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Department of Horticulture and Landscape Architecture
Arkansas Valley Research Center
Extension

Arkansas Valley Research Center 2006 Reports

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NOTICE

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Cover: Construction of the weighing lysimeter at the Arkansas Valley Research Center. Inner soil monolith is being lowered into the outer tank structure. Research Associates Bret Schafer (left) and Kevin Tanabe are standing adjacent to the tank.

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Rocky Ford, Colorado

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Results of the 2006 Field Crop Variety Performance Trials[1]

Abdel Berrada and Jerry Johnson

The variety trials were conducted at the Arkansas Valley Research Center near Rocky Ford, Colorado in collaboration with Colorado State University's Crop Testing Team and Kevin Larson of the Plainsman Research Center. The Nuña bean trial was coordinated by Calvin Pearson of Western Colorado Research Center and Mark Brick and Barry Ogg of Colorado State University's Bean Breeding Program. The predominant soil type at the center is Rocky Ford silty clay (fine-silty, mixed, calcareous, mesic Ustic Torriorthents). Soil pH ranges from 7.5 to 8.0 and ECe from 1.0 to 3.0 dS/m. The elevation is 4180 ft. above sea level. The first fall frost typically occurs in early (32 °F) to mid-October (28 °F) and the last spring frost in late April to early May. The average length of the growing season is 156 (32 °F) to 179 (28 °F) days (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?corock).

Table 1. Monthly precipitation at the Arkansas Valley Research Center.

Month	1918-2006	2005	2006
January	0.31	0.45	0.61
February	0.28	0.24	0.00
March	0.72	1.55	0.91
April	1.23	0.75	0.31
May	1.81	0.49	1.58
June	1.44	1.05	0.28
July	1.97	0.45	3.25
August	1.61	2.17	3.81
September	0.92	1.38	2.84
October	0.78	2.04	2.30
November	0.48	0.04	0.15
December	0.30	0.25	1.64
Total	**11.85**	**10.86**	**17.68**

Total precipitation was above average in 2006 (Table 1). Average air temperatures are depicted in (Fig. 1). The experimental design of all the trials was randomized complete block with four replications, except where indicated. All the trials were furrow-irrigated.

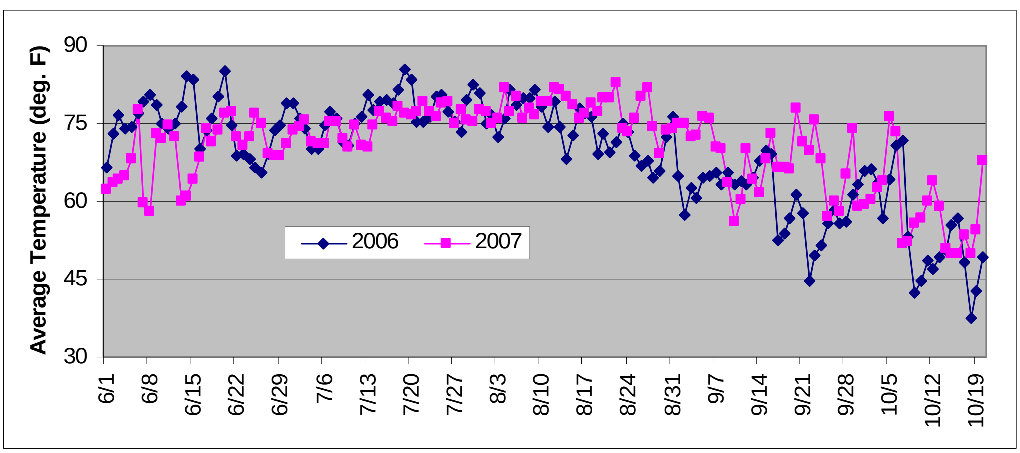

Figure 1. Average daily air temperature in June through 20 October 2006 and 2007.

[1] Some of the results are published in: http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/index.html

Alfalfa:

Alfalfa grown for hay is the largest crop in Otero County and the second largest in southeastern Colorado after winter wheat (Colorado Agricultural Statistics, www.nass.usda.gov/co). It is typically irrigated once or twice before the first cutting, once between cuttings, and once after the fourth (last) cutting. Alfalfa hay yield potential in the Arkansas Valley is high (6 to 8 t/acre) due to productive soils and a relatively long growing season.

This was the third and last year of the alfalfa trial that was planted in the fall of 2003. Total dry matter averaged 6.8 tons/acre, which was similar to that of 2004 and 2005, even though there were only three cuttings in 2005 compared to four cuttings in 2004 and 2006 (Table 2). The yield was highly variable in 2005 and 2006 due to soil compaction and uneven irrigation, which may explain the lack of significant differences among entries.

Winter canola:

There is growing interest in biofuels in Colorado and nationwide. Oil crops that have been tested at AVRC are soybean, canola, and to a lesser extent, sunflowers. Winter canola is better suited to the climatic conditions of the Arkansas Valley than spring canola. In earlier tests, spring canola did poorly, probably due to warm weather (Maximum temperature ≥ 86 ^{o}F) during flowering and seed formation. Winter canola can be rotated with winter wheat since both crops have a similar growth cycle, i.e., fall planting and late June to early July harvest. Studies elsewhere have shown that winter wheat following canola produces better seed yield than wheat after wheat. The meal (byproduct of oil extraction) from canola is a good source of protein in animal diets and marketing it should not be difficult due to the existence of several feeding operations in the Arkansas Valley. Other advantages of canola include high salt tolerance and lower water requirement compared to alfalfa and corn. Canola can also be used to mine selenium from the soil (phytoremediation). Relatively high selenium concentrations have been found in the Arkansas River and its aquifers.

Canola seed yield averaged 1750 lb/acre in 2006 (Table 3). Canola's fall stand was generally good to excellent. Winter survival averaged 70% in 2006. Seed oil content in 2006 ranged from 29 to 41% with an average of 37%. The canola trials at Rocky Ford were part of the National Winter Canola Variety Trial. The 2006 results for all the locations can be found at: http://www.oznet.k-state.edu/library/crpsl2/SRP973.pdf

Winter wheat:

Winter wheat yields in 2006 were adversely affected by severe lodging, especially late in the season (Table 4).

Nuňa beans:

Nuňa beans (*Phaseolus vulgaris*) are hard-shelled beans that burst open when subjected to heat, thus the name "popping beans". They originate from the Andes where they are grown at elevations in excess of 8000 ft.

