

Technical Report TR 14-9

# *Agricultural Experiment Station*

**Colorado  
State  
University**

College of Agricultural Sciences

Department of Soil & Crop Sciences

Extension



Crops  
Testing 

Making Better  
Decisions

**2014 Colorado Dry Bean  
Variety Performance Trials**

## Table of Contents

Authors.....	3
2014 Colorado Dry Bean Performance Trials.....	4
2014 Irrigated Pinto Bean Variety Performance Trial at Lucerne.....	5
COAGMET Monthly Summaries from 2012-2014.....	6
10-Year Summary of Pinto Bean Variety Performance in Colorado.....	7
Pinto Bean Variety Descriptions.....	8
Update on the Fast Track Development of “Slow Darkening” Pinto Beans.....	10
History of Dry Bean Production and Breeding in Colorado.....	12
Acknowledgments.....	19

For the fastest access to up-to-date variety information and results visit us at: [www.csucrops.com](http://www.csucrops.com)

### Disclaimer

\*\*Mention of a trademark proprietary product does not constitute endorsement by the Colorado Agricultural Experiment Station.

Colorado State University is an equal opportunity/affirmative action institution and complies with all Federal and Colorado State laws, regulations, and executive orders regarding affirmative action requirements in all programs. The Office of Equal Opportunity is located in 101 Student Services. In order to assist Colorado State University in meeting its affirmative action responsibilities, ethnic minorities, women, and other protected class members are encouraged to apply and to so identify themselves.

## Authors

Dr. Jerry Johnson - Associate Professor and Extension Specialist - Crop Production, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-1454, E-mail: jerry.johnson@colostate.edu.

Dr. Mark Brick - Professor and Dry Bean Breeding Program Leader, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-6551, E-mail: mark.brick@colostate.edu.

Dr. Howard Schwartz - Professor and Extension Specialist - Plant Pathology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, Phone: 970-491-6987, E-mail: howard.schwartz@colostate.edu.

Jim Hain - Research Associate - Crops Testing Program, Colorado State University, Department of Soil and Crop Sciences, 40335 CR GG, Akron, CO 80720, Phone: 970-554-0980.

Sally Sauer - Research Associate - Crops Testing Program, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-1914, E-mail: sally.sauer@colostate.edu.

J. Barry Ogg - Research Associate – Dry Bean Breeding Program, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-6354, E-mail: barry.ogg@colostate.edu.

Mark McMillan - Research Associate - Plant Pathology, Colorado State University, Department of Bioagricultural Sciences & Pest Management, Phone: 970-214-5538, E-mail: mark.mcmillan@colostate.edu.

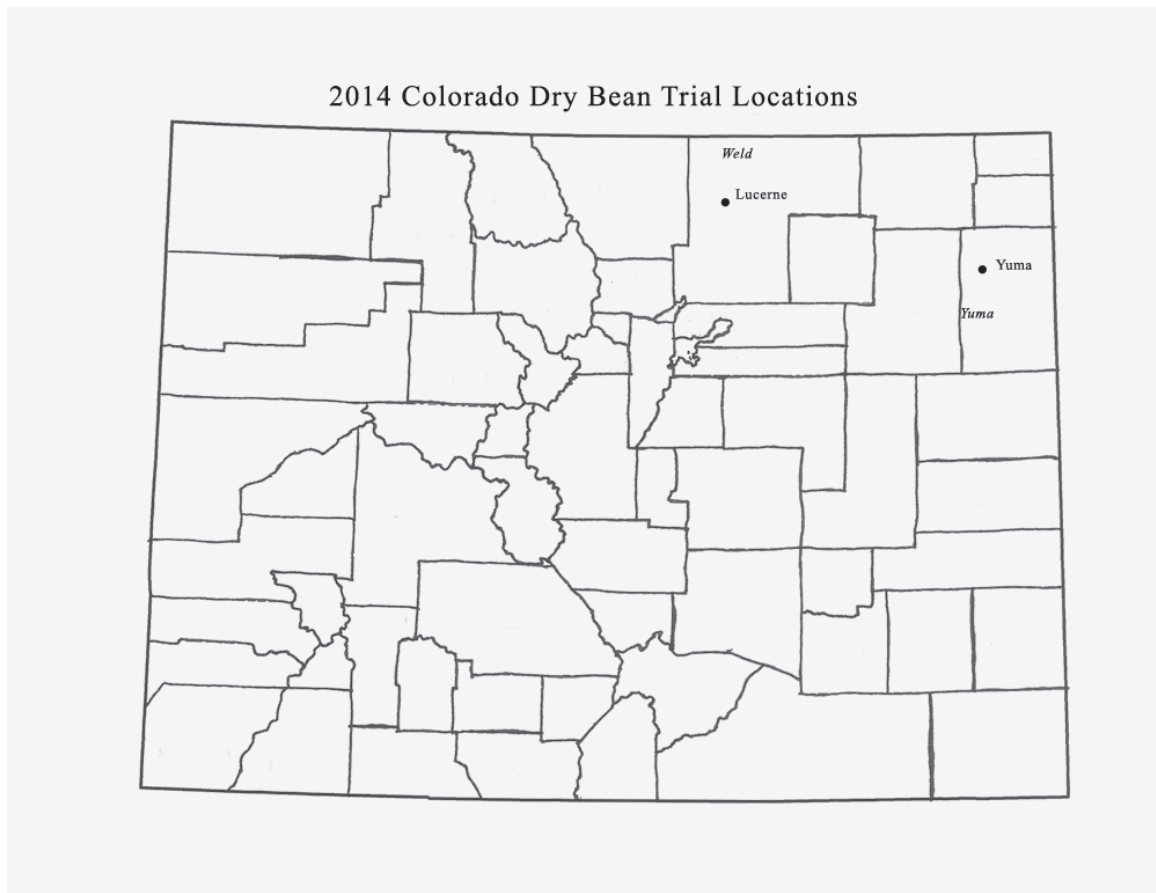
Kierra Jewell - Administrative Assistant III, Colorado State University, Department of Soil and Crop Sciences, Phone: 970-491-6201, E-mail: kierra.jewell@colostate.edu.

