Technical Report TR 22-5

Agricultural Experiment Station

Colorado State University

College of Agricultural Sciences   Department of Soil & Crop Sciences   Extension

Making Better Decisions

2022 Colorado Dry Bean and Cowpea Variety Performance Trials

Crops Testing

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2022 Colorado Dry Bean and Cowpea Performance Trials

Sally Jones-Diamond

The Colorado State University Crops Testing Program provides unbiased, current, and reliable research results and information to help Colorado dry bean producers make better decisions. Colorado State University promotes crop variety and agronomy testing as a service to crop producers and seed companies who depend on us for crop performance information.

Colorado State University personnel planted two irrigated dry bean sites and one dryland cowpea trial in northeast Colorado. Irrigated trial locations were Kirk and Otis. The irrigated site at Otis included four separate pinto bean trials. The trials were 1) a strip trial containing six varieties chosen by bean processors; 2) a small-plot trial with twelve varieties from various public and private breeding programs entered at-will; 3) an inoculant, micronutrient fertilizer, and plant/soil enzyme product trial sponsored by Brandt®; and 4) a row spacing by seeding rate study sponsored by Kelley Bean Company. The irrigated site at Kirk included the strip and small plot trials, with the same varieties that were tested at the Otis site. The dryland cowpea trial was located in Akron at the USDA-ARS Central Great Plains Research Center. All trials were harvested and statistically analyzed and reported after harvest on our website at csucrops.com.

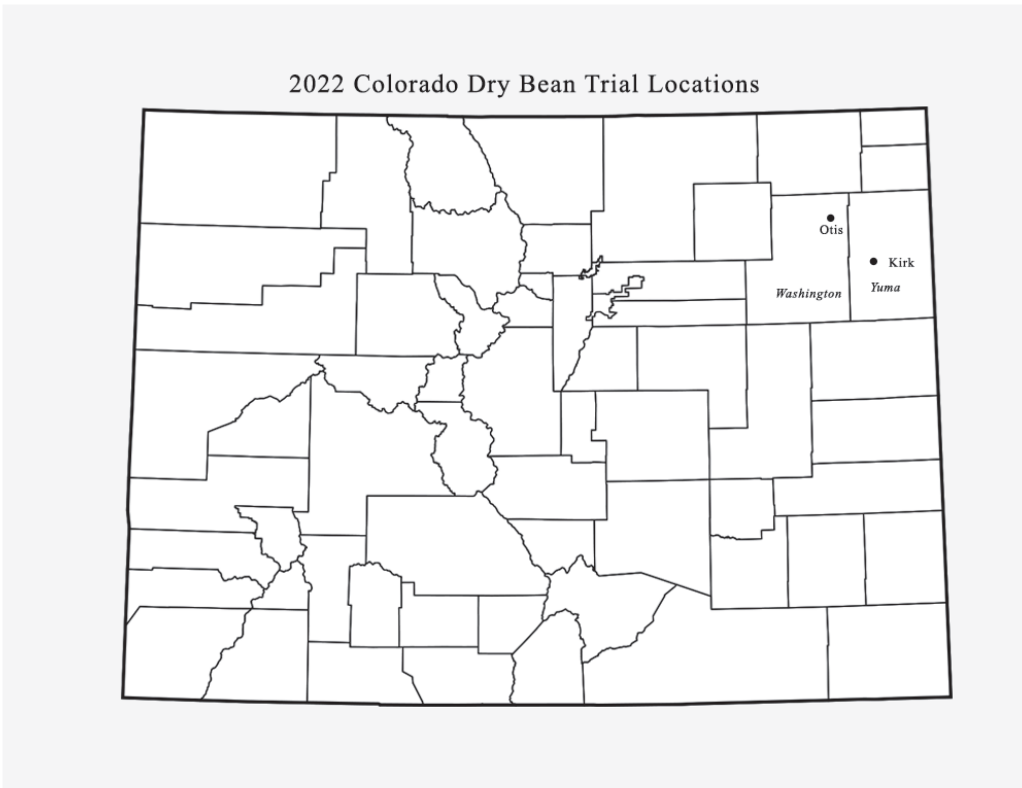
Variety Trial (Small-Plot and Strip) Testing Methods

All trial entries were randomized within each replication using a randomized complete block design. Plot sizes for the small-plot trials were four rows wide (10 feet) by 30 feet long. The strip trial plots were four rows wide (10 feet) by at least 110 feet long. Varieties in the trials were replicated three times within each location and trial. Cultural practices for each trial location are included below the individual site tables when available. Management practices generally match the rest of the producer's field.

All plots were planted using a four-row Seed Research Equipment Solutions (SRES) 2013 Classic Aire vacuum planter equipped with Monosem seed meters. Irrigated trials were planted at 85,000 seeds per acre (with exception of the seeding rate study). The dryland cowpea trial was planted at 52,000 seeds per acre. Plots were harvested using a Case IH 1620 combine modified for small plot use and equipped with a H2 GrainGage weighing system and a flex header.

Interpreting Results

The least significant difference (LSD) is provided at the bottom of the yield tables. The LSD is used to help determine whether differences in variety yield are statistically significant. If the difference between two variety yields equals or exceeds the LSD value, the difference between them is significant. When both an LSD ($P<0.30$) and LSD ($P<0.05$) are provided, farmers should use the LSD (0.30) for selecting superior varieties to minimize economic loss due to false negative results (concluding there is no difference when there is one). Others may use LSD (0.05) to minimize the risk of false positive results (concluding there is a difference when there isn't one). If two varieties being compared have a difference in yield that is less than the LSD value, those two varieties are considered equal yielding. Variety yields in bold in the tables are in the top LSD yield group and are equal yielding. Variety selection may be based on more than yield performance. Other factors to consider when selecting a variety includes maturity, disease resistance, plant architecture, seed quality, and cost.



