2010 Dry Bean Research Report

Assessment of Narrow Row Technology

Michigan Dry Edible Bean Production

RESEARCH ADVISORY BOARD

The Michigan Bean Commission was awarded a grant from the MDA Specialty Crop Block Grant Program-Farm Bill.
The title of this project is "Assessment of Narrow Row Technology for the Michigan Dry Bean Industry".
Expected outcomes from this project are:

1. Identification of adaptable dry bean cultivars.
2. Identification of two new fungicides for control of white mold disease.
3. Identification of approved herbicides and plant desiccants with no adverse food safety implications.
4. Knowledge of row spacing and plant density impact to enable sound recommendations to growers.
5. Understanding and quantification of the economic benefits and improved management strategies associated with narrow row technology.

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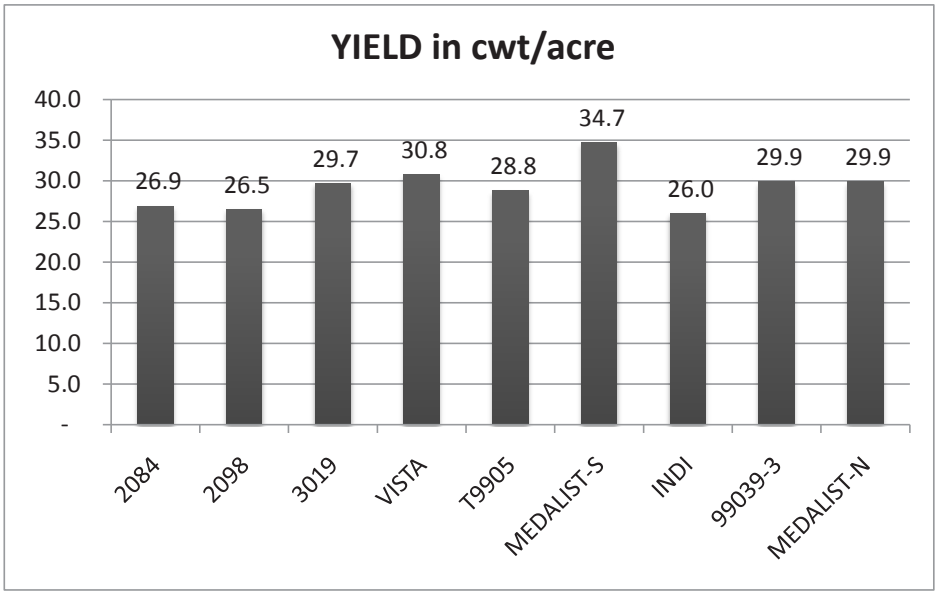
NAVY BEAN VARIETY STRIP TRIAL-15 INCH ROWS
GREENFIELD FARMS INC. PIGEON, MICHIGAN

VARIETY	YIELD	LODGE	PICK %	MOISTURE	HEIGHT	POPULATION	Seeds/lb	g/100 seeds
2084	**26.9**	2	2.8	13.3	20.2	112,559	2162	21.1
2098	**26.5**	2.5	4	13.6	19.7	115,695	2308	20.1
3019	**29.7**	2	3	13.4	19	112,211	2293	20.1
VISTA	**30.8**	2.5	2.2	13.6	19.5	108,029	2259	20.5
T9905	**28.8**	2.5	2.2	13.3	18.3	103,847	1997	22.3
MEDALIST-S	**34.7**	2	4.1	13.8	19.5	98,271	2476	18.3
INDI	**26.0**	1	2	13	22.3	104,544	2359	18.4
99039-3	**29.9**	2	2	13.4	18.6	103,499	2178	20.3
MEDALIST-N	**29.9**	2						

Planted:June 1
Harvested:September 8 99 days after planting
Lodge rating is 1=erect, 5=flat
Wheel tracks from sprayer
INDI and 2098 had two wheel tracks
MEDALIST-N AND 99039-3 had one wheel track
Pick %=FM+Pick
Planting Population= 128,000
Fertilization=18 gallons of 28%+2 gallons thiosol (AMS)
Herbicides=PPI 1 pt Treflan+1.33 pts of metolachlor (generic)
Post= 8 oz Basagran+3 oz Raptor
Fungicides=8 oz Omega
Insecticide=applied with herbicide and fungicide
Harvest Aid=1 quart of Roundup

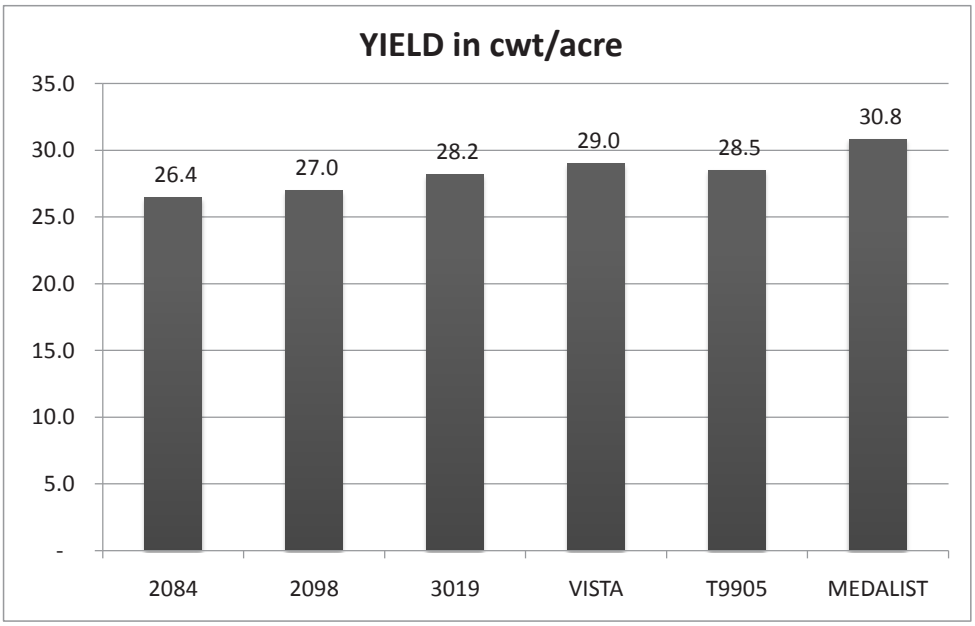


NAVY BEAN VARIETY STRIP TRIAL-20 INCH ROWS
LAKKE EWALD FARMS, INC. UNIONVILLE, MICHIGAN

VARIETY	YIELD	FM	PICK	MOISTURE	LODGE	HEIGHT	POPULATION	Seeds/lb	g/100 seeds
2084	**26.4**	1.4	0.8	17.5	3.5	19.5	111,078	2316	19.0
2098	**27.0**	2.2	0.7	18.3	3.5	20.2	124,146	2490	18.9
3019	**28.2**	1.1	1.2	17.9	3	21	113,169	2214	21.0
VISTA	**29.0**	1.3	1.1	18	3	19.2	110,555	2438	18.0
T9905	**28.5**	1.3	1.3	17.7	2	20.3	98,794	1971	22.9
MEDALIST	**30.8**	1.1	0.9	17.7	3	19.4	98,794	2325	19.0

C.V. Value **9.70%** Three strips of each variety were harvested and weighed separately.
LSD **4.9**

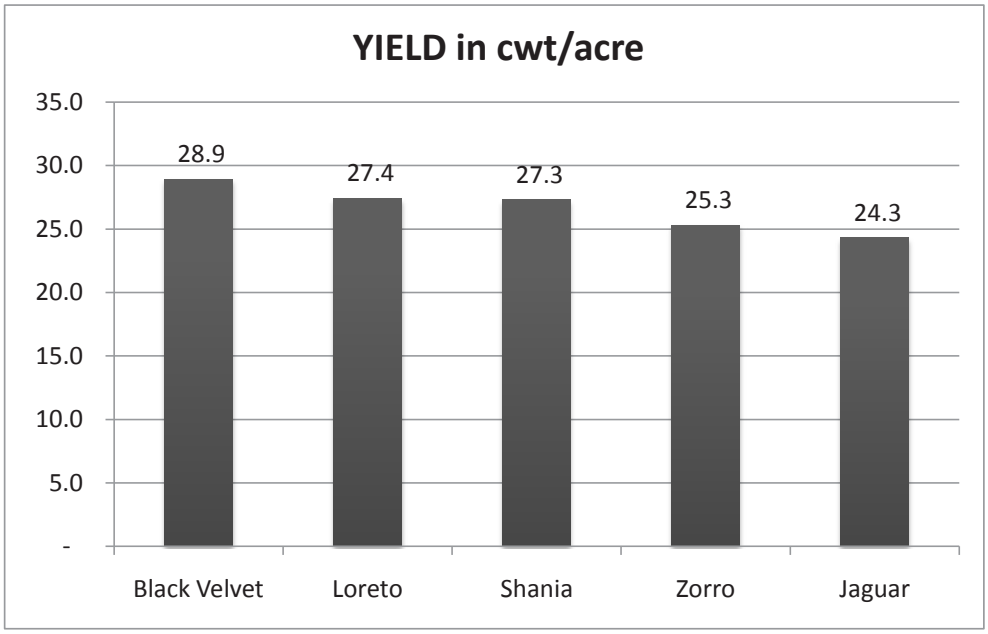
2084 AND 2098 HAD SOME WATER DAMAGE
2098 HAD THE MOST LODGED PLANTS
ONE STRIP OF VISTA HAD SOME LODGED PLANTS
Planted:June 15
Harvested:September 20 97 days after planting
Planting Population= 120,000
Fertilization=16 gallons of 28% banded
Herbicides=PPI: 39 oz Eptam plus 14 oz Outlook
Post=20 oz Basagran+4 oz Reflex+1.5 oz Raptor+12 oz Superb
Fungicides=8 oz Omega+6 oz Powerlock
Insecticide=applied with herbicide and fungicide
Harvest Aid=None



BLACK BEAN VARIETY STRIP TRIAL-20 INCH ROWS
STOUTENBURG FARMS SANDUSKY, MICHIGAN

VARIETY	YIELD	LODGE	PICK %	MOISTURE	HEIGHT	POPULATION	Seeds/lb	g/100 seeds
Black Velvet	**28.9**	3	1.6	16.8	26	127,282	2055	22.5
Loreto	**27.4**	3	1.6	16.1	20.8	139,044	2356	19.3
Shania	**27.3**	3	1.1	15.7	22.9	136,691	2355	19.4
Zorro	**25.3**	2	1.5	16.1	21.3	128,066	2541	18.5
Jaguar	**24.3**	1	1.2	16.3	21.3	136,430	2526	18.1

