Technical Report TR 19-3

Agricultural Experiment Station

Colorado State University

College of Agricultural Sciences | Department of Soil & Crop Sciences | Extension

Making Better Decisions

2019 Colorado Dry Bean Variety Performance Trials

Crops Testing

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Acknowledgments

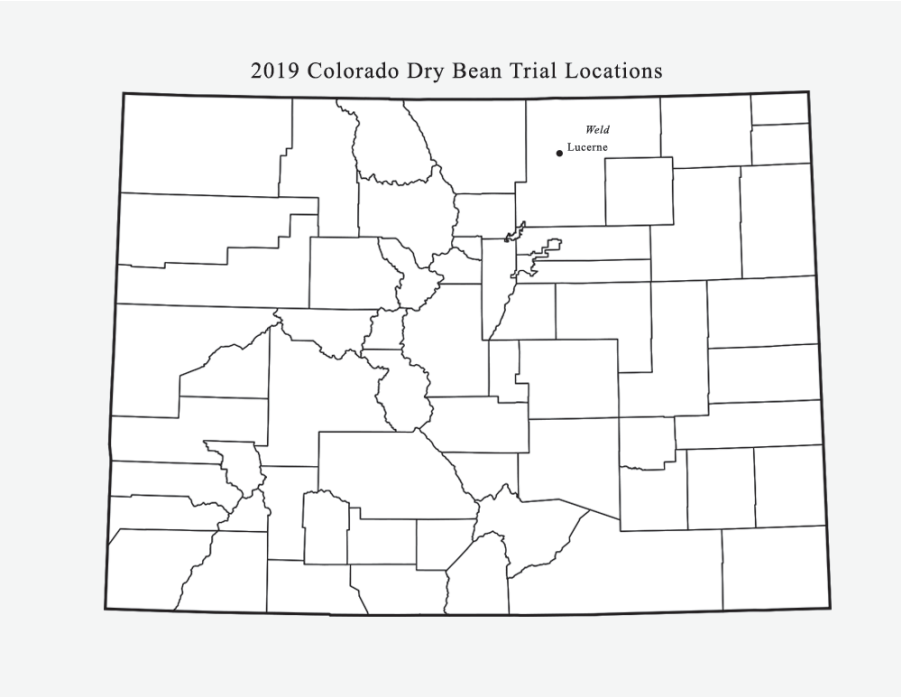
The Colorado State University dry bean improvement team wishes to express their gratitude to our 2019 collaborating farmer, Ed Croissant at Lucerne who voluntarily and generously contributed the use of his land, equipment, and time to facilitate the 2019 dry bean variety trial. We are also thankful to Larry Lande and Dean Larsen from Northern Feed and Bean in Lucerne for their unflagging collaboration. This trial is evidence of bean check off dollars at work. It would not be possible without research support provided by the Colorado Dry Bean Administrative Committee and Colorado State University.

2019 Colorado Dry Bean Performance Trials

The Colorado State University Crops Testing Program provides unbiased, current, and reliable variety performance results and information to help Colorado dry bean producers make better planting decisions. Our dry bean variety trial serves to test public varieties alongside commercially available varieties. 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.

Dry bean production for 2019 is forecast at 672,000 hundredweight, up 1 percent from the 668,000 hundredweight produced a year earlier. Yields are expected to average 1,920 pounds per acre, up 40 pounds per acre from the August 1 forecast but down 200 pounds per acre from last year. Growers expect to harvest 35,000 acres this year, up 3,500 acres from the 31,500 acres harvested last year. As of October 20, Colorado's dry bean harvest was estimated to be 78 percent complete, compared with 95 percent last year and the 5-year average of 88 percent.

One eastern Colorado pinto bean trial was planted, under irrigation, at Lucerne in 2019. Eighteen varieties with diverse origins, maturities, disease resistance, growth habits, and adaptability were tested at the irrigated trial location. The results table for this trial is presented in the following pages. Plot sizes were ~ 300 ft^2 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.