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2022 Irrigated Dry Bean Variety Performance Trial at Kirk

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Variety	Source	Traits	Yield[a]	Test Weight	Seeds/Pound	Moisture
			lb/ac	lb/bu		percent
USDA Rattler	Kelley Bean	-	**3375**	60	1065	12
PT9-5-6	USDA-ARS, Prosser, WA	-	**3144**	60	1258	12
Charro	Michigan State Univ.	-	2813	61	1260	13
PT16-9	Kelley Bean	Slow-Dark	2542	60	1203	14
DRWood	Colorado State Univ.	-	2374	58	1422	17
ND Falcon	North Dakota State Univ.	-	2342	57	1377	13
ND172568	North Dakota State Univ.	Slow-Dark	2285	60	1138	14
BASIN	USDA-ARS, Prosser, WA	-	2208	60	1238	12
ND Palomino	North Dakota State Univ.	Slow-Dark	2206	59	1223	12
PT20-16	USDA-ARS, Prosser, WA	-	1989	61	1228	11
Croissant	Colorado State Univ.	-	1830	60	1187	11
Centennial	Colorado State Univ.	-	1775	59	1342	17
		Average	**2407**	**59**	**1245**	**13**
		[b]LSD (0.30)	283			
		[b]LSD (0.05)	554			
		Coeffecient of Variation (CV)	14.3			

[a]Yields corrected to 14% moisture.

[b]Farmers selecting a variety based on yield should use the LSD (0.30) to protect from false negative decisions. Companies or researchers may be interested in the LSD (0.05) to avoid false positive conclusions. Yields in bold were in the top LSD yield group.

Site Information

Collaborator: TK Farms
Planting Date: June 13, 2022
Harvest Date: September 16, 2022
Soil Type: Haxtun sandy loam
Trial Comments: Excellent plant stands and good weed control throughout the season. Desiccant sprayed on September 8th. All plots were direct-harvested with a combine equipped with a flex-

COLORADO STATE UNIVERSITY EXTENSION

2022 Irrigated Dry Bean Variety Performance Trial at Otis

Variety	Source	Traits	Yield[a]	Test Weight	Seeds/Pound	Moisture	Physiological Maturity
			lb/ac	lb/bu		percent	days after planting
Charro	Michigan State Univ.	-	**3466**	61	1060	10	93
DRWood	Colorado State Univ.	-	**3460**	61	1096	11	93
PT16-9	Kelley Bean	Slow-Dark	**3410**	60	1025	12	93
Croissant	Colorado State Univ.	-	**3323**	60	1127	11	91
PT9-5-6	USDA-ARS, Prosser, WA	-	3225	60	1080	11	91
BASIN	USDA-ARS, Prosser, WA	-	3223	60	1066	11	92
PT20-16	USDA-ARS, Prosser, WA	-	3107	60	1022	11	92
USDA Rattler	Kelley Bean	-	2988	58	859	12	100
Centennial	Colorado State Univ.	-	2834	61	1001	13	93
ND172568	North Dakota State Univ.	Slow-Dark	2775	61	991	12	99
ND Falcon	North Dakota State Univ.	-	2686	57	1109	11	95
ND Palomino	North Dakota State Univ.	Slow-Dark	2566	58	1044	13	95
		Average	**3089**	**60**	**1040**	**11**	**94**
		[b]LSD (0.30)	206				
		[b]LSD (0.05)	402				
		Coeffecient of Variation (CV)	8.3				

[a]Yields corrected to 14% moisture.

[b]Farmers selecting a variety based on yield should use the LSD (0.30) to protect from false negative decisions. Companies or researchers may be interested in the LSD (0.05) to avoid false positive conclusions. Yields in bold were in the top LSD yield group (0.30).

Site Information

Collaborator:	Corman Family Farms
Planting Date:	June 7, 2022
Harvest Date:	September 28, 2022
Soil Type:	Haxtun sandy loam
Fertilizer:	N at 50, P at 32 lb/ac
Herbicides:	Valor at 1 oz/ac, Moccasin at 16 oz/ac, and Prowl at 32 oz/ac
	Eptam at 2 pt/ac applied via chemigation on June 29th and July 20th
	Basagran at 12 oz/ac, Clethodim at 10 oz/ac, and Raptor at 4.2 oz/ac applied July 4th
Insecticides:	Bifenthrin at 6 oz/ac applied July 4th
	Acephate applied on July 19th
Fungicides:	Copper hydroxide applied July 19th
Trial Comments:	Excellent plant stands and weed control throughout the season. Desiccant sprayed on September 20th. All plots were direct-harvested with a combine equipped with a flex-header.

2022 Kirk Dry Bean Strip Trial Results

Variety	Source	Traits	Yield[a]	Test Weight	Seeds/Pound	Moisture	Physiological Maturity
			lb/ac	lb/bu		percent	days after planting
StayBright	Trinidad-Benham	Slow-Dark	**2507**	62	1159	14	88
NE2-17-37	University of Nebraska	Slow-Dark	**2383**	58	1178	12	80
SV6139GR	Seminis	-	2325	60	1114	10	76
ND Palomino	North Dakota State Univ.	Slow-Dark	2216	59	1250	11	88
Windbreaker	Seminis	-	1949	57	993	11	82
NE2-18-3	University of Nebraska	-	1946	57	964	12	84
		Average	**2221**	**59**	**1110**	**12**	**83**
		[b]LSD (0.30)	146				
		[b]LSD (0.05)	303				
		Coeffecient of Variation (CV)	9.6				

[a]Yields corrected to 14% moisture.