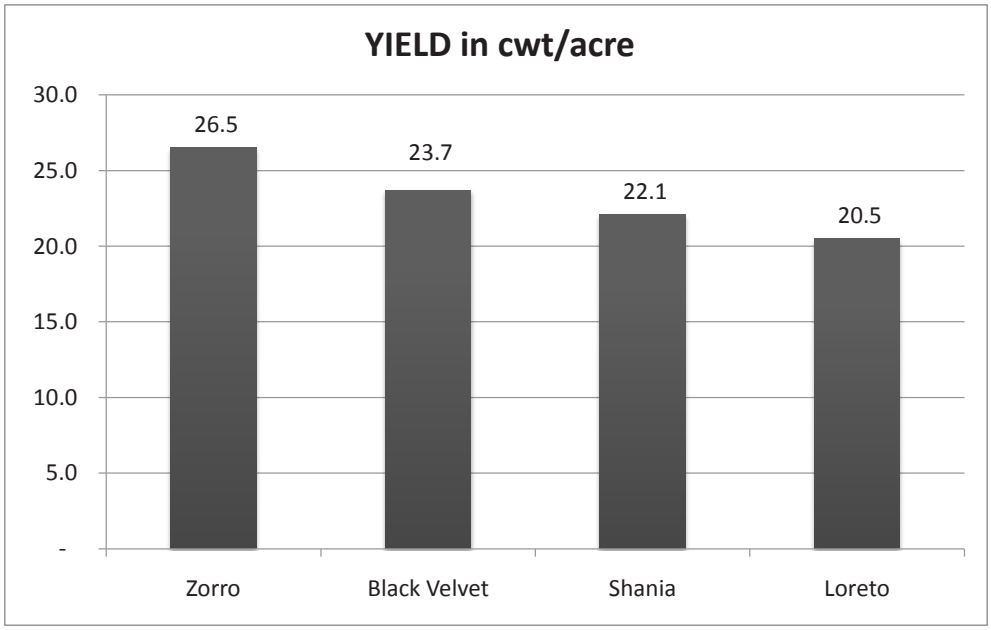
Planted:June 10
Harvested:September 5 87 days after planting
Lodge rating is 1=erect, 5=flat
Pick %=FM+Pick
Planting Population= 145,000
Fertilization=60 pounds Nitrogen, 16 gal 10-34-0
Fungicides=8 oz Endura
Insecticide=Asana applied with herbicide and fungicide
Harvest Aid=1 .5 pints of Gramoxone



BLACK BEAN VARIETY STRIP TRIAL-22 INCH ROWS
SCHINDLER FARMS KAWKAWLIN, MICHIGAN

VARIETY	YIELD	LODGE	PICK %	Screen	MOISTURE	HEIGHT	POPULATION	Seeds/lb	g/100 seeds
Zorro	**26.5**	2	0.3	1.2	16	23.8	92,418	2465	18.6
Black Velvet	**23.7**	2	0.8	1.6	16.7	25.8	100,238	2355	19.4
Shania	**22.1**	2	1	4.1	17.2	24.3	106,163	2587	18
Loreto	**20.5**	3	1.8	3.6	17	19.8	101,186	2581	18.2

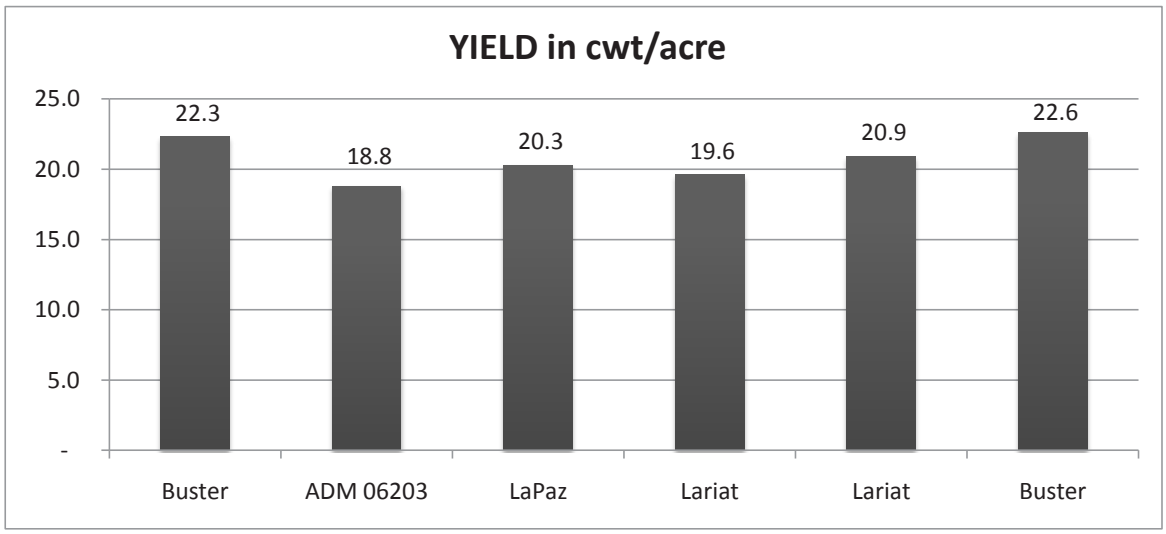
Planted:June 21
Harvested:September 30 101 days after planting
Lodge rating is 1=erect, 5=flat
Pick %=FM+Pick, Screen Out is %
Planting Population= 125,000
Fertilization=20 gallons of 28% N banded at planting
Herbicides=PPI 1 pt Treflan+1 pt Dual
Post= 8 oz Basagran+4 oz Raptor+3 oz Reflex
with DynAmic at 2 quarts/100 gallons and AMS 7 lbs/100 gallons
Fungicides=None
Insecticide=1.5 oz of Warrior applied with herbicide
Harvest Aid=1.5 pints Gramoxone + 1 oz AIM + Dynamic at 1 quart/100 gallons



PINTO BEAN VARIETY STRIP TRIAL-22 INCH ROWS
SCHINDLER FARMS KAWKAWLIN, MICHIGAN

VARIETY	YIELD	LODGE	PICK %	MOISTURE	HEIGHT	POPULATION	Seeds/lb	g/100 seeds
Buster	**22.3**	2	6.3	12.2	17.2	79,859	1072	43.6
ADM 06203	**18.8**	1	2.7	12.8	21.2	92,892	1144	40.7
LaPaz	**20.3**	2	1.8	12.8	21.5	86,020	1114	41.7
Lariat	**19.6**	2	2.9	12.4	18.8	79,859	1160	35.5
Lariat	**20.9**							
Buster	**22.6**							

Planted:May 28
Harvested:August 27 91 days after planting
Lodge rating is 1=erect, 5=flat
Pick %=FM+Pick
Planting Population= 95,000
Fertilization=20 gallons of 28% N banded at planting
Herbicides=PPI 1 pt Treflan+1 pt Dual
Post= 8 oz Basagran+4 oz Raptor+3 oz Reflex
with DynAmic at 2 quarts/100 gallons and AMS 7 lbs/100 gallons
Fungicides=None
Insecticide=1.5 oz of Warrior applied with herbicide
Harvest Aid=1.5 pints Gramoxone + 1 oz AIM + Dynamic at 1 quart/100 gallons



Summary for Saginaw Valley Research and Extension Center (SVREC) Trials

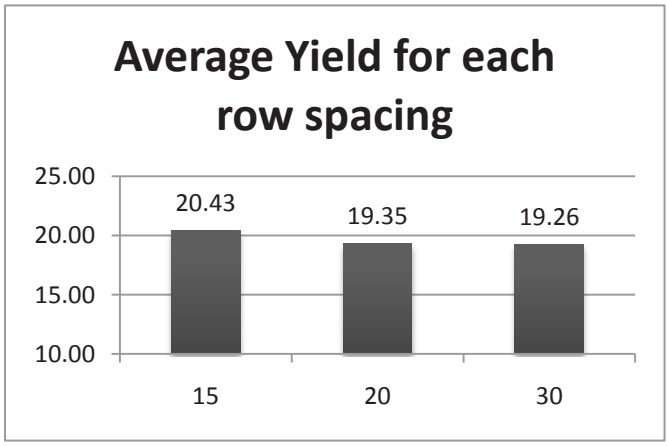
These trials were grown in small plot replicated designs.
Data is shown here and on the next 4 pages.

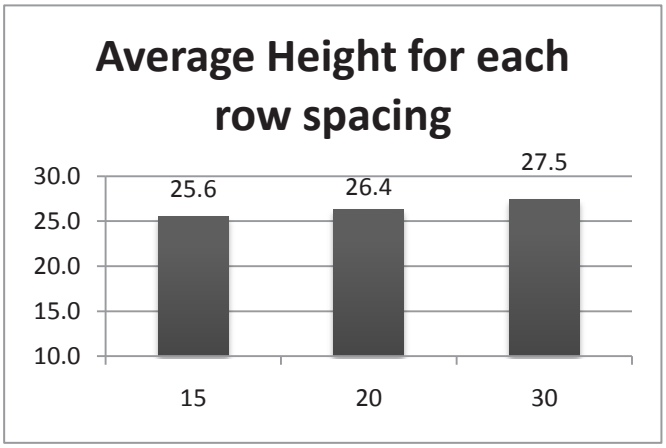
Soil Type: Tappan-Londo loam
Previous Crop: Corn 2009
Planted: June 10
Harvested: September 10, 92 days after planting
Fertilization: 400 pounds of 15-5-13 with 10% S, 2% Zn, 1.4% Mn and .4% Cu
Herbicides: 1.33 pints Dual plus 1.5 quarts Eptam
Rainfall: planting-harvest=4.4"
Planting -September 1=3.27”

*The SVREC Trials had inadequate rainfall which created drought conditions during the last half of the season.

Small Red Row Width
Saginaw Valley Research and Extension Center
Frankenmuth, MI

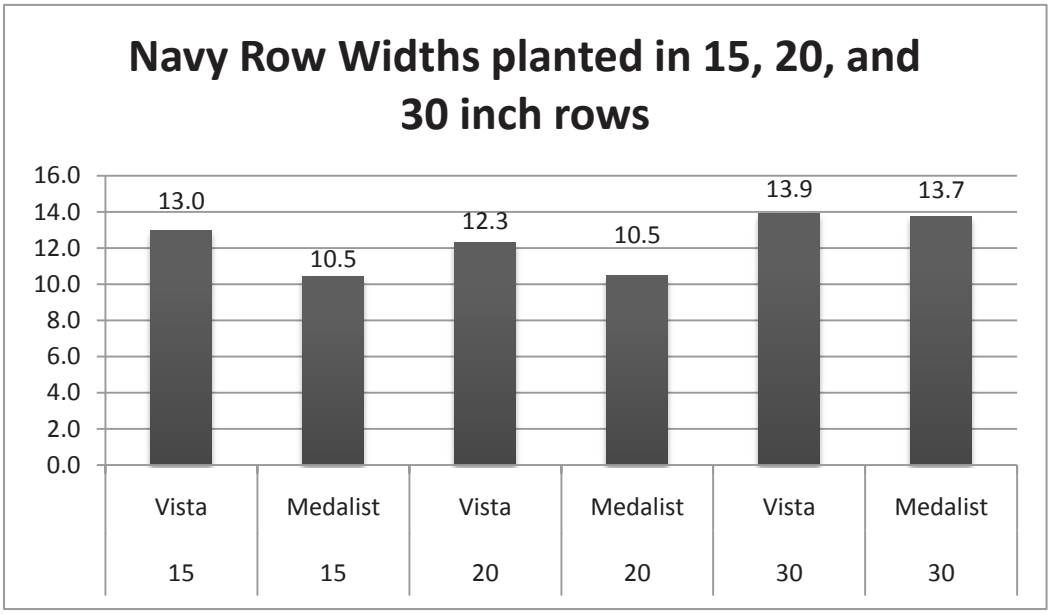
Row width	Variety	Yield	Moisture	Height	Population
15	Merlot	20.43	15.0	25.6	100,188
20	Merlot	19.35	15.0	26.4	92,456
30	Merlot	19.26	14.8	27.5	71,438
		LSD=3.48			
		C.V.=10%			

