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Of
Agriculture

FINAL PERFORMANCE REPORT
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Assessment of “Narrow Row Technology” for the
Michigan Dry Bean Industry
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Submitted by:
Grantee:
Robert Green, Executive Director
Michigan Bean Commission
1031 South US 27
St. Johns, Michigan, 48879
Phone: (989) 224-1361
Fax: (989) 224-6374
E-mail: green@4wbi.net

Employer Identification Number (EIN) 38 180 9520
State Vendor Identification Number: 238 180 9520

Submitted to:
Grant Administrator:
Michael DiBernardo
Michigan Department of Agriculture
P. O. Box 30017
Lansing, Michigan 30017
Phone: (517) 373-9144
Fax: (517) 335-0628
E-mail: dibernardom@michigan.gov
Project Title: Assessment of “Narrow Row Technology” for the Michigan Dry Bean Industry
Final Report

Project Summary
This project will assess the potential for adoption and use of ‘narrow row technology’ by Michigan dry bean growers. This innovative cropping system is essential for growers to be competitive with other crops such as soybeans and corn and enhance the commercial viability and sustainability of this important sector of Michigan’s diverse agricultural base. ‘Narrow row technology provides numerous economic and agronomic advantages for production of dry beans. The traditional dry bean cropping system is contrasted with ‘narrow row technology in the following means: 1. Traditional cropping requires many more field passes to achieve proper tillage while ‘narrow row technology’ employs fewer operations from planting to harvest. 2. Traditional harvesting requires multiple field passes to first pull and window plants for field drying followed by a subsequent pass with a combine for thrashing. This procedure exposes beans to inclement weather and increased levels of stones, which are raised when the plants are uprooted. 3. Direct harvesting requires the use of plant desiccants to defoliate the plant prior to harvest to enable seed and plant dry down. Most of the desiccants have limitations for use in dry beans and new desiccants must be found to eliminate rotation restrictions, residue contamination and extremely high toxicity problems. 4. Traditional cropping allows dry beans to be lodged and close to the ground. There is a need to develop dry bean varieties to stand erect with elevated pods to aid in direct harvesting operations. This project will enhance previously completed work in 2010 with one more year of research data.

Project Approach
Our approach has grower involvement in planning and setting research priorities. A Narrow Row Research Priority meeting was held in March to review 2010 results and plan the 2011 growing season. Greg Varner conducted small plot trials at the research farm and a location in Sanilac County comparing 15, 20 and 30 inch rows on navy, black and small red beans. Small plot trials were also conducted on black and small red bean populations. The second research location was used in case of climatic risk such as the drought conditions experienced in 2010. He also conducted five grower strip trials on navy, black and pinto varieties in the major dry bean counties of Michigan. A nitrogen rate grower strip trial was conducted in Huron County. The white mold fungicide trial was conducted at the Montcalm Research farm where adequate irrigation provides excellent white mold disease expression. Canning trials were conducted at the Michigan State University Food Science Pilot Canning Plant. Canning samples were evaluated using dry bean canners, shippers, and growers. University faculty, graduate students and technicians also rated the canning trials. Dr. Christy Sprague’s research consisted of new desiccants and herbicides in commercial dry bean production systems conducted at the Saginaw Valley research farm and another herbicide trial at the main campus of Michigan State University. Dr. James Kelly conducted research on new dry bean varieties at the Saginaw Valley and Montcalm research farms. Dry bean growers participated in the tours at research sites. Information on research results were put up on websites, compiled for publication and disseminated at grower meetings and tours.

Goals and Outcomes Achieved
Field Plot Trials-Row Width and Plant Populations in Dry Beans
Gregory Varner produced yield, and plant height results from ten row width and population trials conducted at the Saginaw Valley Research and Extension Center (SVREC) north of Frankenmuth, Michigan and a Sanilac County (SC) location. The Merlot small red row width trial at SVREC showed significant difference in yields between the 20 inch and the 30 inch row width. There was no significant yield difference between the 15 inch and 30 inch rows. The 30 inch row width spacing showed the tallest height followed by the 20 inch spacing over the 15 inch rows. Lodging was constant with all the row widths. The SC site showed the same results with 20 inch rows yielding significantly higher than the 30 inch spacing and 15 inch spacing were not significantly higher than the 30 inch row widths. Plant heights were again higher with the 30 inch spacing. Vista and Medalist navy beans planted at SVREC in 30 inch rows were taller than the 20 and 15 inch rows. Vista and Medalist planted in the 20 inch row spacing had the significantly higher yields than the Vista planted in 15 inch rows and the Medalist planted in 30 inch rows. Vista and Medalist yielded almost the same when averaged over the three row widths. The SC site
showed Medalist navy at the 15 inch row width significantly out-yielding the Medalist in 30 inch rows. There was no yield difference between the 15 and 20 inch Medalist beans and the no difference between the 20 and 30 inch Medalist. Vista navy at 30 inch row widths yielded significantly higher than 20 inch Vista navy. There was no yield difference between the 15 and 20 inch Vistas. Medalist significantly out-yielded Vista by 2.3 cwt.