[b]Farmers selecting a variety based on yield should use the LSD (0.30) to protect from false negative decisions. Companies or researchers may be interested in the LSD (0.05) to avoid false positive conclusions. Yields in bold were in the top LSD yield group.

Site Information

Collaborator:	TK Farms
Planting Date:	June 13, 2022
Harvest Date:	September 16, 2022
Soil Type:	Haxtun sandy loam
Trial Comments:	Excellent plant stands and good weed control throughout the season. Desiccant sprayed on September 8th. All plots were direct-harvested with a combine equipped with a flex-header.

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2022 Otis Dry Bean Strip Trial Results

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Variety	Source	Traits	Yield[a]	Test Weight	Seeds/Pound	Moisture	Physiological Maturity
			lb/ac	lb/bu		percent	days after planting
ND Palomino	North Dakota State Univ.	Slow-Dark	**2807**	59	1154	10	94
Windbreaker	Seminis	-	**2780**	57	1064	10	92
SV6139GR	Seminis	-	**2675**	59	1124	10	91
NE2-18-3	University of Nebraska	-	**2655**	56	981	11	96
StayBright	Trinidad-Benham	Slow-Dark	2365	62	1184	11	94
NE2-17-37	University of Nebraska	Slow-Dark	2278	58	1210	10	94
		Average	**2593**	**58**	**1119**	**10**	**93**
		[b]LSD (0.30)	158				
		[b]LSD (0.05)	325				
		Coeffecient of Variation (CV)	6.8				

[a]Yields corrected to 14% moisture.

[b]Farmers selecting a variety based on yield should use the LSD (0.30) to protect from false negative decisions. Companies or researchers may be interested in the LSD (0.05) to avoid false positive conclusions. Yields in bold were in the top LSD yield group.

Site Information

Collaborator:	Corman Family Farms
Planting Date:	June 7, 2022
Harvest Date:	September 28, 2022
Soil Type:	Haxtun sandy loam
Fertilizer:	N at 50, P at 32 lb/ac
Herbicides:	Valor at 1 oz/ac, Moccasin at 16 oz/ac, and Prowl at 32 oz/ac
	Eptam at 2 pt/ac applied via chemigation on June 29th and July 20th
	Basagran at 12 oz/ac, Clethodim at 10 oz/ac, and Raptor at 4.2 oz/ac applied July 4th
Insecticides:	Bifenthrin at 6 oz/ac applied July 4th
	Acephate applied on July 19th
Fungicides:	Copper hydroxide applied July 19th
Trial Comments:	Excellent plant stands and weed control throughout the season. Desiccant sprayed on September 20th. All plots were direct-harvested with a combine equipped with a flex-header.

Contact Sally Jones-Diamond (sally.jones@colostate.edu)

Irrigated Dry Bean Row Spacing by Population Trial at Otis in 2022

Introduction

A dry bean row spacing by seeding rate trial was conducted at one location in Northeast Colorado in 2022. The trial consisted of four treatments. Treatments included two different row spacings and two seeding rates. Data collected and summarized included soil test results, field management, yield, seed size, grain moisture, and grain test weight.

Approach

The trial was planted on a farmer-cooperator field at Otis under center-pivot irrigation. Four combinations of treatments were tested on the pinto bean variety USDA Rattler. The treatments were 1) 30-inch row spacing with 83,000 seeds/acre seeding rate; 2) 30-inch row spacing with 103,000 seeds/acre seeding rate; 3) 15-inch row spacing with 83,000 seeds/acre seeding rate; and 4) 15-inch row spacing with 103,000 seeds/acre seeding rate.

The treatments were replicated four times and planted in ten feet wide plots that were thirty feet long. Harvested rows (and therefore harvested area) were adjusted accordingly for each plot depending on which row-spacing treatments were next to each other. If a 30-inch treatment plot was next to a 15-inch treatment plot, the outside rows were not harvested so data would not be skewed. No starter fertilizer was applied. The plots were desiccated to allow for direct harvest using a modified Case IH plot combine equipped with a flex head. Plot seed weight, moisture, and test weight were collected using a Harvest Master H2 grain weighing system on the combine. Seed yield was adjusted to 14% moisture content. Harvest loss was visually assessed by estimating the percent of total plot seeds left on the ground after the combine had harvested each plot. Treatment yield results were analyzed using the mixed model procedure in SAS 9.4. Significant differences were determined using an alpha level of 0.30, which protects against false negatives (concluding treatments are the same when they are actually different).

Soil samples were pulled at planting (0-12 inch and 12-24 inch depth) and were analyzed at American Agricultural Laboratory, Inc. in McCook, Nebraska.

Results

The average trial yield was 4,010 lb/acre, test weight was 60 lb/bu, moisture was 10 percent, and seeds per pound was 1,012. The purpose of the study was to determine if the combinations of row spacings or seeding rates influenced grain yield, pod distance from the ground, and harvest loss when direct harvesting.

