Technical Report TR13-8

Agricultural Experiment Station

Colorado State University

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Southwestern Colorado Research Center

2012 Results

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Editor: Abdel F. Berrada, Senior Research Scientist & Manager
Colorado State University
Southwestern Colorado Research Center
Yellow Jacket, Colorado

Cover photo shows the winter wheat variety trial (foreground) at the Southwestern Colorado Research Center. Photo taken on July 11, 2012 by Abdel Berrada.

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Soil & Climate at the Southwestern Colorado Research Center

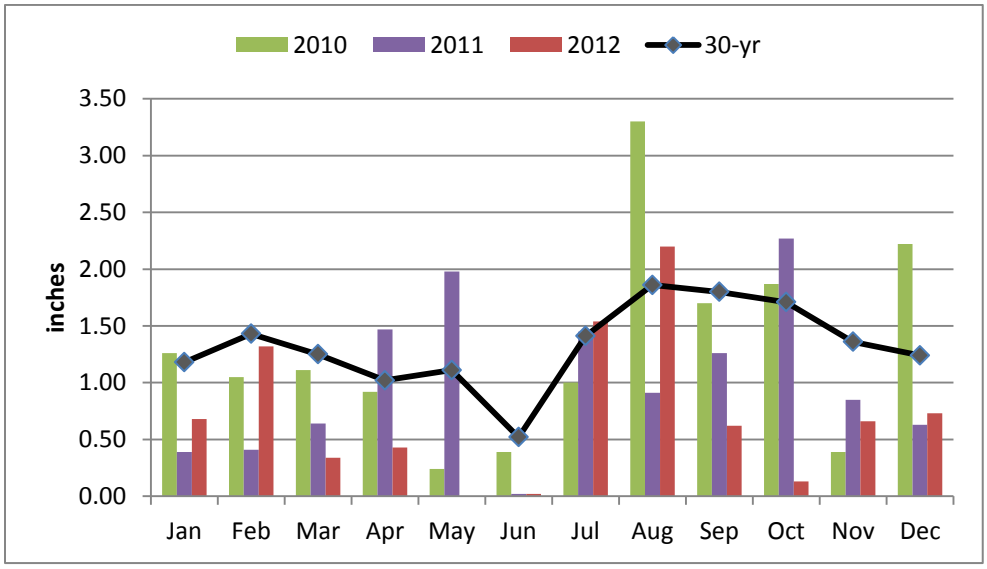
Soil

The principal soil type at the Research Center is Wetherill loam (fine-silty, mixed, superactive, mesic Aridic Haplustalfs). The Wetherill series is made up of generally deep well drained soils, located on mesas and hills. These soils were formed from sandstone material transported by wind from the Southwest. They tend to be reddish on the surface and generally have low organic matter (around 1.0%). Their water holding capacity ranges from approximately 1.8 to 2.0 inches/ft. Soil pH at the SWCRC is around 7.5. The terrain in southwestern Colorado is generally rolling. Slopes vary from 1 to 12% and the elevation from less than 6,000 ft. to above 7,000 ft. The potential exists for significant wind and water erosion on bare ground, especially in the spring.

Precipitation & temperature

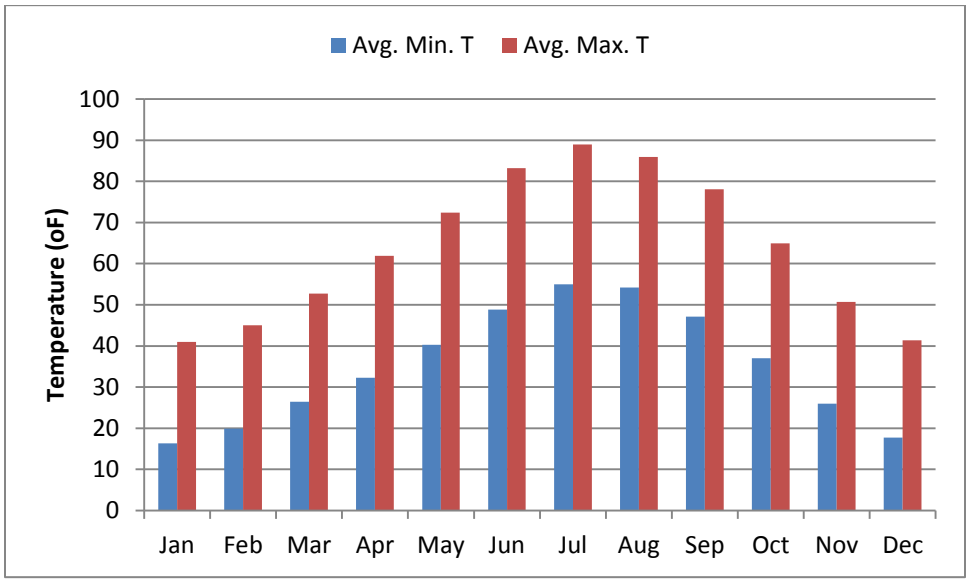
The 30-year (1981-2010) average precipitation at Yellow Jacket is 15.9 inches. The average annual snowfall is 68.1 inches (30-year average from 1971-2000). June is the driest month and August is the wettest month. Average monthly minimum and maximum temperatures are shown in Figure 2. The frost-free period is 100 to 120 days. The Research Center lies at an elevation of 6900 ft., latitude 37°32' N and longitude 108°44' W. The yearly precipitation data is from the CoAgMet (Colorado Agricultural Meteorology) station at the SWCRC. It does not account for all the moisture from snow, since the station uses a simple tipping bucket rain gauge to measure precipitation. Precipitation in 2012 was 8.67 inches and was below average every month except for July and August (Figure 1).

Figure 1. 2010 to 2012 and 30-yr (1981-2010) monthly precipitation at Yellow Jacket, CO[1]



[1] 30 year average was obtained from http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co9275 . Data from 2010-2012 is from http://www.coagmet.com/ (Yellow Jacket station).

Figure 2. 1981-2010 average monthly minimum and maximum temperatures at Yellow Jacket, CO



Summary of the Main Results

Abdel Berrada[2]

Dryland Winter Wheat Variety Trial

The winter wheat yields averaged 27.4 bu/acre, which was a low yield due to the dry weather. The experimental line CO050173 had the highest yield at 31.6 bu/acre. This entry also had the top yield in 2010-2011. The two common hard red winter wheat varieties in southwestern Colorado—Fairview and Deloris—had yields of 26.0 and 25.7 bu/acre, respectively. Grain protein averaged 15.5% (Table 1).

Irrigated Spring Wheat Variety Trial

Spring wheat yields averaged 39.4 bu/acre, which is unusually low due to poor weed control and dry and cool conditions in the spring. The variety Kelse had the highest yield at 45.3 bu/acre, but the yield difference between the top ten varieties was not statistically significant. Grain protein averaged 16.5% (Table 13).

Dryland Winter Canola Variety Trial

Winter canola yield averaged 945 lb/acre. The variety HPX-7228 had the highest seed yield at 1311 lb/acre and the lowest oil content at 33.9%. Durola had the highest oil content at 39.2% but only produced 802 lb/acre. Winter survival was very good for most varieties, averaging 97%. Seed shattering was minimal with an average of only 1% shattered. Fall stand (lack of gaps after the canola emerged) ranged from a poor stand rated at 6 out of 10 for the variety 46W99, to an excellent stand rated 10 out of 10 for the varieties Hybrirock and Durola. The average 50% bloom date was May 7, 2012. The average date of reaching 90% seed maturity was June 27, 2012 (Table 2).

Evaluation of Dryland Crop Rotations that Include Sunflower

Winter wheat yields averaged 26 to 33 bu/acre (Table 15). Spring planted crops including dry bean, corn, safflower, and sunflower had low yields due to low soil moisture and dry weather. Damage to safflower was mostly from ravens. The sunflower did not germinate in certain areas, causing large gaps in some rows. Corn and some dry bean plots were not harvested.

Boosting Sunflower Production in SW Colorado with Supplemental Irrigation

Sunflowers irrigated over the full season yielded the most at 2,715 lb/acre. However, sunflowers that received pre-planting irrigation plus irrigation at growing stage R-1 through stage R-6 yielded 88% as much as the full irrigation treatment with only 60% the amount of irrigation water. The standard-height sunflower hybrid Mycogen H449CLDM outperformed the short-stature hybrid Triumph s870HCL at all irrigation levels. The full irrigation treatment produced the greatest seed oil concentration of 43.8%, significantly more than the treatments

[2] Senior Research Scientist and Manager of the SWCRC.

with limited irrigation. Mycogen 8H449CLDM and Triumph s870HCL averaged 43.2% and 41.9% oil content, respectively (Table 20).

Nitrogen application rates of 0 to 90 lb N/acre had no significant effect on seed yield, plant height, seed weight or test weight. The lack of yield response to N fertilizer may have been due to adequate residual N in the soil below the three foot depth that was sampled.

Dryland Safflower Variety Trial

Safflower was planted into a dry seedbed, plus there was little precipitation in May and June, which negatively affected germination and emergence. Crop stand at harvest averaged 79%. Seed yield averaged 736 lb/acre, which was below previous years' averages (Berrada, TR11-04, 2011). The variety CW 99OL had the highest yield at 888 lb/acre. However, the difference in yield between the top five varieties was not statistically significant. Seed oil content averaged 38.6% and the average 50% bloom date occurred on July 23rd (Table 3).

Irrigated Safflower Variety Trial

Irrigated safflower yields averaged 2734 lb/acre, which is about four times more than the dryland safflower yield. The variety CW 3268-OL had the highest yield at 3037 lb/acre, but the yield differences between the varieties were not statistically significant. Average seed oil content was 38.7% and the average 50% bloom date occurred on July 30th (Table 4).

Evaluation of Corn Hybrids for Drought Tolerance

A preliminary study was conducted in 2012 to test the response of eight corn hybrids to water stress with a line-source irrigation system, whereby the irrigation amount decreases as the distance from the sprinkler line increases. Three of the hybrids were specifically bred for improved drought tolerance. Irrigation plus rainfall (precipitation) amounts ranged from 23.6 down to 6.6 in., of which 3.9 in. came from rain. Grain yield decreased significantly as water input decreased, as did plant height (Figures 8 & 9). Kernel weight was similar at 6, 18, and 30 ft. from the sprinkler line and was significantly lower at 24 and 54 ft. (Table 10). There were no significant differences between corn hybrids in grain yield, plant height, or kernel weight nor was there a significant hybrid by distance interaction. In this first year of the study, there was no clear advantage of the hybrids with the drought tolerance traits over the ones that did not have the so-called drought genes.

2010-2012 Dryland Winter Wheat Variety Trials at Yellow Jacket, CO[1]

Table 1. Results of the 2010-2012 Dryland Winter Wheat Variety Trials.