Kris Otto - Research Associate - Plant Pathology, Department of Bioagricultural Sciences & Pest Management, Phone: 970-491-0256, E-mail: kristen.otto@colostate.edu.

## 2014 Colorado Dry Bean Performance Trials

The Colorado State University Crops Testing Program, Bean Breeding Program, and Bean Pathology Research Program provide unbiased, current, and reliable variety performance results and information to help Colorado dry bean producers make better planting decisions. Our uniform dry bean variety trials serve a dual purpose of screening experimental lines from CSU's Bean Breeding Program as well as testing them alongside commercially available varieties. This allows the breeding program to make variety advancement decisions and helps our program make informed recommendations for Colorado bean producers. Colorado State University promotes crop variety testing as a service to crop producers and seed companies who depend on us for crop variety performance information. The uniform dry bean variety trial is made possible by funding received from Colorado dry bean producers and handlers via the Colorado Dry Bean Administrative Committee, and the CSU Agricultural Experiment Station.

Colorado produced approximately 774,000 hundredweight (cwt) of dry beans on 43,000 harvested acres in 2014. The total value of production was over \$22.6 million in 2013 (most recent available data). Two eastern Colorado trials were planted at Yuma and Lucerne. Sixteen varieties with diverse origins, maturities, disease resistance, growth habits, and adaptability were tested at two irrigated trial locations. The results table for the Lucerne trial is presented in the following pages. Plot sizes were approximately 300 ft<sup>2</sup> and all trials were planted at 85,000 seeds per acre. Seed yields and seed sizes for all trial varieties are reported in the tables. Yields are adjusted to 14% seed moisture content.



## 2014 Irrigated Pinto Bean Variety Performance Trial at Lucerne

Variety	Source	Yield <sup>a</sup>	Moisture	Seeds/Pound
		lb/ac	percent	count
Monterrey	ProVita, Inc.	4043	11.1	1302
Santa Cruz	ProVita, Inc.	3709	10.4	1350
GTS-904	Gentec Inc.	3579	10.0	1257
La Paz	ProVita, Inc.	3440	11.3	1338
Sinaloa	ProVita, Inc.	3423	10.2	1368
GTS-907	Gentec Inc.	3411	9.7	1302
Montrose	Colorado State Univ.	3389	9.9	1212
SV6239 GR	Seminis	3227	10.4	1386
Croissant	Colorado State Univ.	3213	9.6	1335
SV6653 GR	Seminis	3068	10.2	1254
Long's Peak	Colorado State Univ.	3048	10.1	1284
CO 86661-5	Colorado State Univ.	2955	9.6	1239
CO 91216-15	Colorado State Univ.	2931	9.7	1191
Medicine Hat	Seminis	2902	10.0	1209
CO 91212-4	Colorado State Univ.	2854	10.3	1221
Othello	USDA-Prosser, WA	2844	9.5	1134
<b>Average</b>		<b>3252</b>	<b>10.1</b>	<b>1274</b>

<sup>b</sup>LSD (P<0.30)

321

<sup>a</sup>Yields corrected to 14% moisture.

<sup>b</sup>If the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is statistically significant.

Plot Size: 10' x 30'

### Site Information

Cooperator: Ed Croissant

Planting Date: 5/9/2014

Harvest Date: 9/17/2014

### 3-Year Average Irrigated Dry Bean Variety Performance Trial at Lucerne (2012-2014)

Variety	Source	Yield <sup>a</sup>	Moisture	Seeds/Pound
		lb/ac	percent	count
La Paz	ProVita, Inc.	3380	11.5	1288
GTS-904	Gentec Inc.	3306	10.9	1206
Sinaloa	ProVita, Inc.	3127	9.8	1375
CO 91216-15	Colorado State University	3100	10.4	1145
Croissant	Colorado State University	3019	9.8	1292
Montrose	Colorado State University	2936	9.5	1271
Long's Peak	Colorado State University	2864	10.7	1256
Medicine Hat	Seminis	2732	9.1	1224
Othello	USDA-Prosser, WA	2563	9.2	1249
<b>Average</b>		<b>3003</b>	<b>10.1</b>	<b>1256</b>

<sup>a</sup>Yields corrected to 14% moisture.