Most of the 2006 entries exhibited an indeterminate growth habit. There was a frost on 11 October 2006 and a hard freeze a week later; consequently most entries did not reach 80% pod maturity at harvest (Table 5). Leaf bronzing, leaf curling, and symptoms of heat stress were observed on several entries. Entries '49984' and '49990' and to a lesser extend '49956' and '49979' also showed symptoms of bean yellow mosaic or possibly bean common mosaic or alfalfa mosaic virus. However, no viruses were found in the plant samples that were analyzed at Colorado State University's Plant Disease Clinic in Fort Collins. Seed yield averaged 3645 lb/acre in 2006, but some of the entries had a relatively high percentage of immature, shriveled, or stained (from late rains) seeds. The top performing entry was '49979' with 1111 lb/acre and the lowest performing was '49956' with 222 lb/acre.

Other crops: The results of the 2006 corn grain, corn silage, and forage sorghum trials are shown in Tables 6, 7, and 8, respectively.

Table 2. Irrigated Alfalfa Variety Performance Trial at Rocky Ford[1] in 2006.

Entry/Variety	Brand/Source	1st Cut 5/30	2nd Cut 7/21	3rd Cut 9/5	2006 Total	2005 Total	2004 Total
		---------- Tons/acre ----------					
4M124	Croplan Genetics	2.63	2.75	2.55	7.93	8.10	7.13
DS311 Hyb	Dairyland Seed Co.	1.77	2.64	3.30	7.70	6.23	7.23
55H05	Pioneer Hi-Bred Int'l	2.38	2.94	2.39	7.70	8.41	6.96
Goliath	Allied Seed	2.60	2.86	2.24	7.70	7.16	6.85
Expedition	Syngenta Int'l AG	2.40	2.59	2.61	7.59	7.08	6.60
05073	Cal/West	2.60	2.47	2.22	7.28	6.93	6.88
Abundance	Sharp Bros. Seed Co.	1.96	2.65	2.66	7.27	7.18	6.97
Masterpiece	J.R. Simplot	2.37	2.39	2.50	7.26	6.01	7.37
FSG 406	Allied Seed	2.04	2.52	2.64	7.20	7.06	6.73
Rebel	Target Seed	2.24	2.59	2.35	7.18	6.68	6.95
45098	Cal/West	2.11	2.69	2.37	7.17	7.01	7.39
15029	Cal/West	2.30	2.62	2.22	7.14	7.51	6.67
4M125	Syngenta Int'l AG	2.14	2.39	2.49	7.02	7.67	7.11
DS307 Hyb	Dairyland Seed Co.	2.31	2.36	2.33	6.99	7.73	7.11
Baralfa42IQ	Barenbrug USA	2.26	2.47	2.26	6.98	6.80	6.63
Rugged	Target Seed	1.90	2.67	2.28	6.86	5.95	6.61
Arapaho	Dairyland Seed Co.	1.93	2.36	2.51	6.80	6.11	7.05
Reward II	PGI Alfalfa	2.13	2.51	2.16	6.80	6.24	6.75
WL 327	W-L Research	2.03	2.50	2.24	6.76	6.50	7.25
Cimmarron VL400	Cimarron USA	2.28	2.12	2.33	6.72	6.92	7.52
6420	Garst	1.98	2.38	2.33	6.69	7.53	7.12
WL 357 HQ	W-L Research	1.85	2.55	2.29	6.68	6.88	6.46
Bullseye	Target Seed	1.98	2.05	2.43	6.46	6.08	7.04
HybriForce-420/Wet	Dairyland Seed Co.	2.01	2.27	2.11	6.39	6.85	7.20
25035	Cal/West	1.83	2.38	2.07	6.28	7.05	6.13
Lahontan	USDA/NV	1.88	2.39	2.00	6.26	7.10	6.66
Evermore	Allied Seed	2.02	2.32	1.85	6.20	7.44	6.98
Baralfa53HR	Barenbrug USA	1.97	2.13	2.04	6.14	6.35	6.79
6530	Garst	1.72	2.10	2.24	6.06	6.32	7.23
FSG 505	Allied Seed	1.77	2.27	1.99	6.03	7.15	6.95
05009	Cal/West	1.77	2.15	2.06	5.99	7.04	6.90
DS304 Hyb	Dairyland Seed Co.	1.06	1.71	2.00	4.77	5.14	6.61
	Average	**2.07**	**2.43**	**2.31**	**6.81**	**6.88**	**6.93**
	$LSD_{.05}$	NS	NS	0.44	NS	NS	0.49

[1]Trial conducted at the Arkansas Valley Research Center; alfalfa seeded in the fall of 2003.
Fertilizer application: 150 lb/acre of 11-52-0 on 11/11/04 and on 11/9/05.
Pursuit herbicide was applied in March 2005 and 2006 at 0.063 lb ai/acre.

Table 3. Irrigated Winter Canola Variety Trial at Rocky Ford[1] in 2006.