Crop season	2011-2012					2010-2011[2]		
Entry name	Type[3]	Grain Yield (bu/acre)[4]	Grain Test Weight (lb/bu)	Grain Protein (%)	50% Heading Date	Grain Yield (bu/acre)[4]	Grain Test Weight (lb/bu)	Grain Protein (%)
CO050173	HRW	31.6	57.5	15.4	25-May	62.7	55.8	16.2
Brawl CL Plus	HRW-CL2	30.6	57.9	15.5	23-May	61.8	56.5	16.3
TAM 112	HRW	30.4	57.3	15.9	23-May	57.5	55.3	15.5
Curlew	HRW	29.9	56.6	16.0	30-May	49.0	51.1	16.9
Denali	HRW	29.4	57.3	15.0	29-May	54.4	53.9	16.2
Thunder CL	HWW-CL	28.9	57.4	14.3	24-May	52.9	55.2	14.3
CO050337-2	HRW	28.7	56.5	15.6	29-May	47.0	52.4	17.1
Cowboy	HRW	28.5	56.0	15.4	29-May	53.3	52.9	16.1
Byrd	HRW	28.2	56.5	15.5	25-May	48.3	53.0	14.3
Lucin CL	HRW-CL	28.0	57.1	15.4	1-Jun	42.1	52.9	17.1
CO07W245	HWW	27.9	57.4	15.1	28-May	NA	NA	NA
Snowmass	HWW	27.8	55.2	15.3	25-May	55.6	54.2	14.8
IDO816	HRW	27.1	55.6	15.6	3-Jun	48.4	51.2	16.0
CO050233-2	HRW-CL	26.8	56.5	16.2	31-May	54.1	52.3	16.8
Above	HRW-CL	26.7	56.5	14.6	25-May	55.4	54.2	14.3
UI SRG	HRW	26.5	55.7	15.4	1-Jun	50.1	50.2	17.1
CO05W111	HWW	26.4	58.3	15.5	31-May	52.0	55.0	16.6
UI Silver	HWW	26.1	59.1	15.1	1-Jun	50.4	54.8	15.9
Fairview	HRW	26.0	56.9	15.2	31-May	46.0	51.8	15.9

Crop season	2011-2012					2010-2011[2]		
Entry name	Type[3]	Grain Yield (bu/acre)[4]	Grain Test Weight (lb/bu)	Grain Protein (%)	50% Heading Date	Grain Yield (bu/acre)[4]	Grain Test Weight (lb/bu)	Grain Protein (%)
Deloris	HRW	25.7	56.8	15.6	2-Jun	46.3	53.0	17.2
Hatcher	HRW	25.1	56.2	15.4	24-May	58.3	52.3	15.0
UI Darwin	HWW	24.9	57.6	15.8	31-May	52.7	56.0	16.3
Ripper	HRW	24.3	54.2	16.5	23-May	56.8	53.3	15.7
UI LHS	HWW	23.0	56.5	16.7	6-Jun	NA	NA	NA
Mean		**27.4**	**56.7**	**15.5**	**28-May**	**51.1**	**53.2**	**15.9**
CV %		9.7	1.8	3.2	1	11.2	2.5	3.3
$LSD_{.05}$		3.7	1.4	1.0	2	9.4	2.2	1.1
$LSD_{.30}$		2	0.7	0.5	1	NA	NA	NA

[1] The trial was conducted at CSU's Southwestern Colorado Research Center in a RCB design with four replications. Plot size 6 ft x 40 ft.

[2] Means and statistics for 2010-2011 are for 29 entries.

[3] HRW: Hard Red Wheat; HWW: Hard White Wheat; CL: Clearfield (resistant to 'Beyond' herbicide).

[4] Grain yield adjusted to 12% moisture and 60 lb/bu test weight.

Trial information

Crop season	2011-2012	2010-2011
Previous crop	Summer fallow	Summer fallow
Seeding date	September 29, 2011	September 30, 2010
Seeding rate	700,000 seeds/A	700,000 seeds/A
Harvest date	July 11, 2012	July 20, 2011
Fertilizer applied	None	15 lb N + 73 lb P_2O_5/A on September 2, 2010
Pesticide applied	2.4-D Amine @1.12 pt/A on April 21, 2012	None
Rainfall (Oct. – June)	6.6 in. (58.3 % of normal)	9.4 in. (83.7 % of normal)

Figure 3. Photo of the dryland winter wheat variety trial taken on July 11, 2012 by Abdel Berrada.

2011-2012 Dryland National Winter Canola at Yellow Jacket, CO[1]

Table 2. Results of the 2011-2012 Dryland National Winter Canola Trial.

Entry	Seed yield[2] lb/acre	Seed moisture %	Test weight lb/bu	Plant height in.	Fall stand 0-10	Winter survival %	50% Bloom date	Seed Maturity[3&4]	Seed shattering[5] %	Oil[6] %
HPX-7228	1311	6.1	52.6	40	8	97	5-May	178	1	33.9
MH 09H19	1239	5.9	51.8	39	9	100	7-May	179	1	36.4
Hybrirock	1135	6.1	52.3	39	10	96	7-May	179	1	35.7
TCI805	1124	6.1	51.2	36	9	100	7-May	177	1	36.5
Riley	1116	5.9	51.5	34	9	100	7-May	178	1	36.3
Baldur	1103	6.2	53.2	38	9	99	7-May	179	1	36.3
MH 07J14	1086	6.1	51.6	37	9	100	7-May	180	1	35.5
Rossini	1075	5.8	51.3	34	9	99	2-May	178	0	36.9
06.UIWC.1	1065	5.9	52.5	35	9	100	5-May	178	0	35.2
Safran	1055	5.9	51.0	36	9	96	7-May	171	0	36.9
Sitro	1052	6.1	51.5	36	9	97	7-May	178	0	36.2
TCI806	1021	5.8	51.1	37	9	97	7-May	178	1	35.6
Chrome	1009	5.9	51.6	34	8	99	7-May	178	1	37.1
WRH 350	992	5.9	51.1	36	9	96	7-May	180	1	35.1
Visby	943	5.9	51.8	39	7	92	7-May	179	1	36.0
Flash	943	6.0	52.0	42	9	98	8-May	172	1	35.7
Wichita	940	6.0	51.5	37	8	98	7-May	178	1	36.4
MH 06E10	927	6.1	52.7	38	8	99	8-May	178	1	36.6
05.UI.5.6.33	912	5.8	50.1	37	9	96	7-May	180	0	34.5
DKW41-10	911	6.0	52.2	31	9	99	4-May	178	0	34.6
Dynastie	903	5.8	50.9	40	7	82	7-May	162	0	36.9
DKW44-10	903	6.2	52.5	34	9	100	7-May	179	1	34.9

Entry	Seed yield[2] lb/acre	Seed moisture %	Test weight lb/bu	Plant height in.	Fall stand 0-10	Winter survival %	50% Bloom date	Seed Maturity[3&4]	Seed shattering[5] %	Oil[6] %
HPX-7341	880	6.1	51.8	36	9	99	7-May	178	1	36.2
Ulura	879	6.0	53.2	41	8	97	7-May	179	2	36.4
Hornet	876	5.8	52.2	38	7	96	7-May	180	0	35.2
Amanda	858	6.0	52.3	33	9	100	8-May	180	0	35.4
HyClass125W	857	5.9	50.8	34	9	100	7-May	180	1	36.5
Durola	802	6.1	50.7	37	10	98	7-May	178	1	39.2
HyClass115W	801	6.1	52.0	35	9	97	7-May	178	1	35.9
DKW46-15	798	5.9	51.3	37	8	90	7-May	179	1	35.6
46W94	797	6.0	52.7	37	8	97	7-May	178	1	34.9
DKW47-15	780	6.1	51.5	34	9	99	7-May	178	1	35.1
HyClass154W	777	6.2	51.3	35	8	99	7-May	180	1	34.9
Rumba	777	5.9	52.7	37	6	97	7-May	180	1	35.6
46W99	772	6.0	51.9	35	6	90	7-May	178	1	35.4
Claremore	607	6.0	50.7	36	9	100	7-May	180	0	36.3
Average	**945**	**6**	**52**	**37**	**9**	**97**	**7-May**	**178**	**1**	**35.9**
CV (%)	13	3.8	1.8	6	9	5	1	2	73	1.9
LSD.05	199	NS	1.5	4	1	8	1	7	1	1.3

[1]This trial was conducted at CSU's Southwestern Colorado Research Center in a randomized complete block design (RCBD) with three replications. Plot size: 6 ft. x 30 ft. For more information, contact Abdel Berrada at abdel.berrada@colostate.edu

[2]Seed yield adjusted to 9% moisture

[3]Number of days from January 1, 2012

[4]Date at which 90% of the plants have reached a mature color

[5]Shattering was mostly due to bird feeding

[6]Oil data was obtained from http://www.agronomy.ksu.edu/extension/doc4272.ashx . The report at this website also contains 2-year averages.

Trial information

Previous crop: Summer fallow
Planted: 9/2/2011 @ 5.3 lb/acre
Harvested: 7/10/2012
Pesticide: None
Weed control: Hoeing as needed
Fertilizer application: None
Irrigation application: None
Precipitation amount (from rain & snow) from September 2011 through June 2012: 7.8 in. (61% of 30-yr average)

Comments

The seedbed at planting was dry. The first significant rainfall (0.33 in.) after planting occurred on 13-Sept. The fall stand averaged 9.0 on a scale of 0 (no stand) to 10 (excellent stand) but some plots had ratings of 6 and 7. The plot area was weed-free at planting but became infested with weeds, mostly shepherd's purse and prickly lettuce in late winter-early spring, which required hand hoeing since no pre-plant herbicide was applied. Precipitation from rain and snow from planting through harvest maturity was 61% of normal. Only October and February had normal precipitation. Total precipitation from March through June was 0.7 in. or 19% of normal, which negatively impacted seed yield. Average seed yield was 945 lb/acre with a low of 607 and a high of 1311 lb/acre. No irrigation water was applied prior to seeding or throughout the growing season. There was very little pod shattering—which was mostly due to bird feeding—and no lodging.

Figure 4. Photo of the winter canola trial taken on May, 11 2012 by Abdel Berrada.

2012 Dryland Safflower Variety Trial Results[1]

Table 3. Results of the 2012 Dryland Safflower Variety Trial.

Entry	Brand	Primary Oil Type	Seed Yield (lb/acre)[2]	Seed Moisture (%)	Seed Test Weight (lb/bu)	Seed Oil Content (%)	Plant Height (in.)	Bloom Date	Stand at harvest (%)
CW 99OL	Cal/West Seeds	Oleic	888	5.3	39.9	39.2	16.3	21-Jul	73
CW 88OL	Cal/West Seeds	Oleic	844	5.3	40.5	38.1	14.3	23-Jul	86
CW 3268-OL	Cal/West Seeds	Oleic	840	5.4	42.4	39.5	15.3	24-Jul	71
6159	SeedTec	Oleic	833	5.5	43.4	38.2	15.8	24-Jul	82
S-719	SeedTec	Linoleic	811	5.3	42.3	38.5	13.5	21-Jul	87
S-351	SeedTec	Oleic	695	5.4	40.0	38.1	13.5	22-Jul	78
S-333	SeedTec	Oleic	690	5.6	42.1	38.5	15.8	26-Jul	80
S-208	SeedTec	Linoleic	539	5.3	40.6	38.6	14.5	22-Jul	77
S-541	SeedTec	Linoleic	482	5.4	40.4	38.6	14.0	22-Jul	76
Average			**736**	**5.4**	**41.3**	**38.6**	**14.8**	**23-Jul**	**79**
CV (%)			15	2.7	1.4	1.2	6.2	0.0	13
LSD (0.05)			158	NS[3]	0.8	0.7	1.3	1.6	NS
LSD (0.10)			132	0.2	0.7	0.6	1.1	1.3	NS

[1] Trial conducted at Colorado State University's Southwestern Colorado Research Center

[2] Adjusted to 10% moisture

[3] Not significant at the specified probability level

Trial information

Seeded: May 2, 2012 @ 348,480 seeds/acre
Harvested: September 14, 2012
Previous crop: Summer fallow
Fertilizer: None
Herbicide: Treflan @ 1.5 pt/acre on 4/24/12
Rainfall (May - Aug.): 3.76 in. (74% of normal)

Comments: Safflower was planted into a dry seedbed plus there was hardly any precipitation in May and June, which negatively affected germination and emergence. Crop stand at harvest averaged 79%. Seed yield was below previous years' averages (Berrada, TR11-04, 2011).