# COAGMET Monthly Summaries from 2012-2014

Compiled by H. F. Schwartz & M. S. McMillan, Colorado State University [www.coagmet.com](http://www.coagmet.com)

## Daily High Temperature (F)

	2012		
	Holyoke	Burlington	Rocky Ford
May	78.1	77.9	79.9
June	92.1	93.5	91.3
July	94.0	93.1	95.2
Aug	89.2	89.1	92.0
Sept	82.1	75.7	82.7
<i>average</i>	87.1	85.9	88.2

	2013		
	Holyoke	Burlington	Rocky Ford
May	71.5	74.6	78.0
June	86.4	87.3	90.6
July	82.5	86.9	91.3
Aug	87.7	86.6	90.6
Sept	82.0	81.0	85.3
<i>average</i>	82.0	83.3	87.2

	2014		
	Holyoke	Burlington	Rocky Ford
May	72.2	74.8	77.9
June	80.8	82.5	88.9
July	82.7	88.3	89.6
Aug	87.4	87.4	83.9
Sept	79.2	79.6	81.3
<i>average</i>	80.5	82.5	84.3

## Number of Days Above 95 F

	2012		
	Holyoke	Burlington	Rocky Ford
May	1	2	1
June	13	13	14
July	17	20	21
Aug	6	8	10
Sept	4	4	4
<i>total</i>	41	47	50

	2013		
	Holyoke	Burlington	Rocky Ford
May	0	0	0
June	4	5	9
July	2	4	14
Aug	10	2	8
Sept	6	2	5
<i>total</i>	22	13	36

	2014		
	Holyoke	Burlington	Rocky Ford
May	0	0	0
June	0	2	6
July	4	11	13
Aug	1	2	4
Sept	0	1	1
<i>total</i>	5	16	24

## Monthly Rainfall (inches)

	2012		
	Holyoke	Burlington	Rocky Ford
May	1.0	0.0	0.3
June	1.3	0.0	0.1
July	1.2	0.7	1.0
Aug	0.9	3.1	0.1
Sept	0.3	1.0	0.8
<i>total</i>	4.7	4.8	2.3

	2013		
	Holyoke	Burlington	Rocky Ford
May	2.0	0.5	0.2
June	0.9	1.1	0.8
July	4.3	0.9	0.5
Aug	0.7	1.5	1.4
Sept	1.7	3.9	0.9
<i>total</i>	9.6	7.9	3.8

	2014		
	Holyoke	Burlington	Rocky Ford
May	3.4	0.0	0.7
June	7.2	0.0	2.0
July	1.5	1.0	5.1
Aug	1.9	2.5	1.1
Sept	1.2	0.9	0.6
<i>total</i>	15.2	4.4	9.5

**Summary:** 2014 had lower daily temperatures and fewer days above 95 F than 2012 and 2013 for all sites; and rainfall was greater in the Holyoke and Rocky Ford regions in 2014. The cooler temperatures and moderate to high moisture contributed to widespread issues with bacterial diseases in 2014.



## 10-Year Summary of Pinto Bean Variety Performance in Colorado

Every year CSU personnel conduct pinto bean variety performance trials in different locations across eastern Colorado. Variety entries and locations change from year to year, and this table summarizes varieties that have been tested over multiple years. In the table, yield performance by variety has been averaged over locations within each of ten years. Entries reported are public and commercial named varieties common to all trials for a year. Experimental lines are not included in this summary. The number of locations per year varied from one to six. The trial average at the bottom of each year's yield column is a simple average of the yields of reported varieties for that year. Average yield over years is shown in the column at the far right. Varieties are ranked according to highest average percent of average yield across each year they were tested.

10-Year Summary of Pinto Bean Variety Performance in Colorado Variety Trials from 2005-2014.