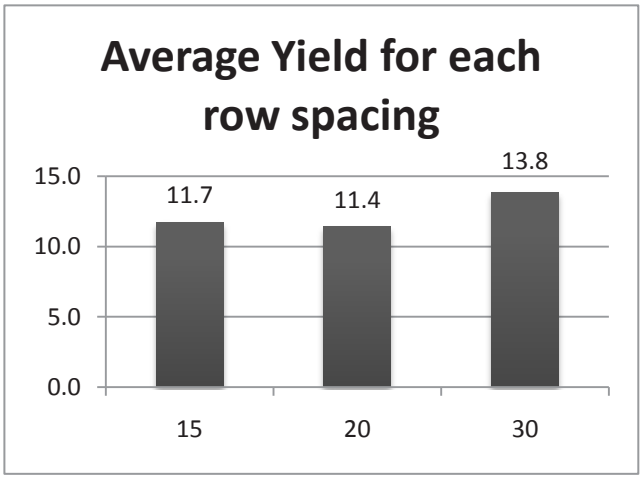


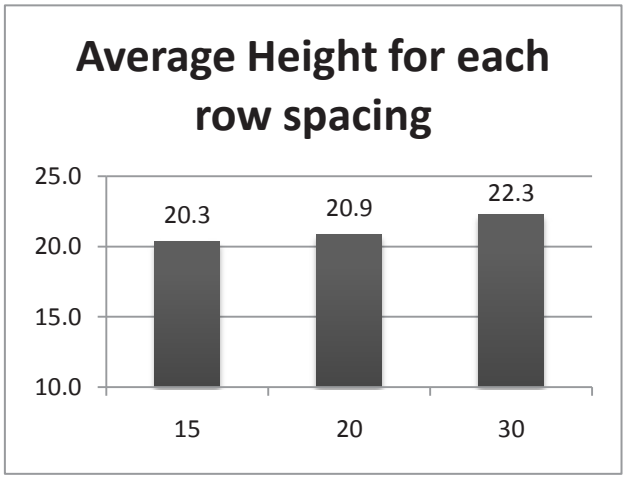


Navy Row Width
Saginaw Valley Research and Extension Center
Frankenmuth, MI

Row width	Variety	Yield	Moisture	Height	Population
15	Vista	13.0	15.9	20.1	118,919
15	Medalist	10.5	15.8	20.6	125,888
20	Vista	12.3	16.0	20.6	100,297
20	Medalist	10.5	15.9	21.1	114,998
30	Vista	13.9	15.6	22.4	85,595
30	Medalist	13.7	15.2	22.2	92,565
		LSD=2.38			
		C.V.= 12%			

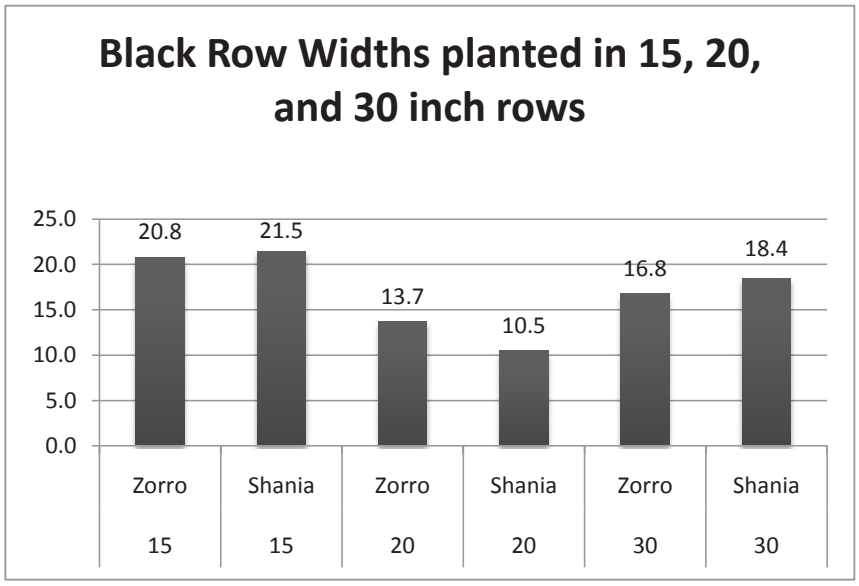


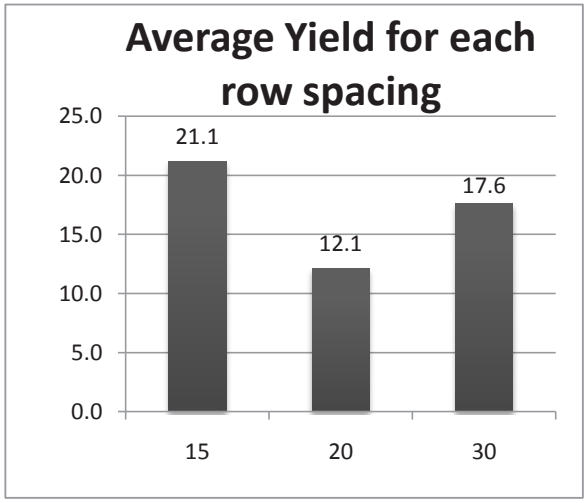


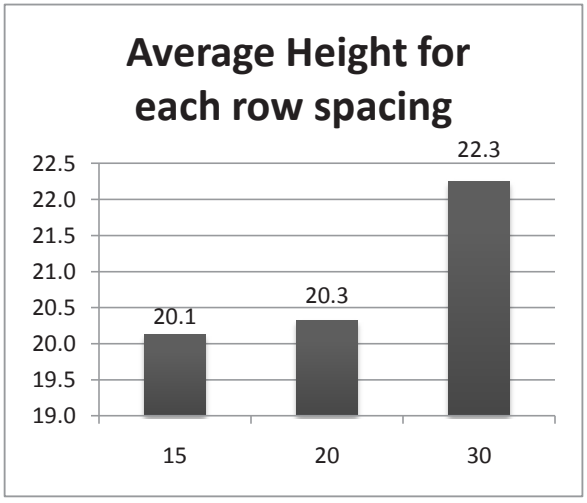


Black Row Width
Saginaw Valley Research and Extension Center
Frankenmuth, MI

Row width	Variety	Yield	Moisture	Height	Population
15	Zorro	20.8	15.2	21.1	118,483
15	Shania	21.5	15.4	19.2	121,968
20	Zorro	13.7	15.3	21.3	107,811
20	Shania	10.5	15.1	19.4	108,464
30	Zorro	16.8	14.8	22.2	85,595
30	Shania	18.4	14.5	22.3	85,378
		LSD=4.01			
		C.V.=16%			

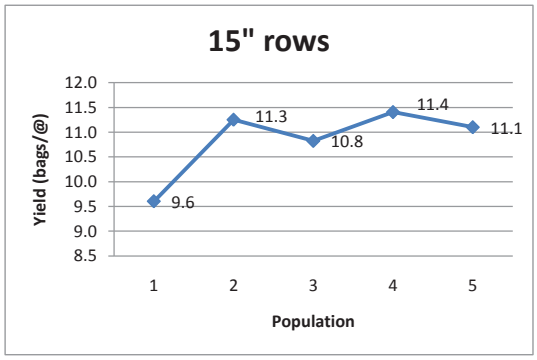


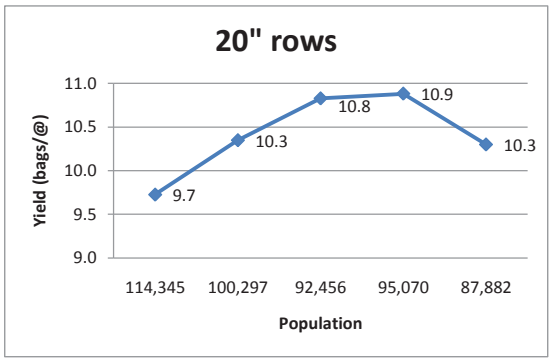


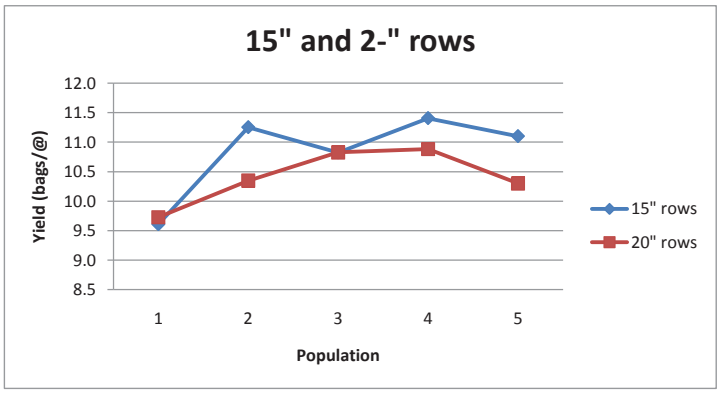


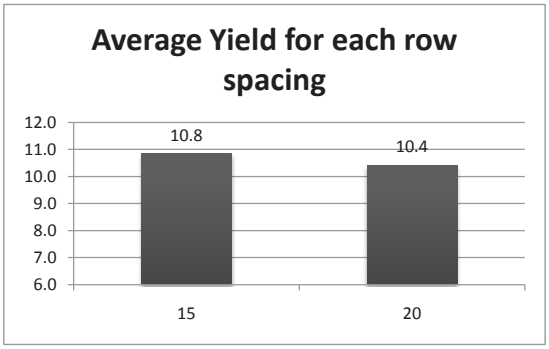
Black Row Width/Population
Saginaw Valley Research and Extension Center
Frankenmuth, MI

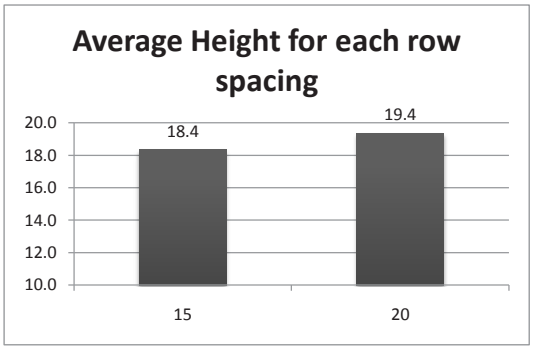
Row width	Variety	Yield	Moisture	Height	Population
15	Zorro	9.6	15.9	17.9	125,453
15	Zorro	11.3	15.8	18.1	112,820
15	Zorro	10.8	16.0	18.4	109,771
15	Zorro	11.4	15.9	18.8	104,544
15	Zorro	11.1	16.0	18.6	107,158
20	Zorro	9.7	15.9	18.3	114,345
20	Zorro	10.3	16.0	19.4	100,297
20	Zorro	10.8	15.8	19.9	92,456
20	Zorro	10.9	16.0	19.7	95,070
20	Zorro	10.3	15.9	19.7	87,882
		LSD=1.52			
		C.V.=10%			





