Search



**Researcher Resources** 



**ABOUT** 

**NEWS & STORIES** 

AFFILIATED PROGRAMS

**PROJECTS** 

Home

**Bean Info** 

**Beet Info** 

**Directions** 

History

InfoVideos

Links

# One Hundred Years of Bean Breeding at Michigan State University: A Chronology

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As a farewell to the 20th Century, I thought it would be interesting to summarize the milestones achieved in bean breeding over the last century.



All breeding research at Michigan State University (MSU) is conducted through the Michigan Agricultural Experiment Station (MAES) housed originally in Michigan State College and now in MSU. The achievements in bean breeding are based on the efforts of dedicated scientists, staff and students, and credit must be given to them.

Forty varieties in eight commercial classes were developed and released during the 20th Century and each has contributed in different ways to the success and stability of the dry bean industry in the state and elsewhere. A more detailed summary of bean breeding activities was described previously by Dr. Axel Andersen in the Michigan Dry Bean Digest, 1982/83.

### **Improved Bean Breeding**

Dr. Spragg was the first plant breeder hired by the MAES and his greatest contribution to plant breeding was the release in 1915 of the first navy bean variety, Robust. Robust was selected as a consistent performer among lines of native landrace strains of navy bean grown in Michigan. Robust was identified as a consistent high-yielder. Other varieties developed during this era were Wells red kidney and Rainy River navy, but all navy beans suffered from being full-season, decumbent plant type, highly susceptible to white mold, mosaic virus and anthracnose. Improved navy bean breeding was achieved through cross breeding rather than pure line selection. After Spragg died, Dr. E.E. Down undertook the breeding effort which resulted in the release of Michelite navy bean in 1938. Michelite was derived from the cross of Early Prolific with Robust and it proved to be higher yielding with better seed quality than Robust. In addition, Michelite was resistant to common strains of bean common mosaic virus (BCMV) present in Michigan during that era.

# **Bush Variety Created with X-ray Mutation**

Following the release and widespread acceptance of Michelite, attempts were made to introduce a determinate bush habit into the navy bean through traditional backcross breeding were unsuccessful, so a program of using X-ray mutation breeding was undertaken in the 1940s. This resulted in the development of the first bush navy bean variety, Sanilac, in 1956. Sanilac was one of the first successful crop varieties to be developed through mutation breeding. The work was the culmination of the efforts of Down and Dr. Axel Andersen, USDA-ARS plant pathologist affiliated with the breeding program. Sanilac was significant for its upright bush habit, earlier maturity, anthracnose and white mold resistance.

Sanilac heralded the era of the development of early season bush navy bean varieties in the 1960s and those efforts were directed by Dr. Wayne Adams. His work resulted in the release of three early-season bush navy bean varieties, Seaway, Gratiot, and Seafarer, all destined for markets in Europe through the newly opened St. Lawrence Seaway. Since the seaway froze early in the winter, early season varieties were essential to sustain the vital export market. Traditional full-season varieties would not have met the needs of this market due to the three week delay in harvesting. The Seafarer variety retained its popularity among growers for two decades after its release in 1968.



In conjunction with Dr. Fred Saettler, the next USDA-ARS plant pathologist to be affiliated with the breeding program, Adams turned his attention to kidney beans. Problems with halo blight were jeopardizing this sector of the industry. Adams and Saettler released the Montcalm dark red kidney variety in 1974 which assured the continued successful production and expansion of kidney bean production in Michigan, particularly Northern Michigan where crop alternatives were scare. A quarter century after its release, Montcalm is still the most widely grown dark red kidney bean variety, sought by growers for its halo blight resistance and processors for its superior canning quality.

#### **Upright Beans**

During the 1960-70s when spectacular yields in wheat and rice were touted internationally as the 'Green Revolution', Adams turned his attention to plant modification in beans as an approach to improving yield. He proposed a more upright plant habit, referred to as a 'archetype', and he designed a new bean plant based on his observations and experience with bean germplasm from

Central America. The approach, known as ideotype breeding, has resulted in development of new upright varieties starting with Swan Valley in 1982, followed by Neptune, C-20, Mayflower and the most recent variety, Mackinac, released in 1996. These varieties and the commercial varieties developed directly from them formed the basis of the significant increase in yield in beans during the current decade.

#### **Diversifying Bean Varieties**

As a direct spinoff from the program to develop upright navy beans, new black bean varieties were developed from the Central American black bean germplasm used as parents in the breeding program. Varieties like Domino and Black Magic sparked a renewed interest in black beans and contributed to the increasingly available markets in Mexico and other Latin

American countries. Diversification became the cry of the bean industry in the 1980s, and as result varieties were developed by the author in pinto and great northern commercial classes to meet that demand. Those efforts continue today but the major market expansion in Michigan continues to be in black beans. In 1998, more acres were planted to black beans than navy beans underscoring the preference among growers for black beans as compared to other non-traditional commercial classes. In order to adapt pinto and great northern beans to Michigan, upright plant architecture was incorporated into both types as traditional varieties grown in the western states all possessed a decumbent viney growth habit that increased significantly their risk to diseases and weather related losses during harvest. Varieties such as Sierra and Aztec pinto and Alpine great northern were among the first pinto and great northern varieties released by MSU.