Variety <sup>a</sup>	Yield by Year										Long Term Average	% of avg.
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014		
Montrose	2449	3466	2587	4854	3569	3261	2660	3675	1869	3470	3186	106
Poncho	2676	3033	3179	4432		3144					3293	105
Sinaloa							2799	3574	1881	3338	2898	105
Mariah					3033	3105		3798	1982		2980	104
Bill Z	2454	3689	2796	4910	3273	3418	2305	3518	1610		3108	104
GTS-904			3118	3513	2634	3091	2468	3854	2055	3598	3041	102
Windbreaker					3415	3316		3358	1615		2926	101
La Paz	2490	3164	2586	3804	2177	2917	2700	3676	2416	3558	2949	101
Galeena	2374	3437	2508	5046	2390	3330					3181	100
Durango		3170	2390	4457	3136	3244	2301				3116	99
Croissant					2855	2792	2479	3236	2079	3250	2782	99
Long's Peak					2973	2786	2684	3329	1842	3117	2789	98
99217		3080	2406	4482	3296	3082	2148				3082	98
Stampede			2502	4015	3100	3081	2280		1843		2804	97
ND-307					2735	2949	2298		1899		2470	96
Medicine Hat					2902	2877		3267	1940	2851	2767	95
Grand Mesa	2265	2944	2429	4450	3132	2864	2204				2898	95
Lariat			2528	4472	3010	3123	2204		1463		2800	95
Othello		3033				3020		3411	1534	2778	2755	91
Average	2451	3224	2639	4403	2977	3078	2425	3518	1859	3245	2938	

<sup>a</sup>The following varieties were only tested for a few years during the ten year period, and are not included in this performance summary: Baja, Buckskin, Buster, Kimberly, Rally, Shoshone, and Sonora.



## Pinto Bean Variety Descriptions

- 99217** An AmeriSeed Inc. pinto variety from ProVita, Inc. that is late maturing (98-102 days) with a II B plant type. It has an intermediate resistance to rust and *Bean common mosaic virus* (BCMV).
- Bill Z** A pinto variety released in 1985 from Colorado State University. Bill Z has been one of the most widely grown pinto varieties in the western US and northern highland regions of Mexico. It combines medium maturity (94-97 days), high yield, excellent seed quality and yield stability into a variety that both growers and processors desire. It has semi-vine growth habit and carries resistance to beet curly top virus (BCTV), BCMV and *Bean common mosaic necrosis virus* (BCMNV), with tolerance to Fusarium root rot, common bacterial blight and bacterial brown spot.
- Croissant** A pinto variety released in 2008 from Colorado State University. Croissant combines several desirable commercial pinto bean traits including excellent seed color and size, high yield potential, resistance to prevalent strains of rust in the High Plains, and resistance to BCMV and BCMNV. Croissant has medium harvest maturity (93 to 98 days) and semi-upright plant architecture in most environments, however, it can lodge in soils with high nitrogen and soil moisture content.
- Durango** An AmeriSeed Inc. pinto variety from ProVita, Inc. with intermediate resistance to rust and BCMV. It is a mid to late season maturing variety (98-102 days) with a II B plant type.
- Galeena** An AmeriSeed Inc. pinto variety from ProVita, Inc. with intermediate resistance to rust and BCMV. It is a full season maturing variety (100-104 days) and has a II B plant type with a medium to wide profile.
- Grand Mesa** A pinto variety released in 2001 from Colorado State University. Grand Mesa is a medium maturity (94-98 days) variety that combines resistance to rust, BCMV, and field tolerance to white mold, but is susceptible to common bacterial blight and bacterial brown spot. It has moderate yield potential and good seed quality with a semi-upright Type II plant architecture.
- La Paz** An AmeriSeed Inc. pinto variety from ProVita, Inc. with intermediate resistance to rust and BCMV. It is a full season maturing variety (99-103 days) that has an upright medium to narrow profile and a II B plant type.
- Lariat** A pinto line released by the North Dakota Agricultural Experiment Station in 2008 and tested as ND020069. It has a Type II upright short vine with good lodging resistance. In Colorado it is a full season variety at approximately 99-100 days. It is resistant to rust and BCMV.
- Long's Peak** A pinto variety released in 2011 from Colorado State University. Long's Peak combines several desirable commercial pinto bean traits including excellent seed color and size, high yield potential, resistance to prevalent strains of rust in the High Plains, and resistance to BCMV and BCMNV. Rust resistance is derived from a single recessive gene that allows small rust pustules to form on the leaves late in the growing season. Long's Peak has upright plant architecture in most environments and has medium plant maturity (94-98 days).