Figure 5. Photo of dryland safflower taken on August 6, 2012 by Abdel Berrada. There are gaps between some plants due to poor germination in those areas.

2012 Irrigated Safflower Variety Trial[1]

Table 4. Results of the 2012 Irrigated Safflower Variety Trial.

Entry	Brand	Primary Oil Type	Seed Yield (lb/acre)[2]	Seed Moisture (%)	Seed Test Weight (lb/bu)	Seed Oil Content (%)	Plant Height (in.)	Bloom Date
CW 3268-OL	Cal/West Seeds	Oleic	3037	5.2	39.4	37.8	22.8	1-Aug
S-719	SeedTec	Linoleic	2962	4.7	40.2	39.9	21.3	29-Jul
6159	SeedTec	Oleic	2903	4.8	40.5	38.8	23.8	2-Aug
S-351	SeedTec	Oleic	2886	4.8	38.3	38.4	19.8	30-Jul
S-333	SeedTec	Oleic	2711	5.2	41.1	38.1	23.3	2-Aug
S-208	SeedTec	Linoleic	2616	4.6	40.8	38.9	21.3	28-Jul
CW 99OL	Cal/West Seeds	Oleic	2613	4.8	36.1	39.4	22.5	29-Jul
CW 88OL	Cal/West Seeds	Oleic	2502	4.5	38.1	37.6	23.0	1-Aug
S-541	SeedTec	Linoleic	2373	4.8	40.2	39.9	22.8	30-Jul
Average			**2734**	**4.8**	**39.4**	**38.7**	**22.3**	**30-Jul**
CV (%)			11.2	5.0	3.7	2.0	8.2	0.0
LSD (0.05)			NS[3]	0.3	2.1	1.1	2.7	2.9
LSD (0.10)			369	0.3	1.8	1.0	2.2	2.4

[1] Trial conducted at Colorado State University's Southwestern Colorado Research Center

[2] Adjusted to 10% moisture

[3] Not significant at P=0.05

Trial information

Seeded: May 1, 2012 @ 479,160 seeds/acre

Harvested: October 3, 2012

Previous crop: Spring wheat

Fertilizer: 50 lb N + 29 lb P_2O_5 + 6 lb Zn/acre on 4/18/12

Herbicide: Sonalan @ 2.5 pt/acre on 4/23/12

Irrigation: Approximately 14 in. with sideroll in six applications

Rainfall (May - Sept.): 4.38 in. (66% of normal)

Figure 6. Photo of irrigated safflower taken on August 6, 2012 by Abdel Berrada. The variety trial is near the center of the image, but it is hard to separate it out from the rest of the safflower field.

Evaluation of Corn Hybrids for Drought Tolerance

Principal Investigator: Abdel Berrada[3]
Main collaborator (Co- PI): Denis Reich[4]

Introduction

Corn is a minor crop in southwestern Colorado. However, with advances in drought tolerance, the potential exists for an increase in acreage. In recent years, several corn hybrids were developed to withstand water stress better than "conventional" hybrids and yet perform well when water does not limit production. The drought tolerance of corn is enhanced through breeding (e.g., the so-called native gene approach) or with the use of molecular and transgenic techniques.

The amount and distribution of precipitation from rain and snow makes it a challenge to grow grain corn economically in southwestern Colorado, especially at the higher elevations. This could be overcome to a certain extent with the cultivation of short-season hybrids and hybrids that are specifically bred for improved drought tolerance. Production will be enhanced with supplemental irrigation. There are over 100,000 acres of irrigated land in Montezuma, Dolores, and La Plata Counties alone. The main field crop by far is alfalfa. Corn would be a good alternative to spring wheat, oat, and pinto bean, in rotation with alfalfa. It would utilize residual N and water efficiently and may help increase soil organic matter in reduced till conditions, given the amount of dry matter (crop residues) it would generate.

The objective of this study was to test several corn hybrids for their response to water stress. Three of the hybrids had the so-called drought tolerance genes bred into them.

Methodology

Eight corn hybrids with or without genetic improvements for drought tolerance were tested in 2012 for their response to water stress. A line-source sprinkler irrigation system similar to the one described by Hanks[5] et al. (1976) was used. With this system, the amount of irrigation water applied decreases as the distance from the sprinkler line increases, generally in a linear or near-linear fashion, depending on nozzle configuration. The entire trial received about 2 inches of irrigation on May 21, 2012 in order to improve corn germination. Daily crop ET data was obtained from the Yellow Jacket Colorado Agricultural Meteorology (CoAgMet) weather station, which is located at the SWCRC.

The following parameters were measured:

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[3] Senior Research Scientist/Manager, Colorado State University, Southwestern Colorado Research Center.

[4] Water Resource Specialist, Western Region, Colorado State University Extension, Colorado Water Institute.

[5] Hanks, R.J., J. Keller, V.P. Rasmussen, and G.D. Wilson. 1976. Line source sprinkler for continuous variable irrigation-crop production studies. Soil Sci. Soc. Am. J. 40: 426-429

- The amount of irrigation water applied at 6, 18, 30, 42, and 54 ft. from the sprinkler line
- Rainfall amount
- Plant height at physiological maturity
- Number of ears per plant and per harvest area
- Number of kernels per ear at harvest
- Kernel weight
- Grain yield, moisture content and test weight

All eight corn hybrids were planted on May 17, 2012 at 29,870 seeds/acre in a randomized complete block design with four replications (Figure 7 and Table 5). Main plot size was 10 ft. (4-rows of corn) by 60 ft. on each side of the sprinkler line. Corn yield and yield components were measured from two 6-ft long (middle) rows centered at 6, 18, 30, 42, and 54 ft. from the sprinkler line.

Figure 7. Corn trial layout.

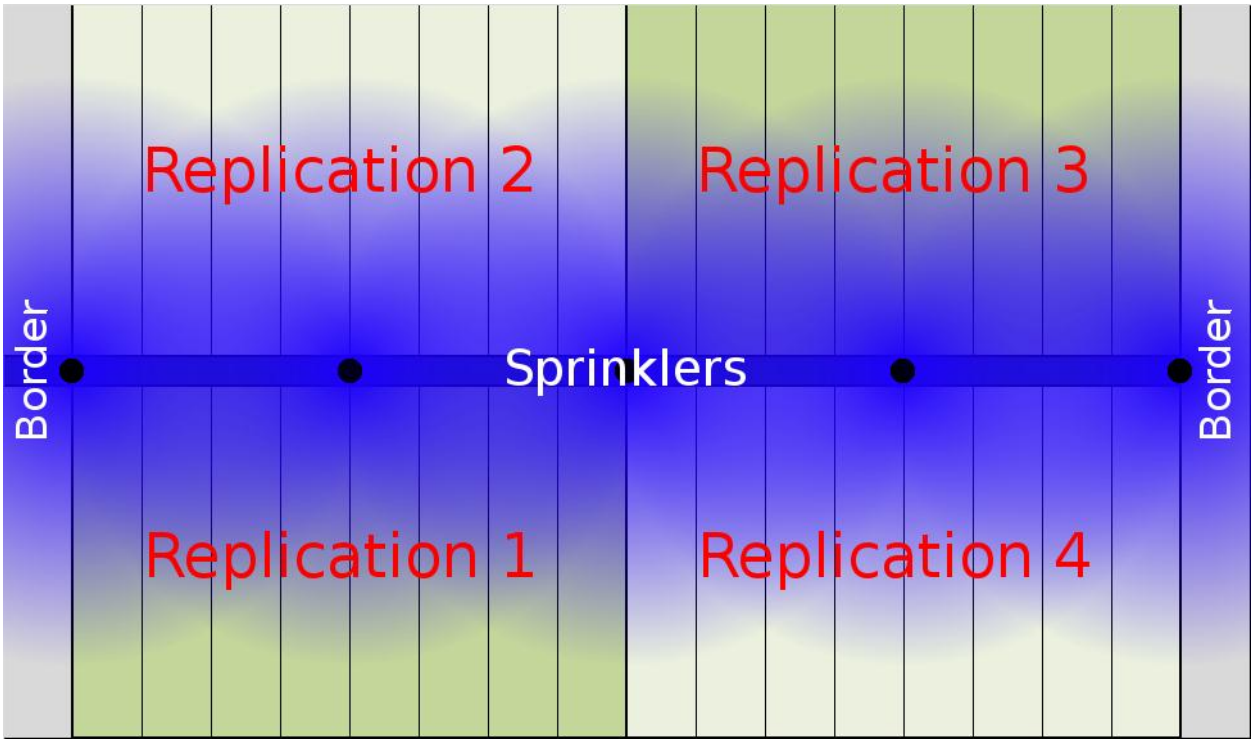


Table 5. Corn trial information.

Location	Yellow Jacket, CO
Previous crop	Dry bean
Soil type	Wetherill loam
Planting date	5/17/12
Planting rate (seeds/acre)	29,870
Row spacing	2.5 ft.
Rainfall (from planting to last irrigation date)	3.94 inches
Fertilizer	50.2 lb N + 28.6 lb P_2O_5 + 5.5 lb Zn/acre on 4/18/12
Herbicide	Mad Dog (Glyphosate) @ 2 pint/acre on 6/7/12
Cultivation	6/15/12
Last irrigation date	9/14/12
Harvest date	10/17 to 10/19/12

Results

The total corn evapotranspiration from planting to Sept. 14th when all hybrids reached or exceeded physiological maturity was about 23.22 inches[6]. The average irrigation plus precipitation at 6 feet from the sprinkler line was 23.6 inches (Table 6) which is fairly close to the total ET. The amount of water received decreases further from the sprinkler line, down to 6.6 inches at 54 feet away. Most of the water received at 54 feet away from the sprinkler line was from precipitation and pre-planting irrigation (6.60" = 3.94 " precipitation + 2" pre-planting irrigation + 0.66 " sprinkler line irrigation). Plots at the same distance north and south of the sprinkler line received similar amounts of irrigation with the exception of the distance of 42 ft. At 42 ft., the north side received 14.0" irrigation + precipitation while the south side received only 9.1". This might have been due to wind, which typically blew from the south more than the north.

[6] Source: http://www.coagmet.com/ . The evapotranspiration value on July 24, 2012 was missing so it was estimated based on values from the previous and following days.

Table 6. Corn trial water input.

Distance from the sprinkler line (ft.)	Irrigation + Precipitation (in.)		
	Direction		Average
	north	south	
6	24.3	22.9	**23.6**
18	20.9	20.4	**20.7**
30	17.5	17.0	**17.2**
42	14.0	9.1	**11.6**
54	7.2	6.0	**6.6**
Average	**16.8**	**15.1**	**15.9**

Grain yield decreased as water input decreased (Table 7 and Figure 8). The Hybrid DKC52-04 performed best on average, but the hybrid DKC43-10 had a substantially higher yield than the other hybrids in the lowest irrigation treatment. The yield differences were statistically significant between all irrigation treatments except between 6 and 18 feet from the sprinkler line. Corn in this trial was not managed for maximum yield, in terms, for example, of fertilizer application. There was no variation in production inputs, regardless of the distance from the sprinkler line.

Table 7. Corn Yield.