Shania and Zorro black beans planted at SVREC in 15 inch rows yielded significantly different than the 30 inch row spacing and the 20 inch row Zorro. 15 inch Zorro blacks yielded significantly higher than the 20 inch Shania. 15 inch Shania showed no difference in yield to 20 Shania, but showed higher yields when compared to 30 inch Shania. The 30 inch row widths were taller than the 20 and 15 inch rows. Zorro and Shania yields were only .6 cwt different when averaged across all row widths. The SC site showed Zorro black at the 15 inch row width significantly out-yielding the Zorro in 20 and 30 inch rows. Shania black at the 15 inch width out-yielded the Shania in 20 and 30 inch row widths. Zorro black in 20 inch rows out-yielded the 30 inch Zorro. Zorro out-yielded Shania by 3.5 cwt when averaged over the three row widths.

Zorro black beans at the SVREC planted in ten populations ranging from 106,288 to 144,619 showed no yield increase between populations and between the 15 inch and 20 inch row spacing. Average plant height was highest in the 20 inch rows. These findings validate 2010 results showing no difference in yield over populations ranging from 87,882 to 125,453. The SC site had populations ranging form 108,464-148,975. Zorro blacks showed no yield increase between the populations. Dry beans will and can compensate for varying populations by adding more growth and pods per plant to produce an optimum yield. It would be expected to lose 10-15% from the planting population to the harvest population.

Merlot small red beans at the SVREC planted in six populations ranging from 96,703 to 126,614 showed no yield increase between populations and between the 15 inch and 20 inch row spacing. Plant height was very similar in both the 15 and 20 inch rows. The SC site had populations ranging form 92,129-121,968. Merlot small red beans showed no yield increase between the populations.

All fungicide treatments used to control white mold disease showed yield increases over the untreated check on Merlot small red beans, conducted at the Montcalm Research Farm in Entrican, Michigan. The fungicide treatments of Omega at the 8 and 13.7 oz. rate, Propulse at the 8.6 oz rate, and Propulse at the 10.3 oz rate yielded significantly higher than the untreated check. All these treatments except Propulse at 8.6 oz (at 100%), had two applications at 100% bloom and seven days later. Propulse fungicide produced by Bayer Crop Science is supposed to receive a label for use in dry beans in 2012.

Grower Strip Trials
Two navy bean strip trials were grown at the Voelker farm in Pigeon and the Schindler farm in Auburn. The Voelker navy bean strip trial ranged in yields of 21.6-29.0 cwt per acre. Merlin navy had the highest yield in this trial and Medalist was close second. The Schindler trial ranged between 25.0-30.0 cwt per acre. Medalist was had the highest yield in the Schindler navy bean strip trial. Merlin navy was the second highest. Plant populations varied between the navy varieties in both locations. This variation difference was likely caused by seed size differences. Smaller seed size generally will plant thicker because of more doubles being planted from the seed plate.

The Stoutenburg black bean strip trial in Sandusky ranged in yields of 28.1-30.6 cwt per acre. Zorro had the highest yield. The Lakke Ewald black bean trial in Unionville ranged between 25.9-27.7 cwt per acre. Zorro had the highest yield although three other varieties, Shania, Black Velvet and Loreto were all within 100 pounds of Zorro. These two trials varied in planting population of 145,000 versus 120,000 and yield did not vary significantly between the two locations.

The Schindler pinto bean strip trial in Auburn ranged in yield of 19.4 and 22.4 cwt per acre. This trial received 3.5 inches of rain on June 22 slowing down overall growth in this trial. La Paz pinto had the highest yield. The popular La Paz variety from North Dakota had the tallest height and Buster was the shortest. Second highest yielding pinto was experimental line ADM 06189.

