Mex bean beetle	plant bugs	potato leafhopper	spider mite	stink bugs	thrips	western bean cutworm	Pre harvest interval (PHI) in days	Precautions and Remark
abamectin Abba Ultra Agri-Mek SC Reaper 0.15EC Reaper Clearform	(a) 4 - 8 oz (a) 1.75 - 3.5 oz (a) 8 - 16 oz									a				7	<ul style="list-style-type: none"> • Ground application recommended (instead of air), at minimum 10 gal per acre. • Abba Ultra label indicates product must be applied with a “non-ionic activator type wetting, spreading or penetrating spray adjuvant” that is approved on dry beans. See label for details
acephate Acephate 90WDG Acephate 90WSP Acephate 90 Prill Acephate 97UP Acephate 97 WDG Orthene 97	(a) 4 - 8 oz (b) 8 - 17.6 oz (c) 12.8 - 17.6 oz (a) 4.4 - 8.9 oz (b) 8.9 - 17.6 oz (c) 13.3 - 17.6 oz (a) 4 - 8 oz (b) 8 - 16 oz (c) 12 - 16 oz	b	b	c	a	b	b	b	b			b		14	<ul style="list-style-type: none"> • Minimum 20 gal per acre (ground) or 2 gal per acre (air) • Do not feed treated vines to livestock • WSP formulation is in water soluble packets
Bacillus thuringiensis (Bt) Agree Dipel ES Javelin Xentari DF	(a) 0.5 - 2.0 lbs (a) 1 - 2 pints (a) 0.25 - 1.5 lbs (a) 0.5 - 1.5 lb					a								0	<ul style="list-style-type: none"> • Larvae must eat treated foliage to be killed, so good coverage is needed • Bt sprays are most effective on small caterpillars • Biobit, Dipel DF, and Xentari can be used on organic beans
bifenazate Acramite 4SC	(a) 16-24 oz									a				7	<ul style="list-style-type: none"> • Apply in minimum of 20 gal per acre (ground) or 7 gal per acre (air) • Max 2 applications per year; 14 days between sprays

Active ingredient Trade Names	Labelled rate per acre (unless stated)	aphids	bean leaf beetle	Euro corn borer	grasshopper	green cloverworm	Mex bean beetle	plant bugs	potato leafhopper	spider mite	stink bugs	thrips	western bean cutworm	Pre harvest interval (PHI) in days	Precautions and Remark
bifenthrin Bifen2AgGold Bifenthrin 2EC Bifenture EC Brigade 2EC Fanfare EC, 2EC, & ES Reveal & Reveal Endurx Sniper & Sniper Helios Tundra EC	(a) 1.6 - 6.4 oz (b) 2.1 - 6.4 oz (c) 5.12 - 6.4 oz	b	b	b	b	a b	b	b	a	c	b	b	b	14	<ul style="list-style-type: none"> Extremely toxic to bees. See labels for details
Nirvana RTU	(a) 2.1 – 8.5 oz (b) 2.8 – 8.5 oz (c) 2.8 – 8.5 oz														
bifenthrin + biofungicide Ethos XB	(a) 2.8 - 8.5 oz	a	a	a	a	a	a	a	a	a	a	a	a	14	<ul style="list-style-type: none"> Combination product with the biological fungicide strain <i>Bacillus amyloliquefaciens</i> - otherwise similar in activity and precautions to bifenthrin alone.
bifenthrin + pyraclostrobin Nirvana Complete	(a) 13 oz	a	a	a	a	a	a	a	a	a	a	a	a	14	<ul style="list-style-type: none"> Combination product with fungicide - similar precautions to bifenthrin alone. Bifenthrin rate is similar to high rate in bifenthrin-only products
bifenthrin + chlorantraniliprole Elevest	(a) 4.8 – 9.6 oz (b) 5.6 – 9.6 oz (c) 7.7 – 9.6 oz	b	b	b	a	a	b	c	a	c	b	b	b	14	<ul style="list-style-type: none"> For spider mites, coverage is essential For grasshoppers, performance improved by adding methylated seed oil Highly toxic to fish and aquatic life & to bees
bifenthrin +cypermethrin Hero Hero EW Steed	(a) 4.0 - 10.3 oz (b) 10.3 oz (a) 4.5 - 11.2 (b) 11.2 oz (c) 3.5 - 4.7 oz	a c	a c	a c	a c	a c	a c	b	a c	b	a c	b c	a c	21	<ul style="list-style-type: none"> Highly toxic to bees
bifenthrin + imidacloprid (2:1 ratio) Skyraider	(a) 2.1 - 5.6 oz (b) 5.12 - 5.6 oz	a	a	a	a	a	a	a	a	b	a	a	a	14	<ul style="list-style-type: none"> Do not make applications less than 7 days apart Extremely toxic to bees. See label for details
bifenthrin + imidacloprid (1:1 ratio) Brigadier Swagger	(a) 3.8 - 5.6 oz (b) 5.6 oz (a) 7.6 - 11.2 oz (b) 11.2 oz	a	b	b	a	b	b	a	a			a		14	<ul style="list-style-type: none"> Extremely toxic to bees. See label for details