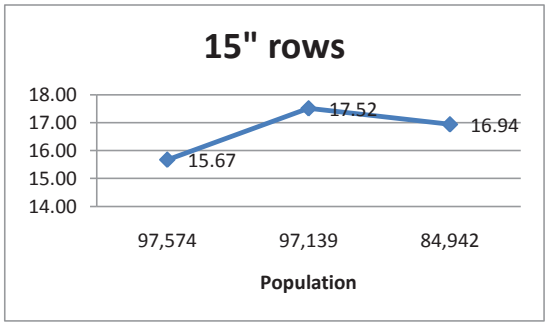


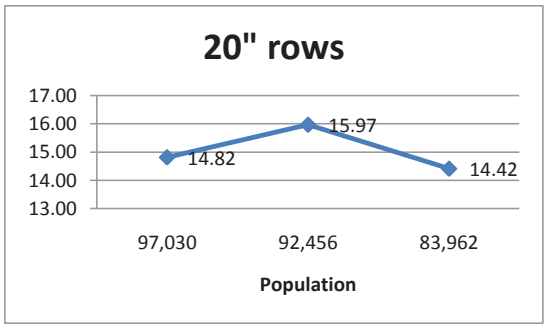


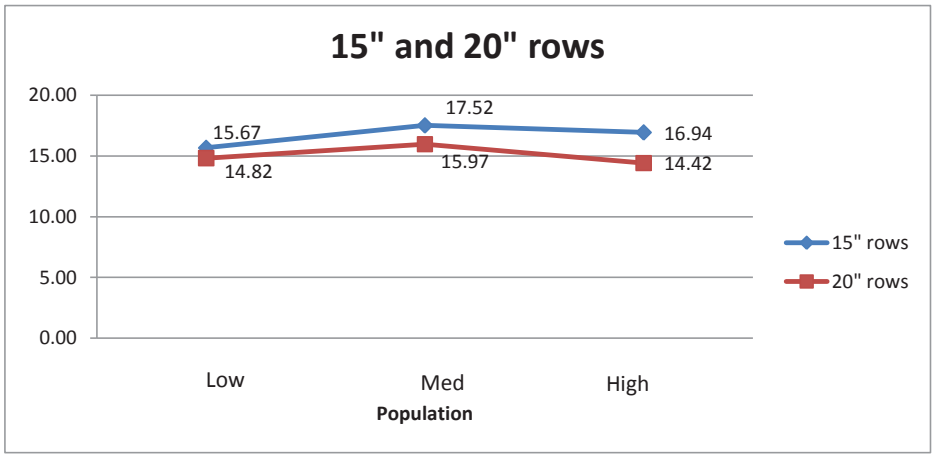


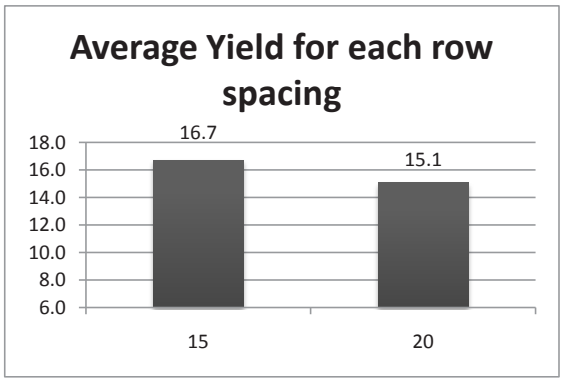
Small Red Row Width/Population
Saginaw Valley Research and Extension Center
Frankenmuth, MI

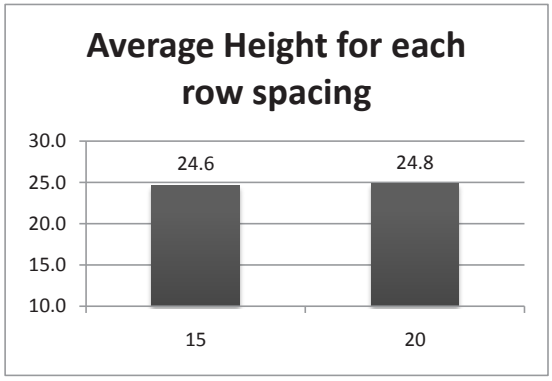
Row width	Variety	Yield	Moisture	Height	Population
15	Merlot	15.67	15.3	24.6	97,574
15	Merlot	17.52	14.9	24.9	97,139
15	Merlot	16.94	15.1	24.5	84,942
20	Merlot	14.82	15.2	24.6	97,030
20	Merlot	15.97	15.3	25.2	92,456
20	Merlot	14.42	15.0	24.8	83,962
		LSD=4.14			
		C.V.=17%			











2010 White Mold Fungicide Trial

Montcalm Research Farm, Entrican, Michigan

Treatment	Rate	Application Code	% Pick	Incidence %infection	Severity %severity	YIELD	BU/AC
UTC			3.8	67	49	2255	37.6
ENDURA+NIS	8 oz	A	1.4	38	23	2820	47
HEADLINE+NIS	6 oz	A	3.7	47	33	2117	35.3
OMEGA+NIS	8 oz	A	0.98	35	20	2868	47.8
ENDURA+NIS	8 oz	AB	1.3	31	18	3065	51.1
TOPSIN M+NIS	30 oz	A	1.2	27	13	3042	50.7
ENDURA+TOPSIN M+NIS	8+24 oz	A	0.95	21	10	3363	56.1
ENDURA+TOPSIN M+NIS	6+20 oz	A	1.2	35	19	3078	51.3
PROPULSE+NIS	6.4 oz	A	0.83	29	15	3010	50.2
PROPULSE+NIS	10.3 oz	A	1.2	22	11	3143	52.4
PROLINE+NIS	5.7 oz	A	1.3	29	17	2666	44.4
PROPULSE+NIS	6.4 oz	AB	1.6	27	15	3076	51.3
PROPULSE+NIS	10.3 oz	AB	1.5	20	10	3127	52.1
PROLINE+NIS	5.7 oz	AB	2.2	37	22	2693	44.9
		LSD @.05	0.92	8.7	6.1	431	7.18
		C.V. Value	34.70%	16.80%	19%	10.90%	10.90%

Merlot Small Red Beans planted in 20" rows. Irrigation of two .5 inch per week
Planted:June 22 Harvested: October 1
First Spray: August 2 Second Spray: August 9
Sprayed with 4 row bicycle-wheel CO2 sprayer using 26 gpa at 65 psi.
Twin-Jet nozzle placed directly over the row.
Application Code:A=100% or first bloom, B=7 days after 100% bloom
Rating - % infection "rating" on September 22, % Incidence, %severity
Plot size sprayed was 4 Rows by 30 feet.
Harvest area was middle 2 Rows by 15 feet.

Endura, Omega, Propulse, Topsin M and combination of Endura plus Topsin M treatments provided good control in 2010
Proline at 2 applications, yielded significantly higher than untreated check

EXPERIMENT 0101 STANDARD NAVY YIELD TRIAL PLANTING DATE 06/10/10

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

ENTRY	NAMES	YIELD CWT /ACRE	100 SEED WT.	DAYS TO FLOWER	DAYS TO MATURITY	LODGING	HEIGHT	DES. SCORE
N09175	N05311/B05055	19.4	21.9	41.0	89.1	1.0	50.3	6.0
N09174	N05311/B05055	18.2	22.3	41.0	88.4	1.0	50.6	5.9
N08003	N00844/N02237	17.9	20.9	39.0	88.2	1.0	49.2	5.5
I10103	**OAC 7-2** (CDBN)	17.4	20.8	37.0	89.9	1.5	47.0	4.0
N09021	N05319/B04316	17.3	19.8	37.5	87.3	1.0	48.3	5.5
N09045	N05311/B05034	16.8	20.1	40.0	88.1	1.0	47.5	5.0
N08004	N00844/N02237	16.7	18.7	39.5	86.6	1.0	47.5	5.1
N05324	N00838/N00809//N00792	16.6	20.8	38.5	88.3	1.0	49.8	5.5
N09020	N05319/B04316	16.3	19.3	39.0	87.2	1.0	47.7	4.6
I10101	**COOP 02084**	16.2	22.2	38.0	87.8	1.0	49.2	4.9
N09046	B04554/N05357	16.1	18.8	40.5	90.2	1.5	50.5	5.0
N09054	N04152/N05346	15.3	20.4	37.5	87.0	1.0	48.9	5.4
I92002	C-20*6/CN49-242, **VISTA**	15.2	20.6	38.0	90.5	2.0	50.5	4.9
I08902	**HYLAND T9905**	14.8	22.2	37.0	89.8	1.0	49.0	4.0
N08007	N01792/N03614	14.6	18.3	41.5	87.1	1.0	48.2	5.5
N09104	N05311/B05055	14.5	19.4	41.5	87.2	1.0	48.3	4.9
N09050	N04154/N00833	14.2	18.1	40.5	86.6	1.0	45.6	4.0
N06702	N00809//B95556*2/I93154	14.0	19.3	40.5	86.3	1.0	47.2	3.5
N07007	N03614/N00844	13.9	17.3	38.0	86.8	1.0	46.7	4.1
N08002	N00844/N02237	13.9	19.7	38.0	88.3	1.0	47.8	5.0
I06271	ND012103,**AVALANCHE**	13.7	20.6	38.5	90.2	2.0	48.9	4.9
N07009	N03614/N00844	13.6	21.5	39.5	88.0	1.0	50.0	5.1
N09044	N05311/X06121	13.5	18.3	41.5	89.2	1.0	47.9	4.6
N09056	N04152/N05346	13.3	19.9	40.0	88.1	1.0	47.7	4.6
N09055	N04152/N05346	12.9	18.3	39.5	87.0	1.0	47.4	4.0
N09059	N04141/N05317	12.9	19.3	40.0	89.2	1.0	49.7	5.4
N09038	B04316/B00101	12.8	21.2	35.5	87.8	2.0	48.6	4.9
N09041	B05070/B05044	12.4	20.5	38.5	87.9	2.0	48.7	4.4
N09053	N04154/I04101	12.2	20.3	41.5	87.3	1.0	45.8	3.6
N09034	B05055/B05070	12.0	20.8	37.0	87.2	1.0	48.7	4.1
N09035	B05055/B05070	11.5	19.9	38.5	88.3	1.5	48.4	4.0
I08958	**MEDALIST**	11.5	20.0	38.5	91.2	2.0	50.7	4.0
N09039	B05070/B05040	11.4	20.4	36.5	87.9	1.0	47.9	3.6
N09106	N04109/B05055	10.6	17.3	36.0	86.5	1.0	44.5	4.0
N09037	B04316/B00101	10.5	20.2	38.5	86.6	1.0	47.9	3.9
I08903	**LIGHTNING**	9.0	18.8	38.5	92.6	1.5	49.7	3.1
AVERAGE OF36 MEANS		14.3	20.0	38.9	88.2	1.2	48.4	4.6
LSD (P=.05)		2.5	1.2	1.4	0.9	0.2	0.9	0.4
(P=.01)		3.2	1.6	1.8	1.2	0.2	1.2	0.5
COEFFICIENT OF VARIATION		12.2	4.3	2.5	0.8	11.2	1.4	6.3
EFFICIENCY OF LATTICE		287.1	108.0	100.0	138.8	103.4	122.2	117.1