2019 Irrigated Pinto Bean Variety Performance Trial at Lucerne

Variety	Source	Yield[a]	2-Year Avg. Yield	2-Year Avg. Yield	Moisture	50% Flowering	Seeds/Pound	2-Yr Avg. Seeds/Pound
		lb/ac	lb/ac	percent of avg.	percent	date	count	count
Monterrey	ADM Seedwest	**4177**	3765	115%	10.4	23-Jul	1175	1196
PT16-9	USDA-ARS Prosser, WA	**4172**	3818	117%	10.4	23-Jul	1223	1185
PT11-13-1	USDA-ARS Prosser, WA	**4004**	3504	107%	10.3	23-Jul	1117	1180
Cowboy	ADM Seedwest	**3898**	3327	102%	10.2	21-Jul	1187	1231
StayBright	Trinidad-Benham	3783	3680	113%	10.4	20-Jul	1131	1241
DR Wood	Colorado State University	3646	3189	98%	9.8	21-Jul	1213	1256
Vibrant	ADM Seedwest	3568	3208	98%	10.0	19-Jul	1178	1216
Snowy Mountain #7	Preator Bean Company	3459	3269	100%	10.3	20-Jul	1151	1195
GTS-904	Gentec Inc	3418	3562	109%	10.1	22-Jul	1143	1124
Torreon	ADM Seedwest	3234	3206	98%	10.0	21-Jul	1145	1165
Wyoming 50	Preator Bean Company	3134	2476	76%	10.5	21-Jul	1120	1195
ND-Falcon	North Dakota State University	3126	-	-	10.4	24-Jul	1169	-
Poncho	Northern Feed and Bean	3043	-	-	10.1	16-Jul	1109	-
Centennial	Colorado State University	3034	3172	97%	10.5	21-Jul	1134	1172
Windbreaker	Jack's Bean	2767	-	-	9.8	19-Jul	1137	-
Long's Peak	Colorado State University	2750	3002	92%	10.3	21-Jul	1143	1198
ND-Palomino	North Dakota State University	2736	2858	88%	10.0	20-Jul	1181	1207
Radiant	ADM Seedwest	2727	2938	90%	10.0	18-Jul	1166	1168
Average		**3371**	**3265**		**10.2**	**22-Jul**	**1157**	**1195**
[b]LSD (P<0.30)		386						

[a]Yields corrected to 14% moisture.

[b]If the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is statistically significant. Variety yields in bold are in the top LSD group.

Plot Size: 10' x 30'

Site Information

Collaborator:	Ed Croissant
Planting Date:	June 6, 2019
Harvest Date:	September 24, 2019
Fertilizer:	N at 115, P at 40, and K at 20 lb/ac
Soil Type:	Weld loam
Herbicides:	Eptam at 2 qt/ac and Dual at 1.3 pt/ac
Fungicide:	Copper 3L sprayed twice

Pinto Bean Variety Descriptions

Centennial is a 2015 release by Colorado State University. It has resistance to common rust and bean common mosaic virus, excellent seed quality, and semi-upright architecture. It possesses the Ur-3 and Ur-6 alleles that condition resistance to strains of rust found in the High Plains and western US. It is 95 to 100 days to maturity. Yield, 97% of 2-yr trial average yield. Above average seed size (1172 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Cowboy is an ADM Seedwest variety from ProVita, and is upright, medium width, short vine, BCMV (bean common mosaic virus) resistant, and resistant to rust strains commonly found in CSU rust trial. Yield, 102% of 2-yr trial average yield. Below average seed size (1231 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

DR Wood is a 2018 release from Colorado State University. It is a full season variety; 97 to 100 days to maturity with semi-upright architecture (Type II). It possesses disease resistance alleles for resistance to US strains of BCMV and BCMNV (bean common mosaic necrosis virus); resistance to endemic strains of bean common bacterial blight, and resistance to all endemic strains of foliar rust in the Central High Plains and western US. Yield, 98% of 2-yr trial average yield. Below average seed size (1256 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

GTS-904 is a Gentec, Inc. variety. It is a tall, semi-determinate bush plant that holds pods off the ground and has fair to good lodging resistance. It has an upright growth habit which could be suitable for direct harvest. It is a mid-to-full season variety. Yield, 109% of 2-yr trial average yield. Above average seed size (1124 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Long's Peak is a 2011 release from Colorado State University. It has excellent seed color; 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 medium plant maturity (94-98 days). Yield, 92% of 2-yr trial average yield. Average seed size (1198 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Monterrey is an ADM Southwest variety from ProVita and it is a upright, broad, short vine, BCMV resistant, and resistant to strains commonly found in the CSU rust trial. Medium early maturity. Yield, 115% of 2-yr trial average yield. Average seed size (1196 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

ND-Falcon is a North Dakota State University release with upright architecture (type IIa) with short vines. Under North Dakota conditions it matures in approximately 105 days. It is resistant to the new race of rust (20-3) predominant in the region and BCMV. It shows resistance to Soybean Cyst Nematode and has agronomic traits of economic importance such as canning quality and seed shape/size are within commercially acceptable ranges. First year in trial, no two-year data available for relative seed size and yield.