Entry	Seed Yield	Total Oil	Fall Stand	Winter Survival	50% Bloom	Plant Height	Shattering
	lb/ac	%	0-10	%	%	in.	%
DKW13-83	3171	36.2	4.3	56	29-Apr	34	6.6
KS2064	2580	38.0	9.5	80	24-Apr	35	4.5
Ceres	2481	38.1	2.2	89	24-Apr	36	17.1
KS3067	2438	37.7	9.2	81	26-Apr	34	2.6
DSV 05103	2410	38.7	6.8	77	25-Apr	37	2.3
ARC97019	2200	36.3	9.3	53	12-May	37	12.8
KS3068	2188	37.8	9.3	77	25-Apr	33	3.1
Kronos	2153	35.8	5.8	80	24-Apr	36	16.1
Sumner	2141	36.3	8.3	71	25-Apr	34	3.5
KS7436	2058	37.0	8.3	67	26-Apr	33	8.3
DSV 05100	2016	38.2	9.5	58	11-May	35	3.6
DSV 05104	1948	36.1	8.0	65	--	35	4.9
KS9135	1947	37.1	9.3	80	25-Apr	36	14.3
ARC98007	1945	38.5	10.0	56	11-May	35	13.4
KS3254	1897	38.8	9.5	76	12-May	30	7.4
Plainsman	1861	38.3	8.2	86	25-Apr	35	2.1
Abilene	1852	38.3	9.0	77	2-May	33	8.6
Wichita	1838	37.9	9.5	60	3-May	33	2.3
KS3350	1665	31.7	10.0	69	26-Apr	36	5.0
KS3074	1644	38.5	8.8	78	26-Apr	32	2.0
ARC98015	1541	39.3	9.5	73	12-May	34	21.5
KS9124	1530	38.0	8.7	85	26-Apr	35	5.8
Baldur	1445	40.9	7.5	74	24-Apr	33	4.5
DSV 05102	1265	39.1	8.3	65	9-May	36	4.3
DKW13-62	1261	37.3	8.8	60	13-May	33	NA
KS2185	1251	29.4	9.2	68	25-Apr	32	3.3
Jetton	1226	37.4	9.2	57	12-May	35	7.4
Rasmus	1167	37.0	8.7	67	1-May	32	2.8
KS3018	1125	33.8	9.5	82	24-Apr	29	6.0
DSV 05101	1111	35.7	8.3	58	11-May	31	2.4
Virginia	839	38.3	9.0	46	--	29	7.0
Casino	807	38.6	9.3	75	2-May	34	10.0
VSX-2	752	38.6	9.0	66	--	28	4.5
ARC2180-1	--	--	10.0	25	16-May	38	9.8
ARC97018	--	--	9.5	31	--	34	12.5
TCI Exp 983	--	--	9.5	23	--	36	--
Mean	**1750**	**37.2**	**8.6**	**66**	--	**34**	**7.1**
CV (%)	35	5.5	5.9	17	--	10	--
LSD (.07)	1036	4.2	8.2	17	--	NS	--

[1]Trial conducted at the Arkansas Valley Research Center, seeded on 8/31/05 at 6.4 lb/acre and Harvested manually on 6/28 thru mid-July 2006. Previous crop: Winter wheat
Pest control: Roundup at 1 lb/ac & Treflan at 1.5 pt/ac on 8/29/05, Select 2EC at 4.5 oz/ac on 9/29/05, and Capture 2EC at 2.5 oz/ac to control flee beetles.
Irrigation: Three times in the fall and five times in the spring.
Fertilizer: 100 lb N/acre as Urea applied in the fall (50 lb) and early spring (50 lb).

Table 4. Irrigated Winter Wheat Variety Performance Trial at Rocky Ford[1] in 2006.

Variety	Grain Yield	Grain Moisture	Test Weight	Plant Height	50% Heading	Lodging 28-Jun
	bu/ac	%	lb/bu	in	date	1-9
CO03637	71.6	8.6	55.3	34	12-May	4
Platte	71.0	8.7	56.7	35	17-May	0
Westbred Keota	70.4	9.4	57.5	37	14-May	0
CO03621	69.4	8.5	56.4	32	13-May	3
TAM111	68.1	9.0	57.3	37	16-May	0
NuHills	66.6	10.3	57.7	33	13-May	0
CO03W238	66.6	9.7	56.0	33	12-May	0
AP530W	64.9	8.8	57.5	34	15-May	0
CO03W267	63.4	9.1	57.0	34	15-May	1
CO03W261	62.5	7.9	55.3	33	16-May	3
Jagalene	62.1	9.1	57.8	36	12-May	1
AP50W	62.0	8.7	54.3	34	16-May	1
CO03W239	61.0	8.6	56.0	35	13-May	1
AP03-20	60.9	9.5	56.9	35	14-May	0
CO02W237	60.7	10.0	56.4	31	13-May	3
Yuma	60.6	9.8	56.7	33	16-May	0
CO02322-A2	60.6	10.2	57.3	33	16-May	0
Bond CL	60.6	10.5	56.6	37	14-May	1
Guymon	60.6	10.0	56.9	32	16-May	1
NI03427	60.5	9.7	58.3	32	15-May	0
CO03W269	60.3	8.8	57.1	34	17-May	1
Prairie Red	59.2	10.4	56.7	32	8-May	0
CO02320-A1	58.6	8.7	55.9	36	15-May	5
Antelope	58.3	9.5	56.4	31	13-May	0
Ankor	58.1	8.6	56.1	35	14-May	2
CO01385-A1	57.2	9.2	57.8	32	17-May	3
CO03W262	56.8	8.5	54.3	35	15-May	1
Danby	56.5	8.7	58.1	33	14-May	3
CO03W253	55.2	8.4	56.3	35	16-May	5
CO03W263	54.8	8.3	54.8	33	16-May	1
NuFrontier	54.4	9.2	58.0	36	16-May	0
Hatcher	54.2	9.7	56.9	33	14-May	2
CO02W280	52.8	9.3	56.7	35	11-May	5
CO02W040	52.6	8.9	56.7	33	11-May	2
CO01212	50.6	8.7	57.4	34	15-May	2
CO02265	49.2	8.9	57.3	34	14-May	3
Wesley	47.6	9.8	55.7	33	16-May	0
NW98S097	47.6	10.4	57.2	31	17-May	0
CO02W214	47.2	8.6	56.2	34	14-May	6
NI02425	44.3	10.8	55.7	31	12-May	0
Average	**59.0**	**9.2**	**56.6**	**34**	**-**	**2**
$LSD_{(0.05)}$	12.6	1.5	1.3	3		

[1]Trial conducted at the Arkansas Valley Research Center; seeded 9/16/05 and harvested 7/17/06.
Irrigation: 9/16/05, 11/4, 3/10/06, 4/20/06, 5/12/06, and 6/10/06
Insecticide: Lorsban at 16 oz/ac on 4/14/06 to control a light to moderate RWA infestation

Table 5. Irrigated Nuna Bean Variety Performance Trial at Rocky Ford[1] in 2006.

Entry No.	Seed Yield	100-Seed Weight	Seed Count	Beginning Flowering	Ending Flowering	Pod Maturity on 10/16	Odd Seeds by Weight[2]
	lb/acre	grams	seeds/lb	date	date	%	%
49991	4200	40.3	1129	13-Jul	7-Sep	69	5.4
50004	3900	37.8	1202	12-Jul	7-Sep	70	5.9
49979	3802	39.3	1157	13-Jul	10-Sep	43	13.2
49978	3775	41.3	1100	12-Jul	9-Sep	48	12.6
49990	3602	41.7	1091	17-Jul	5-Sep	68	4.1
49956	3594	51.7	881	14-Jul	3-Sep	81	2.1
49957	3534	53.1	857	14-Jul	1-Sep	84	1.8
49961	3475	45.9	991	12-Jul	2-Sep	53	12.7
49984	3445	43.1	1054	16-Jul	3-Sep	73	2.6
49982	3127	39.5	1154	13-Jul	10-Sep	48	16.6
Mean	**3645**	**43.4**	**1062**	**--**	**--**	**64**	**8**
LSD (.19)	445	2	47	--	--	--	6.5

[1]Trial conducted at the Arkansas Valley Research Center; seeded 5/25 and harvested 10/24.