EXPERIMENT 0102 STANDARD BLACK YIELD TRIAL DATE 06/10/10

ENTRY	NAMES	YIELD CWT /ACRE	100 SEED WT.	DAYS TO FLOWER	DAYS TO MATURITY	LODGING	HEIGHT	DES. SCORE
B09174	N05311/B05055	19.2	25.7	42.5	88.0	1.0	49.0	6.0
B09128	B05055/B05044	18.3	19.0	40.0	86.8	1.0	48.3	4.6
B04554	**ZORRO**	18.2	19.1	41.0	88.9	1.0	48.4	4.9
B09208	B04644/B04588	17.8	21.0	41.0	86.5	1.0	46.0	5.0
B09135	B04316/B05040	17.7	20.6	41.0	88.8	1.0	49.8	6.1
B09175	N05311/B05055	17.6	25.1	39.5	87.7	1.0	48.1	5.1
I10102	**LORETO**	17.6	22.2	40.0	89.2	1.0	48.7	4.5
B09188	B05054/B04588	17.2	22.9	42.0	89.9	1.0	49.1	5.4
B09166	B04554/B04587	17.2	20.9	41.5	87.3	1.0	47.2	5.5
B09200	B04444/B05044	17.2	17.7	40.0	88.1	1.0	49.6	4.9
B09129	B05055/B04587	17.1	20.0	42.0	86.8	1.0	47.7	4.9
I81066	SEL-BTS,**T39**	17.1	20.6	42.0	88.6	2.0	48.7	4.6
B09202	B04444/B04588	17.0	19.6	40.5	87.1	1.0	46.7	4.5
I03390	ND9902621-2, **ECLIPSE**	17.0	20.2	38.5	86.2	1.0	47.5	4.6
B09194	B05055/B05044	16.9	18.1	42.5	88.5	1.0	47.5	5.6
B09196	B05055/B04588	16.8	21.2	39.0	89.1	1.0	46.5	4.0
B09138	B05054/B04588	16.8	23.1	41.0	87.9	1.0	47.4	5.5
I07116	B201240, **SHANIA**	16.8	20.6	41.0	90.0	1.0	49.1	4.6
B08102	B01792/B02549	16.8	21.2	41.5	87.0	1.0	46.1	5.1
B09184	B04349/B05001	16.8	17.9	38.0	89.3	1.0	47.4	5.1
B09198	B05055/B04587	16.6	19.6	39.5	88.0	1.0	48.4	5.4
B09165	B04554/B04587	16.5	20.2	40.5	86.6	1.0	48.1	4.5
B09170	B04554/B04587	16.5	19.3	42.0	88.9	1.0	46.9	5.4
B09136	B04316/B05040	16.3	21.8	39.0	87.5	1.0	47.3	5.4
B09224	B05054/B04588	16.3	23.2	40.5	87.0	1.0	46.9	5.0
I08907	**BLACK VELVET**	16.3	24.8	41.5	91.0	1.0	49.0	4.1
B09183	B04349/B05001	16.2	17.4	38.5	87.3	1.0	47.4	4.9
B09210	B04644/B04588	16.1	20.7	41.0	86.6	1.0	45.7	4.2
B09203	B05054/B04588	16.1	21.8	40.5	86.1	1.0	45.6	4.1
B09164	B04554/B04587	16.0	19.4	42.0	87.0	1.0	48.5	4.5
B09104	N05311/B05055	16.0	20.6	40.0	86.5	1.0	47.1	5.0
B05055	1308//HR45/KABOON	16.0	20.6	41.0	87.4	1.0	45.9	4.1
B09209	B04644/B04588	15.9	21.9	39.0	86.9	1.0	47.3	5.5
B09199	B05055/B04587	15.9	22.3	41.5	87.3	1.0	46.2	5.3
B09119	B04554/X06127	15.9	19.6	42.0	86.1	1.0	47.1	4.7
B09120	B04554/X06127	15.8	19.7	40.5	87.0	1.0	47.1	4.0
B09171	B04554/B04587	15.4	19.2	41.5	87.0	1.0	47.0	5.0
B95556	B90211/N90616,**JAGUAR**	15.4	19.0	42.0	86.0	1.0	46.0	4.0
B09130	B05055/B04587	15.4	19.3	39.0	85.9	1.0	45.9	5.0
B09201	B04444/B05044	15.3	17.2	42.0	89.4	1.5	49.4	5.3
B00101	**CONDOR**	15.2	20.8	39.5	89.0	1.5	48.5	5.0
AVERAGE OF 64 MEANS		15.7	20.4	40.7	87.6	1.0	47.0	4.7
LSD (P=.05)		2.9	1.1	1.1	0.8	0.1	0.8	0.4
COEFFICIENT OF VARIATION		12.8	3.8	1.9	0.7	6.8	1.1	6.2

Effect of row width, population, and herbicide treatment on dry bean yield (Saginaw Valley Research and Extension Center – 2010)

Christy Sprague, Ryan Holmes, and Gary Powell, Michigan State University

Location:	Richville (SVREC)	**Tillage:**	Conventional
Planting Date:	June 10, 2010	**Herbicides:**	see treatments
Soil Type:	Clay	**Replicated:**	4 times

Table 1. The main-effects of row-width and herbicide treatment affected black bean yield. Black bean population did not significantly affect yield.

'ZORRO' BLACK BEANS					
ROW-WIDTH EFFECT		**POPULATION EFFECT**		**HERBICIDE EFFECT**	
	— cwt/A —	— seeds/A —	— cwt/A —		— cwt/A —
15-inch	14.3 B[b]	**79,500**	15.0	**Weed-free**	14.4 B
20-inch	14.9 AB	**106,000**	14.8	**POST[a]**	15.8 A
30-inch	16.0 A	**132,500**	15.5		
$LSD_{0.05}$	1.4		N.S.		1.14

[a] Raptor (4 fl oz) + Basagran (8 fl oz) + COC (1%) + AMS (2.5 lb) applied to 2-4" weeds.
[b] Means in each column followed by the same letter are not significantly different at $P \leq 0.05$, N.S. = not significant.

Table 2. Small red bean yield was affected by row-width, population, and herbicide treatment.

'MERLOT' SMALL RED BEANS						
	WEED-FREE			**POST[a]**		
Population	**15-inch**	**20-inch**	**30-inch**	**15-inch**	**20-inch**	**30-inch**
	cwt/A			cwt/A		
60,000	15.3 ABC	15.1 ABC	15.3 ABC	15.8 ABC	14.5 ABC	14.3 BCD
79,500	17.2 A	13.7 CD	16.7 AB	16.3 ABC	16.0 ABC	14.9 ABC
106,000	13.9 BCD	15.6 ABC	13.8 BCD	14.5 ABC	11.8 D	14.9 ABC
$LSD_{0.05}$			2.9			

[a] Raptor (4 fl oz) + Basagran (8 fl oz) + COC (1%) + AMS (2.5 lb) applied to 2-4" weeds.
[b] Means followed by the same letter are not significantly different at $P \leq 0.05$.

Summary: This trial was conducted to determine the effect of row width and population on yield of two classes of dry bean. This trial was conducted at two different locations, this location the Saginaw Valley location suffered from drought, resulting in average yields of 15 cwt/A for both black and small red beans. Black bean population did not have a significant affect yield; however row width had a major impact (Table 1). The main effect of row width indicated that black beans planted in wide rows (30 inches) benefited under drought conditions compared with black beans planted in 15 inch rows. However, yield of black beans planted in 20 inch rows were not different from black bean planted in 30 or 15 inch rows. There was a three-way interaction for yield of the small red beans (Table 2). With small red beans, yield was generally higher either at lower populations or narrower row-widths. Due to lower weed populations at this location we did not observe any differences in weed suppression for any of the treatments. Black and small red beans reacted differently to row-width and population under these drought conditions. This research was funded by Project GREEEN and the Michigan Dry Bean Commission grant from the Michigan Department of Agriculture Specialty Crops.

Effect of row width, population, and herbicide treatment on dry bean yield (MSU Agronomy Farm East Lansing – 2010)

Christy Sprague, Ryan Holmes, and Gary Powell, Michigan State University

Location:	East Lansing	**Tillage:**	Conventional
Planting Date:	June 16, 2010	**Herbicides:**	see treatments
Soil Type:	Loam	**Replicated:**	4 times

Table 1. Black bean yields are combined over herbicide treatments. At P≤0.01 row-width and population affected yield. Black beans planted in narrow rows had higher yields.

'ZORRO' BLACK BEANS				
Population	**15-inch**	**30-inch**	**MAIN ROW-WIDTH EFFECT**	
	cwt/A			
79,500	27.1 ABC[a]	26.7 BC	**15-inch**	29.0 A
106,000	30.4 A	25.5 CD	**30-inch**	24.8 B
132,500	29.5 AB	22.2 D	$LSD_{0.05}$	2.6
$LSD_{0.1}$	3.7			

[a] Means followed by the same letter are not significantly different.

Table 2. There were no differences in small red bean yield, regardless of row-width or population.

'MERLOT' SMALL RED BEANS		
Population	**15-inch**	**30-inch**
	cwt/A	
60,000	21.1	22.1
79,500	22.8	22.7
106,000	24.3	21.6
$LSD_{0.05}$	N.S.[a]	

[a] N.S. = not significant.

Summary: This trial was conducted to determine the effect of row width and population on yield of two classes of dry bean. This trial was conducted at two different locations. At this location, East Lansing, moisture was not as limiting as the Richville location. Yield was favored for dry beans planted in narrow rows. Average black bean yield for this trial were 27 cwt/A. The main effect of row width showed a 4.2 cwt/A advantage for black beans planted in 15 inch rows over black beans planted in 30 inch rows (Table 1). The row width by population interaction was significant at (P = 0.0916), favoring black bean planted in narrow rows at the mid-population. For small red beans, regardless of row width or bean population the average yield was 22 cwt/A (Table 2). Indicating the 'Merlot' small red beans may have the ability to compensate for space regardless of population or row width. White mold did not develop in this trial and there did not appear to be a row width or population effect on the low level of western bean cutworm found. One thing we observed was the ability of narrower row widths to suppress weed growth in our POST only treatments in these trials. We also observed that the small red beans significantly reduced weed growth compared with the black beans. Under these environmental conditions there was a clear yield and weed suppression benefit to planting black beans in narrow rows.
This research was funded by Project GREEEN and the Michigan Dry Bean Commission grant from the Michigan Department of Agriculture Specialty Crops.