There was not a significant difference in yield between the two seeding rate treatments ($p = 0.35$), nor an interaction between the row spacing and seeding rate effects. There was a significant difference ($p = 0.12$) in yield when comparing the two row spacing treatments averaged across the two seeding rates. The 15-inch spacing treatment had a yield of 4,181 lb/acre compared to a yield of 3,839 lb/ac for the 30-inch row spacing. There was not a significant difference of harvest loss among the treatments, but there was a difference ($p = 0.003$) when comparing pod distance greater than 2 inches from the ground. The 15-inch row spacing treatments had fewer pods that were close to the ground (7% on average) compared to the 30-inch row spacing treatments (12% on average). Soil test results for the site appear before the yield results. The soil type at the trial site is a Haxtun sandy loam.

Soil Test Results (Pre-Season)

Organic Matter	Total $N0_3$-N Available	Soil pH	Phosphorus (Olsen)	Potassium	Sulfur (SO_4)	Calcium	Magnesium	Sodium	Zinc	Iron	Manganese	Copper
percent	lb/acre		parts per million									
0.8	96	6.6	3	129	5	540	87	23	1.6	1.6	3.6	0.1

*Samples were pulled down to 24 inches, nitrate is total for the 24-inch depth. Other results are based on top 12 inches of soil profile.

Results Table

2022 Otis Dry Bean Row Spacing by Seeding Rate Trial Results

Treatment	Yield[a]	Test Weight	Seeds/Pound	Moisture	Pods less than 2" from ground	Harvest Loss
	lb/acre	lb/bu		percent	percent	percent
15" Row Spacing	**4181**	**61**	**1068**	**11**	**7**	**4**
83,000 seeds/acre	4049	61	1040	12	8	4
103,000 seeds/acre	4312	60	1096	10	6	4
30" Row Spacing	**3839**	**60**	**956**	**9**	**12**	**4**
83,000 seeds/acre	3775	60	937	9	11	5
103,000 seeds/acre	3902	60	974	10	13	4
Average	**4010**	**60**	**1012**	**10**	**10**	**4**
Coefficient of Variation (CV)	9.9					

[a]Yields corrected to 14% moisture.

Site Information

Collaborator:	Corman Family Farms
Planting Date:	June 7, 2022
Harvest Date:	September 28, 2022
Soil Type:	Haxtun sandy loam
Fertilizer:	N at 50, P at 32 lb/ac
Herbicides:	Valor at 1 oz/ac, Moccasin at 16 oz/ac, and Prowl at 32 oz/ac Eptam at 2 pt/ac applied via chemigation on June 29th and July 20th Basagran at 12 oz/ac, Clethodim at 10 oz/ac, and Raptor at 4.2 oz/ac applied July 4th
Insecticides:	Bifenthrin at 6 oz/ac applied July 4th Acephate applied on July 19th
Fungicides:	Copper hydroxide applied July 19th
Trial Comments:	Excellent plant stands and weed control throughout the season. Desiccant sprayed on September 20th. All plots were direct-harvested with a combine equipped with a flex header.

Irrigated Dry Bean Brandt® Product Trial at Otis in 2022

Introduction

A dry bean product application trial was conducted at one location in Northeast Colorado in 2022. The trial consisted of six treatments and an untreated control. Treatments included an inoculant, micronutrient fertilizers (both in-furrow and foliar applied), and plant/soil enzymes. Data collected and summarized included soil test results, field management, yield, seed size, grain moisture, and grain test weight.

Approach

The trial was planted on a farmer's field at Otis under center-pivot irrigation. Six combinations of products were tested on the pinto bean variety Windbreaker. The treatments were 1) EnzUp® Zn in-furrow applied at 32 oz/ac; 2) Smart K B, Smart Trio®, and Smart Cu products applied at first bloom at 32, 16, and 24 oz/ac, respectively; 3) EnzUp® P DS in-furrow applied at 4 lb/ac mixed with 4 gal water; 4) Talc USA Dry Bean Inoculant at ¼ cup per 80,000 seeds; 5) Smart Quatro® Plus and Smart Cu applied at first bloom at 32 and 24 oz/ac, respectively; 6) Smart Quatro® Plus and Smart Cu applied at 3rd trifoliate stage at 32 and 24 oz/ac, respectively; and 7) untreated check.

The treatments were replicated six times and planted in 4-row plots that were 10' wide by 31' long (harvested area). Plots were planted using 30" row spacing, and the variety was seeded at a rate of 85,000 seeds/acre. No starter fertilizer was applied. The plots were desiccated to allow for direct harvest using a modified Case IH plot combine equipped with a flex header. Plot seed weight, moisture, and test weight were collected using a Harvest Master H2 grain weighing system on the combine. Seed yield was adjusted to 14% moisture content. Soil samples were pulled at planting (0-12" and 12-24" depth) and were analyzed at American Agricultural Laboratory, Inc. in McCook, Nebraska Treatment yield results were analyzed using the mixed model procedure in SAS 9.4. Significant differences were determined using an alpha level of 0.05, which protects against false positives (concluding treatments are different when they are actually the same).

Results

The average trial yield was 2,560 lb/ac, test weight was 57 lb/bu, moisture was 9 percent, and seeds per pound was 974. The purpose of the study was to determine how the various product types and applications affected the grain yield compared to the untreated control. Therefore, a traditional yield table has been omitted. In place of a yield table, a bar graph comparing each product treatment to the untreated control has been provided on the following page. Error bars were added to the bars to help visualize treatment differences (or lack thereof). When the bars overlap between the two treatments being compared, it indicates that those treatments were likely not significantly different.

There were no significant differences among the seven treatment yields ($p = 0.13$), and no significant difference was found when comparing each of the product treatments to the untreated control. Test weight, moisture percentage, and seeds per pound for each treatment were not significantly different among the seven treatments.