- Mariah** A pinto variety released by Seminis. It is a medium maturing plant (93-97 days) with an intermediate, short-vine growth habit and resistance to BCMV and rust.
- Medicine Hat** A pinto variety released by Seminis. Medicine Hat is an early season variety (88-90 days) with short-vine growth habit. It is resistant to BCMV and rust.
- Monterrey** A pinto variety released in 2012 and distributed by AmeriSeed through ProVita Inc. It is a full-season variety, taking approximately 100-101 days to reach maturity. Upright plant type with high pod set and able to be direct harvested. Smaller seed size.
- Montrose** A pinto variety released in 1999 from Colorado State University. Montrose was released to provide a high yielding pinto variety with improved resistance to rust. It is a medium season variety (94-97 days) with a semi-vine type growth habit. Montrose is resistant to all known races of rust in the High Plains and western US. It has excellent seed quality and possesses resistance to CTV, BCMV, BCMNV, and it has tolerance to Fusarium root rot. It is highly susceptible to white mold.
- ND-307** A pinto variety developed by North Dakota State University. It is a late season (>100 days) high yielding variety with upright short-vine growth habit and has resistance to rust and BCMV.
- Othello** A pinto variety released by the USDA in 1987. It is an early variety (84 to 87 days) with resistance to BCMV, some root rot pathogens, and CTV. It is susceptible to local strains of rust, all bacterial blights, and white mold. It has good seed quality.
- Poncho** A medium maturity (97 days) pinto variety released by Rogers/Syngenta Seeds, Inc. in 1998. It has resistance to BCMV, high yield potential, and excellent seed quality. It has a Type III growth habit. It is susceptible to rust and bacterial brown spot.
- Santa Cruz** An AmeriSeed Inc. pinto variety distributed by ProVita, Inc. It is an upright plant type with short vines, which makes direct harvest possible. Released in 2012.
- Sinaloa** An AmeriSeed Inc. pinto variety from ProVita, Inc. It has a high yield potential and is a medium-full season maturing variety (96-100 days) with a II B plant type.
- Stampede** A pinto line released by the North Dakota Agricultural Experiment Station in 2008 as ND0203 51. It has full season maturity in the High Plains (96-99 days), high yield capacity and excellent seed size, shape, and appearance. Stampede is an erect variety, with very good lodging resistance. It is resistant to rust and BCMV.
- Windbreaker** A pinto line released by Seminis. It is a medium maturing pinto bean (94-98 days) with an upright, short-vine growth habit, and resistance to BCMV and rust.

**Pinto Bean Experimental Lines from:**

- CO86661-5** Colorado State University.  
**CO91212-4** Colorado State University.  
**CO91216-15** Colorado State University.  
**GTS-904** Gentec, Inc.  
**GTS-907** Gentec, Inc.  
**SV6239 GR** Seminis.  
**SV6653 GR** Seminis.

# Update on the Fast Track Development of “Slow Darkening” Pinto Beans

Mark A. Brick  
J. Barry Ogg  
Dry Bean Breeding and Genetics,  
Colorado State University

Last year, I reported on our breeding efforts to develop pinto bean varieties that possess the “slow darkening” (SD) trait. The SD trait is inherited as a single recessive gene and provides a bright cream background color and slows the darkening process during storage (Figure 1). Slow darkening pinto varieties have been released in Canada and Mexico, however, those varieties are not adapted to Colorado and have unacceptably small seed size for the premium pinto markets that Colorado targets. Because other states are also in the process of developing SD bean varieties, it is imperative that Colorado develop slow darkening pinto varieties for our region.



Figure 1. Example of the excellent seed quality of a slow darkening line harvested from a CSU trial at Lucerne in 2014.

The Dry Bean Breeding Project at Colorado State University initiated breeding SD pinto beans about 7 years ago. We made initial crosses to incorporate the slow darkening trait into breeding lines, however, the resulting lines lacked disease resistance and acceptable agronomic traits required for modern dry bean production practices. Subsequently, we backcrossed two more generations to adapted dry bean germplasm in our breeding program to obtain acceptable seed size and harvest maturity, however, these lines still did not possess upright architecture desired by the industry today.

In 2012, we received a grant from the USDA Specialty Crops Research Program through the Colorado Department of Agriculture to initiate “Fast Track” breeding efforts that will allow us to release slow darkening varieties by 2015. This grant allowed us to rapidly advance generations and increase clean seed of lines that possessed upright plant architecture. During the summer of 2013, we tested 800 advanced breeding lines from these crosses for yield potential, disease reaction and plant architecture. From these lines, we selected 30 lines for seed increase and testing in replicated yield trials during summer 2014. To-date we have narrowed our focus to ten lines for further seed increase and potential release. We will send seed of these ten lines back to New Zealand during winter 2014-15 for increase of Breeder Seed and further field testing in 2015. Based on the results of field testing in 2015, we will select two lines for variety release and provide Foundation seed to seed producers in late 2015.

Pinto beans are the most important and largest class of dry beans produced and consumed in the US and represent a major export market for the bean industry. Colorado currently ranks between 6th and 7th nationally in total dry bean production and second in pinto bean production. The development of slow-darkening pinto bean varieties will allow Colorado to remain competitive in both the U.S. and international markets, and maintain their status as the producer of the highest quality pinto beans in the world. A conservative impact of 5 to 10% would equate to an increase in crop value between \$3 and \$5

million annually in Colorado alone, and this figure does not include the income from seed production. The timely goals of this project could only be accomplished by funding from the USDA Specialty Crops Program administered by the Colorado Department of Agriculture, the Colorado Dry Bean Administrative Committee, and the Colorado State Agricultural Experiment Station.

# History of Dry Bean Production and Breeding in Colorado

Dr. Mark A. Brick

Dry beans have been grown commercially in Colorado for more than 100 years. The primary market class has always been the pinto bean, usually comprising more than 90% of the total crop. Other market classes have been produced, including small red, Anasazi, pink, light red kidney, small white and others. Today light red kidney is the second largest market class, comprising 5 to 15% of total production.