Hybrid	Relative Maturity[2]	Yield (bu/acre)[1]					
		Distance from sprinkler line (ft)					
		6	18	30	42	54	Average
DKC52-04	102	176	165	143	122	73	**136**
DKC43-10	93	166	152	139	119	87	**133**
P0210HR[3]	102	169	161	144	118	65	**132**
P9690HR[3]	96	158	150	150	116	78	**130**
DKC46-20	96	167	163	139	110	67	**129**
P0876HR[3]	108	163	154	130	103	72	**124**
DKC43-48	93	156	151	133	105	71	**123**
DKC38-89	88	140	137	117	92	74	**112**
Average		**162 a[4]**	**154 a**	**137 b**	**111 c**	**73 d**	**127**

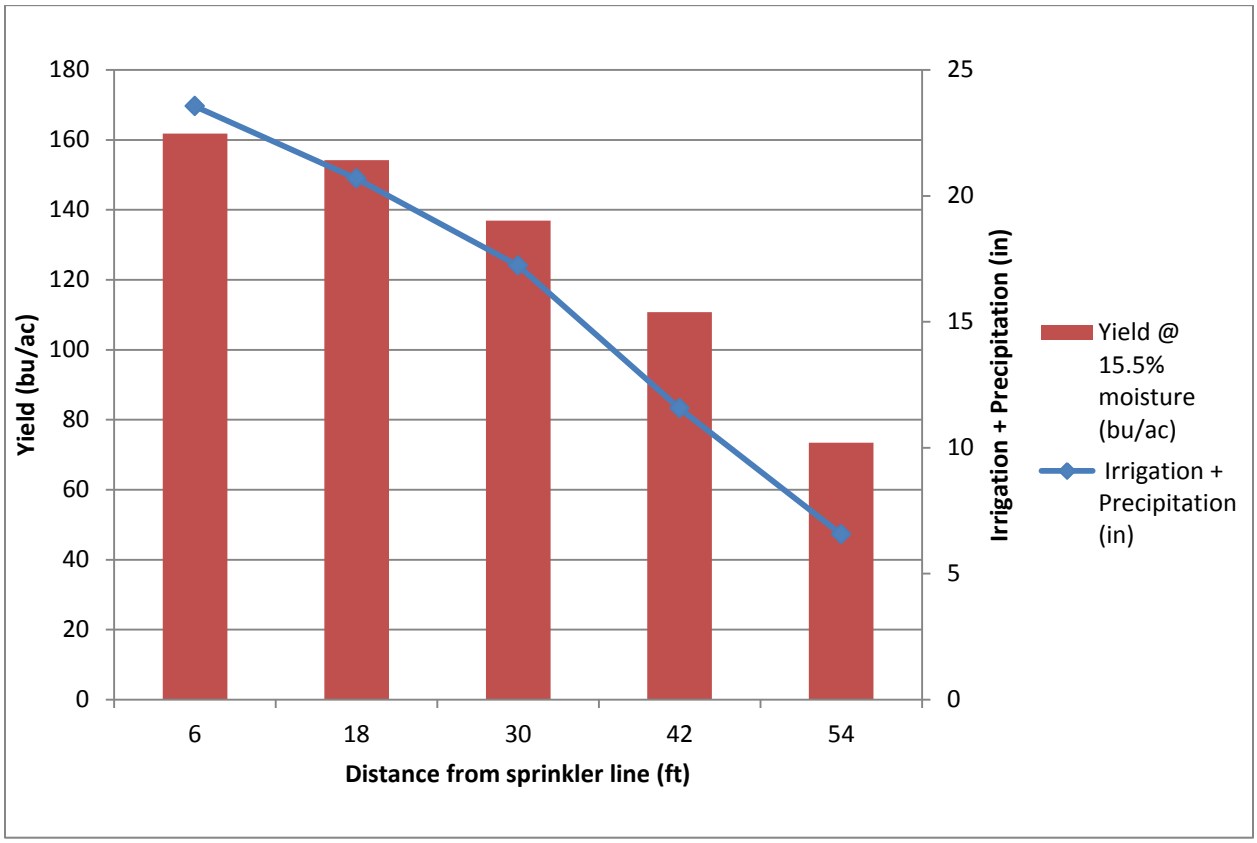
[1] Adjusted to 15.5% seed moisture.

[2] Relative maturity ratings are commonly based on comparisons among hybrids and may not reflect the actual number of days from planting to (harvest) maturity.

[3] Has a drought resistance gene.

[4] Numbers followed by the same letter are not significantly different at P = 0.05.

Figure 8. Corn yield response to water input.



The height of the corn plants generally decreased as water input decreased (Table 8 and [1] Numbers followed by the same letter are not significantly different at P = 0.05.

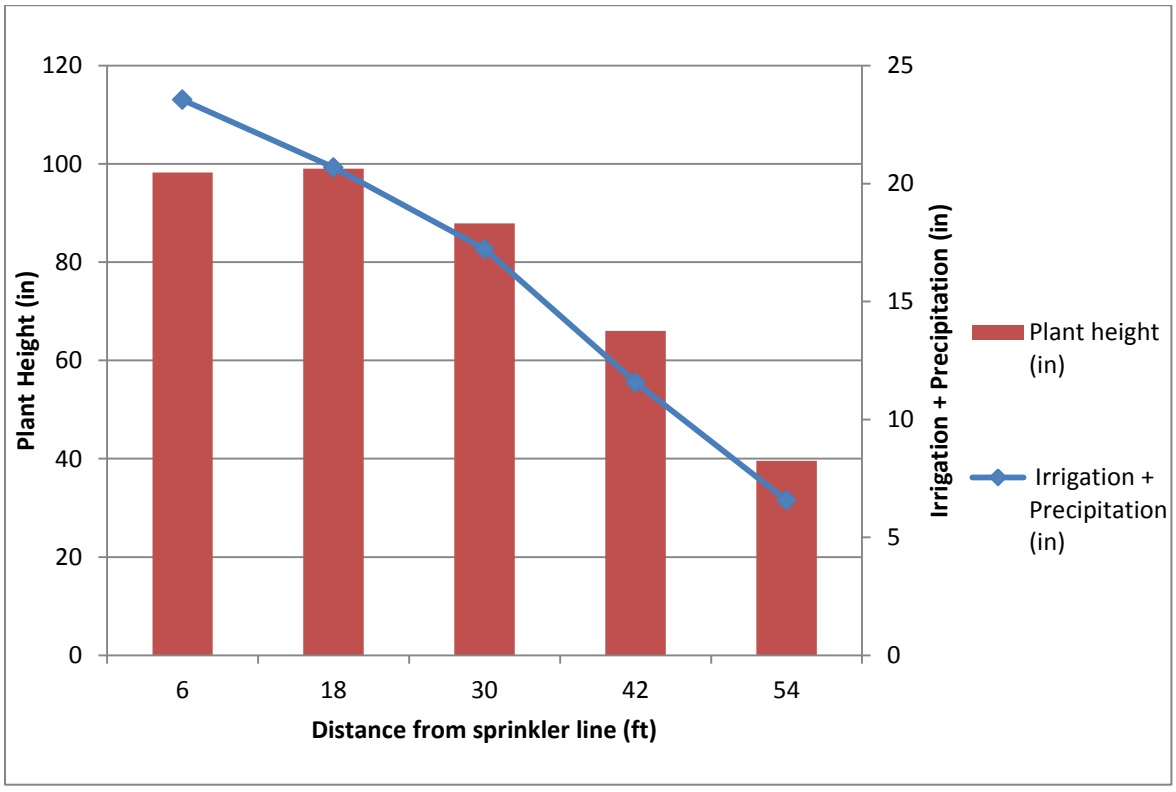
Figure 9), but the height at 6 feet and 18 feet from the sprinkler line was nearly the same. The height differences between different distances from the sprinkler line were statistically significant except between 6 and 18 feet. Corn height was measured on October 16, 2012 and by that date some of the plants had become bent over. Some of the height measurements would have been taller if they had been taken at an earlier date.

Table 8. Corn height.

Hybrid	Plant height (in.)					
	Distance from sprinkler line (ft)					
	6	18	30	42	54	Average
P0876HR	106	110	95	70	41	**84**
DKC43-10	94	102	96	78	47	**83**
DKC43-48	105	105	93	67	35	**81**
P0210HR	107	106	97	55	33	**80**
DKC52-04	101	99	94	66	37	**79**
DKC38-89	94	94	85	70	47	**78**
DKC46-20	90	93	76	57	39	**71**
P9690HR	90	84	68	66	39	**69**
Average	**98 a[1]**	**99 a**	**88 b**	**66 c**	**40 d**	**78**

[1] Numbers followed by the same letter are not significantly different at P = 0.05.

Figure 9. Corn height.



The number of kernels per ear is similar at 6, 18, and 30 feet from the sprinkler line (Table 9). There is a slight reduction 42 feet away and a substantial reduction at 54 feet. Kernel weight displays the same pattern: weight per kernel is about the same at 6, 18, and 30 feet from the sprinkler line ([1] Includes all ears that had kernels, whether they were partially or completely filled.

Table 10). There is a slight reduction at 42 feet away and more significant reduction at 54 feet.

Table 9. Kernels per ear.

Hybrid	Kernels per ear[1]					
	Distance from sprinkler line (ft)					
	6	18	30	42	54	Average
DKC43-10	476	436	471	503	404	**458**
P0876HR	463	449	480	472	371	**447**
P0210HR	463	462	469	437	361	**438**
DKC52-04	449	465	445	456	348	**433**
P9690HR	429	433	431	417	349	**415**
DKC46-20	451	452	451	419	293	**413**
DKC43-48	437	439	431	388	293	**398**
DKC38-89	390	415	408	402	345	**392**
Average	**445**	**444**	**448**	**437**	**345**	**424**

[1] Includes all ears that had kernels, whether they were partially or completely filled.

Table 10. Weight per kernel.

Hybrid	Weight per kernel (g)					
	Distance from sprinkler line (ft)					
	6	18	30	42	54	Average
P9690HR	0.31	0.29	0.29	0.25	0.21	**0.27**
DKC43-10	0.29	0.30	0.28	0.25	0.22	**0.27**
DKC38-89	0.30	0.29	0.26	0.26	0.23	**0.27**
DKC46-20	0.29	0.28	0.27	0.25	0.21	**0.26**
P0210HR	0.28	0.28	0.29	0.25	0.19	**0.26**
DKC52-04	0.27	0.27	0.28	0.25	0.20	**0.25**
DKC43-48	0.26	0.27	0.26	0.23	0.21	**0.25**
P0876HR	0.26	0.27	0.25	0.22	0.19	**0.24**
Average	**0.28 a[1]**	**0.28 a**	**0.27 a**	**0.25 b**	**0.21 c**	**0.26**

[1] Numbers followed by the same letter are not significantly different at P = 0.05.

The number of ears per plant steadily decreases as the distance from the sprinkler line increases (Table 11). The hybrid DKC52-04 had the most ears per plant and the most ears per acre (Table 12).

Table 11. Ears per plant.

Hybrid	Ears per plant					
	Distance from sprinkler line (ft)					
	6	18	30	42	54	Average
DKC52-04	1.3	1.3	1.2	1.1	1.0	**1.2**
P0876HR	1.3	1.3	1.2	1.0	1.0	**1.2**
P9690HR	1.2	1.2	1.0	1.0	1.0	**1.1**
P0210HR	1.2	1.3	1.1	1.0	0.9	**1.1**
DKC43-10	1.3	1.2	1.1	1.0	0.9	**1.1**
DKC46-20	1.2	1.2	1.0	1.0	1.0	**1.1**
DKC43-48	1.2	1.1	1.1	1.0	1.0	**1.1**
DKC38-89	1.4	1.0	1.0	1.0	0.9	**1.1**
Average	**1.3**	**1.2**	**1.1**	**1.0**	**0.9**	**1.1**

Table 12. Ears per acre.