[2]Stained and immature seeds. Does not include cracked seeds.

Preceding crop: Soybean

Pest control: Warrior on 7/28/06 at 3.0 oz/a to control sporadic Mexican bean beetle infestation.

Irrigation: Five furrow-irrigation applications

Fertilizer: None

Table 6. Irrigated Corn Variety Performance Trial at Rocky Ford[1] in 2006.

Hybrid	Grain Yield	Grain Moisture	Test Weight	Plant Height	Density	Lodging	Silking[2]
	bu/a	%	lb/bu	in	plants/a	%	date
Triumph 1536CbRR (YGCB/RR)	241.3	17.4	55.5	88	28949	5.7	196
Mycogen 2T828 (YGCB/LG/RW/RR)	235.7	18.3	55.7	91	29857	4.9	197
Producers Hybrids 7373 (YGCB/BT/RR)	235.2	17.4	56.0	92	28768	2.9	196
Producers Hybrids 7361 (YGCB/BT)	232.4	18.0	55.6	90	28949	1.7	194
Crows 7532Z (BT/RR)	229.7	16.5	57.0	88	29040	0.9	195
NK Brand N68-B8 (Bt/LL)	228.3	15.7	56.2	84	28314	7.9	195
Mycogen 2T780 (HXI)	227.6	16.2	55.7	93	27951	4.1	197
NK Brand N76-D3 (Bt/LL)	219.1	17.5	56.0	87	27225	4.1	198
Dyna-Gro 57P93 (YGCB/RR)	217.4	17.0	56.1	88	25410	1.3	198
NK Brand N72-B2 (Bt/LL)	214.3	16.3	56.1	90	28496	2.7	197
Triumph 1756CbRR (YGCB/RR)	213.2	18.1	54.0	92	28586	13.9	199
Producers Hybrids 7073 (YGCB/BT)	211.9	14.6	56.5	81	26045	0.4	194
NK Brand N67-D6 (GT/Bt/LL)	211.5	16.2	56.6	85	28859	0.6	192
NK Brand N70-C7 (GT/Bt/LL)	204.5	17.0	55.9	87	27497	5.4	193
Average	**223.0**	**16.9**	**55.9**	**88**	**28139**	**4.0**	**196**
$LSD_{(0.30)}$	16.5						

[1]Trial conducted at the Arkansas Valley Research Center; seeded on 4/27 at 33,000 seeds/ac and harvested on 11/1 and 11/2
[2]Julian date, 70% silking.
Previous Crop: Onions Irrigation: As needed.
Growing Degree Days: 2948 (2006 GDD); 2837 (Long Term Ave GDD)
Fertilization: 200 lb/acre of 11-52-0 on 10/5/05 and 300 lb/acre of Urea (46-0-0) on 1/17/06
Herbicide: Dual II Magnum at 1.43 ai/acre plus glyphosate at 1.0 lb ai/acre in 18 gal/a on 5/1/06
Bactericide: None other than as seed treatment
Insecticide: None other than as seed treatment

Table 7. Irrigated Forage Sorghum Variety Performance Trial at Rocky Ford[1] in 2006.

Hybrid	DM Yield[2]	Moisture	Plant Height	Plant Density	Stem Sugar	Growth Stage at Harvest
	t/ac	%	in	plants/ac	%	
Sordan 79	37.6	69.6	123	25749	5	Soft dough
Hikane II	29.3	73.0	109	20522	13	Hard dough
NB 305B	25.1	75.9	113	17424	16	Milk
NK 300	25.1	71.1	79	21005	4	Hard dough
Average	**29.3**	**72.4**	**106**	**21175**	**9.4**	
$LSD_{(0.30)}$	2.8		5		3	

[1]Trial conducted at the Arkansas Valley Research Center; seeded 5/17 and harvested 8/29.

[2]Yield adjusted to 70% moisture.

Site Information

Plot Size: 5' x 32' with 30" row spacing
Experimental Design: Randomized complete block, three replications
Previous Crop: Onions
Irrigation: As needed
Soil Type: Rocky Ford silty clay (fine-silty, mixed, calcareous, mesic Ustic Torriorthents)
Fertilization: 200 lb/acre of 11-52-0 on 10/5/05 and 300 lb/acre of Urea (46-0-0) on 1/17/06
Bactericide: None other than as seed treatment
Insecticide: None other than as seed treatment

Table 8. Irrigated Corn Silage Variety Performance Trial at Rocky Ford[1] in 2006.

Hybrid	DM Yield[2]	Moisture	Plant Height	Plant Density	Silking[3]
	t/ac	%	in	plants/ac	date
Dyna-Gro 58K22 (RR)	36.2	67.7	102	30492	200
Mycogen 2Q806	35.4	69.7	99	29948	202
Triumph 1866 (BT/YGCB)	35.2	64.5	100	27633	197
Mycogen 2N802 (RR)	34.2	66.8	102	29267	194
Crows 6621R (RR)	31.6	66.7	90	29585	202
NK Brand N76-M5 (Bt/LL)	30.9	64.8	88	31581	196
Triumph 1756CbRR (YGCB/RR)	30.4	70.7	90	30946	199
Mycogen 2F797	28.6	68.9	95	30220	192
Average	**32.8**	**67.5**	**96**	**29959**	**198**
$LSD_{(0.30)}$	2.2		3		

[1]Trial conducted at the Arkansas Valley Research Center; seeded 4/27 and harvested 8/29.

[2]Yield adjusted to 70% moisture.

[3]Julian date, 70% silking.

Note: Most entries were at the hard dough growth stage at harvest (cutting).