## Facts and Figures

Average bean yield in Michigan around the turn of the last century was less than eight cwt (13 bushel) per acre and the average price of \$1.50 per bushel (10 year average) generated an income of under \$20.00 per acre to growers 1. Contrast that with the record 1999 state average of 20 cwt per acre with an average price of \$18.00 per cwt for a grower gross income approaching \$400.00 per acre. This represents a 150% increase in bean yields in Michigan over a 100 year period for an average increase in yield of 1.5% per annum.

1 Raven, W.F. 1910. Bean production. Mich. State Agric. College Expt. Stat. Bulletin 259.

Individuals contributing to the earlier effort in black beans including the release of Blackhawk include Dr. Ardeshir Ghaderi, who retired early after a serious automobile accident in 1984. The work on bean diseases suffered a major set back when Saettler died in 1990. Work on the genetics of food quality traits in beans received a boost in the late 1970s with the arrival of Dr. George Hosfield, USDA-ARS plant geneticist affiliated with the breeding program. Hosfield worked collaboratively with scientists such as Dr. Mark Uebersax in food science. They developed small scale canning method capable of evaluating small quantities of seed of a large number of different bean breeding lines.

This collaboration has ensured that all new varieties in all market classes meet an acceptable standard of quality sought by the processing industry. New varieties such as Huron navy bean, Red Hawk dark red kidney and Matterhorn great northern excel in quality as a result of the rigorous screening for quality imposed on all new varieties in each commercial class under development at MSU.

#### **Partnerships Create Success**

The success of the breeding program had two import allies outside the university — the members of the Michigan Crop Improvement Association and their long term loyalty and financial support for the program and the varieties generated by the program. The second group is headed by Greg Varner, the research director of the Production Research Advisory Board – PRAB, funded by the Michigan Bean Commission and the Michigan Bean Shipper Association. Efforts by Varner and his predecessors have been invaluable in testing all new MSU bean breeding lines and giving them a fair evaluation in comparison with other public and private varieties. This performance information gathered from growers' fields in the production area is critical to assist the breeder in making the decision to release a breeding line as a new variety. In retrospect, however, much of the success of the bean breeding program can be attributed to the technical personnel employed by MAES. Two technicians who contributed the greatest long term effort were Jerry Whitford in the 1940-60's and Jerry Taylor who has contributed over 30 years of dedicated service and effort and is still actively employed in the breeding program today.

## **New Millennium, New Challenges**

As we look to the new millennium, challenges and exciting times face the bean industry in Michigan. Production wise, yields are at an all time high and varieties suitable for narrow row production and direct harvest are now available. The potential application of molecular tools and markers to improve the efficiency of the breeding program is exciting. However, the issue of genetically modified --GM -- crops is on everyone's mind. Bean growers would like the opportunities that biotechnology offers in weed and pest control, whereas industry must deal with the realities of the market place and the fact that the European market, that consumes over 40% of our beans, does not want GM beans. Each decade appears to produce a decisive or contentious issue that has the potential to polarize people. At the turn of the 20th century, GM food has certainly achieved that fame and could have a decisive influence on the future production of many crops. How the bean industry is able to strike the right balance and optimize benefits of all will be the challenge for the next century.



Bean varieties released by MAES-MSU (PDF)

## **History Is A Great Teacher**

Finally, can we learn from history? Sometimes it is valuable to look back before striking forward. I would, therefore, like to conclude this article by raising the rhetorical question: Are Michigan bean producers still as "tied to" the navy (pea) bean in 1999 as they were in 1910? I refer to a quote from the Hon. A. B. Cook of Owosso, Michigan, published by W.F. Raven in  $1910^{\frac{1}{2}}$ : 'I have come to the conclusion that as a money crop, one year with another, the little old fashioned pea (navy)

This statement appears to have significant relevance to the bean industry 90 years after it was articulated. Despite major efforts to diversify the industry, the navy bean is still the dominant commercial class in Michigan at the turn of the century.

### **MILESTONES**

**1900's**Establishment of bean breeding program at Michigan Agricultural Experiment Station , Michigan State College under the direction of Dr. Spragg.

bean has the advantage. It is hardy, early maturing, is always in demand and is the safest to tie to'.

1910'sRelease of Robust navy bean variety in 1915. Robust was a line selected yield, uniformity and resistance to virus from among a lot of commercial

beans

- 1920's Active program in navy bean strain testing and breeding at MSU.
- **1930's**Release of Michelite navy bean variety in 1938. Michelite was the first bred variety released by MSU.
- **1940's**Attempts to use X-rays to generate novel genetic variability useful in bean breeding.
- **1950's**Release of Sanilac navy bean in 1956. Sanilac was the first bush navy bean released by MSU.
- 1960's Release of series of early season bush navy bean varieties, Seaway, Gratiot, and Seafarer, destined for European markets via the St. Lawrence Seaway.
- 1970's Release of Montcalm dark red kidney bean in 1974. Montcalm was the first halo blight resistant kidney bean which revitalized that industry in Northern Michigan.
- 1980'sClass diversification in black and pinto beans. Release of first black, pinto, great northern bean varieties, Domino, Black Magic, Sierra and Alpine by
- **1990's**Broad adoption of the full-season, high-yielding, upright short vine navy and black bean varieties by growers.
- $^{1}$ Raven, W.F. 1910. Bean production. Mich. State Agric. College Expt. Stat. Bulletin 259.
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