Pinto beans have been an important crop in Colorado agriculture since production statistics were first compiled in 1909. At that time, 5,000 acres were planted that had an average yield of 580 lb/A at a price of \$3.60/cwt. Pinto bean production increased rapidly thereafter. In 1914, 20,000 acres were planted and by 1917 production increased to 243,000 acres, of which only 40,000 acres were under irrigation. Annual production in Colorado increased from 180,000 cwt in 1914 to 900,000 cwt in 1917. The industry enjoyed steady growth throughout the 20s and 30s, and saw a record high in 1943 with 460,000 harvested acres. Average yield at that time was 535 lb/A at \$5.70/cwt. From 1970 to mid-1990's, acreage fluctuated between 120,000 to 225,000 acres annually, and average yields steadily increased to more than 1800 lb/A. Prices during this period varied from \$8.60 to \$31.20/cwt. Acreage since the mid-1990s has steadily declined due to low prices. In 2011, the area planted to bean was the lowest since the mid-1910s at 38,000 acres. Prices currently vary between \$14 to to 24/cwt. Given that the current cost of production is estimated at \$15/cwt, it is clear that the profit margin for the bean crop is minimal and lower prices have reduced the number of acres planted to historic lows.

## Dry Bean Improvement and Breeding

Alvin Kezer and Walter Sackett were among the first scientists in Colorado to work with dry beans. In 1918, they reported on dry bean production practices in Colorado during the early 20th century in publication "Beans in Colorado and Their Diseases". Early bean varieties were derived from land races that were grown by Native Americans or imported from other regions, including Mexico. The market class that we recognize today as pinto bean was known by several names during the early years of cultivation including: Mexican, Mexican bean, Mexican tick bean, Colorado bean, army bean, and others. The name pinto was well established by the mid-20th century, and the pinto is now recognized market class according to USDA Agricultural Marketing Standards.

Dry bean breeding activities in Colorado during the early 20th century were primarily focused on single-plant selections from land races and varieties that were brought into Colorado. Kezer and Sackett stated that, "...much progress can be made from selection with pinto beans as is sometimes done with corn in the Midwest". Suggested selection criteria included high individual plant yield, early maturity, uniform ripening of pods, and freedom from disease. The selections were planted in rows, and the highest-yielding rows that had desirable agronomic characteristics were saved for future planting stock. Kezer and Sackett stated that "Preliminary work with bean selection shows that it is easily possible to increase the yield 25% by selection alone". Undoubtedly, these early selections produced both higher yield and better disease resistance than in early varieties.

Pinto beans were also very important in the San Juan Basin of south central Colorado during the early 20th century. Early varieties were also derived from land races imported from other regions, especially

the highlands of Mexico. During the 1930's, pinto bean varieties such as San Juan showed severe symptoms of bean common mosaic virus (BCMV) infection. Dwight Koonce, who worked on beans for Colorado A&M at Hesperus, CO, cooperated with a local bean grower Homer Norton to identify and select disease-free plants in the field. Their work led to the release of the variety "San Juan Select", a virus-resistant variety, the most widely grown pinto in the region until the early 1980's, when the pinto variety "Cahone" was released by CSU. Today, a small amount of acreage is still planted to San Juan Select in the San Juan Basin.

### **Origin of the Breeding Program**

The first formal breeding program at CSU was first proposed in 1948 by Donald Wood. Don was hired as an Assistant Professor in 1947 to assist Dr. Warren (Red) Leonard with the barley breeding, and to help teach an undergraduate genetics course in the Department. In a draft proposal titled "A Plant Breeding Program for the Improvement of Pinto Beans in Colorado", Wood stated that "The objectives of the bean improvement program should be to: 1) Further study the bacterial blight organism, 2) Develop and maintain a Colorado pinto bean seed industry, 3) Breed for resistance to the rust pathogen, 4) Study improved cultural practices, and 5) Breed for improved resistance to bean common mosaic virus and curly top (an aphid transmitted virus disease)".



**Don Wood**

Don Wood recalled his first years at Colorado A&M as follows:

"My appointment as Assistant Agronomist in Colorado Agricultural Experiment Station began January 1, 1947. I can still remember the beautiful snow that fell during the preceding Christmas holiday as contrasted to the wind-driven blizzards of my Kansas experience. I was assigned to assist Warren H. Leonard in his Genetics classes, develop an MS thesis problem with Ralph Weihing, teach Crops Laboratory, and audit the other crops courses being taught. Two other graduate students joined the Department soon after I came, Ronald Ensign and Robert Osler. We were all pursuing MS degrees. I was under Dr. Leonard's tutelage, Osler was "Scotty" Robertson's student, and Ron Ensign also worked under Robertson on barley".