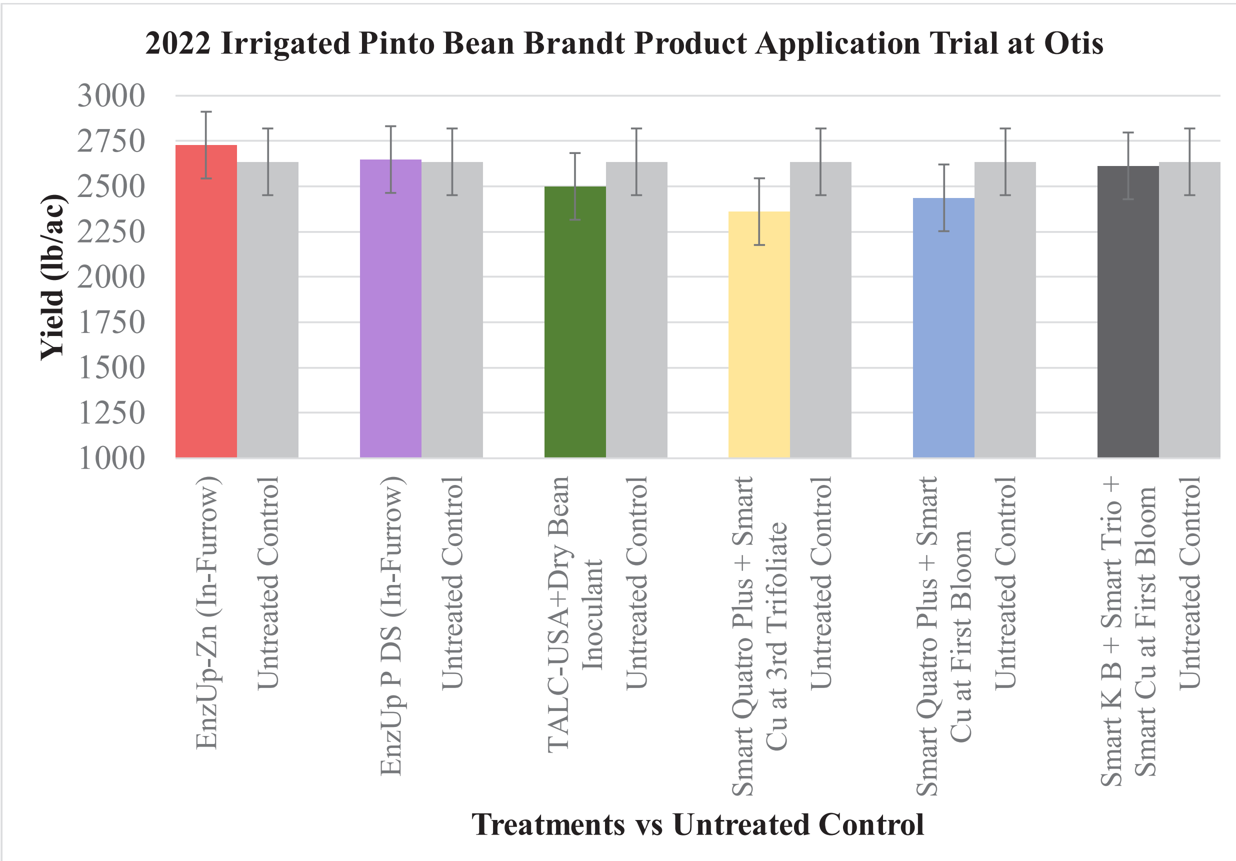
Soil test results for the site appear before the yield results. The soil type at the trial site is a Haxtun sandy loam.

Soil Test Results (Pre-Season)

Organic Matter	Total $N0_3$-N Available	Soil pH	Phosphorus (Olsen)	Potassium	Sulfur (SO_4)	Calcium	Magnesium	Sodium	Zinc	Iron	Manganese	Copper
percent	lb/acre		parts per million									
0.8	96	6.6	3	129	5	540	87	23	1.6	1.6	3.6	0.1

*Samples were pulled down to 24 inches, nitrate is total for the 24-inch depth. Other results are based on top 12 inches of soil profile.

Trial Results



2022 Pinto Bean Strip Trial 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.

Charro is a variety released by Michigan State University AgBioResearch as a high-yielding, upright, full-season cultivar with excellent canning quality. It has the I-gene that confers resistance to BCMV and BCMNV and was resistant to rust race 31:7 in the CSU rust nursery. Maturity is 97 days on average.

Croissant was released in 2008 from Colorado State University. It has resistance to prevalent strains of rust in the High Plains, to bean common mosaic virus (BCMV) and bean common mosaic necrotic virus (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.

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.

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.

ND Palomino is a slow darkening variety jointly released by North Dakota State University and the USDA-ARS. 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.

StayBright is a slow-darkening pinto 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.

SV6139GR is a variety released by Seminis with an upright, semi-determinate plant growth habit and good pod position making it suitable for direct combining. It has good yield potential and improved lodging resistance with a broad adaptation and possesses disease resistance to bean common mosaic virus and bean rust.

USDA Basin is a variety released by USDA-ARS with license to a seed company pending. It has resistance to potyvirus (BCMV) and bean rust. It performs well under lower fertility conditions. It has semi-upright architecture and moderate resistance to lodging. Around 96 days to maturity.

USDA Diamondback (PT16-9) is a variety released by USDA-ARS and licensed to Kelley Bean Co. It has slow darkening seed coat. It has resistance to potyvirus (BCMV and BCMNV) and bean rust. It performs well under drought and low soil fertility conditions. It has upright architecture and resistance to lodging. Around 97 days to maturity.