Active ingredient Trade Names	Labelled rate per acre (unless stated)	aphids	bean leaf beetle	Euro corn borer	grasshopper	green cloverworm	Mex bean beetle	plant bugs	potato leafhopper	spider mite	stink bugs	thrips	western bean cutworm	Pre harvest interval (PHI) in days	Precautions and Remark
bifenthrin + sulfoxaflor Ridgeback	(a) 5.5 – 13.8 oz (b) 11.0 – 13.8 oz	a	a	a	a	a	a	a	a	b	a	a	a	14	<ul style="list-style-type: none"> Do not make applications less than 14 days apart Max 2 consecutive applications per crop
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 0.5 - 1.0 qt (b) 1.0 qt (c) 1.0 - 1.5 qt		a	c		a	a	c	b		c	b	b	21 beans 14 forage	<ul style="list-style-type: none"> Application to wet foliage or in periods of high humidity may cause plant injury "May kill honey bees and other bees in substantial numbers"; do not apply when crop or weeds are in bloom
chlorantraniliprole Coragen Prevathon	(a) 2 - 5 oz (b) 3.5 - 7.5 oz (a) 8 - 20 oz (b) 14 - 20 oz			b	a								b	1	<ul style="list-style-type: none"> Thorough coverage is important; insects must eat treated foliage for optimum control See label for specific directions for grasshopper control
chlorantraniliprole + cyhalothrin Besiege	(a) 5 - 8 oz (b) 6 - 10 oz	b	b	b	b	a	a	b	b		b	b	b	21	<ul style="list-style-type: none"> Do not graze or harvest vines for forage 'suppression' of spider mites
cyantraniliprole Exirel	(a) 10.0- 20.5 oz			a										7	<ul style="list-style-type: none"> Label lists suppression of potato leafhopper and thrips See label statement about 'adverse crop response'
cyantraniliprole + abamectin Minecto Pro	(a) 7.5 - 10 oz			a							a			7	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre ground or 5 gal per acre air; ground application recommended for coverage Label lists suppression of potato leafhopper and thrips See label statement about 'adverse crop response'
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 0.8 - 1.6 oz (b) 1.6 - 2.4 oz (c) 2.4 - 3.2 oz		c	c	c	c	c	b	a		b		*	7	<ul style="list-style-type: none"> Do not feed treated vines or hay to livestock <p>* Western bean cutworm is not on the current labels, but cyfluthrin is labeled for WBC in corn</p>
cyfluthrin + imidacloprid Leverage 360	(a) 2.4 - 2.8 oz	a	a	a	a	a	a	a	a					7	<ul style="list-style-type: none"> Label lists suppression of stink bugs at high rate Do not feed treated vines or hay to livestock
cyhalothrin (gamma) Declare Proaxis	(a) 0.77 - 1.28 oz (b) 1.28 - 1.54 oz (a) 1.92 - 3.30 oz (b) 2.56 - 3.84 oz	b	b	b	b	a	a	b	b		b	b	b	21	<ul style="list-style-type: none"> Do not graze or harvest vines for forage

Active ingredient Trade Names	Labelled rate per acre (unless stated)	aphids	bean leaf beetle	Euro corn borer	grasshopper	green cloverworm	Mex bean beetle	plant bugs	potato leafhopper	spider mite	stink bugs	thrips	western bean cutworm	Pre harvest interval (PHI) in days	Precautions and Remark
cyhalothrin (lambda) Grizzly Too Lamcap II Province II Ravage II Warrior II w/Zeon Tech. Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag LambdaStar Lambda-T Kendo Paradigm VC Ravage Silencer Willowood Lambda-Cy1EC	(a) 0.96 - 1.60 (b) 1.28 - 1.92 (a) 1.92 - 3.2 (b) 2.56 - 3.84	b	b	b	b	a	a	b	b		b	b	b	21	<ul style="list-style-type: none"> Do not graze or harvest vines as forage or hay
cypermethrin (alpha) Fastac EC or CS	(a) 2.7 -3.8 (b) 3.2 - 3.9 oz	b	a	a	b	a	a	a	a		b	b	*	21	<ul style="list-style-type: none"> CS formulation is microencapsulated * western bean cutworm is not on the current labels, but cypermethrin is labeled for WBC in corn
cypermethrin (zeta) Mustang Maxx	(a) 2.72- 4.0 oz (b) 3.2 - 4.0 oz	b	a	a	b	a	a	a	a		b	b	*	21	<ul style="list-style-type: none"> Extremely toxic to bees. Do not apply to blooming crops if bees are visiting the field * western bean cutworm is not on the current labels, but cypermethrin is labeled for WBC in corn
dimethoate Dimate 4E Dimethoate 400 and 4EC	(a) 0.5 - 1.0 pt	a	a		a		a	a	a	a				0	<ul style="list-style-type: none"> Max 2 pints/ acre per year; 14-day retreatment interval Do not feed treated vines to livestock Highly toxic to bees
esfenvalerate Asana XL S-FenvaloStar Zyrate	(a) 2.9 - 5.8 oz (b) 5.8 - 9.6 oz				b	b	a		b				b	21	<ul style="list-style-type: none"> Do not feed or graze livestock on treated vines See label language about grasshopper control Highly toxic to bees; See label for details
flupyradifurone Sivanto HL Sivanto 200 SL Sivanto Prime	(a) 3.5 - 7.0 oz (a) 7 - 10.5 oz (a) 7 - 14 oz	a							a					7	<ul style="list-style-type: none"> Foliar applications have systemic properties. Product moves from deposition point to leaf tips and controls insects on underside of leaves
GS-omega/kappa-Hxtx-Hv1a Spear-Lep	(a) 1 – 2 pts			a		a							?		<ul style="list-style-type: none"> Novel mode of action. MUST be applied with a low dose of Bt insecticide (see label for details). Bt damages the caterpillar gut, allowing Spear-Lep to enter the body WBC is not on the label, but Spear-Lep probably has a similar activity on them