In 1946, a severe rust epidemic occurred in eastern Colorado. At that time, Dr. William (Bill) Zaumeyer, a USDA scientist working on beans at the Potato Research Station in Greeley, Colorado, studied the rust pathogen and conducted a breeding program to improve garden and pinto beans for the western US. Dr. Zaumeyer spent summer months in Greeley conducting field plots and winter months at Beltsville, MD conducting laboratory and greenhouse research. He made crosses during the winter in Beltsville, MD and planted the progeny in Greeley for evaluation and selection. Dr. Zaumeyer planted about three acres of garden beans and one acre of pinto beans in his search to find new sources of resistant genes and improved varieties. After the epidemic, Dr. Zaumeyer requested funding from the Colorado State Legislature to work on control mechanisms for rust and incorporation of rust resistant genes and incorporation of rust resistance into pinto bean. In 1947, Bill Zaumeyer found the perfect stage of rust and convinced the Colorado State Legislature to provide \$10,000 to fund bean research. From these funds, research on control methods using sulfur and variety testing were initiated. The following years, economic damage to the bean crop due to bean rust was significantly reduced due to timely applications of sulfur at the first sign of rust.

Graduate Research Assistant Ron Ensign also conducted a variety testing program that included new lines developed at the University of Idaho and resistant strains from Zaumeyer's program. According to Don Wood, "Bean varieties from Idaho had a growth habit that was attractive to the growers and although susceptible to rust, they soon became the choice of farmers in the eastern irrigated counties". Zaumeyer and his assistant, H. Rex Thomas, worked hard to get an agronomic type equal to the Idaho varieties with rust resistance. During the latter part of the 1940's, Bill Zaumeyer wanted to reduce his travel to Greeley in the summer, so he worked out an agreement with Don Wood to have the USDA package seed of pinto breeding lines and mail them to the Colorado for planting, evaluation, and selection. Eventually, Don Wood planted the entire Zaumeyer nursery. From these efforts the variety "Scout" was released; however Scout was not widely grown because it did not have the agronomic desirability that was available in the pinto varieties released from the University of Idaho, namely UI 71, UI 78 and UI 111.

In 1950, Don Wood pursued a PhD at the University of Wisconsin. Don recalled the day he left for Wisconsin to start his studies; "As I was driving out of town, I heard about the invasion of South Korea by North Korea on the radio. Because I had served in the Marine Corps during WWII, I thought that I may as well turn around and return home because I would be recalled to duty. However, I kept on driving and the recall never occurred." At the UW, Don studied corn genetics and the genetic mechanism involved in variegated seed color. In 1956, he completed the PhD degree and returned to CSU.

Don immediately continued his involvement and cooperation with the USDA on dry bean breeding. In 1957, Dr. Doug Burke was hired as a permanent breeder for the USDA to work at Greeley. However, shortly thereafter, Dr. Burke was transferred by the USDA to Prosser, WA, and the USDA no longer sent breeding material to Colorado. Consequently, Dr. Wood initiated a crossing program with continued emphasis on breeding for improved resistance from other *Phaseolus* species into pinto beans for disease resistance, especially common bacterial blight resistance. Because, hybrids among species are difficult to obtain, he was among the first to attempt embryo rescue techniques to rescue fertile F1 hybrids. Unfortunately fertile hybrids were never recovered.

With the assistance of Mr. Ballarin, the breeding program became computerized and expanded the number of crosses made each year and subsequently the size of the greenhouse and field nurseries. The size of the field nursery went from approximately five acres in the early 1980s to more than twelve acres by 1989. Mr. Ballarin left the University to pursue other career goals in 1989, when Mr. J. Barry Ogg was hired to replace him. Barry continued upgrading computer utilization on the project and by the early 1990s, the project replaced the use of mainframe computers with desktop computers to keep all records. With Barry's assistance, the project doubled the number of crosses made each year and included field nurseries at three research stations with more than 18 acres of breeding nurseries at ARDEC in Fort Collins. Ogg continues his work on the project today.

Dr. Wood released three important pinto varieties that were widely grown under irrigation in the High Plains and western US. The varieties included, "Ouray" in 1975, the first upright growth habit pinto bean; "Olathe" in 1981, the first rust resistant pinto variety; and "Bill Z" in 1985, the most widely grown pinto in the US throughout the 80s and early 90s. These varieties replaced previous pinto varieties that were susceptible to rust and provided growers with higher yield potential.

The dryland pinto breeding program in Southwestern Colorado began at Arboles, Colorado during the mid-1950s. The program continues today at Southwestern Colorado Research Station at Yellow Jacket,

CO. This program was initiated in connection with the Dolores River Project to improve bean yields in the San Juan Basin in cooperation with Howard Morre and Adrian Fisher at the research station in Ariola. Crosses for the breeding program were made by Don Wood at Fort Collins, and progeny were evaluated in southwestern Colorado under non-irrigated field conditions. The project released two important varieties including “Cahone” in 1982 and “Fisher” in 1995. Cahone was the first pinto variety to become accepted in San Juan Basin since San Juan select was released in the 1940s. Today, these varieties encompass essentially 100% of the pinto bean acreage in San Juan Basin.