Dry bean samples from four of the five grower strip trials were processed at the Michigan State University Food Science Pilot Canning Plant. Canned product was opened and evaluated. One navy (COOP 2098) and two pinto bean cultivars (La Paz and ADM 06203) showed poor canning quality. Canning quality ratings used a 1-7 scale with 7 being perfect appearance and 2 and 1 being poor appearance.

A strip trial was also planned to evaluate a biological control agent, Coniothyrium minitans (Contans) that shows promise in managing white mold in various crops. Contans was applied on the Bernia farm in Akron at planting and the field was heavily damaged by excessive rainfall. Fungicide sprays were planned for late July, but the trial site was abandoned due to severe stand losses.
The Nitrogen Strip trial conducted in Northeast Huron County showed highest yields with 50 pounds banded and broadcasted and 70 pounds banded. These yields though were not significantly higher than the 30 pounds of banded nitrogen fertilizer. This trial verified the Michigan State University recommendation of 50-60 pounds of nitrogen for upright short vine beans grown in narrow rows.

“Evaluation of selected treatments (herbicides and plant desiccants) to enhance dry bean ‘narrow row’ efficiency and productivity”. Optimizing row width and plant populations to improve weed management and yield in Michigan dry bean production systems.

Team leader: Christy L. Sprague, Associate Professor, Department of Crop and Soil Sciences

At the Saginaw Valley Research and Extension Center, conditions were mildly dry but otherwise favorable, resulting in average yields of 26.2 cwt/A for black beans and 22.2 cwt/A for small red beans. Black bean yield was not significantly affected by row width, bean population or herbicide treatment. However, small red bean yield was significantly higher in narrow rows (15- and 20-inch) compared with 30-inch rows. There was not a significant difference in yield between small red bean populations. In both classes, 15-inch rows suppressed weed growth after the POST herbicide treatment. In black beans, the 20-inch rows weed suppression was similar to the 15-inch rows, but this was not the case for the small red beans. In some cases, narrow rows also reduced *Alternaria* and western bean cutworm feeding severity. At the East Lansing location moisture was abundant, resulting in average yields of 37.4 cwt/A in black beans and 27.4 cwt/A in small red beans. Yield was 6 cwt/A and 4 cwt/A higher in narrow rows in the black and small red beans respectively. Yield was also higher in weed-free treatments than in POST treatments in both classes. In black beans, population did not have a significant impact on yield. In small red beans, yield was marginally higher at high population than at low population with medium population intermediate. In black beans, and at high population in small red beans, narrow rows greatly reduced weed biomass compared with wide rows. Narrow rows also reduced *Alternaria* and cutworm feeding severity. This research has been conducted for the past two years at two different locations, while yield of both classes of beans has not always benefited from planting in narrow rows, the majority of times there has been a yield advantage, and suppression of late-season weed growth has been a benefit.

Potential preharvest options for narrow row dry edible bean desiccation

Christy Sprague

These treatments included the current standards of Gramoxone and glyphosate (Roundup) and also newer registered compounds of Aim, Valor, and Sharpen. The treatments also included various tank-mixtures of registered products and two non-labeled potential products. At the 3 days after treatment (DAT) evaluation, Valor (1.5 oz/A) + MSO and Sharpen (1 fl oz/A) + MSO + AMS provided significantly higher (p ≤ 0.05) dry bean desiccation than Gramoxone Inteon, Roundup PowerMax, or Aim. However by 7 DAT, all treatments except Aim alone provided greater than 90% dry bean desiccation. Higher rates of Valor (2 oz/A) or Sharpen (2 fl oz/A) did not improve dry bean desiccation. The addition of Aim to Sharpen or Gramoxone Inteon did not improve dry bean desiccation over any of these treatments alone. The combination of Valor and Roundup PowerMax also was not different than Valor alone. The two potential new products, Reglone and a Reglone premixture look promising at the 7 DAT. From these results and those from previous years there are several effective desiccation products. However, each of these products has specific precautions and limitations that need to be considered. Information on these restrictions and how to best use these products can be found in chapter 5 of the 2012 MSU Weed Control Guide for Field Crops (E-434).

Title: Development and Maintenance of High-Yielding, Disease Resistant, Processor Quality Dry Bean Varieties suitable for Direct Harvest in Michigan

Principal Investigator: James D. Kelly and Evan Wright, Crop and Soil Sciences, Michigan State University.