Active ingredient Trade Names	Labelled rate per acre (unless stated)	aphids	bean leaf beetle	Euro corn borer	grasshopper	green cloverworm	Mex bean beetle	plant bugs	potato leafhopper	spider mite	stink bugs	thrips	western bean cutworm	Pre harvest interval (PHI) in days	Precautions and Remark
imidacloprid Admire Pro Advise Four Alias 4F Montana 4F Nuprid 4FMax Provoke Wrangler Nuprid 2SC Prey 1.6F and Sherpa	(a) 1.2 oz (a) 1.4 oz (a) 2.8 oz (a) 3.5 oz	a							a					7	<ul style="list-style-type: none"> Highly toxic to bees. See label for details
imidacloprid + cyhalothrin Kilter	(a) 1.9 – 2.5 oz (b) 2.5 – 3.8	b	b	b	b	a	a	b	b		b	b	*	21	<ul style="list-style-type: none"> Highly toxic to bees. See label for details Do not graze livestock in treated areas or harvest vines * WBC is not on label, but cyhalothrin alone is effective for WBC control. Use the higher rate
indoxacarb Avaunt eVo Steward	(a) 3.5 – 6.0 (a) 6.7 - 11.3 oz			a										7	<ul style="list-style-type: none"> For ground application use minimum 20 gal per acre
methomyl Annihilate LV Corrida 29SL Lannate LV Lanveer LV Nudrin LV Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) 0.75 - 3 oz (b) 1.5 - 3 oz (a) 0.25- 1 oz (b) 0.5 - 1 oz	b		b			a	b	a		*	b		14	<ul style="list-style-type: none"> Kills both eggs and larvae of corn borer. See label for specific on timing Highly toxic to bees. See label for details * Lannate lists brown marmorated stink bug as a target
methoxyfenozide Intrepid 2F Invertid 2F	(a) 8 - 16 oz			a									*	7	<ul style="list-style-type: none"> Apply in a minimum of 20 gal per acre (ground) in a full canopy or 10 gal per acre (air) See label for info on specific application timing Endangered species warning for use in these MI counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Access EPA's 'Bulletins Live! Two' * Also labeled for various armyworm species. Western bean cutworm not on the label, but likely is effective

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naled Dibrom 8E	(a) 1.0 pint (b) 1.5 pint	a				a		a	a	a	b			1	
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4 _{II} PyGanic EC 5.0 _{II}	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a	a	a	a		a	a	a	0 when sprays dry	<ul style="list-style-type: none"> Plant-derived insecticides that knock down insects quickly but with short residual control. Coverage is critical PyGanic is OMRI listed for organic crops, Evergreen is not Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds
spinosyns (spinetoram & spinosad) Entrust Blackhawk Radiant SC Entrust SC Spintor 2SC	(a) 1 - 2 oz (b) 1.5 - 2 oz (a) 1.7-3.3 oz (b) 2.5 - 3.3 oz (a) 3 - 8 oz (b) 5 - 8 oz (a) 3 - 6 oz (b) 4.5 - 6 oz			a								b		28	<ul style="list-style-type: none"> Do not make more than two consecutive applications of products with spinetoram or spinosad For European corn borer, sprays must target eggs and small larvae; see label for information on application timing For thrips, control improved by adding an adjuvant; see label for details Do not feed forage to meat or dairy animals
spirotetramat Movento Movento HL	(a) 4 - 5 oz (a) 2 - 2.5 oz	a												7	<ul style="list-style-type: none"> Movento label also lists 'suppression' of spider mites and some species of thrips
sulfoxaflor Transform WG	(a) 0.75-1.0 oz (b) 1.5 - 2.25 oz	a						b						7	<ul style="list-style-type: none"> Moves within the leaf to target sucking pests Label also lists 'suppression' of thrips & some stink bugs



MICHIGAN BEAN COMMISSION

Production Research Advisory Board

Production Practices Survey

1. Open the camera on your smartphone
2. Hold it over the QR code below
3. Click on the link that appears at the top of the screen
4. Complete the survey on dry bean production practices and help direct future research!

Thank you!



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