Growing Degree Days: 2948 (2006 GDD); 2837 (Long Term Ave GDD)

Corn Response to Nitrogen Following Onion in Rotation

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SUMMARY

In 2006, we evaluated the effects of residual soil N level plus applied N fertilizer (6 N rates) on corn grain yields and corn N uptake following the 2005 onion crop. Residual soil N levels in the 0- to 6-ft soil profile at corn planting ranged from 86 to 189 lb N/a where furrow irrigation was used in 2005 and 106 to 398 lb N/a where drip irrigation was used in 2005. Corn grain yields increased from 202 bu/a with no N applied to 267 bu/a with 80 lb N/a applied, then leveled off at higher N rates near 270 bu/a when corn followed the drip irrigated onions. Corn yields following furrow irrigated onions ranged from 166 bu/a with no N applied to a maximum yield of 262 bu/a with the application of 120 lb N/a. Thus, the corn responded to the higher level of residual soil N present in the drip irrigated onion plots. Residual soil NO_3-N levels were relatively low (generally less than 50 lb N/a in 0-6 ft soil profile) in the 2005 furrow irrigated onion plots after corn harvest in Sept. 2006 compared to >200 lb N/a present in the 0- to 6-ft soil profile at the highest N rate where drip irrigation was used in 2005. Corn was effective in utilizing soil residual N from the root zone but considerable residual soil N remained in the higher rate N plots of the 2005 drip irrigated onions plots. Therefore, corn will be grown on these same plots in 2007 to recover additional residual soil N. Using corn to recover residual fertilizer N applied to a previous onion crop will help reduce the potential of NO_3-N contamination of the groundwater in the lower Arkansas River Valley in Colorado and improve N use efficiency.

PROBLEM

High nitrate-N (NO_3-N) levels have been reported in groundwater in the Arkansas River Valley in Colorado, where melons, onions, and other vegetable crops are grown in rotation with alfalfa, corn, sorghum, winter wheat, and soybeans. Relatively high rates of N fertilizer are used to optimize vegetable and fruit crop yields and quality, generally without regard to soil testing for residual N levels. Vegetable crops generally have shallow rooting depths (< 3ft) and require frequent irrigation to maintain yield and market quality. High residual soil NO_3-N levels, high N fertilization rates to shallow-rooted crops, shallow water tables, and frequent irrigation all contribute to a high NO_3-N leaching potential. Little information is available on the ability of corn to recover unused N fertilizer applied to onions in the Arkansas River Valley of Colorado (Halvorson et al., 2002a). Generally, residual soil N is very high in fields used for production of vegetable crops as a result of past N fertilization history and management. We completed a four year continuous corn production study in 2003 with varying N rates (Halvorson et al., 2005). Residual soil N levels in this study had been reduced to relatively low levels by corn harvest in

2003. Chile pepper was grown in the plots in 2004 following 4 years of corn production. Residual soil N following chile pepper remained relatively low. This provided an opportunity to evaluate the response of onion to N fertilization in 2005 without having extremely high levels (> 200 lb/a) of residual soil N in the profile. Nitrogen rates applied to onion were 0, 40, 80, 120, 160, and 200 lb N/a. Our plan was to follow the onion crop with corn to determine if one corn crop could effectively utilize the residual N fertilizer left from the onion crop. Nitrogen management research is needed to develop improved N management practices for irrigated crops in this area. Improved N management practices for crops in the Arkansas River Valley should optimize crop yields and improve N use efficiency while minimizing N fertilizer impacts on ground water quality.

OBJECTIVES. The objectives of this research were to: 1) determine N fertilizer needs of furrow-irrigated corn following onion in rotation; and 2) evaluate the influence of N fertilizer application rate and corn, as a N scavenger crop, on residual soil NO_3-N levels.

STUDY DETAILS. Corn (Var. Asgrow *RX752RR/YG*) was planted on April 21, 2006 at a rate of about 37,500 seeds per acre under a conventional moldboard plow tillage and furrow irrigation production system on a calcareous Rocky Ford silty clay loam soil at the Arkansas Valley Research Center (AVRC) on plots previously cropped to onion in 2005. Nitrogen (0, 20, 40, 80,100, and 120 lb N/a or N1, N2, N3, N4, N5, N6, respectively) was applied to the established N1, N2, N3, N4, N5, N6 plots on April 4, 2006. The N source was ESN® (a polymer-coated urea fertilizer produced by Agrium Inc., Calgary, AB[3]), which provided about a 30 to 60 day release period from time of N application. The N fertilizer was broadcast and incorporated with a harrow before corn planting. A split-plot, randomized complete block design with four replications was used with N rate as main plots and 2005 onion irrigation methods (drip or furrow) as subplots.

Herbicides were applied for weed control, with the plots being essentially weed free during the entire growing season. Soil NO_3-N levels in the 0-6 ft profile were monitored in the spring before N fertilizer was applied and in the fall after corn harvest. An average corn harvest stand of 36,220 plants/a was attained. On September 5th, 15 plants were hand harvested for biomass yield. On October 17th the plots were combine harvested to determine grain yield.

Need for irrigation of the plot area was determined by monitoring soil water content weekly by the feel method. The plots were irrigated 7 times in 2006, with about 45.1 inches of total water applied with about 17.4 inches measured running off the end of the field, resulting in a net application of 27.7 inches. The NO_3-N level in the water was monitored at each irrigation with an average N content of 1.3 ppm. Assuming 61% irrigation efficiency, about 8.2 lbs of N may have entered the soil with the irrigation water. Growing season precipitation (April through October) amounted to 12.5 inches, with a rather wet July, August, and September.

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RESULTS

The soil NO_3-N levels in the 0-6ft soil profile on April 4, 2006 are shown in Table 1. The soil NO_3-N levels were similar for both the 2005 drip and furrow systems at the zero N rate but were nearly two times greater at the highest N rate in the drip irrigated onion plots compared to the furrow irrigated onion plots in April of 2006 before N fertilizer application on April 4th for the 2006 corn crop. This shows that less leaching of soil NO_3-N occurred where drip irrigation was used in 2005. The total amount of residual NO_3-N in the 6-ft profile increased with increasing N rate. Residual soil NO_3-N levels were very low following chile pepper harvest in 2004, so most of the residual N was the result of N fertilization of the onions.