2010 MICHIGAN DRY BEAN TRIALS

Compiled by Gregory V. Varner, Bean Research Director

COUNTY & COOPERATOR: BAY-Schindler Farms
GRATIOT-Giles Farms; HURON-Tom Haag Farm; MONTCALM-Ken Rader Farm
SANILAC-Tom VanSickle Farm; TUSCOLA-Mark Bauer Farm

PLANTING DATES			JUNE 21	JUNE 17	JUNE 15	JUNE 11	JUNE 13	JUNE 16	2010 AVE	lodge rating direct-cut Huron Sanilac & Tuscola	Huron White Mold
VARIETY-NAVY	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA	3-6 LOC		
VISTA	87-100	GTS	2216	3148	2727	2974	2235	1601	2188-2484	3-2-2.5	3
RELIANT	86-99	GTS	1999	2864	2274	3087	1902	1515	1897-2274	2.5-2-2	3
HYLAND T9905	85-97	HYLAND	2357	2892	2657	2904	2223	1533	2138-2428	2.5-2-2.5	2.8
MEDALIST	86-102	COOP	2110	3193	2387	3161	2246	1876	2170-2496	2-1.5-1.5	2.5
INDI	80-96	ADM	2468	2938	2682	2973	2248	1557	2162-2478	1--1-1	2
HYLAND T10303	84-100	HYLAND		3081	2490		2395	2237	2374	2-2-2.5	3
HYLAND T10704	82-98	HYLAND		2851	2314		2331	1674	2106	2.5-2-1.5	3.3
GTS 544	87-102	GTS			1819		2041	1452	1771	3-3.5-3	4
GTS 564	84-96	GTS			2128		2010	1378	1839	3-3-1.5	4.3
GTS ob5551-99	89-98	GTS			2736		2123	1725	2195	2-4-3.5	2.5
ADM N5060539	92-98	ADM	2212		2311		2108			3.5-3-na	2.5
ADM N5039540	90-97	ADM	2383		2780		2365			2-1-na	3.3
ADM N5059541	91-97	ADM	2017		2169		1875			1.5-1.5-na	2
ADM N5021556	87-92	ADM	1430		1009		1858			4-3-na	3
ADM N5058576	93-98	ADM	2236		2406		2292			3-3-na	3.8
ADM N5023584	91-97	ADM	2248		2777		2520			2-1.5-na	2
COOP 03019	85-94	COOP			3132		2829	1847	2603	1.5-2--2	2.5
COOP 03015	83-94	COOP			2328		2387	1508	2074	3-3.5-2	2.8
COOP 02084	81-92	COOP			2423		2551	1598	2191	1.5-2-1	3
COOP 02098	83-94	COOP			2189		2186	1529	1968	2--2-1	3.5
COOP 99039-3	83-94	COOP			2693		2498	1648	2280	2--2-2	3.3
COOP 03036	83-93	COOP			2630		2660	1748	2346	2.5-3--1.5	4
COOP 06060	81-92	COOP			2171		2359	1937	2156	4-3--2	3.5
COOP 06061	81-93	COOP			2218		2403	1705	2109	3-2.5-1.5	3.5
COOP 05062	82-93	COOP			1853		2268	1427	1849	3-2-1.5	3.5
COOP 06063	82-93	COOP			2381		2316	1961	2219	2-2-1.5	3.8
COOP 07073	82-92	COOP			2018		2326	1923	2089	3-2--2	3.5
OAC LIGHTNING	82-94	OAC			2573			1681		2-na-1.5	2.3
OAC 07-2	85-97	OAC			2496			1983		3-na-2	3.5
HR 199	84-95	AAFC			2825			2064		3-na-1.5	2.8
SCHOONER	84-99	ADM		2573	1607			1697		5-na-4	3
MSU N09056	82-97	MSU		2909	2142			1732		2-na-1.5	2.8
MSU N09046	83-9	MSU		2924	2401			1408		2.5-na-1.5	3.5
			LSD=408	LSD=460	LSD=446	LSD=479	LSD=245	LSD=315			
			CV=13.1%	CV=11.3%	CV=13.7%	CV=10.3%	CV=7.6%	CV=13.1%			
BLACK									4-6 LOC		
ZORRO	86-98	MSU	2815	3335	2755	3305	2137	2201	2477-2758	2-2-1.5	3
JAGUAR	86-96	MSU	2589	2964	2509		1896	1851	2211	2-1--1	2.5
CONDOR	86-98	MSU	2403	3092	2481		2024	1921	2207	3.5-2-2.5	3.5
SHANIA	88-104	ADM	2673	3240	2590	3191	2174	1985	2356-2642	2.5-2.5-2	4
BLACK VELVET	88-98	SEMINIS	2871		2311		2215	2095	2373	2-2.5-2	3.5
LORETO	86-97	COOP	2690		2137		1921	2192	2235	3.5-2.5-2.5	2.5
T-39	85-96	CAL	2021				2060	1868		na-4-4	
ECLIPSE	84-90	NDSU	2546				2142	2012		na-1-1	
MIDNIGHT	90-98	NYC	2536				2066	1993		na-2-2	
DOMINO	86-97	MSU	2602				1760	2176		na-3-3	
BL 05222	86-94	COOP			1517		1967	1679		3.5-3-3.5	3.5
BL 05225	85-93	COOP-PRO			2225		2046	1860		2-2.5-2.5	3.5
BL 05226	85-93	COOP-PRO			1618		2027	1775		2-2--2	3
BL 05227	86-94	COOP-PRO			2696		2253	2272		2-2.5-3	2.5
BL 04352	85-94	COOP-PRO			2433		2172	2120		2.5-2.5-2	3

BLACKS-CONT.	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA	3-6 LOC	direct-cut	Mold
BL 06252	86-94	COOP-PRO			2458		2294	2230		2.5-2-2.5	3
BL 06253	85-94	COOP-PRO			1940		1994	1874		3-2--2	4.5
ADM B6017225	86-98	ADM		3203	2522		2121			3-2.5-2	4
ADM B6020035	85-98	ADM		3256	2699		2316			2.5-2.5-1.5	3
GTS 1103	85-94	GTS			2949			1976		2.5-na-2.5	3.5
COB 2159-00	89-98	GTS			1906			1476		4-na-4	3
MSU B09197	86-94	MSU	2818				2262	2283		na-2-1.5	
MSU B09204	84-93	MSU	2636				2533	2122		na-1.5-1.5	
MSU B09209	84-93	MSU	2497				1945	2171		na-1.5-1	
MSU B09175	86-94	MSU	2781				2489	2247		na-2-2	
			LSD=268	LSD=329	LSD=454		LSD=335	LSD=387			
			CV=7.2%	CV=6.9%	CV=13.6%		CV=11.2%	CV=13.7%			
TEBO											
TEBO	90-102	JAPAN	2186				1475				
FUJI	87-95	MSU	2130			2958	1468				

SMALL RED	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA	3 LOC
MERLOT	87-95	USDA/MSU	2373		2356	3348	1853	2154	2121
SR 06233	85-92	PROVITA			1216		1931	2145	1764
SR 07261	81-89	PROVITA			661		1398	1793	1284
SR 07264	90-98	PROVITA			1323		1896	1868	1696
SR 09303	87-96	PROVITA			2675		2112	2306	2364
SR 09304	83-90	PROVITA			2276		2122	2119	2172
SR 09306	84-91	PROVITA			1884		1503	1750	1712
MSU R09508	86-96	MSU			2479		2024	1736	2080
MSU R08512	90-98	MSU			2391		1792	1678	1954
MSU R08516	86-96	MSU			2613		1789	1947	2116
MSU R08541	85-95	MSU			2495		1998	1935	2143
					LSD=543		LSD=369	LSD=298	
					CV=18.5%		CV=13.8%	CV=10.6%	

PINTO	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA	3-6 LOC
OTHELLO	82-85	USDA	2825	1848			1703		2125
SANTA FE	90-94	MSU	3042	2798		3409	2198		2679
LA PAZ	90-94	PROVITA	3007	2431			2376		2605
GTS 907	91-94	GTS	3055	2799			2315		2723
LARIAT	91-95	NDSU	2810	2794		3295	2129		2578
MSU P07863	90-103	MSU	2897	3237	2929	3820	2159	2255	2764-2883
MSU P08339	85-92	MSU	2833	2515		3400			
MSU P08312	90-92	MSU	2992	2885					
MSU P09420	85-92	MSU	3097	2738		3785			
MSU P09417	85-92	MSU	2707	2326		3325			
			LSD=518	LSD=489		LSD=591	LSD=380		
			CV=12.2%	CV=13.9%		CV=11.2%	CV=11.7%		
GREAT NORTHERN									
MATTERHORN	80-88	MSU	3046					2105	
MSU G08254	80-87	MSU	3246					1961	
MSU G08263	80-88	MSU	3452					2158	
MSU G09830	80-89	MSU	3356					1870	
			LSD=444					LSD=281	
			CV=8.5%					CV=8.7%	
PINK									
SEDONA	86-95	MSU	2369		2086		1691	1830	
MSU S08409	84-94	MSU			2578		1640	2179	
MSU S08418	85-94	MSU			2142		1621	1695	
MSU S08419	85-94	MSU			2024		1778	1898	
					LSD=565		LSD=233	LSD=265	
					CV=16.0%		CV=8.7%	CV=8.7%	

CRANBERRY	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA
SVM TAYLOR	93-94	ADM		2471		3014		
CAPRI	94-95	MSU		2564		2500		
ETNA	92-93	SEMINIS		2472		3005		
CHIANTI vine	94-96	SEMINIS		2179		3074		
BELLAGIO vine	94-97	MSU		2370		3167		
ADM C213259	92-93	ADM		2003		3108		
MSU C08709	92-92	MSU		2404		2657		
MSU C08714	92-93	MSU		2523		3123		
KRIMSON	94-95	BASIN		2215		3060		
				LSD=362		LSD=457		
LIGHT RED KIDNEY				CV=10.5%		CV=10.6%		
CHINOOK 2000	98-100	MSU		2690		3546		
CALIF ELRK	91-92	CAL		2481		3364		
PINK PANTHER	93-93	SEMINIS		2722		3299		
CLOUSEAU	93-94	SEMINIS		3006		3480		
ADM L9451381	92-92	ADM		2512		2954		
GTS cob 1966-99	98-104	GTS		1860		2233		
OAC 07-L1	98-104	OAC		2626		3206		
MSU K06619	95-100	MSU		2667		3056		
MSU K07712	95-99	MSU		2730		2915		
MSU K06604	95-100	MSU		2658		2982		
				LSD=305		LSD=411		
DARK RED KIDNEY				CV=10.5%		CV=9.1%		
RED HAWK	93-96	MSU		2419		3393		
MONTCALM	96-99	MSU		2378		3267		
RED ROVER	93-95	SEMINIS		2720		3362		
ADM D118376	95-100	ADM		2604		3017		
GTS 104	94-99	GTS		2557		3081		
GTS 106	94-98	GTS		2817		3178		
MSU K07305	93-97	MSU		2547		3221		
MSU K08222	93-96	MSU		2748		3398		
MSU K08228	92-95	MSU		2698		3415		
				LSD=332		LSD=316		
				CV=8.5%		CV=6.7%		

ALUBIA-W. KID.	DAYS	ORIGIN	BAY	GRATIOT	HURON	MONTCALM	SANILAC	TUSCOLA
BELUGA	98-99	MSU	2214			2422		
MSU K07921	98-99	MSU	2374			2792		
MSU K08961	93-94	MSU	2502			3604		
MSU K08920	98-99	MSU				2098		
MSU K10902	96-97	MSU				3039		
			LSD=364			LSD=348		
YELLOW EYE			CV=13.7%			CV=8.1%		
GTS 1701y. eye	92-95	GTS				2572		
ADZUKI								
ERIMO	100-102	JAPAN		2194				

ORIGIN KEY

MSU=MICHIGAN STATE UNIVERSITY
GTS=GEN-TEC SEEDS LIMITED
SEMINIS-SEMINIS SEEDS
ADM==ARCHER DANIELS MIDLAND
HYLAND=HYLAND SEEDS, LIMITED
COOP=COOPERATIVE ELEVATOR-PROVITA
CAL=UNIVERSITY OF CALIFORNIA-DAVIS
NYC=CORNELL UNIVERSITY-NEW YORK
USDA=UNITED STATES DEPT. OF AGRIC.ARS

UI=UNIVERSITY OF IDAHO
NDSU=NORTH DAKOTA STATE UNIVERSITY
OAC===UNIVERSITYofGUELPH
PROVITA=PROVITA SEEDS
AAFC==AAFC GPCRC HARROW
BASIN==BASIN SEED COMPANY

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Huron, Sanilac and Tuscola were direct harvested with a plot combine
Bay navies and blacks were direct harvested and colored beans were hand pulled
Gratiot and Montcalm were hand pulled and harvested.