ND-Palomino is a slow darkening variety derived from the cross Santa Fe/PS08-108. It has an upright, indeterminate (short vine) growth habit (Type 2A), white flowers, and matures in approximately 102 days. It is resistant to BCMV, but susceptible to both rust and anthracnose diseases. It was found acceptable in canning tests performed by two major canning companies, but they warned against mixing/comingling regular darkening with slow darkening beans in the same canning line because the final color of the beans will be very different. Yield, 88% of 2-yr trial average yield. Below average seed size (1207 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Poncho is a medium maturity (97 day) pinto variety released by Rogers/Syngenta Seeds, Inc. in 1998 with resistance to BCMV, and has excellent seed quality. It has Type III growth habit. It is susceptible to rust and bacterial brown spot. Two-year data not available for relative seed size and yield.

PT16-9 is a slow darkening pinto bean from USDA-ARS, Prosser, WA, that is being considered for release as a cultivar. It has resistance to BCMV and rust, exhibits broad adaptation, and performs well under stressful conditions including low soil fertility and drought. It has upright growth habit and medium maturity. Yield, 117% of 2-yr trial average yield. Above-average seed size (1185 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

PT11-13-1 is an advanced pinto bean line from USDA-ARS, Prosser, WA, that is being considered for release as a cultivar. It has resistance to BCMV (I + bc-3 genes) and rust (Ur-3 and Ur-11 genes), exhibits broad adaptation, and performs well under stressful conditions including low soil fertility and drought. It has semi-upright growth habit and medium maturity. This line is sensitive to white mold. Yield, 107% of 2-yr trial average yield. Above average seed size (1180 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Radiant is a slow darkening ADM Seedwest variety from ProVita. It is an indeterminate plant that is upright in architecture. It is about three days later in maturity when compared to Poncho. It is resistant to rust and BCMV. Yield, 90% of 2-yr trial average yield. Above average seed size (1168 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

StayBright is a slow darkening seed coat pinto bean variety released by Colorado State University and marketed by Trinidad-Benham. The slow darkening allele was derived from the germplasm line SDIP-1 by the University of Idaho in 2006. It is resistant to endemic strains of foliar rust in the High Plains and all strains of BCMV. It has semi-upright architecture. Harvest maturity is 96 to 99 days in the High Plains region. Yield, 113% of 2-yr trial average yield. Below average seed size (1241 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Snowy Mountain #7 is a Preator Bean Company variety and originally a Colorado State University release named Sundance. It was tested as COSD 7. It is a slow darkening variety with medium maturity (92 to 95 days in the High Plains). The slow darkening allele was derived from the germplasm line SDIP-1 by the University of Idaho in 2006. It is resistant (small pustule response) to the prevalent races of dry bean rust in Colorado, resistant to the NL3 strain of Bean Common Mosaic Virus. It has upright Type II architecture. Yield, 100% of 2-yr trial average yield. Average seed size (1195 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Torreon is an ADM Seedwest variety from ProVita. It has medium maturity and an upright short vine architecture. It is medium width, BCMV resistant, and resistant to rust strains commonly found in CSU rust trial. Yield, 98% of 2-yr trial average yield. Above average seed size (1165 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Vibrant is a slow darkening ADM Seedwest variety from ProVita. It is indeterminate and has upright plant architecture. Its maturity is approximately 99 days. It is resistant to rust and BCMV. Yield, 98% of 2-yr trial average yield. Below average seed size (1216 seeds/pound compared to 2-yr trial average of 1195 seeds/pound).

Windbreaker is a variety released by Seminis and currently marketed by Jack's Bean. It is an indeterminant mid-season (94 to 98 day) pinto bean with upright, short-vine growth habit. It has resistance to BCMV and rust. Two-year data is not available for relative seed size and yields.

Wyoming 50 is a Preator Bean Company variety that has been discontinued.