Corn yields were increased significantly (∀ = 0.05) by N fertilization (Fig. 1). Grain yields were higher where drip irrigation was used in 2005 compared to furrow irrigation with a significant N rate x 2005 irrigation system interaction. The higher grain yields with the 2005 drip irrigation treatments reflects the higher level of residual soil NO_3-N present in the soil at corn planting in 2006 (Table 1) compared with the furrow irrigated treatments. These were excellent corn yields considering the relatively low rates of N fertilizer applied. Corn residue levels were 8262, 8664, 8966, 9253, 9802, and 9889 lb/a for the 0, 20, 40, 80, 100, and 120 lb/a N rates, respectively. Grain N removal increased with increasing soil plus fertilizer N level as shown in Fig. 2, with greater N removal from the 2005 drip irrigation plots than from the 2005 furrow irrigation plots. Averaged over N treatments, 16.7 lb N/a more N was removed in the grain from the 2005 drip irrigation plots than from the furrow irrigation plots. Residue N uptake did not vary with the 2005 irrigation system, but increased linearly with increasing N rate (Fig. 2).

Table 1. Soil NO_3-N levels in 2006 with soil depth for each N rate treatment before planting and after corn harvest as a function of drip and furrow irrigated onion plots in 2005.

Soil Depth	2005 Onion fertilizer N rate (lb N/a)						2006 Corn fertilizer N rate (lb N/a)					
	0	40	80	120	160	200	0	20	40	80	100	120
	N1	N2	N3	N4	N5	N6	N1	N2	N3	N4	N5	N6
	4 April 2006						18 October 2006					
Ft	Residual Soil NO_3-N, lb N/a											
	2005 Drip Irrigation Plots											
0-2	67	119	166	165	291	262	11	26	24	152	61	123
0-3	78	142	209	198	334	293	12	28	25	174	81	139
0-6	106	186	266	257	398	357	14	31	30	222	111	224
	2005 Furrow Irrigation Plots											
0-2	63	77	93	119	156	122	7	16	18	56	22	39
0-3	69	82	100	129	169	135	9	18	19	90	24	42
0-6	86	98	114	257	189	158	11	20	21	95	30	48

This N study will be continued on the same plots in 2007 with another crop of corn to further reduce the residual soil N levels at the higher N rates. If residual soil N rates are reduced sufficiently by the corn in 2007, chile pepper will be grown in the plot area in 2008. Nitrogen fertilization effects on residual soil NO_3-N levels will continue to be monitored.

Fig. 1. Corn grain yields as a function of N rate and irrigation system.

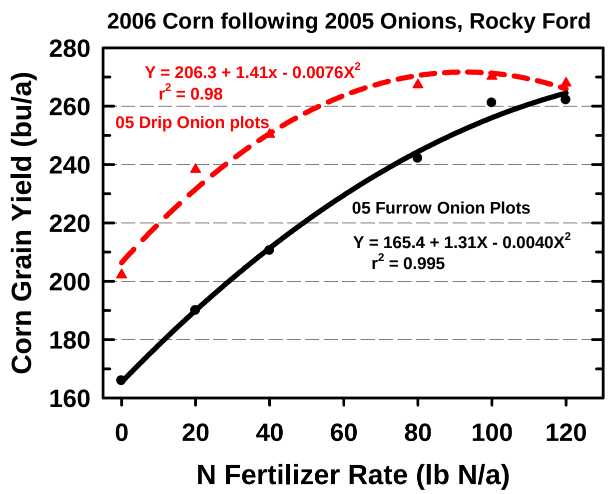
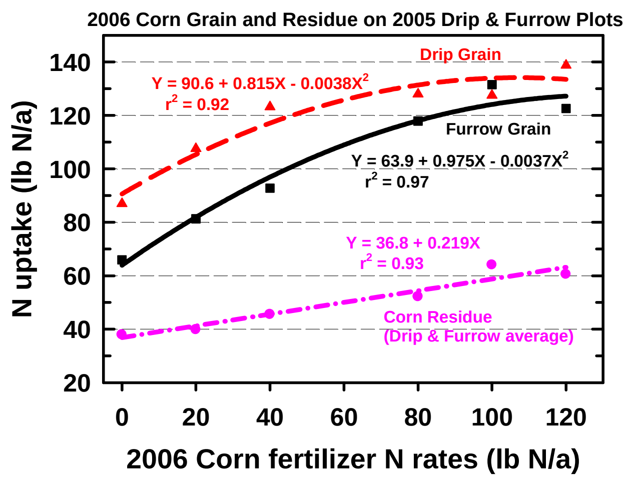


Fig. 2. Grain and residue N uptake as a function of N rate and irrigation system.



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Corn Micronutrient Trial

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In the Arkansas Valley and other parts of Colorado, many crops, particularly lower value agronomic crops, are not fertilized with micronutrients due to the high elemental levels that often exist in soils and irrigation waters. Despite being at high levels in the soil, some micronutrients may not be readily available to a plant due to localized depletions around the root zone or limited mobility of the nutrient.

Corn used for grain or silage is an important crop in Colorado. Corn is used to support the state's large and economical vital livestock industry and is grown in many regions of the state. Most Colorado soils contain relatively high levels of micronutrients and agronomic crops like corn may not be fertilized with anything but the major nutrients. Nonetheless, some deficiencies may exist in certain soil types. Further, deficiencies may exist in irrigated soils that are prone to nutrient leaching. Because of this potential, this study was conducted to determine the effect of several soil-applied micronutrient fertilizers on the yield of a furrow-irrigated corn crop grown for grain.

Overall, there was not a significant (p=0.1) increase in grain yield by the application of different rates of commercially available micronutrient sources compared to the unfertilized control.

MATERIALS AND METHODS

A micronutrient rate study was initiated under conventional till, furrow-irrigated corn on a calcareous Rocky Ford silty clay loam soil at Colorado State University's Arkansas Valley Research Center (AVRC) in 2006. Three commercially-available fertilizer products were evaluated at rates of 40 and 80 lbs product per acre. The products were 'Crop MixI' (Agriliance), Micro Mix 5% Zn (Mezfer Crown), Granulated Zn with Sulfur (Bay Zinc Co. Inc.). The table below contains the analysis of the aforementioned products.

Elemental analysis of fertilizer products (%)

Product	Zn	S	Cu	Fe	B	Mn
Micro Mix 15% Zn	15.0	8.0	0.7	7.0	-	1.0
Crop Mix I	8.0	7.0	1.0		1.0	3.0
Zinc with Sulfur (Zinc Sulfate)	35.5	17.2	-	-	_	-

The mironutrients were broadcast on top of 30 inch corn beds prior to planting. Immediately after broadcasting the fertilizer was incorporated with a rotary hoe. A randomized complete block design with 4 replications was used. Each plot was 4 beds wide (10 feet) and 36 feet long.