Maturity days = planting until harvest in 2010

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

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

DRY BEAN CHARACTERISTICS

Greg Varner, Michigan Dry Edible Bean Production Research Advisory Board

Variety	Class	Plant Type	Maturity	Origin	BCMV	Anthracnose 73	Anthracnose 7	Canning Quality	White Mold	Halo Blight	Common Blight	Rust	Air Pollution	Direct Cut-Rating
Seahawk	N	USV	M-F	MSU	R-I	S	R	3	2	R	S	S	T	3
Vista	N	USV	F	GEN	R-I	S	R	2	2	R	S	T	T	2
Schooner	N	SV	F	SYN	R-I	S	R	3	3	R	S	T	T	5
Medalist	N	USV	F	COOP	R-I	S	R	3	2	R	S	T	T	2
GTS 544	N	USV	F	GEN	R-I	S	R	2	3	T	S	T	T	2
Reliant	N	USV	F	GEN	R-I	S	R	3	2	R	S	T	T	2
Hyland T9905	N	USV	M	HYLAND	R-I	S	R	2	2	R	S	T	T	2
Navigator	N	USV	F	SYN	R-I	S	R	2	3	R	S	T	T	1
COOP 03019	N	USV	M-F	COOP	R-I	S	R	3	2	R	S	T	T	2
Indi	N	USV	M-F	ADM	R-I	S	R	3	2	R	S	T	T	1
Othello	P	V	E	USDA	R	S	S	4	3	T	S	S	S	5
Buster	P	USV	M	SEMINIS	R-I	S	S	2	3	T	S	R	T	4
Santa Fe	P	USV	M	MSU	R-I	S	R	3	2	T	S	R	T	3
Condor	B	USV	F	MSU	R-I	R	R	5	2	R	S	T	T	2
T-39	B	SV	F	UCD	R-I	S	S	3	3	R	S	T	T	4
Midnight	B	USV	F	CUNY	R-I	S	S	4	3	R	S	T	T	2
Domino	B	USV	F	MSU	R-I	S	S	4	2	R	S	T	T	2
Jaguar	B	USV	F	MSU	R-I	R	R	5	2	R	S	T	T	3
Black Velvet	B	USV	F	SEMINIS	R-I	S	R	4	3	R	S	T	T	2
Zorro	B	USV	F	MSU	R-I	S	R	5	2	R	S	T	T	2
Eclipse	B	USV	M	NDSU	R-I	S	R	4	2	R	S	T	T	2
Shania	B	USV	F	ADM	R-I	S	?	3	3	R	S	T	T	2
Loreto	B	USV	F	COOP/ADM	R-I	R	R	3	2	R	S	T	T	2
Chinook 2000	LRK	B	F	MSU	R-I	R	R	3	2	R	S	T	T	6
Calif. ELRK	LRK	B	E	UCD	R-I	R	S	3	2	S	S	T	T	6
Clouseau	LRK	B	M	SEMINIS	R-I	R	S	3	2	S	S	T	T	6
Pink Panther	LRK	B	M	SEMINIS	R-I	R	S	3	2	S	S	T	T	6
Montcalm	DRK	B	F	MSU	R-I	R	S	4	2	R	T	T	T	6
Red Hawk	DRK	B	F	MSU	R-I	R	R	4	2	T	S	T	T	6
SVM Taylor	C	B	E	ADM	R-I	R	S	2	3	S	S	T	T	6
Etna	C	B	E	SEMINIS	R-I	R	S	2	2	S	S	T	T	6
Taylor	C	B	E	MIB	S	S	S	2	3	S	S	T	T	6
Chianti	C	SV	M	SEMINIS	R-I	S	S	5	3	S	S	T	T	6
Capri	C	B	M	MSU	R-I	R	S	3	3	S	S	T	T	6
Hooter	C	B	F	SEMINIS	R-I	S	S	2	3	S	S	T	T	6
Merlot	SR	USV	M	MSUUSDA	R	S	S	4	2	R	S	T	T	2
Matterhorn	GN	USV	E	MSU	R-I	S	S	3	4	T	S	R	T	3
Tebo	W	B	M	JAPAN	S	R	S	2	3	T	S	S	S	4
Fuji Tebo	W	B	M	MSU	R-I	R	S	3	3	T	S	S	S	4
Beluga	WK-AL	B	F	MSU	R-I	R	S	3	3	S	S	T	T	6
Aurora	SW	SV	M	CUNY	R-I	S	S	3	3	R	S	R	S	4

Plant Type: B=Bush, SV=Short Vine, USV=Upright Short Vine, V=Vine

Maturity: E=Early (less than 88 days), M=Mid-Season (89-95 days), F=Full Season (96-102 days), L-F=Late Full Season (greater than 102 days) JAN-2011

Canning Quality: 1=Poor, 2=Fair, 3=Good, 4=Above Average, 5=Excellent **Disease -R=Resistant, S=Susceptible, T=Tolerant, R-I=I gene, VS=Very Susceptible**

White Mold: 1=Less than 10% Infection, 2=Less than 20% Infection, 3=20-40% Infection, 4=40-60% Infection, 5=Greater than 60% Infection

Direct Cut Rating: 1=Very erect, 2=lodging, pods off ground, 3=lodging, pods close to ground, 4=high yield loss, 5=severe yield loss, 6=not recommended

TABLE 5A – Chemical Weed Control in Dry Edible Beans

Dry Edible Beans — Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses (including lambsquarters)	EPTC *(Eptam)*	2.25	1.25 qt 7EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Eptam* suppresses common ragweed and wild mustard. • ***Prowl* (pendimethalin)**, ***trifluralin***, or ***Sonalan*** should be **tank mixed** with ***Eptam*** for additional broadleaf control, including lambsquarters. • *Pursuit* (2 oz) can be added to tank mixes with *Prowl, trifluralin,* or *Sonalan* for nightshade control. • *Pursuit* (2 oz) may also be applied preemergence after preplant incorporated applications of *Eptam* tank mixed with *Prowl, trifluralin,* or *Sonalan*. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses, Annual broadleaves (some exceptions)	trifluralin *(many)*	0.5	1 pt 4EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Trifluralin* provides better pigweed control than *Prowl* or *Sonalan*. • ***Trifluralin*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	pendimethalin *(Prowl)* OR *(Prowl H_2O)*	0.75	1.8 pt 3.3EC OR 1.6 pt 3.8ACS	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Prowl* provides better velvetleaf control than *trifluralin* or *Sonalan*. • ***Prowl*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin *(Sonalan)*	0.75	2 pt 3EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • ***Sonalan*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses, Annual broadleaves (some exceptions)	imazethapyr + pendimethalin *(Pursuit Plus)*	0.47	20 oz 2.9EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT apply *Pursuit Plus* if cold and/or wet conditions are present or predicted to occur within one week of application. • Delayed maturity may result from applications of *Pursuit Plus*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • 20 oz of *Pursuit Plus* contains 1.1 pt of *Prowl* 3.3EC, which may not be adequate grass control under heavy infestations. • On heavy soils with greater than 2% organic matter and heavy weed pressure, 30 oz of *Pursuit Plus* may be applied. • Dry bean varieties vary in their sensitivity to *Pursuit Plus*. Use ONLY on navy, black turtle, pinto, kidney and cran - berry 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.

	alachlor *(IntRRo)* OR *(Micro-Tech)*	2	2 qt 4EC OR 2 qt 4ME	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Alachlor should be incorporated in the top 2 inches of soil to minimize the danger of bean injury. • DO NOT use on sands or sandy loam soils – injury can occur. • Alachlor provides better nightshade and pigweed control than metolachlor products. • *Prowl, trifluralin* or *Sonalan* can be tank-mixed for lambs-quarters control. • *Pursuit* (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. • DO NOT use on adzuki beans. • 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 **Yellow nutsedge**	s-metolachlor *(Dual Magnum)* OR *(Dual II Magnum, Cinch)*	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • PREPLANT INCORPORATED *Dual Magnum* minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Dual Magnum* 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. • *Dual Magnum* provides better yellow nutsedge control than *alachlor* or *Outlook*. • *Prowl, trifluralin* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control. • *Pursuit* (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. • DO NOT apply *Dual Magnum* within 60 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	metolachlor (*Parallel PCS, Stalwart)*	1.3	1.33 pt 8EC	• **May be applied preplant incorporated or preemergence.** • *Stalwart/Parallel PCS* 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, *Stalwart/Parallel PCS* 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 *Dual Magnum/ Dual II Magnum/Cinch* (s-metolachlor). • Refer to Table 5C for weed control and crop tolerance ratings. • See remarks and limitations for *Dual Magnum*. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.66	14 oz 6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • PREPLANT INCORPORATED *Outlook* minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Outlook* rate to 12 oz/A on coarse-textured soils with low organic matter. • Navy and black beans are more sensitive to *Outook* applications than to *Dual Magnum*. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Outlook* provides better pigweed and nightshade control than *Dual Magnum*.