Hybrid	Ears per acre					
	Distance from sprinkler line (ft)					
	6	18	30	42	54	Average
DKC52-04	35,574	32,670	28,677	26,862	25,410	**29,839**
DKC43-48	32,670	30,855	28,677	27,588	27,225	**29,403**
P0876HR	34,122	31,944	27,588	25,047	25,410	**28,822**
DKC46-20	31,218	31,581	27,951	26,862	26,499	**28,822**
P9690HR	29,403	28,677	29,040	25,773	19,602	**26,499**
P0210HR	30,855	30,129	25,773	19,239	22,143	**25,628**
DKC43-10	28,677	27,951	25,047	22,143	22,506	**25,265**
DKC38-89	28,314	26,499	25,773	21,054	22,869	**24,902**
Average	**31,354**	**30,038**	**27,316**	**24,321**	**23,958**	**27,397**

Conclusions

Grain yield decreased significantly as water input decreased, as did plant height. Kernel weight was similar at 6, 18, and 30 ft. from the sprinkler line and significantly lower at 24 and 54 ft. There were no significant differences between the corn hybrids in grain yield, plant height, or kernel weight nor was there a significant hybrid by distance interaction. In this first year of the study, there was no clear advantage of the hybrids with the drought tolerance traits over the ones that did not have the so-called drought genes.

2012 Spring Wheat Variety Trial

Abdel Berrada[7]

Table 13. Results of the 2012 Spring Wheat Variety Trial.

Variety	Type	Grain yield (bu/acre)[8]	Grain Moisture (%)	Grain Test Weight (lb/bu)	Grain Protein (%)
Kelse	HRS	45.3	10.7	57.7	17.6
Advance	HRS	44.2	11.3	56.6	16.5
IDO 858	HWS	44.1	11.3	56.7	17.9
Sylvan	HRS	43.1	11	55.1	16.4
IDO 644	SWS	42.6	11.5	54.3	15.0
IDO694	HWS	42.2	13.4	56.6	15.6
IDO 686	SWS	40.6	12.2	56.3	15.2
IDO 599 (UI Stone)	SWS	40.4	12	55.7	15.2
SY Soren	HRS	40.4	11.3	56.2	17.5
WB-Paloma	HWS	39.6	11	56.1	17.0
UI Winchester	HRS	35.5	12	56.9	16.7
03S0253-7	HRS	35.2	12	55.5	16.3
IDO 669	SWS	34.9	12.3	53.8	15.4
IDO 377s	HWS	34.8	10.3	53.6	17.9
Jefferson	HRS	34.6	12.2	57.9	17.4
02S0178-1	HRS	33	11.2	57	16.8
Average		**39.4**	**11.6**	**55.9**	**16.5**
$LSD_{.05}$		8.2	-	1.5	0.8

[7] Senior Research Scientist/Manager, CSU-SWCRC, Yellow Jacket, CO.

[8] Adjusted to 12% moisture & 60 lb/bu.

Trial information

Location	Yellow Jacket, CO
Previous crop	Native plants
Soil type	Cahona-Sharps-Wetherill complex
Planting date	4/30/2012
Seeding rate (seeds/acre)	1,200,000
Irrigation	Sprinkler irrigation (siderolls) as need be
Precipitation (from planting to harvest)	3.74 inches
Fertilizer	100 lb N/acre + 57 lb P_2O_5/acre of 11-52-0 + 11 lb Zn/acre on 4/18/2012
Herbicide	Sprayed 2,4-D at 1.2 pints/acre on 6/6/2012.
Harvest date	8/27/2012

Comments

The yield this year was unusually low due to poor weed control and dry and cool conditions in the spring.

Figure 10. Photo of spring wheat taken on August 21, 2012 by Abdel Berrada. A significant amount of pigweed can be seen which caused reduced yields.

Evaluation of Dryland Crop Rotations that Include Sunflower: 2012 Result Summary

Investigators: Abdel Berrada, Kim Dillivan, and Bob Hammon
Sponsor: The National Sunflower Association

The main objective of this project is to test the effects of sunflower and other crops on soil and crop productivity in winter wheat-based dryland crop rotations in SW Colorado. The following crop rotations were tested in 2011-2012.

- Winter Wheat-Fallow
- Winter Wheat-Safflower-Fallow
- Winter Wheat-Sunflower-Fallow
- Winter Wheat-Dry Bean-Sunflower-Fallow
- Winter Wheat-Dry Bean-Dry Bean-Fallow
- Winter Wheat-Opportunity Crop-Sunflower-Opportunity Crop

The opportunity crop was corn in 2012. Before that it was camelina [Camelina sativa (L.) Crantz]. Each phase of each crop rotation is present every year and replicated three times in a RCBD. Plot size is 30 ft. x 167 ft. Minor adjustments were made to the crop rotations in 2011. Planting and harvest dates are shown in Table 14.

Table 14. Crop information.

Crop	Variety	Planting date	Planting rate	Unit	Harvest date
Corn	DKC43-10	17-May	22,000	seeds/ac	10-Oct.
Dry bean	Montrose	31-May	23,232	seeds/ac	18-Sept.[1]
Safflower	CW 99OL	2-May	27	lb/ac	14-Sept.
Sunflower	Triumph s671	24-May	17,294	seeds/ac	1-Nov.
Winter wheat	Fairview	22-Sept-11	57	lb/ac	11-July

[1]Date at which dry beans were cut.

Spring crops seed yields were substantially below those obtained in 2011. Soil moisture at planting was low (Table 16) followed by below average rainfall (Figure 12), which resulted in poor stands and crop growth. In addition, safflower and sunflower suffered from bird and deer damage. Damage to safflower was mostly from ravens, which, to our knowledge, are the only birds in our area that can peck their way through the heavily spined safflower heads to the seeds, when other feed sources are scarce. Sunflower after camelina did the best with 628 lb/acre (Table 15) in spite of the fact that soil moisture at planting was less than for the other treatments (Table 16). Sunflower after dry bean averaged 412 lb/acre while sunflower after winter wheat produced a meager 245 lb/acre. In comparison, sunflower after summer fallow and sunflower after dry bean produced around 1200 lb/acre in 2011 (Berrada, TR12-07, 2012).

Table 15. 2012 Seed Yield and Test Weight.

Crop in 2012	Previous crop		Average seed yield lb/acre (bu/ac)[1]	Test weight (lb/bu)
	2011	2010		
Corn	Winter wheat	Fallow[2]	1804[3]	NA
Dry Bean	Dry Bean	Fallow	-[4]	-
Dry Bean	Winter Wheat	Fallow	327	59.4
Safflower	Winter Wheat	Fallow	129	39.4
Sunflower	Dry Bean	Fallow	412	26.7
Sunflower	Camelina	Camelina	628	28.2
Sunflower	Winter Wheat	Fallow	245	29.6
Winter Wheat	Fallow	Dry Bean	1758 (29)	55.6
Winter Wheat	Fallow	Fallow	1959 (33)	57.8
Winter Wheat	Fallow	Safflower	1572 (26)	54.2
Winter Wheat	Fallow	Sunflower	1841 (31)	55.1

Figure 11. Photo of the dryland crop rotation trial taken on August 6, 2012 by Abdel Berrada.

[1] Seed yields of dry bean, safflower, sunflower, and winter wheat were adjusted to 14%, 9%, 10%, and 12%, respectively.

[2] Summer fallow

[3] Dry matter. Corn produced very little grain due to drought and bird (ravens) damage.

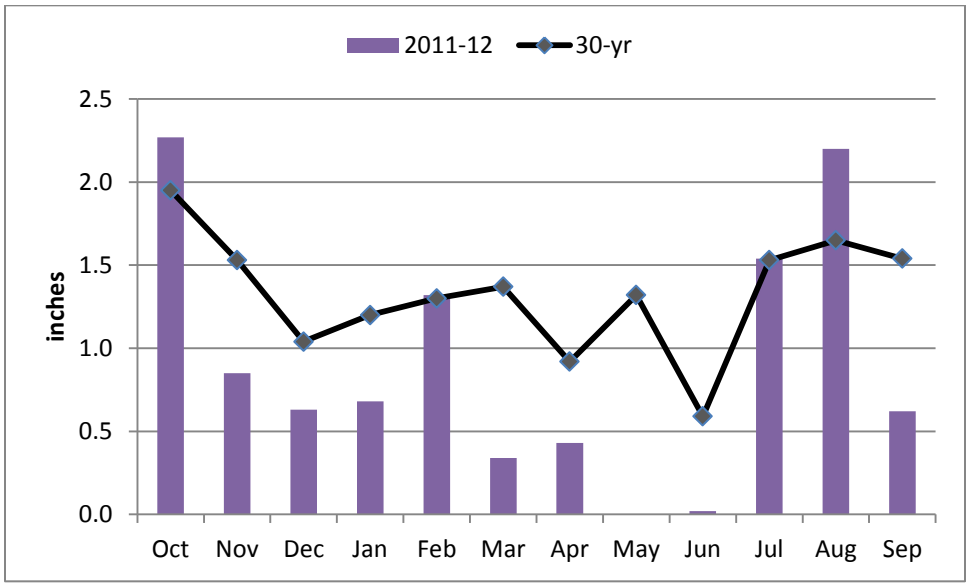
[4] Most of the bean plants came up late and remained green through harvest.

Table 16. Soil moisture content and soil test NO3-N prior to planting of spring crops.

Crop in 2012	Crop in 2011	Available soil moisture (in.) in 0-3 ft[1]	lb NO_3-N/A in 0-2 ft	lb P_2O_5/A in 0-2 ft
		May 16, 2012	April 13, 2012	April 13, 2012
Dry Bean	Dry Bean	1.9	85	53
Dry Bean	Winter Wheat	2.0	37	55
Safflower	Winter Wheat	NA	50	55
Sunflower	Dry Bean	1.7	98	55
Sunflower	Camelina	1.3	46	47
Sunflower	Winter Wheat	1.7	43	47
Corn	Winter Wheat	2.3	37	47
Average		**1.8**	**56**	**51**

[1] It wasn't always possible to dig down to 3 feet so some of these values are estimated from the soil that could be obtained.

Figure 12. Oct. 2011 thru Sept. 2012 precipitation at Yellow Jacket and 30-yr. averages.



Nitrate-N in the top two feet of soil was highest after dry bean and average after winter wheat or camelina (Table 16). Under favorable conditions, 40 lb of available N/acre, after a non-legume crop, would produce close to 1700 lb of sunflower seeds/acre in our soils (High Plains Sunflower Production Handbook, Kansas State University, April 2009). Sunflower seed oil content was greatest after winter wheat (38.5%) or camelina (38.2%) and lowest after dry bean (35.0%), which is consistent with literature findings, i.e., that oil content decreases as N availability increases.

Boosting Sunflower Production in SW Colorado with Supplemental Irrigation: 2012 Result Summary

Investigators: Abdel Berrada and Joel Schneekloth
Sponsor: The National Sunflower Association

The main objective of this study was to determine the response of two sunflower hybrids to four irrigation treatments and four N rates. The ground to be planted to sunflower was in proso millet in 2011. It was sprayed with Sonalan on April 23, 2012 at 2.5 pt/acre. Sunflower hybrids Mycogen 8H449 CLDM and Triumph s870HCL were planted on June 1st at 25,344 seeds/ac and harvested on October 31st. The Irrigation treatments are shown in Table 17. They were assigned to the main plots while sunflower hybrids were assigned to the sub-plots in a split-split plot RCBD with three replications. Ammonium nitrate (34-0-0) was applied at 0, 30, 60, and 90 lb N/acre to the designated plots on May 29th. It was broadcast with a hand-held fertilizer spreader and incorporated into the soil with a field cultivator. Water was applied with a wheel-line sprinkler irrigation unit (sideroll) prior to sunflower planting and with a subsurface drip irrigation system after planting.