Corn (var Asgrow 752RR) was planted on April 27, 2006 at a seeding rate of about 32,000 seeds per acre. A single line of corn was planted on top of the bed with a 30 inch row spacing (furrow to furrow). Conventional corn production practices were used throughout the course of the season. Irrigation was by gravity-flow furrows with water being applied to every other furrow (every 60 inches). The corn was harvested at full black layer maturity and 15% grain moisture.

RESULTS

Treatment (Preplant in Furrow)	Rate Per Acre	% Grain Moisture	Yield bu/acre
Check / Control	-	16.0	210.9 a
Mezfer Micromix 15%	40 lbs.	16.0	213.1 a
Mezfer Micromix 15%	80 lbs.	16.0	211.2 a
Origin Crop Mix 1	40 lbs.	16.0	219.0 a
Origin Crop Mix 1	80 lbs.	16.0	223.4 a
Zinc Sulfate 35%	40 lbs.	16.0	219.5 a
Zinc Sulfate 35%	80 lbs.	16.0	220.4 a
lsd(0.1)			ns

This work was generously supported by Agriliance LLC under the direction of Mr. Joe Bush.

Corn Starter Fertilizer Trial

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Corn used for grain or silage is an important crop in the Arkansas Valley and other regions of the state. In 2006, a study was conducted to characterize the response of corn to commercially available forms of starter fertilizers containing zinc and other nutrients. Applications were applied below the seed row at the planting. Overall, the seed treatments and applications of fertilizers did not significantly increase yield compared to an unfertilized control.

MATERIALS AND METHODS

This study was conducted with conventional tilled, furrow-irrigated corn on a calcareous Rocky Ford silty clay loam soil at Colorado State University's Arkansas Valley Research Center (AVRC) in 2006. Six treatments, including an untreated control, were applied just prior to planting. After marking out the seed lines with an empty plot planter, fertilizer materials were applied in a small trench. Each fertilizer material was uniformly placed at the bottom of a 1-2" deep trench and after the application, the trench was carefully re-filled. Corn (Asgrow RX752) was planted on April 27, 2006 at a seeding rate of about 32,000 seeds per acre. A single line of corn was planted on top of the bed with a 30 inch row spacing (furrow to furrow). Conventional corn production practices were used throughout the course of the season.

RESULTS

Treatment (Preplant in Furrow)	Rate Per Acre	% Grain Moisture	Yield bu/acre
Check / Control		16.0	219.4 a
10-34-0	10 gal.	16.0	219.2 a
10-34-0 ORGIN 10% Zinc	10 gal. 3 pts.	16.0	218.8 a
10-34-0 ORGIN 10% Zinc AGM0424	10 gal. 3pts. 3.2 oz.	16.0	219.8 a
10-34-0 AGM0424	10 gal. 3.2 oz.	16.0	211.6 a
10-34-0 AGM0435	10 gal. 3.2 oz.	16.0	215.1 a
lsd(0.1)			ns

This work was generously supported by Agriliance LLC under the direction of Mr. Joe Bush.

Alfalfa Growth Regulator Trial

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Alfalfa is a major crop in the Arkansas Valley. Improving the yield and quality is a constant goal of producers. In some instances, growth regulators have been shown to enhance yields and quality by altering plant metabolism and architecture. This study was conducted to examine the response of alfalfa to commercially available formulation of growth regulators.

Overall, the applied materials did not have a significant effect on yield or quality as measured by leaf to stem ration. Some materials did, however, have an effect on plant height.

MATERIALS AND METHODS

An established, three-year old, alfalfa (var.*Reno*) field located at the Arkansas Valley Research Center was used in this study. Alfalfa was treated on 8-1-06 after the second cutting, when regrowth was approximately 5-6 inches high. Applications were in the form of a foliar spray (in 30 gal/acre) water. The crop was harvested on 8-31-06. Fresh weights and plant heights were taken at harvest. Sub-samples were taken from each individual plot and dried to determine leaf:stem ratio.

RESULTS

Treatment	Rate Per Acre	Leaf:Stem Ratio By weight	Plant Height inches	Fresh Weight Yield lbs per acre
AGM 04014	1 qt.	1.092 a	36.5 ab	11,194 a
AGM 040024	3.2 oz.	1.116 a	36.0 bc	12,617 a
AGM 04014 + AGM 04024	1 qt. + 3.2 oz.	1.12 8 a	35.0 c	12,080 a
AGM 04014 + AGM 04021	1 qt. + 8 oz.	1.104 a	35.2 c	11,688 a
Untreated Control	-	1.021 a	37.2 a	12,559 a
lsd(0.1)		0.165	1.0	1,468

This work was generously supported by Agriliance LLC under the direction of Mr. Joe Bush.

Onion Response to Nitrogen and Irrigation Type following Soybean in 2006

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SUMMARY

Onion is a high cash value crop with a very shallow root system that requires frequent irrigation and is frequently fertilized with N rates exceeding 200 lb N/a to maximize yield. In 2006, we established six N treatments (0, 40, 80, 120, 160, and 200 lb N/a) in an area cropped to soybean in 2005 to determine N fertilization requirements to optimize onion yields following soybean. The N treatments were split to allow irrigation by furrow (normal method) and a drip system to evaluate the effects of irrigation system on N needs of onion. At the end of the season, a total of 34.6 inches of irrigation water had been applied with the drip system and 79.8 inches with the furrow system. Total marketable fresh onion yields were not significantly increased by N fertilization in 2006. Significantly greater onion yields were obtained with the drip system compared with the furrow irrigation system. Estimated gross economic returns were greater with drip irrigation than with furrow irrigation. This work demonstrates that economic returns can be maintained by using the more efficient drip irrigation system for onion production rather than the less efficient furrow irrigation system. The drip system had significantly more colossal and jumbo size onions and used 57 % less irrigation water than the furrow irrigation system. Nitrogen uptake by onion was greater with the drip irrigation system compared with the furrow irrigation system, resulting in improved N use efficiency.