USDA Rattler is a variety released by USDA-ARS and licensed to Kelley Bean Co. It has resistance to potyvirus (BCMV and BCMNV) and bean rust. It performs well under drought and low soil fertility conditions. It has upright architecture and resistance to lodging. Around 97 days to maturity.

Windbreaker is a variety released by Seminis and currently marketed by Jack's Bean. It is an indeterminate mid-season (94 to 98 day) pinto bean with upright, short-vine growth habit. It has resistance to BCMV and rust.

<u>Experimentals</u>

ND172568 is a slow-darkening line from North Dakota State University. It is about 99 days to maturity.

NE2-17-37 and **NE2-18-3** are pinto lines from the University of Nebraska that are being considered for release. NE2-17-37 is a slow-darkening line. It's 85-90 days to maturity and a semi-upright plant. It has resistance to BCMV and common rust. NE2-18-3 is 93-94 days to maturity and is not as upright as NE2-17-37.

PT9-5-6 is an advanced line from USDA-ARS. It has resistance to potyvirus (BCMV) and bean rust. It performs well under drought and low soil fertility conditions. It has upright architecture and resistance to lodging. Around 97 days to maturity.

PT20-16 is a breeding line from USDA-ARS. It has resistance to potyvirus (BCMV). It performs well under drought conditions. It has upright architecture. Around 95 days to maturity.

Common Bacterial Blight of Bean

Emma Barrett and Dr. Robyn Roberts

Disease and symptoms

Common bacterial blight (CBB) is caused by the bacterial pathogen *Xanthomonas axonopodis pv. phaseoli*, which infects bean foliage, pods, seeds, and stems. CBB can cause a 22% yield reduction in intercropping systems, with even higher losses reported in sole cropping systems (Fininsa, 2003). The pathogen only infects beans, including dry beans and snap beans, and some other legumes.

Figure 1. Common bacterial blight symptoms on foliage. Photo: Howard F. Schwartz, Colorado State University, Bugwood.org.

Symptoms of CBB include lesions that appear water-soaked and yellow, which eventually turn into patches of brown, dead tissue with irregular margins (**Figure 1**). These lesions typically follow the leaf veins and become larger over the season. Often, a yellow ring develops around the edges of the lesions. Stems will appear wilted and necrotic, and pods will form circular, dark, water-soaked spots that appear sunken (**Figure 2**). Additionally, seeds may have yellow or brown spots and take on a shriveled appearance, which can be difficult to observe on brown seed varieties. Symptomatic seeds often have poor germination after planting.

Infection and pathogen survival

Climate, irrigation, and cropping practices all play important roles in the severity and spread of CBB. The pathogen thrives under hot, humid conditions where seasonal daytime highs reach temperatures ranging from 82°F to 90°F. Overhead sprinkler irrigation systems promote the disease more than furrow irrigation.

Figure 2. Common bacterial blight symptoms on bean pods. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org.

The pathogen is unable to survive for long periods of time in soil as free bacteria, but, because the bacteria can overwinter in crop debris, bacterial levels can accumulate in fields and infect beans in non-rotated fields the following year. However, CBB is more typically transmitted through seeds, farming equipment, or water. The pathogen can also travel to and infect plants through insect vectors, including root weevils and leaf beetles. This causes feeding damage on plants and an opening for bacteria to enter the plants.

Management

Integrated pest management approaches are the best methods to manage CBB. Because the pathogen is very specific for beans, implementing a crop rotation can minimize the bacterial inoculum in fields and, therefore, subsequent disease. Overhead sprinklers can promote bacterial spread, as the water picks up bacteria and splashes between plants. Thus, using furrow irrigation rather than overhead sprinklers limits the spread of bacteria. Disinfecting farming equipment prevents the movement of bacteria between fields and limits spread. Proper row spacing promotes air flow and reduces leaf wetness, which reduces the ability of the pathogen to survive on leaf surfaces. Planting clean seed and/or treating seed with hot water, dry heat, or antibiotics can limit seed transmission. Some copper and antibiotic pesticide applications are approved for use against CBB in beans; however, applying pesticides to symptomatic plants rarely improves yield, even though leaf symptoms may improve.

Photos (used with permission):

Howard F. Schwartz, Colorado State University, Bugwood.org. IPM Images. https://www.forestryimages.org/browse/detail.cfm?imgnum=5363005.

Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org. Common bacterial blight affecting pod. IPM Images. https://www.forestryimages.org/browse/detail.cfm?imgnum=1634010.

Reference:

Fininsa, C. 2003. Relationship between common bacterial blight severity and bean yield loss in pure stand and bean-maize intercropping systems. Int J Pest Manag. 49(3):177–185. DOI: doi.org/10.1080/0967087021000049269.

2022 Dryland Cowpea Variety Performance Trial at Akron

Variety or Accession	Origin	Yield[a]	Test Weight	Moisture
		lb/ac	lb/bu	percent
TVu-14253	Botswana	**812**	59	10
UCR 5275	Australia	**789**	52	11
CB46	USA, California	**688**	49	11
CB27	USA, California	**671**	47	12
524-B	USA, California	**666**	47	11
UCR 24	USA	607	47	12
CB5	USA, California	580	52	11
Gorda	Puerto Rico	573	48	11
UCR 5385	Italy	561	57	10
Vg50	Portugal	535	50	11
Cp 5556	Portugal	522	48	11
Cp 4906	Portugal	520	47	11
1393-1-2-3(-)	USA, California	504	50	11
Vg72	Portugal	481	47	11
CB3	USA, California	445	48	10
Vg56	Portugal	430	51	10
CB5-2	USA, California	410	46	11
Tvu-9651	Egypt	345	52	12
TVu-1811	Puerto Rico	288	53	12
Average		**549**	**50**	**11**
[b]LSD (0.05)		156		

[a]Yields corrected to 14% moisture.