Table 17. Irrigation treatments.

Irrigation treatment	Description	Net irrigation depth (in.)[1]	Crop ET[2] (in.)
I-1	Pre-plant irrigation (PPI) only	0.0	13.6
I-2	PPI + Full-season irrigation[3]	16.2	20.5
I-3	PPI+ Irrigation at R-1 to R-6[3]	8.7	19.7
I-4	PPI + Irrigation at R-4 to R-6[3]	4.5	17.0

[1] Depth of irrigation after planting. Irrigation efficiency was assumed to be 90%. PPI was 2.5 in. Season rainfall was 4.4 in.

[2] Crop evapotranspiration.

[3] Water application to meet crop ET during the irrigation period. Reference ET was 33.1 in. The evapotranspiration value on July 24, 2012 was missing so it was estimated based on values from the previous and following days. Data source: http://www.coagmet.com/

Table 18. Irrigation and evapotranspiration for each variety and irrigation treatment.

Irrigation treatment	Net irrigation (in)		Crop ET	
	8H449CLDM	s870HCL	8H449CLDM	s870HCL
I-1	2.5	2.5	13.6	13.6
I-2	18.7	18.8	20.5	20.5
I-3	11.2	11.1	19.7	19.7
I-4	7.6	6.5	17.4	16.5
Average	**10.0**	**9.7**	**17.8**	**17.6**

Results

The full irrigation regime produced the highest seed yield of 2,721 and 2,708 lb/acre with H449CLDM and s870HCL, respectively (Table 20). Treatment I-3 produced 318 lb/acre less seed on average than I-2. Treatments I-4 and I-1 averaged 1547 and 965 lb/acre, respectively. Sunflower hybrid H449CLDM outperformed s870HCL at all irrigation levels. On average, I-1 produced the most seeds (in lb/ac) per inch of water (irrigation + rain) applied (Figure 13). Treatments I-3 and I-4 had similar precipitation use efficiencies (PPUE) while I-2 the lowest PPUE.

Seed weight was greatest at I-3 followed by I-2 and I-4. Treatment I-1 had the lowest seed weight overall (Table 20). Treatment I-2 had the highest seed oil content of 43.8%, significantly more than I-3 and I-4. Treatment I-1 had the lowest oil content. Mycogen 8H449CLDM and Triumph s870HCL averaged 43.2% and 41.9%, respectively.

Birds caused the most damage at I-2 with H449CLDM (9% seed loss) and the least damage at I-4 (Table 20). As would be expected, hybrid H449CLDM was taller than the short stature hybrid s870HCL at all the irrigation treatments. Plants of both hybrids were tallest at I-2, followed by I-3. Treatments I-4 and I-1 had similar plant heights with either of the two hybrids (Table 20).

Nitrogen application rates of 0 to 90 lb N/acre or N by Irrigation or N by Hybrid had no significant effect on seed yield, plant height, seed weight or test weight. Based on soil test results (top three ft. of soil), N fertilizer was recommended for seed yields above 1800 lb/ac (Table 19). For example, a yield goal of 2800 lb/ac would have required the addition of 68 lb N/ac. Deeper soil sampling (e.g., 0 to 4 ft) will be required in 2013 to get more accurate N recommendations (Joel Schneekloth, Personal Communication, December 2012).

Table 19. Fertilizer recommendations from soil tests done in the spring of 2012.

Yield goal (lb/ac)	1,200 lb/ac	2,400 lb/ac	3,600 lb/ac
Nitrogen to apply (lb/ac)	-36	42	120

In conclusion, the full-season irrigation treatment (I-2) produced the highest seed yield (2715 lb/acre), oil content (43.8%), and plant height (44.8 in.). Irrigation from the beginning of the reproductive stage through flowering (I-3) produced 2397 lb/acre with 49% less post-planting irrigation water than I-2. Rainfall accounted for approximately 20% of crop ET at I-2 and I-3. The short stature hybrid Triumph s870CL averaged 278 lb/acre less seed than Mycogen 8H449CLDM but it is more suitable to irrigation with siderolls, which are prevalent in SW Colorado. There was no significant increase in seed yield due to N application, possibly because not all the residual N in the root zone was accounted for.

Table 20. Sunflower response to irrigation and N rate in 2012.

Irrigation treatment	Sunflower hybrid[1]	Seed yield lb/ac[2]	Seed oil %	Plants/ac[3]	Plant height in.	Seed weight mg	Test weight lb/bu	Bird damage %
I-1 [Pre-plant (PP) irr. only]	H449CLDM	1144	42.2	18177	33.2 a[4]	40.9	33.7 a[4]	5.8
	s870HCL	786	41.2	18093	19.7 b	35.5	32.2 b	5.9
	Average	965 D[4]	41.7 C[4]	18135	26.5	38.2 D[4]	33.0	5.8
I-2 (PP+full irr. to meet crop ET)	8H449CLDM	2721	44.6	17879	56.3 a	52.4	33.6 a	9.1
	s870HCL	2708	43.0	16036	33.4 b	47.8	30.0 b	3.1
	Average	2715 A	43.8 A	16957	44.8	50.1 B	31.8	6.1
I-3 (PP+irr. at R-1 to R-6)	8H449CLDM	2533	43.0	18533	41.9 a	55.5	32.2 a	2.2
	s870HCL	2261	41.4	17090	30.5 b	49.6	28.9 b	2.7
	Average	2397 B	42.2 B	17811	36.2	52.6 A	30.6	2.5
I-4 (PP+irr at R-4 to R-6)	8H449CLDM	1781	43.0	18167	31.4 a	47.2	34.6 a	0.6
	s870HCL	1314	42.1	20074	20.1 b	39.7	32.3 b	0.8
	Average	1547 C	42.5 B	19120	25.7	43.5 C	33.4	0.7
8H449CLDM		2045 A	43.2 A	18189	40.7	49.0 A	33.5	4.4
s870HCL		1767 B	41.9 B	17823	25.9	43.2 B	30.8	3.1
N rate (lb/ac)								

[1] Mycogen H449CLDM and Triumph s870HCL

[2] Seed yield adjusted to 10% moisture. The number of plants/ac was used as covariate.

[3] Number of plants with heads at harvest

[4] Numbers followed by the same letter (within the same column) are not significantly different at P = 0.05.

Irrigation treatment	Sunflower hybrid[1]	Seed yield lb/ac[2]	Seed oil %	Plants/ac[3]	Plant height in.	Seed weight mg	Test weight lb/bu	Bird damage %
0		1908	42.8	18841	33.5	46.9	32.3	3.2
30		1957	42.6	17548	33.5	45.3	32.4	5.3
60		1864	42.3	18027	32.7	46.1	32.1	3.3
90		1895	42.4	17607	33.4	46.0	32.0	3.3
Average		**1906**	**42.5**	**18006**	**33.3**	**46.1**	**32.2**	**3.8**
CV (%)		-	2.3	11	7.1	7.0	2.1	-
Analysis of variance (P > F)								
Irrigation (Irr)		0.00	0.00	0.03	0.00	0.00	0.00	-
Hybrid (Hyb)		0.00	0.00	0.42	0.00	0.00	0.00	-
Irr X Hyb		0.16	0.51	0.06	0.00	0.52	0.00	-
N rate		0.32	0.35	0.08	0.60	0.40	0.18	-
N * Irr		0.15	0.93	0.45	0.96	0.25	0.11	-
N*Hyb		0.20	0.24	0.42	0.55	0.32	0.12	-
N*Hyb*Irr		0.23	0.33	0.27	0.31	0.78	0.42	-

Figure 13. Average seed yields and precipitation efficiencies (PPUE) in 2012.

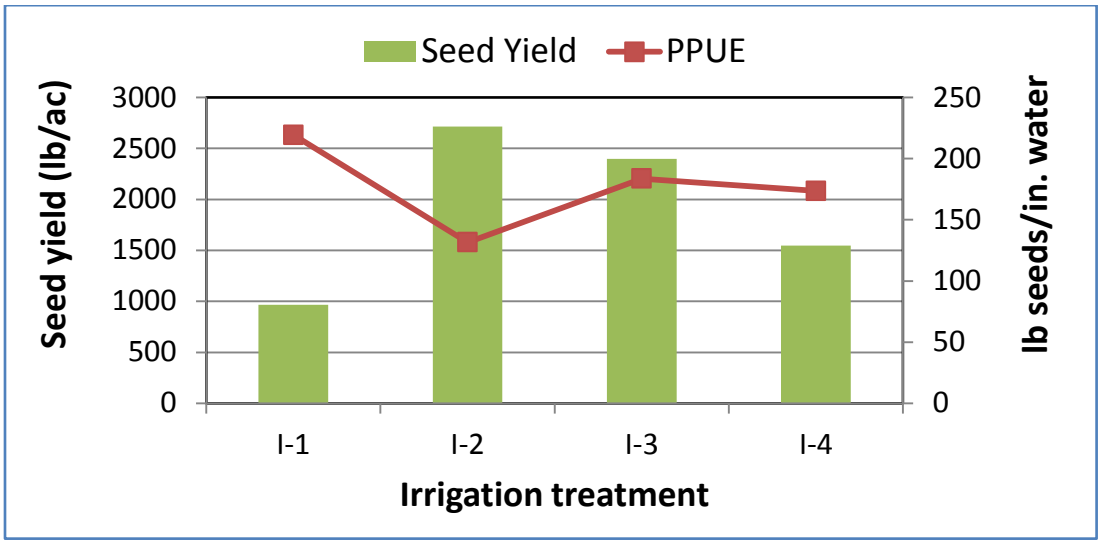


Figure 14. Photo of sunflower taken on July 30, 2012 by Abdel Berrada. The image is centered on the short sunflower variety s870HCL. The irrigation treatment is I-2. Part of the drip irrigation system can be seen in the foreground.

Figure 15. View of the sunflower trial at bloom. Photo taken on August 9, 2012 by Abdel Berrada.

Yellow Jacket Fruit Tree and Vineyard Research and Demonstration Project: 2012 Report

Tom Hooten - Colorado State University Extension, Montezuma County Director
Kim Dillivan - Colorado State University Extension, Dolores County Director
Dan Fernandez - Colorado State University Extension, former Dolores County Director
Abdel Berrada - Colorado State University, Southwestern Colorado Research Center Manager

Figure 16. U-PICK Day. Master Gardeners (persons wearing orange vests) were on hand to answer customer questions. Photo taken by Abdel Berrada

Project Background

The Fruit Tree and Vineyard Research and Demonstration Project was implemented in April 1991, and is a cooperative effort among Montezuma County Extension, Dolores County Extension, Natural Resources and Conservation Service in Dolores County, and the Colorado State University Southwest Colorado Research Center at Yellow Jacket, Colorado. The

completion of the Dolores Irrigation Project resulted in a substantial number of new client requests for local research based information/data on fruit tree and vineyard varieties, equipment usage, and cultural practices. Prior to this project, all fruit tree information originated from the Grand Junction area Experiment Stations which have a considerably different growing environment. Presently, the Team is evaluating 44 different fruit tree varieties including 21 field apples, 12 trellised apple varieties, 2 apple varieties planted in a "super high density," 4 peach varieties, 4 pear varieties, and 3 plum varieties. The Team is also studying 6 trellised grape varieties, 1 raspberry variety, and 14 grass varieties.