Cowpea: A climate-resilient legume that could become an alternative crop to improve Colorado cropping systems

Maria Muñoz-Amatriaín

Cowpea (*Vigna unguiculata*), usually known in the U.S. as black-eyed pea or southern pea, could be a good alternative crop to increase sustainability of Colorado cropping systems. Cowpea is an ancient crop originating in Africa. It has spread to all other continents and today it is widely cultivated around the world. The crop was introduced in the southern U.S. in the early 1700's by West Africans, who grew it for its grain but also to enrich the soil and control weeds, and as a fodder crop for cows (hence the name cowpea). Although many seed colors and patterns are available in cowpea, the largest market class in the U.S. is black-eyed pea. Cowpea varieties have diverse growth habits, with bush types being best suited for direct harvest and dry seed production, and vining types being preferred for intercropping, forage or cover crop use.

Figure 1. Different Cowpea Varietites Growing At ARDEC In 2019.

Cowpea is very well known for its good adaptation to drought, heat, and poor soils, which makes it a successful crop in the arid and semi-arid regions of the world where other legumes don't perform as well. In the U.S., most cowpea production is in the southern states and California. However, historical cowpea research together with the current experience of several growers in Colorado indicate that cowpea has the potential of becoming an important alternative crop for both irrigated and dryland cropping systems. Under irrigated conditions, cowpea requires less water to grow than competing crops including common bean. In addition, it is known to perform better in poor soils than other leguminous crops. Due to nitrogen fixation, it could reduce, or perhaps eliminate, the nitrogen fertilizer requirement of the cowpea crop. Most smallholders in Africa grow cowpea in rain-fed farming systems with little or no fertilizer. As a rotation crop, cowpea could become an important part of dryland cropping systems, preventing soil erosion and providing nitrogen to fall-planted crops like winter wheat. In such systems, it could be utilized for different purposes (seed, forage, or green manure) depending on seasonal weather patterns. In particular, cowpea can be hayed or grazed as a forage, or harvested for seed.

Despite its potential to increase the sustainability of Colorado cropping systems, only a few varieties have been tested to date, mostly California varieties, CB5 and CB46. Extremely wide germplasm diversity exists for cowpea. At Colorado State University, we have obtained a collection of 368 varieties from all over the world which was planted at CSU's Agricultural Research, Development and Education Center (ARDEC) in summer 2019 under well-watered and rainfall-only conditions. The collection showed wide diversity in plant types, flowering and maturity dates, and seed quality characteristics (Figure 1). This germplasm diversity, coupled with available genomic resources for the species, would promote rapid progress in

cowpea research and breeding to support the development of cowpea varieties well adapted to Colorado cropping systems. Specific traits that could be targeted include: tolerance of lower germination temperatures for earlier planting, early maturity for seed production, drought tolerance, and seed yield and quality.

There is need for water-efficient alternative crops in Colorado cropping systems that can make climate-smart agriculture profitable for farmers. Cowpea may be one of those crops.

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White Mold in Dry Beans

Dr. Kirk Broders

One of the most important diseases impacting dry beans in eastern Colorado is white mold caused by the fungus *Sclerotinia sclerotiorum*. Losses from this disease have averaged as high as 20%, with a few individual fields having losses in excess of 65%.

Disease Identification

Symptoms of white mold are first observed as wet, soft spots or lesions on infected leaves, branches, stems and pods. These lesions enlarge into a watery, rotten mass of tissue that is covered by a white moldy growth. Infection of stems and branches will cause affected plant parts to wilt and later die, taking on a bleached and dried appearance. This bleaching symptom is characteristic of white mold infected pinto and great northern types and differs from normal tan color resulting from senescence or other diseases. Black and irregularly-shaped sclerotia (survival structures of the fungus) form on and within infected plant parts. These sclerotia can then survive on or in the soil until the next cropping season.

Disease Cycle

The fungus *S. sclerotiorum* has a wide host range and is able to infect numerous crops such as alfalfa, potato, pepper, soybean and sunflower. In addition, weeds including amaranths, lambsquarter and pigweed can serve as hosts. The white mold disease cycle starts when sclerotia located near the upper 2-cm of the soil surface germinate and produce a mushroom-like structure which produces millions of spores over several days (Fig. 1). Multiple apothecia can sprout from the sclerotia over the course of several weeks. These spores can be dispersed locally and only rarely are dispersed to other locations. Under some conditions, sclerotia may germinate and produce thread-like hyphae, which infect plant roots, crowns, and other low-lying plant parts.

Germination of sclerotia occurs during cool (50-68°F) periods typically following heavy rains or irrigation. A 16-48 hour wet period is required for the production of spores, which are forcibly discharged and moved by air currents to susceptible plant tissue (Figure 1). Infection often takes place on flowers, and once inside the plant, the fungus grows and produces stem lesions that eventually girdle the stem. Sclerotia form in or on plant tissues, where they eventually fall from plants or overwinter inside senesced stems on the soil surface (Figure 1).