[b]Significant differences were determined using an alpha level of 0.05, which protects against false positives (concluding treatments are different when they are actually the same).

Site Information

Collaborator:	Central Great Plains USDA-ARS Station
Planting Date:	June 10, 2022
Harvest Date:	September 16, 2022
Herbicides:	Pre-Plant Burdown: Sharpen at 1 oz/ac and Roundup at 24 oz/ac Pre-Emerge: Spartan at 2.5 oz/ac and Dual Magnum at labeled rate Post-Emerge: Permit at 0.6 oz/ac
Soil Type:	Weld silt loam
Trial Comments:	Trial planted into excellent moisture and heavy wheat residue. Excellent stands. Radar estimates showed the trial received about 6 inches of rain from planting to harvest and 10.3 inches since January 1st, which is 75% of the ten-year average (year-to-date).

Irrigation Management of Cowpea for NE Colorado

Joel P. Schneekloth, Derek Witkze, and Maria Muñoz-Amatriain

Cowpea is a relatively new pulse crop for Northeast Colorado. Cowpea is well known for its adaptation to drought, heat and poor soils. Crop consultants have expressed concern that the irrigation response of cowpea is not like typical dry beans grown in Northeast Colorado. The thought was that cowpea may have a negative response to typical full irrigation management practices for dry beans such as pintos and kidney beans grown here.

In 2021 and 2022, a study was conducted utilizing a rainout shelter at Central Great Plains Research Station near Akron, Colorado. Use of the rainout shelter ensures that excessive precipitation events do not interfere with the potential water response and timing of water needs. The rainout shelter is connected to a tipping bucket precipitation gauge that will move the shelter over the plants to protect them from rainfall when precipitation is recorded, and open after the precipitation event is over. The water was applied with a drip irrigation system.

Four strategies were looked at within this study: dryland, 4 inches of irrigation, 8 inches of irrigation, and full irrigation practices. All plots received average weekly precipitation amounts of 0.5 inches via a drip system on the plots. The 0.5 inches is the average weekly precipitation for June, July and August at Akron for the prior 20 years. The 4-inch and 8-inch irrigation treatments were targeted towards the reproductive growth stages of cowpea with 2 inches of water applied per week either on a bi-weekly basis or weekly basis. The final treatment was full irrigation management which targeted maintaining plant available soil moisture between 50 and 80% during the growing season.

Results:

Irrigation did increase yield compared to dryland to a point (Table 1). Increasing irrigation past the 8-inch allocation did not increase yields. On the 2-year average, yields increased from 1185 to 2469 pounds per acre from dryland to 8 inches of applied irrigation. Additional irrigation beyond 8 inches did not increase yield but did increase evapotranspiration (ET). Most crops, for example corn or pinto beans, generally have a yield response of increasing yield as ET increases. The cowpea response to increasing ET showed a yield plateau past 15 inches of ET.

One of the factors to look at is how irrigation impacted yield components such as pods per plant, seeds per pod and seed size. Irrigation did not significantly increase seeds per pod. Although increasing ET did not significantly increase seeds per pod, there was a tendency for seeds per pod to increase with water applied compared to dryland. The number of seeds per pod ranged from about 4.9 to 5.7 for dryland and irrigated, respectively.

The two major impacts due to irrigation were pods per plant as well as seed size or seeds per pound. Dryland production produced smaller seeds, as shown by the seeds per pound as compared to irrigated production. Irrigation at 4 inches seasonally did not increase pods per plant but did significantly increase seed size resulting in the overall yield increase. The tendency for each of the 2 years was for the 4-inch management to produce the biggest seed size, although not statistically different from the 8-inch or full irrigation management.

As irrigation increased to 8 inches, pods per plant increased to generate the increased yield per acre compared to the 4-inch allocation. Adding additional irrigation beyond the 8 inches applied did not increase pods per plant, seeds per pod or seed size for the full irrigation management.

Harvest index is the amount of seed produced compared to the total plant biomass production on a dry basis. This is an indication of the efficiency of the plant to produce seed as compared to total biomass. Although there was no statistical difference among water management treatments, the harvest index tended to slightly increase with irrigation up to the 8-inch allocation. Additional irrigation above 8 inches did increase biomass production but did not increase seed production resulting in a slightly lower harvest index. Increased biomass production typically results in greater crop water use or ET. The measured increase in ET for full irrigation compared to the 8-inch allocation was 2.6 inches of water use. This shows the potential savings in irrigation for cowpea with limited irrigation.

Overall, dryland cowpea yields averaged 1,184 pounds per acre. This has the potential to either replace fallow or become another crop within the rotation for dryland producers. For irrigated producers, the potential of this crop for water savings with either limited water supplies or low-capacity wells could prove beneficial in cropping systems to spread limited water. Overall, 15 inches of ET maximized yield of cowpea. An estimate of ET for a dry bean crop such as pinto is 19.5 inches for full irrigation management according to CoAgMet calculations. This is an approximate 4.5-inch savings of water overall in the system.