Orchard management practices such as irrigation techniques, frost and freeze management, high-density apple planting, trellised apple planting, fruit thinning, tree pruning, and integrated pest (insect, disease, weed, and wildlife) management have been tested and demonstrated. Thirteen grass species or varieties and one legume were planted between fruit tree and grape rows in 1993 and 1995 to control soil erosion and suppress weeds. A popular fruit tree pruning workshop is held every year. The proceeds from the sale of the fruit during an annual "U-Pick" help fund the operation of the orchard. The annual "U-Pick" attracts hundreds of people and is also used as an educational opportunity to inform the public of different fruit varieties and their uses, as well as proper long-term storage of fruit. The fruit tree and vineyard demonstration project is managed by the Extension personnel of Dolores and Montezuma Counties. It has generated considerable interest and attracts a large number of visitors throughout the year, including students from Fort Lewis College in Durango and San Juan College in New Mexico.

Highlights of the 2012 Season

The 2012 season started with an exceptionally dry and warm spring. This led to a 2-3 week earlier timing for orchard development. The earlier development persisted through the year and resulted in a "U-Pick" harvest two weeks earlier (at September 15) than normal. Fruit production also increased; with an increase of 25% in apples and a 45% increase in total fruit production compared to 2011 (see Table 21). Fruit quality was exceptionally good due to successful pest management (especially codling moth) and fruit thinning (both chemical and manual methods were used). A new chemical (Altacor) was used for codling moth control. It was very successful when timed with codling moth monitoring and also cost effective due to its long residual effects and low toxicity. Insect resistance will need to be managed by alternating with another product. An "organic" control for codling moth (Spinosad) was used early in the year but was deemed too costly to warrant its continued use. "Organic" weed management (hoeing) was also demonstrated. However, the weeds easily grew ahead of the available labor. Thus it was deemed too labor intensive to continue the method and management was switched to chemical using glyphosate.

Variety Testing Results to Date

Apples - The apples have performed exceptionally well since they began producing. With the exception of four seasons (a freeze in 2001 and hail in 1995, 2003, and 2004), the orchard has

experienced consistent production. Even with the hail damage in 2004, over 7,000 pounds of fruit were sold. Tree losses included 4 trees out of 226 planted, with 3 of those lost as the result of severe trunk damage due to excessive crop overload. Ten trees were lost in the trellis due to herbicide drift in 2010. They were replaced in 2011 with Improved Golden Delicious and four new varieties: Scarlet Spur, Spartan, Ruby Mac, and Schlect Spur. With the exception of varieties on the wrong rootstock for field or trellis applications, additional varieties that are questionable for our area include Honey Crisp, Improved Red Delicious, and possibly Idared. Roughly 1/3 of the crop (15,000 lbs.) was sold at the annual "U-Pick" in 2012.

Peaches - A much different situation exists here when compared with the apples. Virtually all of the plantings (old and new) have suffered 50% tree losses within the first year. This is attributed in part to a late planting date for peaches and the possibility that planted trees were of too large a diameter with a limited root system. The peach trees arrived partially leafed out, and when this is compounded with tree transplant shock, early tree death is inevitable. The first 2 varieties planted in 1991, Redskin and J.H. Hale, have been eliminated with one crop in seven years and significant yearly die-back. Four new varieties have been added: Flamin'Fury PF#15A, Starfire FA11, Suncrest, and Red Globe which seem to have more promise. The severe hail of 2004 damaged the upper surface of branches that led to infection with perennial canker. Many of the peach trees exhibit gradual decline and branch death since then.

Pears - The four varieties planted; Max Red Bartlet, Du Comice, D'Anjou, and Bronze Beauty have all developed well with minor problems. They do require considerable limb training and are highly susceptible to the pear slug and pear psylla. A small outbreak of Fire Blight occurred in 2007, but immediate action of pruning out the infected wood, complete cleanup of leaves and debris and several applications of Streptomycin have apparently taken care of the problem for now. No evidence of the disease has been observed to date (2012). Pears take time to produce with the Max Red and Du Comice (planted in 1996) producing their first crop in 2001. All trees are now in production and have produced generously.

Plums - Three varieties of plum on Myro rootstocks (Empress, Improved Duarte, and President) were planted in 2008 in three row-groups of five trees each. Initial growth was very good. However, in 2010 President suffered significant die-back to the main scaffold limbs due to freezing temperatures. The damaged trees required substantial reconstructive pruning. Recovery has been very good. Observations will continue. The first significant crop of 1,000 lbs. was produced in 2012.

Grapes - Of the original 8 varieties planted in 1994, Seyval Blanc, Pinot Noir, and White Riesling were removed in 1998. These varieties require a longer growing season than what is "normal" for the location of the vineyard. In their place, Cayuga White, DeChaunac, Edelweiss, and Chardonel were planted in 1999. The performance of these four varieties has been extremely disappointing. The year 2001 was the third growing season and the vines have not performed any better. The reason for this poor performance is baffling as these vines received the same treatment as the more mature plantings. In 2000, there was a 100% infestation of crown gall in

the Foch, Gewurztraminer, Merlot, and Chardonnay vines. When the infestation of 2000 occurred in all of the 4 above named varieties, they were removed.

The only remaining original planting is Lemberger. This red variety has produced crops from the third season until present. Shoot thinning and cluster removal prior to veraison are methods used to promote fruit development and maturation. This is continuing, though labor for the tasks is limited.

Grasses - Thirteen different grasses along with one legume were planted between the fruit tree rows in the demonstration orchard between April 1993 and November 1995 to evaluate their erosion control potential. These were dryland plantings with no supplemental water given. Lovington blue grama, Canbar canby bluegrass, birdsfoot trefoil/Ephraim crested wheatgrass mix, and Topgun buffalograss have been judged unsuitable for erosion control.

Irrigation

The team is currently evaluating a variety of irrigation systems including various types of drip emitters, several types of maxi and mini sprinklers, pulsators, and surface drip tubing. We currently use a 50-mesh filtration system due to very good irrigation water quality. Plugging of the filter screens has not been a problem, though they do need occasional cleaning. Our only significant problem has been with the maxi and mini sprinklers that have moving parts. A slight buildup of calcium carbonate causes the spinners to jam and spray only in one direction. These were removed and replaced with static sprinkler heads with a 360-degree spray pattern.

Additional Investigations

Work continues on frost protection management for the fruit trees and grapes, bird control, and integrated pest management of insects and diseases. Workshops on pruning and fruit management are conducted every year in cooperation with the Colorado Master Gardener program. Volunteers from the program are instrumental in maintaining the viability of the orchard project.

Strong emphasis continues to be placed on demonstrating, evaluating, and testing varieties, irrigation equipment, orchard equipment, and cultural practices that are cost effective, user friendly, and available through local suppliers.

Interest in “organic” production methods has been increasing. Some methods have been utilized on a trial basis (see **Highlights of the 2012 Season** above) but have been limited by cost and labor. Investigation into alternative management practices will continue as time and resources allow.

The team continues to investigate marketing opportunities as well as “Home-Based Business” opportunities as they relate to fruit and vineyard product utilization, i.e. fruit by-products. In addition, there has recently been interest in landowners to begin to rejuvenate some of the old,

neglected apple orchards in Montezuma County. This may be due to the surging interest in local food production that has been burgeoning in the county over the last several years. The Fruit Tree and Vineyard Research and Demonstration Project will continue to attract interest and visitors as it remains relevant to the needs of the stakeholders in Southwest Colorado.

Table 21. 2012 Production Information-- Southwest Colorado Fruit Tree and Vineyard Demonstration Project.

Variety	Tree Count	lbs. / tree	Total Production (lbs.)
Apples *		ESTIMATES	ESTIMATES
Scarlet Gala	20	400.00	8,000.00
Nured Jonathan	2	100.00	200.00
Lustre Elstar	4	400.00	1,600.00
Super Jon	5	350.00	1,750.00
Red Jonagold	5	400.00	2,000.00
Golden Delicious	10	600.00	6,000.00
Honey Crisp	5	400.00	2,000.00
Red Fuji *Trellis	16	30.00	480.00
Swiss Gourmet *Trellis	16	150.00	2,400.00
Royal Empire *Trellis	16	150.00	2,400.00
Liberty *Trellis	16	300.00	4,800.00
Mor-Spur McIntosh	5	200.00	1,000.00
Improved Red Delicious	5	200.00	1,000.00
Royal Gala *Trellis	5	200.00	1,000.00
Rubinstar	4	250.00	1,000.00
Ida Red	4	75.00	300.00
Gravenstein	0		
Lodi	0		
Myra Fuji *Trellis	8	20.00	160.00
Sun Fuji	5	100.00	500.00
Galaxy Gala	5	50.00	250.00
Improved Gala	5	250.00	1,250.00
Pacific Gala	5	500.00	2,500.00
Pinova	5	400.00	2,000.00
Cameo	5	100.00	500.00
Improved Golden Delicious	5	350.00	1,750.00
Golden Supreme	5	250.00	1,250.00
Nured Jonathan Sport	18	150.00	2,700.00
Improved McIntosh *Trellis	5	25.00	125.00
Buckeye Gala	5	300.00	1,500.00
September Wonder Fuji **SHD	10	30.00	300.00
Honey Crisp **SHD	10	20.00	200.00
Scarlet Spur *Trellis	4	new	
Imp. Golden Delicious *Trellis	5	new	
Spartan *Trellis	4	new	
Ruby Mac *Trellis	4	new	

Variety	Tree Count	lbs. / tree	Total Production (lbs.)
Schlect Spur *Trellis	5	new	
TOTALS	256		50,915.00
Peaches			
Suncrest	4	200.00	800.00
Flamin' Fury	5	200.00	1,000.00
Red Globe	5	200.00	1,000.00
Starfire FA11	5	200.00	1,000.00
TOTAL CROP	19		3,800.00
Pears			
Max Red Bartlett	5	250.00	1,250.00
D'Anjou	3	200.00	600.00
Bronz Beauty	3	250.00	750.00
DuComice	5	400.00	2,000.00
TOTALS	16		4,600.00
Plums			
Improved Duarte	5	50.00	250
Empress	5	75.00	375
President	5	75.00	375
Total	15		1,000.00
Grand Total			60,315.00

* Trellis - Trees on Trellis
**SDH - Trees in Super High Density Trial
* *Freezes occurred 4/16/02, 27˚*, 4/20/02, 28˚, 4/21/02, 21.9˚, 5/22/02, 29˚
Hail Storm 9/9 eliminated crop
2004 CROP WAS HAIL DAMAGED
2005 NO DAMAGE TO CROP
* 2007 Crop was partially damaged by a freeze on June 8, 2007 & later by birds
2008 Freezes on May 23 & 24 affected the lower portion of the orchard
2009 Cold May and June delayed peach and pear harvest
2010 several Spring Freezes Damaged Crop
2011 Ten new apple trees to replace those damaged by herbicide drift.
Freeze April 26 - May 3: no production loss
2012 Warm spring resulted in high production and a two-week earlier harvest.

Annual Meeting of the Advisory Committee of CSU-Southwestern Colorado Research Center

Friday February 1, 2013

Pleasant View Fire Department

15529 County Road CC, Pleasant View, CO 81331

Note: the information in this meeting report is not in chronological order. Some of it was rearranged in order to make it easier to read.