- *Prowl, trifluralin,* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control.
- *Pursuit* (2 oz) can be tank mixed for nightshade and additional broadleaf control.
- A postemergence application of *Basagran, Pursuit,* or *Raptor* may be necessary for additional broadleaf control.
- DO NOT apply *Outlook* within 70 days of harvest.
- DO NOT use on adzuki beans.
- 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
Annual broadleaves	imazethapyr *(Pursuit)*	0.031	2 oz 2L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT apply *Pursuit* if cold and/or wet conditions are present or predicted to occur within 1 week of application. • Delayed maturity may result from applications of *Pursuit*. 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, 1.0 oz of *Pursuit 70DG* may be applied. • Pursuit can be tank mixed and applied preplant incorporated with *Eptam* plus *trifluralin, Prowl,* or *Sonalan*; or *alachlor*, *Dual Magnum* or *Outlook*; or preemergence with *Dual Magnum* or *Outlook. Pursuit* in these mixes will control eastern black nightshade. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Pursuit* will NOT control common ragweed. • Dry bean varieties vary in their sensitivity to *Pursuit*. 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.
	halosulfuron *(Permit/Sandea)*	0.023	0.67 oz 75DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • Reduce the rate of *Permit/Sandea* to 0.5 oz/A on lighter textured soils with low organic matter. • *Permit/Sandea* can cause injury under cool and wet growing conditions. • Delayed maturity may result from applications of *Permit/Sandea*. • Dry bean varieties and classes vary in their tolerance to *Permit/Sandea*. From MSU research, CAUTION should be taken when applying *Permit/Sandea* to kidney and black beans. • *Permit/Sandea* can be tank mixed with *Eptam* for grass and additional lambsquarters control. • *Permit/Sandea* can be tank mixed with *metolachlor* products or *Outlook* for annual grass control. • *Permit/Sandea* will not control ALS-resistant weed species. • DO NOT plant SUGAR BEETS within 21 months of a *Permit/Sandea* application. • 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
(continued)				
Annual broadleaves	fomesafen *(Reflex)*	0.25	1 pt 2L	• **May be applied preplant surface or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • *Reflex* will provide 4-5 weeks of control and/or suppression of broadleaf weeds. • Rainfall that splashes treated soil onto newly emerged seedlings can cause temporary crop injury. • Tank mixtures or sequential herbicide applications are needed to broaden the spectrum of weed control. • *Reflex* can be applied only in the Lower Peninsula of Michigan. • DO NOT apply *Reflex* to the same field in CONSECUTIVE years. • The maximum use rate of *Reflex* 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
Annual broadleaves (including cocklebur, velvetleaf, and jimsonweed)	bentazon *(Basagran)* + crop oil concentrate	0.75	1.25 pt 4L + 1 qt	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds. Check *Basagran* dry bean label for specific rate and proper weed growth stage. • Beans MUST HAVE one fully expanded trifoliate 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 *Basagran* (1 pt + 1 pt) plus crop oil concentrate (1 pt + 1 pt) can be used for more consistent common ragweed and lambsquarters control. Make the first application when weeds are less than 1 inch tall, and make second application 10-14 days later. • For CANADA THISTLE and YELLOW NUTSEDGE control, apply sequential applications of *Basagran* (1.5 pt + 1.5 pt) plus crop oil concentrate (1 qt + 1 qt) when Canada thistle is 6-8 inches tall and yellow nutsedge is 4-6 inches. Make second application 7-10 days later. • Allow 30 days between *Basagran* application and dry bean 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
Common ragweed, Pigweed, Nightshade	fomesafen *(Reflex)* + surfactant	0.25	1 pt 2L + 0.25%	• Refer to Table 5C 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 *Reflex*. • Beans MUST HAVE one fully expanded trifoliate 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. • *Reflex* can be tank-mixed with *Basagran, Raptor*, or *Pursuit*. Include a COC when tank-mixing *Reflex* + *Basagran*. ONLY include a non-ionic surfactant when tank-mixing with *Raptor* or *Pursuit*. DO NOT add AMS or 28%N. • *Reflex* can be applied only in the Lower Peninsula of Michigan. • DO NOT apply *Reflex* to the same field in CONSECUTIVE years. • DO NOT apply within 45 days of harvest. • Refer to Table 12 for crop rotation restrictions.
Pigweed, Nightshade, Wild mustard	imazethapyr *(Pursuit)* + surfactant	0.031	2 oz 2L + 0.25%	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • Apply *Pursuit* 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 *Basagran* is added to “safen” this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Pursuit* to control common cocklebur and jimsonweed. • Delayed maturity may result from applications of *Pursuit*. 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 *Pursuit*. 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.

(Continued on next page)

Dry Edible Beans — Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Pigweed, Nightshade, Wild mustard	imazamox *(Raptor)* + bentazon *(Basagran)* + crop oil concentrate + ammonium sulfate	0.032 0.25	4 oz 1L + 8 oz 4L + 1% + 2.5 lb	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate 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 *Raptor* with crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v). • At least 8 fl oz of *Basagran* **must** be tank mixed with *Raptor*, if ammonium sulfate (12-15 lb/100 gal) or 28% liquid nitrogen (2.5% v/v) are added. *Basagran* "safens" this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Raptor* 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 *Raptor* + *Basagran* on adzuki beans. *Basagran* causes significant injury to adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Grasses	sethoxydim *(Poast)* + crop oil concentrate + ammonium sulfate	0.19	1 pt 1.5SC + 1 qt + 2.5 lb	• Refer to Table 5C for weed control and crop tolerance ratings. • Reduced rates of *Poast* (12 oz/A) may be used when barnyardgrass, green and giant foxtail, and fall panicum are less than 4 inches tall and the target species. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between *Poast* application and dry bean harvest. • *Poast* is generally less effective than other postemergence grass herbicides for perennial grass control. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + surfactant + ammonium sulfate	0.094 0.068	6 oz 2EC + 1% OR 9 oz 0.97EC + 0.25% + 2.5 lb	• Refer to Table 5C for weed control and crop tolerance ratings. • Reduced rates of *Select/Arrow* (4-5 oz/A) or *Select Max* (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. • *Select/Arrow* or *Select Max* can be tank mixed with *Basagran*. Increase the *Select/Arrow* rate to 8-10 oz/A and the *Select Max* rate to 12 oz/A and apply with crop oil concentrate (1% v/v). • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Select/Arrow* (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 *Select Max* (12 + 12 oz/A) are needed to control 4 to 12 inch quackgrass. • Refer to label and Table 12 for crop rotation restrictions.
	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.044	7 oz 0.88L + 1% OR 0.25%	• Refer to Table 5C 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 *Assure II/Targa* application and dry bean harvest. • *Assure II/Targa* can be tank mixed with *Basagran* for foxtails and barnyardgrass. Increase the *Assure II/Targa* rate by 2 oz. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Assure II/Targa* (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.

Table 5B - Preharvest Treatments in Dry Edible Beans

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preharvest	glyphosate *(many)* + ammonium sulfate	0.75 lb a.e.	See Table 10 + 17 lb/100gal	• 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, *Duramax*, *Durango DMA, Touchdown Total* and *Traxion* are some glyphosate products that are currently labeled. • ***DO NOT*** use glyphosate for **vine desiccation** — residues of glyphosate have been found in harvested beans if applications are made too early. • Glyphosate should be applied when beans are in the ***hard dough stage*** **(30% moisture or less)**. • Glyphosate applications should be made at least 7 days before harvest. • ONLY one application should be made per year. • DO NOT apply glyphosate to beans grown for seed. • DO NOT feed treated vines and hay from these crops to livestock.
	paraquat *(Gramoxone Inteon)* + surfactant	0.3-0.5	1.2–2 pt 2SL + 0.25%	• *Gramoxone Inteon* is a restricted-use pesticide. • Apply when crop is mature, at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • Always add a non-ionic surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v. • Apply by air in 5 gal water/A or by ground in 20-40 gal of water/A. • If growth is lush and vigorous, make either a single application of the higher rate of *Gramoxone Inteon*; or split applications at the lower rates. Split applications may improve vine coverage. DO NOT exceed 2.0 pt/A of *Gramoxone Inteon*. • Do not harvest within 7 days of application.
	paraquat *(Parazone)* + surfactant	0.5	1.33 pt 3SL + 0.25%	• *Parazone* is a restricted-use pesticide. • *Parazone* contains the same active ingredient as *Gramoxone Inteon* (paraquat), but is at a different concentration. • See the Remarks and Limitation section for *Gramoxone Inteon*.

(Continued on next page)

Preharvest Treatments in Dry Edible Beans (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Preharvest	flumioxazin *(Valor)* + methylated seed oil	0.05	1.5 oz 51WG + 1 qt	• 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. • *Valor* can be applied at rates up to 2 oz/A. • Dry beans can be harvested 5 days after *Valor* application. However, it generally takes 7 to 14 days to reach maximum desiccation activity. • Dry bean desiccation is similar to that from *Gramoxone* and glyphosate; however, the spectrum of weed control is not as broad. • *Valor* provides residual activity that may reduce winter annual growth. • Follow sprayer clean-up instructions — residues of *Valor* can be trapped in poly-tanks and hoses if not adequately cleaned. • Crop rotation restrictions are dependent on rainfall, *Valor* use rate and tillage. • Rotation restrictions for 2 oz or less of *Valor* 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 *Valor* preharvest treatment resulted in major sugar beet stand reduction. Tillage reduced the effect of *Valor* on sugar beet; however, slight injury may occur on sandier soils. • Refer to label and Table 12 for crop rotation restrictions.
	cafentrazone *(Aim)* + methylated seed oil	0.015-0.03	1-2 oz 2EC + 1%	• 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. • *Aim* is not as effective as glyphosate or *Gramoxone Inteon*. • *Aim* at 1 oz/A combined with glyphosate or *Gramoxone* will broaden the spectrum of weed control over *Aim* alone. • Sequential applications may be needed — thorough coverage is required. • Do not harvest within 3 days of application.

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

			ANNUAL BROADLEAVES									ANNUAL GRASSES								PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																								
DUAL MAGNUM/PARALLEL/STALWART	O	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
EPTAM	O	2	P	P	**G**	F	F	F	F	F	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	F	F
OUTLOOK	O	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
INTRRO	O	3	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
PROWL	O	1	N	N	**G**	P	F	P	P	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
PURSUIT	B	3	F	F	P	**E**	**E**	P	F	F	**G**	P	P	F	F	F	P	P	P	N	N	N	N	F
SONALAN	O	1	N	N	**G**	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
TRIFLURALIN	O	1	N	N	**G**	N	**G**	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
PURSUIT PLUS	O/B	3	F	F	**G**	**E**	**E**	P	F	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	F
Preemergence																								
OUTLOOK	O	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
DUAL MAGNUM/PARALLEL/STALWART	O	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
PURSUIT	B	3	P	P	P	**E**	**E**	P	F	P	**G**	P	P	F	F	F	P	P	P	N	N	P	N	F
PERMIT/SANDEA	B	3	F	F	F	P	**E**	**G**	P	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N	F
REFLEX	O	2	P	P	**G**	**E**	**E**	**G**	**G**	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
Postemergence																								
BASAGRAN[b]	O	2	**E**	**G**	F	P	P	F	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	**G**	N	**G**
POAST	A	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	F	N
SELECT/SELECT MAX/ARROW	A	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
ASSURE II/TARGA	A	1	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	N	N	N	**E**	N
PURSUIT[c]	B	3	F	P	P	**E**	**E**	P	F	F	**E**	P	P	F	P	P	P	P	P	N	N	P	N	F
PURSUIT[c] + BASAGRAN	B/O	2	**E**	**G**	F	**E**	**E**	F	**G**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	**G**
RAPTOR[c]	B	3	F	F	F	**E**	**E**	P	F	**G**	**E**	F	P	F	P	P	P	P	P	N	N	P	N	P
RAPTOR[c] + BASAGRAN (8 oz)	B/O	2	**G**	F	F/**G**	**E**	**E**	F	**G**	**G**	**E**	F	P	F	P	P	P	P	P	N	N	F	N	F
RAPTOR[cd] + BASAGRAN (16 oz)	B/O	2	**E**	**G**	**G**	**E**	**E**	F	**E**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	F
REFLEX	O	2	P	F	P	**G**	**G**	**E**	P	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
REFLEX + BASAGRAN	O/O	2	**E**	**G**	F/**G**	**G**	**G**	**E**	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	F	N	**G**
REFLEX + RAPTOR[d]	O/B	3	F	F	F	**E**	**E**	**E**	F	**G**	**E**	F	P	F	P	P	P	N	N	N	N	P	N	P

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Photosynthesis inhibitor; O = Other.
P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

Crop Tolerance: 1 = Minimal risk of crop injury; 2 = Crop injury can occur under certain conditions (soil applied — cold, wet; foliar applied — hot, humid); 3 = Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4 = Risk of severe crop injury is high. Recommended only in rescue situations.

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

[a] Crop tolerance for navy and black beans = 3. For other bean classes, crop tolerance = 2. Preplant incorporation will increase tolerance of navy and black beans to *Outlook*.

[b] Control of **hairy nightshade** with *Basagran* is good.

[c] Control of **hairy nightshade** with *Pursuit* and *Raptor* is excellent.

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