Activities, Accomplishments, Impacts: The bean breeding program harvested 5,600 yield trial plots (32 tests) in 2011 and over 2,360 single plant selections were made in the early generation nurseries. Yield trials at SVREC (Richville) included 36-entry standard navy test; two 36-entry standard black tests; two 56-entry prelim navy tests; 84-entry prelim black test; 36-entry standard GN; 36-entry standard pinto test; 20-entry standard red/pink test; 84-entry prelim GN test; 36-entry prelim pinto test; 36-entry prelim GN test; 36-entry prelim pinto test; 30-entry prelim FM test; 32-entry USDA red/pink test; 300-entry BeanCAP test; two canning quality trials for CONAGRA: 8-entry navy and 14-entry pinto; and 48-entry Co-op and regional test that includes pinto, GN, red and pinks. At Montcalm two bush cranberry test with 128 and 72 entries; 112-entry prelim
kidney test; 12-entry mayacoba test; two white mold tests: one with 64-entries and one 96-entry pinto trials; 100-entry BeanCAP drought trial; two 36-entry certified organic trial in Tuscola county and SVREC; on campus one potato leaf hopper (PLH) trial with 80-entries; and 130-entry nitrogen fixation (BNF) test. All trials except for kidney, cranberry, drought, BNF and white mold were direct harvested using the new plot combine. Plots at SVREC suffered from an early drought through late-July but recovered well with top yields exceeding 30cwt/a. The drought reversed maturities with full-season black and navy beans maturing ahead of pinto and great northern. Plots at Montcalm had adequate rainfall and yield in kidney beans exceeded 39 cwt. Yield in cranberry beans was lower at 35 cwt and many lines with resistance to CBB were identified in both nurseries. Rust is becoming an increasing threat to navy and black bean producers in Michigan, and we have identified resistance to race 22:2 in new navy and black bean lines.

**Progress in black bean breeding:** Zorro performed very well in statewide and strip trials in 2011, but its major weakness is a lack of anthracnose resistance. CBB, rust and anthracnose resistance is currently being integrated into the Zorro genetic background. Over 150 new black bean lines were trialed in 2011 and a number of new lines with resistance to CBB, anthracnose and rust show promise and one line (B10244) is under increase in the MDA greenhouse. B10244 has superior canning quality and is anthracnose resistant. Canning quality and color retention following canning still needs to be assessed in these new lines.

**Progress in navy bean breeding:** The new Merlin navy bean topped trials in 2011 and Medalist fell below average in trials at SVREC. The program trialed 148 new navy bean lines in 2011 and a group of lines with high yield, improved upright architecture, lodging resistance and better dry down than Vista and Medalist were identified. Many of these lines possess anthracnose and rust resistance and two lines (N11258 and N11283) are under increase in MDA greenhouse. These two navy lines are high yielding with superior canning quality. They are both resistant to rust and anthracnose.

**Progress in pinto bean breeding:** P07863 pinto continues to dominate yield trials in Michigan followed by La Paz (95%), Lariat (90%) and Santa Fe (81%). It has outstanding yield potential, erect architecture, full season maturity-plants stay green late but advance to harvest maturity in 7 days. P07863 was tested extensively in 40 statewide trials and is suitable for direct harvest to compete against other varieties and market classes. Highest yields were recorded in white mold trials in Montcalm, so it would be suited to narrow row production. P07863 will be considered for release this winter.

**Progress in small red/pink bean breeding:** In 2011, Merlot exhibited stay green trait at maturity and efforts to correct this in new lines is being made. One new pink line S08418 is being considered for release. It possesses virus resistance, has good seed color, outyielded Sedona by 5% (equivalent to Merlot in yield) and does not exhibit the stem breakage observed in Sedona. In general pink beans showed better overall dry down than the small red seed types.

**Progress in GN/Tebo bean breeding:** The anthracnose resistant line G09303 repeated as top yielder in 2011. It out yielded Matterhorn but did not display the problem of fish mouth and will be tested further. Seed quality is a major selection criterion in this class and other high yielding lines are being selected for improved seed quality. A group of upright lines in Tebo seed class are being tested as the bush Tebo types are not performing well under more stressful conditions.