A secondary impact of cowpea is soil moisture utilization (data not shown). Total water extraction from the soil tended to be 2.5 inches or less from planting to maturity in a 6-foot profile. This is lower water use as compared to most other crops. The impact of lower soil water extraction during the growing season is the potential for planting winter wheat after this crop compared to other crops in a rotation. Harvest time for cowpea is early enough to allow for timely planting of winter wheat during September which is like that of millet most years. However, previous research has shown that millet will extract more moisture from the soil as compared to cowpea.

Continued work on cowpea will look at incorporating cowpea into a dryland rotation with winter wheat and corn as a fallow replacement in comparison to millet.

Table 1. Yield components, yield and ET of cowpea under 4 irrigation management strategies for 2021, 2022 and average.

2021

Water Treatment	Pods/Plant	Seeds/Pod	Seed Size (seed/lb)	Yield (lb/ac)	Harvest Index (yield/biomass)	ET (inches)
Dryland	4.0b	4.9a	2185b	1028c	0.36b	7.8d
4"	4.3b	5.9a	1753a	1594b	0.42ab	10.5c
8"	7.3a	5.5a	1941a	2663a	0.46a	14.5b
Full	6.8a	5.9a	1935a	2573a	0.41ab	17.8a

2022

Water Treatment	Pods/Plant	Seeds/Pod	Seed Size (seed/lb)	Yield (lb/ac)	Harvest Index (yield/biomass)	ET (inches)
Dryland	4.2b	4.7a	2076b	1341b	0.39a	8.7d
4"	5.7b	4.5a	1708as	2012a	0.33a	12.3c
8"	5.2b	6.0a	1895a	2275a	0.36a	15.6b
Full	7.5a	5.1a	1910a	2395a	0.37a	17.4a

Average

Water Treatment	Pods/Plant	Seeds/Pod	Seed Size (seed/lb)	Yield (lb/ac)	Harvest Index (yield/biomass)	ET (inches)
Dryland	4.1b	4.8a	2131b	1185c	0.37a	8.3d
4"	5.0b	5.2a	1731a	1803b	0.38a	11.4c
8"	6.2a	5.7a	1918a	2469a	0.41a	15.0b
Full	7.1a	5.5a	1923a	2484a	0.39a	17.6a

*Significant differences based on ANOVA using alpha level of 0.10

Pulse Agronomy Program at CSU

Jessica G. Davis

Since I stepped down from administration at the end of 2021, I am focusing my research and outreach efforts on beans and pulse crops more generally. The Pulse Agronomy Team aims to increase the acreage and diversity of pulse crops grown in Colorado and around the world. Our intent is that by increasing pulse acreage we will advance environmental outcomes including improved soil health, reduced water use, and diminished demand for fertilizer.

This year, we received a USDA-ARS Pulse Crop Health Initiative grant to quantify the potential of pulse crops to improve environmental and economic sustainability through incorporation into both dryland and irrigated wheat rotations in semi-arid and arid climates. Three-year crop rotations are being evaluated in two different parts of Colorado: semi-arid, dryland rotations with cowpea in eastern Colorado (Akron) and arid, irrigated rotations with dry pea and lentils in western Colorado (Fruita). We will be evaluating sustainability including water use, soil health, nitrogen cycling, and profitability, which will then be applied to a thorough life cycle analysis.

In a project funded by the Colorado Water Conservation Board at the Western Colorado Research Center in the Grand Valley (Fruita), we are growing five varieties of winter peas under furrow irrigation with three treatments: no spring water at all, a May 1 irrigation cutoff, and a June 1 irrigation cutoff. We will develop a cropping budget that will consider the income from peas, income from water banking, grazing income, and fertilizer and seed costs. We are evaluating the feasibility of a crop regimen based on growing winter pulses to reduce summer irrigation water demand and offer producers additional revenue sources through water sharing arrangements.

We are continuing a CDA-funded project to develop best management practices for organic chickpea production to provide practical guidelines for organic producers to successfully grow chickpea (aka garbanzo beans). Since a good market is currently available for organic chickpea, we expect the findings of this project to be adopted by growers quickly, and organic chickpea production and sales to expand in the state. We are conducting replicated research trials on three research centers in western Colorado; Grand Valley, Rogers Mesa, and Southwestern, to evaluate chickpea varieties and planting dates in both spring and fall. Plant establishment, weed infestation, yield, and quality of chickpea will be measured.

We are surveying growers to develop a pulse suitability map for Colorado. The map will illustrate which pulses grow well in various regions across the state. Our goal is to provide recommendations to growers regarding which pulses may grow successfully in their location. By using Geographic Information Systems, we will identify environmental factors like climate and soil types related to grower success and then model which other locations with similar environments have potential to successfully grow those crops. If you would like to participate, please find the survey link here: arcg.is/1H5HmT0.

We are also doing soil fertility research on pulses. We are evaluating to what degree different pulse species (dry beans, peas, cowpeas, and tepary beans), market classes, and varieties emit root exudates that solubilize soil phosphorus (P) and alter the microbial community of the rhizosphere. In addition, we are applying P fertilizer and measuring how that influences the microbial community, specifically Rhizobium, and ultimately, how P additions impact nodulation and nitrogen fixation. Finally, we are in the early stages of designing a salinity project in which we will evaluate the salinity tolerance of different pulse crops through germination, vegetative, and reproductive growth stages. Our goal is to be able to recommend pulse types and varieties with greater salt tolerance for situations where that is necessary.

Learn more about all of these projects here: agsci.colostate.edu/soilcrop/research/davis-lab/.

If you have input you'd like to share with me about any of these projects or ideas for new research, please email me at: jessica.davis@colostate.edu.

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