**Mark Brick**

In 1986, Dr. Wood retired as the leader of the Dry Bean Breeding Project at CSU and Dr. Mark Brick became the project leader. Mark had experience breeding forage crops, particularly alfalfa, and at the time of appointment he served as the Manager of the Colorado Seed Growers Association. The Dry Bean Breeding Program continued emphasis on the improvement of pinto bean varieties that possessed multiple pest resistance for the High Plains and western US. The program initiated crosses for improved varieties in market classes other than pinto bean, specifically black and great-northern beans in 1990. To date, the program released “Fisher” in 1995, “Montrose” in 1999, “Shiny Crow” in 2000 and “Grand Mesa” in 2001. These varieties represent unique varieties for the high yield potential and possessed a new gene for resistance to the rust pathogen.

Shiny Crow was the first black bean variety released in the US that possessed a shiny seed coat rather than the traditional opaque (dull) seed coat luster. The shiny seed coat is a desirable characteristic for dry packaged black beans. Grand Mesa is semi-upright multiple pest-resistant pinto bean that possesses tolerance to rust, bean common mosaic virus, and white mold pathogen, a first in the pinto market class.

A major influence on Dry Bean Breeding Program in the 1990s and later was the organization of the dry bean industry to provide funding for research program. In 1986, certified seed producers in western Colorado through the Colorado Seed Growers Association agreed to provide a voluntary contribution to the bean research programs at CSU based on certified seed tag sales. These funds enabled the breeding and plant pathology programs to enhance breeding efforts, especially for greenhouse and field screening efforts to improve and broaden resistance to rust and other diseases. Further, in 1991, the Colorado Dry Bean Administrative Committee formed, based upon a statewide commodity, “check-off” on the commercial sale of dry beans. The money was earmarked for use to support dry bean marketing and research in Colorado. These funds enabled the dry bean programs at CSU to improve research efforts in breeding, variety testing, pathology, and Integrated Pest Management. The funds were especially useful for replacing outdated equipment and hiring students to assist with research efforts.

In 2014, the dry bean research programs at CSU have activities in breeding, variety testing, pathology, seed production, and entomology that take place on campus and at three Agricultural Research Centers throughout Colorado. The emphasis includes breeding, and research to solve environmental, pest, and cultural constraints to production. Scientists cooperating on the dry bean programs today include Drs. Mark A. Brick (breeder) and Jerry Johnson (variety testing), Department of Soil and Crop Sciences; Drs. Howard Schwartz (plant pathology), Scott Nissen (weed science) and Frank Peairs (entomology), Department of Bioagricultural Sciences and Pest Management; Dr. Calvin Pearson and Fred Judson, Western Colorado Research Center at Fruita; Mark Stack, Southwestern Colorado Research Center, Yellow Jacket; and Dr. Abdel Berrada, Arkansas Valley Research Center, Rocky Ford. Colorado dry bean producers benefit significantly from one of the most diverse and productive dry bean research programs in the US today.



In the mid-2000s, the Dry Bean Breeding Project initiated research on the chemical and nutritional composition of dry bean cultivars. Dr. Henry Thompson of the CSU Cancer Prevention Laboratory is collaborating with Dr. Brick to identify bean cultivars and market classes that have maximal health benefits. The research includes laboratory and pre-clinical trials regarding the ability of beans in the diet to influence the development of cancer, diabetes, and other diseases. Future work will focus on the identification of the genetic control of the factors that relate to health benefits of bean.

Article available online at: <http://beans.agsci.colostate.edu/history.html>



## Acknowledgments

The Colorado State University dry bean improvement team wishes to express their gratitude to the Colorado farmers who voluntarily and generously contributed the use of their land, equipment, and time to facilitate the 2014 dry bean variety trials. We are thankful to the collaborating farmers, Richard Wacker at Yuma and Ed Croissant at Lucerne. These trials are evidence of bean check off dollars at work. They would not be possible without research support provided by the Colorado Dry Bean Administrative Committee and the Colorado State University Agricultural Experiment Station. The publication of this report made possible by The Colorado Bean Network. We are also thankful to Larry Lande and Dean Larsen from Northern Feed and Bean in Lucerne, CO, Bill Newth from Trinidad/Benham Bean Co. in Sterling, CO, and Debbi Heid from C & F Foods in Yuma, CO for their assistance in identifying trial collaborators.

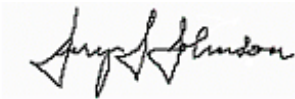


Trials conducted by Colorado State University Crops Testing Program, funded by the Colorado Dry Bean Administrative Committee, and reported by the Colorado Bean Network.

# Colorado State University



Department of Soil and Crop Sciences  
1170 Campus Delivery  
Fort Collins, Colorado 80523-1170



Jerry Johnson, Extension Specialist Crop Production