**Progress in kidney/cranberry bean breeding:** The program trialed 112 new kidney beans and 200 new cranberry bean lines in 2011 and top yields ranged from 35-39 cwt/a. White kidney K08961 yielded over 37 cwt and has outperformed Beluga by 20% over 4-years. It matures 5-7 days earlier and dries down well but canning quality is a notch lower than Beluga. K08961 is being considered for release this winter. A number of red kidney lines with CBB resistance were identified and need further testing. DRK lines, K08222 and K08228 were evaluated in statewide trials in 2011 and were competitive in yield. New high-yielding early-season cranberry bean lines were identified, many with resistance to CBB. These lines will continue to be advanced and tested by MSU.

**Beneficiaries**
Direct beneficiaries of the project activities were the 1300 dry bean growers in Michigan who participated in some of the various activities of the project. This research project will also indirectly benefit other dry bean growers in the United States. Attendance numbers for each of the events are listed below:
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Lessons Learned
Having activities for grower participation has raised the overall knowledge of narrow row production systems in dry beans. The benefit of having a panel of four dry bean growers on the State Dry Bean Day Program was well received with many positive comments. Newsletter articles before planting season to remind dry bean growers the best narrow row practices have been well received. Growers like to hear what other growers in narrow rows are doing. As soon as research data becomes available in the harvest season, it is important to distribute this new data as soon as possible by newsletter, radio and internet postings. There is an overall yield increase when dry beans are planted in 15 to 20 inch rows in comparison to 30 inch rows. Many planning decisions for the future cropping plans are being made in September and October. The 2011 Dry Bean Research Report for Narrow Rows is well received by Michigan growers and they now ask when the publication is available.

Contact Person
Gregory Varner, 989-751-8415, varnerbean@hotmail.com
Dr. James Kelly, 517-355-0271 Ext 1181, kellyj@msu.edu
Dr. Christy Sprague, 517-355-0271 Ext 1224, sprague1@msu.edu

Additional Information
Presentation of results to Michigan growers and agri-business representatives:
1) Saginaw Valley Research and Extension Center Field Day. August 2, 2011. Richville, MI. Presentation on dry bean row widths and plant populations.
2) Bay, Gratiot, Huron, Montcalm, Sanilac and Tuscola County Dry Bean Tours. August 17- 31, 2011. Showed 228 dry bean growers commercial and experimental dry bean cultivars planted in 20 inch rows.
4) Published and distributed 1000 copies of the Second Year Dry Bean Narrow Row Research Report. These reports will be handed out at dry bean elevators and at the 2012 County Dry Bean Meetings.
5) PowerPoint Presentation on Narrow Row Grower Strip Trials and Small Plot Trials at 2012 County Dry Bean Meetings.

FINAL REPORT
“Evaluation of selected treatments (herbicides and plant desiccants) to enhance dry bean ‘narrow row’ efficiency and productivity”. Optimizing row width and plant populations to improve weed management and yield in Michigan dry bean production systems.
Team leader:  Christy L. Sprague, Associate Professor, Department of Crop and Soil Sciences
Accomplishments:

Previous research in other crops has indicated that narrow rows often suppress weeds, and several studies have also suggested that narrow rows may also improve yield. In order to determine the benefits and limitations of growing dry beans in narrow rows in Michigan, field research was conducted in 2011 at two locations, the Saginaw Valley Research and Extension Center near Richville and the MSU Agronomy farm in East Lansing. This research examined the effect of varying row widths and bean populations on: 1) weed suppression, 2) plant architecture, 3) white mold development, 4) western bean cutworm egg laying and survival, and 5) yield in two classes of dry edible beans. The two dry bean classes examined were ‘Zorro’ black beans and ‘Merlot’ small red beans. Three row widths were examined at one location: 1) 15 inch, 2) 20 inch, and 3) 30 inch rows, while at the other location only 15 and 30 inch rows were examined. The three populations examined for black beans were 1) 79,500 plants per acre, 2) 106,000 plants per acre, and 3) 132,500 plants per acre. For small red beans, the populations were 1) 60,000 plants per acre, 2) 79,500 plants per acre, and 3) 106,000 plants per acre. Dry bean yield results varied between bean classes and locations. At the Saginaw Valley Research and Extension Center, conditions were mildly dry but otherwise favorable, resulting in average yields of 26.2 cwt/A for black beans and 22.2 cwt/A for small red beans. Black bean yield was not significantly affected by row width, bean population or herbicide treatment. However, small red bean yield was significantly higher in narrow rows (15- and 20-inch) compared with 30-inch rows. There was not a significant difference in yield between small red bean populations. In both classes, 15-inch rows suppressed weed growth after the POST herbicide treatment. In black beans, the 20-inch rows weed suppression was similar to the 15-inch rows, but this was not the case for the small red beans. In some cases, narrow rows also reduced Alternaria and western bean cutworm feeding severity. At the East Lansing location moisture was abundant, resulting in average yields of 37.4 cwt/A in black beans and 27.4 cwt/A in small red beans. Yield was 6 cwt/A and 4 cwt/A higher in narrow rows in the black and small red beans respectively. Yield was also higher in weed-free treatments than in POST treatments in both classes. In black beans, population did not have a significant impact on yield. In small red beans, yield was marginally higher at high population than at low population with medium population intermediate. In black beans, and at high population in small red beans, narrow rows greatly reduced weed biomass compared with wide rows. Narrow rows also reduced Alternaria and cutworm feeding severity. This research has been conducted for the past two years at two different locations, while yield of both classes of beans has not always benefited from planting in narrow rows, the majority of times there has been a yield advantage, and suppression of late-season weed growth has been a benefit.