Unlike foliar diseases such as bean rust, white mold only produces one set of infective spores per season. Plant-to-plant spread is possible if adjacent plants come into contact with diseased plants, particularly under humid conditions. Development of white mold ceases when temperatures reach around 90^{0}F or the environment dries out. Moderate air temperatures, frequent rain or irrigation, and high humidity from flowering through pod development also favor disease development. In addition, beans with dense canopies or rapid canopy closure tend to be most susceptible to the disease. Yield loss is often associated with disease incidence in the field.

Management

No single management method effectively prevents the infection process from occurring; however, research has indicated that several measures can help reduce damage from white mold, thereby minimizing yield losses. The following management practices should be followed if you have fields with consistent white mold disease pressure:

1. Long rotations to corn, wheat or other small grains can help reduce inoculum by stimulating germination of sclerotia. Short rotations between corn/wheat and beans or other susceptible hosts (sunflower, soybean, potato) can increase the buildup of inoculum over time.
2. Avoid over-fertilization. Thick dense plant growth that results from excessive fertilization causes the canopy to close sooner resulting in cooler more humid conditions within canopies, creating an ideal environment for white mold development.
3. Space rows at the widest distance that will maintain maximum yields. It is important to avoid high plant populations and narrow rows. This will also cause the canopy to close sooner favoring disease development
4. Avoid excessive irrigation. Efficient use of irrigation water is important since disease development depends on there being moist soil beneath the canopy. Infection can be reduced by keeping the soil surface as dry as possible during pod fill and maturation.
5. Harvest fields with white mold last to avoid introducing the diseased plant tissue or sclerotia attached to equipment into other fields.
6. Timing of fungicide application. This is critical to protect as many blossoms as possible from infection. Fungicides must be applied in sufficient volume of water to provide thorough coverage of all susceptible plant parts.

If a susceptible variety is planted in a field with a history of disease, treatment with a fungicide may be needed. During the season, white mold can be managed with the use of fungicides including Thiophanate-methyl (FRAC group 1), Boscalid (FRAC group 7), and/or Prothioconazole (FRAC group 3) groups. Review recent fungicide efficacy trials (https://www.ag.ndsu.edu/carringtonrec/plant-pathology/fungicide-efficacy-testing-results-2013-dry-edible-beans) to compare a more extensive list of compounds currently registered for use on dry beans. These products are most effective if applied at the R1 (every plant has one or more open blossoms) growth stage, before symptoms develop. Fungicide applications made later or after disease is detected may not provide adequate control. Canopy penetration and coverage are essential to manage white mold with fungicides. Follow all label directions whenever using fungicides

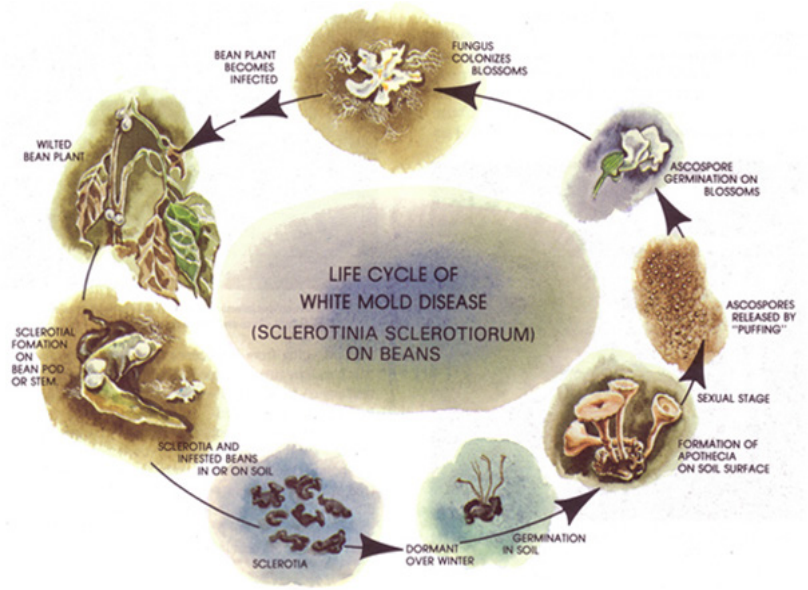

Figure 1. Life cycle of white mold disease (http://extension.colostate.edu/topic-areas/agriculture/white-mold-of-dry-beans-2-918/)

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