Meeting Opening

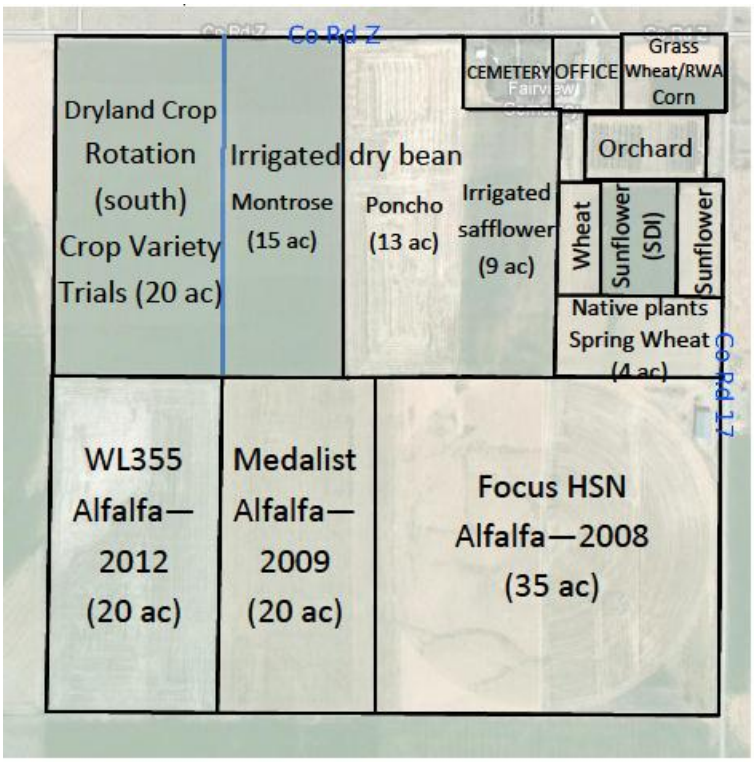
Chairman, David McCart, called the meeting to order. He discussed the possibility of in kind work for the research center. Minutes from the previous advisory committee meeting were approved. The election of officers was held, and David McCart was uncontested for the position of Chairman and he accepted. Introductions of everyone present at the meeting were made.

Research Center Accomplishments and Future Plans

Abdel Berrada, Research Center Manager

Abdel gave an overview of crops planted at the research center (Figure 17) and discussed alfalfa production at the research center.

Figure 17. Farm Map – Southwestern Colorado Research Center.



Last season was very dry and as a result spring wheat had the lowest yield we've ever seen, dryland sunflower yield was low, and dryland dry bean yield was low.

Winter Wheat Variety Trial

Soil moisture in the winter wheat variety trial was decent at planting. However, kernel size was small so yield wasn't great (yield was about half of the yield in 2010-2011). Protein was pretty good and there is the possibility of releasing one entry for the Colorado wheat breeding program, although it lacks resistance to dwarf bunt.

Dryland Crop Rotation Trial

Many of the crop yields were low. There were problems with spring crop germination because of the dry seedbed. The sunflower that had higher residual nitrate nitrogen in the soil had lower oil content. Ravens ate the safflowers even though safflowers have sharp parts and do not normally suffer much wildlife damage.

Safflower

The dryland safflower had some stand problems but overall was not too bad. The irrigated safflower had very good yield (14” of irrigation water was applied).

Limited Irrigation Sunflower Trial

As expected, the yield went up as irrigation went up. Seed oil content was best in the full irrigation treatment. The variety Mycogen 8H449CLDM was taller than Triumph s870HCL at every irrigation treatment. The variety s870HCL was grown in the experiment because it is short enough to be irrigated throughout the season with a sideroll.

Gradient Irrigation Corn Trial

A gradient irrigation trial is used to screen for drought tolerance. Corn that is grown closest to the sprinkler line gets the most water. The hybrid P9690HR was consistently a good performer compared to the other hybrids.

There were several comments from audience members including that people in the area have been showing interest in growing corn, that corn made more money than dryland bean, and that Pioneer is doing a lot of work on drought tolerance. There was a question for Abdel about the effect of corn on the soil. Abdel responded that corn is a good crop for the soil because it produces a lot of dry matter and some crops do better when grown after corn than after other crops.

Various Topics

A lot of people came to the orchard last year including students from Monument Valley.

This season the research center plans to do more crop testing, possibly including winter safflower (which can be planted in the fall), winter camelina (which maybe a better crop for this

area than spring camelina—spring camelina hasn't done so well), sunflower, corn, malting barley, and maybe others.

Abdel thanked the organizations and people who have helped the research center, including Lee Sommers who will be retiring soon.

San Juan NF Native Seed Research

Cara Gildar, USFS/BLM

Federal agencies are looking for native plant seed sources—they particularly want to try to get more local seed sources. The plants that we have commercially available don't always work.

The Forest Service and BLM are providing funding for research. The research at the Southwestern Colorado Research Center provides information about how hard it is to plant native plants, harvest them, etc. Some plots at the research center are large and others are small. Dusty penstemon and a few other species had decent seed yield.

Other topics discussed include using native plants in the land management plan and native plant food sources for the sage grouse. David McCart asked if they are tracking the microbiology of the soil. Cara Gildar answered that they are doing some, but would like to do more. They would like to research more about seed zones in the future. The goal is to use Colorado plateau genetics.

Tom Hooten asked if there were challenges in germinating and harvesting native plants. Someone answered that yes that was very much the case.

Judy Jolly: Agronomist for MillerCoors

Judy works for the MillerCoors Company. Colorado is the second largest growing area for MillerCoors. They found that 2-row barley is very good for their products. There is interest in growing barley in this area (southwestern Colorado) and northwestern New Mexico. Judy talked about the possibility of working with the research center and Abdel expressed an interest in doing so.

The spring barley variety they use is Moravian69 and it achieves a yield of 200 bu/ac in the San Luis Valley. They may look at different dryland varieties and winter barley. They are trying to get away from 6 row barley—there are problems getting seed.

The growing specifications are:

- protein: 7.5-14%
- disease and damage: ≤ 5%

- Xanthomonas and blacktip may be caused by overwatering. They don't really have problems with Russian Wheat Aphid in the San Luis Valley.

For barley that doesn't meet specifications they will provide a rejection letter if the grower needs it for insurance purposes.

The contract price for barley is about $14/100 weight including freight to Monte Vista. They are looking for 5-6 growers in this area. The barley will require irrigation and the grower would need grain storage. The proprietary variety seed costs about $23.50/100 weight.

They are hoping to see how dryland varieties do by having a trial at the research center.

Soil and Crop Sciences Update

Dr. Gene Kelly, Department Head

The people at the Department of Soil and Crop Sciences include 130 undergraduate majors, 36 graduate students, 32 research associates, 5 support staff, and 23 faculty. There is an increase in the number of online courses and new concentrations in soils and global change and in soil ecology. There has been a lot of interest in a course about global and environmental sustainability.

Research highlights include new grants, new contracts, and a shift in research towards climate change and environmental aspects. Faculty who have received national recognition include Gary Peterson, Ken Barbarick, Mark Brick, Pat Byrne, and Raj Khosla. There has been an increase in research funds and student retention numbers are higher. CSU wants to get bigger and is looking for more space; some operations may have to move off-campus.

For next year Gene will tweak strategic planning, talk to student groups, attend alumni events, be involved with the Ag day, and conduct fund raising.

Agricultural Experiment Station (AES) Update

Dr. Lee Sommers, AES Director & CAS Associate Dean for Research

Programs of research and scholarly excellence include wheat and meat safety and quality. 70% of the wheat in Colorado is CSU developed varieties. 95% of the varieties are public varieties which are dependent on sharing germplasm across states, while 5% are commercial varieties. The center for meat safety and quality is developing technologies to reduce food borne diseases.

Several off-campus research centers have been closed over the last few years. However, the budget at the SWCRC (Southwestern Colorado Research Center) has been stable. Since the funding situation has improved the research center at Yellow Jacket will be maintained for the foreseeable future. Long-term there is going to be little funding for higher education. Funding sources for the CSU Agricultural Experiment Station come from the Farm Bill, the State

Legislature, contracts, and grants. Marketing efforts include a contract with kglobal to target the House and Senate Appropriations Committees. There is a twitter feed (@AgIsAmerica) representing land grant universities.

Orchard Mesa got approval to start Rams Point Winery. It will be a location for student internships. The viticulture program is 100% funded by industry. Proceeds from the sale of the Roger's Mesa Research Center will go toward enhancing the Orchard Mesa program.

Modeling Ancestral Pueblo Agricultural Yields: The Village Ecodynamics Project

Mark Varien, Research and Education Chair, Crow Canyon Archeological Center

Pueblo culture begins with agriculture. Corn was domesticated thousands of years ago and domestication was relatively complete by about 9,000 years ago. Corn transformed humans from hunter/gatherers to settled people.

The Village Ecodynamics Project is funded by the National Science Foundation. It includes computer simulation and analysis of all known archaeological sites in the area. The computer simulation reconstructs what the forest looked like, reconstructs animal populations, and estimates how much wood they would need every day and the resulting deforestation. Over-hunting of animals led to turkeys replacing wildlife as a source of protein. The water resources and social landscape can also be reconstructed. Past yields can be predicted down to fairly small areas of land using the computer simulation. The computer simulation indicates that the human population fluctuated a lot over time.

There are over 17,000 known sites in study area which covers western Montezuma County. Sites are dated using wooden beams at the sites in conjunction with a tree ring record. This method of dating is relatively inexpensive and is very accurate. Pottery designs can then be put into time periods.

Average precipitation between AD 600 and 1300 was 18 inches. When droughts happened they typically occurred as single years but there were nine droughts (AD 600-1300) that lasted more than 15 years. Eventually, people moved out of the area because the environment worsened.

Hopi still grow many different traditional varieties of corn, though it's not needed for subsistence.

An audience member noted that he has a farm with a large ruin on it and yield in a certain area goes way up. He was wondering if Native Americans may have done something to the soil that is causing the yield to go up.

Updates from Dolores, La Plata, and Montezuma Extension

Tom Hooten, Kim Dillivan, and Darrin Parmenter

The presentation on the orchard was given by Tom Hooten. Everything in the orchard was about 2-3 weeks early. The yield was incredible—up 45%. There was 60,000 lbs of fruit which was mostly apples but also included pears and peaches.

There were coddling moths in the orchard. A pesticide called Altacor was used to control them. An organic pesticide was tried, but it wasn't economically viable.

The annual U-Pick was held 2-3 weeks earlier than usual. The quality and size of the fruit was very good. About 350 people attended which is about half as many as the year before. The reduced attendance might have been because there were a lot of other apples in the area. About 15,000 lbs of apples were sold which raised about $6,000. Expenses for the orchard were a little over $10,000.

The pruning workshop was held in early March. About 50 people attended. In future workshops there will be several stages of neglected trees which have not been pruned to aid in teaching.

Kim Dillivan told people to come see him if they need help. The SARE program includes 5 different types of grants.

Darrin Parmenter discussed a program that leases out incubator plots in Hesperus to try to get young and beginning farmers into agriculture without going into serious debt. Irrigation at the site is spring fed.

Meeting Closing

An audience member asked how much of the SWCRC budget comes from farm income. Abdel answered that it was about 60%. Lee Sommers confirmed it was about 50-60%.

Linda McCart read a number of ideas for future research left by Cara Gildar.

David McCart asked if there were any comments or questions. Then he thanked people for coming and the meeting was adjourned.