Potential preharvest options for narrow row dry edible bean desiccation

Christy Sprague

Even dry down of dry edible beans is important for direct cut harvest operations. These harvest operations often favor planting dry beans in narrow row widths. Growers often need to apply a preharvest herbicide application help aid in desiccation of dry edible beans. Currently, there are five herbicide options labeled for preharvest application in dry edible beans. The current options aren’t always 100% effective and there are potential issues with herbicide residues found in the harvested crop if applications are not made at the appropriate time. In late-summer of 2011, 18 potential preharvest treatments were evaluated for the speed and effectiveness of desiccation of dry beans planted in narrow rows. These treatments included the current standards of Gramoxone and glyphosate (Roundup) and also newer registered compounds of Aim, Valor, and Sharpen. The treatments also included various tank-mixtures of registered products and two non-labeled potential products. At the 3 days after treatment (DAT) evaluation, Valor (1.5 oz/A) + MSO and Sharpen (1 fl oz/A) + MSO + AMS provided significantly higher (p < 0.05) dry bean desiccation than Gramoxone Inteon, Roundup PowerMax, or Aim. However by 7 DAT, all treatments except Aim alone provided greater than 90% dry bean desiccation. Higher rates of Valor (2 oz/A) or Sharpen (2 fl oz/A) did not improve dry bean desiccation. The addition of Aim to Sharpen or Gramoxone Inteon did not improve dry bean desiccation over any of these treatments alone. The combination of Valor and Roundup PowerMax also was not different than Valor alone. The two potential new products, Reglone and a Reglone premixture look promising at the 7 DAT. From these results and those from previous years there are several effective desiccation products. However, each of these products has specific precautions and limitations that need to be considered. Information on these restrictions and how to best use these products can be found in chapter 5 of the 2012 MSU Weed Control Guide for Field Crops (E-434).
Dissemination of Results (Year 2):

Presentation of results to Michigan growers and agri-business representatives:
Results from this research have been presented at several grower meetings and have been written up as newsletter articles for Michigan dry bean growers.

Presentation of results at Scientific Meetings:

Scheduled Scientific Presentations for FY12:
One presentation is scheduled at the 2012 Weed Science Society of America annual meeting in February in Kona, HA.

Projected Activities: Finish analysis on economic impact data. Continue to disseminate results at grower meetings, field days and scientific conferences. Publish research in peer-reviewed scientific journals.

Impacts:
- Development of recommendations for Michigan growers with the benefits and limitations of narrow row dry bean production
- Reduction in soil erosion and compaction by eliminating the use of inter-row cultivation for weed control
- Improved sustainability and profitability of dry bean production in Michigan

Funding Partners: Michigan Department of Agriculture’s Specialty Crops Program through the funded Michigan Dry Bean Industry’s proposal titled Assessment of “Narrow Row Technology” for the Michigan Dry Bean Industry ($10,000 to Sprague) and Michigan State University’s Project GREEEN.
2011 Grower Strip Trial Canning Evaluation

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7=Excellent  
5-6=Above Average  
3-4=Average  
2=Poor  
1=Unacceptable