PROBLEM

High NO_3-N levels have been reported in groundwater in the Arkansas River Valley in Colorado, which is a major producer of melons, onions, and other vegetable crops grown in rotation with alfalfa, corn, sorghum, winter wheat, and soybeans. High rates of N fertilizer (>200 lb N/a) are usually applied to onion to increase overall yield and bulb size, generally without regard to soil testing. N fertilizer use efficiency (NFUE) by onion was found to be about 15% in research we conducted at Arkansas Valley Research Center (AVRC) under furrow irrigation. Onion has a shallow rooting depth (<2 ft) and requires frequent irrigation to maintain market grade and quality. High N fertilization rates, shallow-rooting depth of onion, and frequent irrigation contribute to a high NO_3-N leaching potential in this area. Irrigation, crop, and N management practices need to be developed to reduce NO_3-N leaching potential and improve N use efficiency (NUE). In 2005, onions were grown under drip and furrow irrigation and six N fertilizer rates in a long-term N study started in 2000. Four years of corn production followed by chile pepper in 2004 preceded the 2005 onion crop. This study was repeated in 2006 with same N and irrigation treatments but on a new plot area that had been in soybeans in 2005. The same experimental design was used in the 2006 onion study.

OBJECTIVES: The objectives of the 2006 research reported here were to: 1) determine N fertilizer requirements of onion under drip and furrow irrigation in Arkansas River Valley needed to optimize yield and bulb size; and 2) evaluate the influence of N fertilizer rate and irrigation system on residual soil NO_3-N levels.

STUDY DETAILS: A new N rate and irrigation method study was initiated using conventional tillage practices on a calcareous Rocky Ford silty clay loam soil at the Arkansas Valley Research Center (AVRC) in 2006. The plot area had previously been in soybean with uniform N applications in previous years over the whole plot area. Six N treatments (0, 40, 80, 120, 160, and 200 lb N/a) were established on February 22, 2006 in a field previously cropped to soybean in 2005. The N source was a controlled-release polymer-coated urea (Duration Type III® produced by Agrium Inc., Calgary, AB[b]; cost $950/ton or $1.10/lb N) with a 90 to 120 day release period. The N fertilizer was broadcast on February 22nd and incorporated with a harrow on February 24, 2006. Two irrigation systems were used, furrow irrigation (normal practice) and drip irrigation. A split-plot, randomized complete block design with N treatment as main plots and irrigation system as subplots with 4 replications was used.

Onion (var. Ranchero) was planted on March 8, 2006 at a seeding rate of about 129,500 seeds per acre. At harvest, the plant population was 125,815 plants/a when averaged over all plots. Two rows of onion were planted on a 10 inch bed with a 30 inch row spacing (furrow to furrow). The onions were harvested on August 30th for fresh weight yield and graded for size. Marketable onion sizes were colossal (>4" diameter), jumbo (3 to 4" diameter), and medium (2 to 3" diameter). Onion yields are expressed on a fresh weight basis. Estimated gross return per acre was calculated based on a Rocky Ford harvest price of $28/cwt of colossal, $24/cwt of jumbo, and $16/cwt of medium size onions. Water cost was estimated at $11 per acre-ft. The drip irrigation system was estimated to cost $750 per acre (disposable drip tube used plus amortized cost for pump, filter, and set-up material used for more than one year). Labor costs were not considered in the economic analysis. Herbicides were applied for weed control, with the plots being relatively weed free during most of the growing season. Soil NO_3-N levels in the 0-6 ft profile were measured before fertilization and after harvest. The spring soil NO_3-N level on 22 February 2006 before applying N fertilizer were 48 lb N/a in the 0- to 2-ft soil depth, and 68 lb N/a in the 0- to 6-ft soil depth for the plot area with no differences between N and irrigation treatments. Soil pH was 7.8; soluble salts, 0.70 mmho/cm; SOM, 1.7%; Mehlich-3 P, 32 ppm; and ammonium acetate extractable K, 296 ppm in the 0- to 12-inch soil depth. The plot area received 100 lb P/a as triple super phosphate (0-46-0) prior to onion bed formation.

Soil water in the onion row was monitored almost daily during the early part of the onion growing season using Watermark[3] soil moisture sensors (Irrometer Company, Riverside, CA[3]) and "feel" method. Soil water tension was maintained at about 20 kPa in the drip-irrigated plots, but was more variable in the furrow-irrigated plots due to less frequent irrigation. The onions under drip irrigation were irrigated 17 times during the growing season with a total water application of 34.6 inches (2.88 acre feet). The drip tape was located about 2-3 inches below the soil surface near the center of the bed between the two onion rows. Onions under furrow irrigation received a total of 79.8 inches (6.65 acre feet) of irrigation water in 12 irrigations. Under furrow irrigation, water was applied to every furrow (30 inch spacing) to obtain uniform wetting of both onion rows on the bed. The runoff water from the furrow irrigated plots was estimated using a flume placed in the furrow at the lower end of the field. Approximately 24.4 inches (2.03 acre feet) of water ran off the end of the field in the furrow irrigated system. No

[b] Trade names and company names are included for the benefit of the reader and do not imply any endorsement or preferential treatment of the product by the authors or the USDA, Agricultural Research Service.

water was lost off the end of the field with the drip system. The average NO_3-N level in the irrigation water for the season was 1.3 ppm, with about 7.2 lb NO_3-N/a added to the soil with the drip system and 16.3 lb NO_3-N/a with the furrow irrigation system.

Precipitation during the growing season was 0.91” in March, 0.31” in April, 1.58” in May, 0.28” in June, 3.25” in July, and 3.81” in August. Total precipitation for the growing season was 10.1 inches, with a rather wet July and August.

RESULTS

Excellent onion yields were obtained in 2006. Onion yields were not influenced by N rate in 2006. The drip system had significantly greater yield than the furrow irrigation system (Table 1) in 2006, similar to the 2005 results. The N rate x irrigation system interaction was not significant. The drip system had more colossal and jumbo size onions than the furrow system, but fewer medium size onions than the furrow system (Table 1). Colossal size onions averaged 8.9 cwt/a with the drip system and 0.8 cwt/a with the furrow irrigation system. Jumbo size onion averaged 603.6 cwt/a with the drip system and 394.8 cwt/a with the furrow system. Medium size onions averaged 159.5 cwt/a with the drip system and 253.1 cwt/a with the furrow system. The drip system had fewer discard sized onions (4.9 cwt/a) than the furrow irrigation system (9.1 cwt/a).

An estimated gross dollar return per acre was calculated for each treatment. Gross returns were not influenced by N rate but were significantly greater with the drip system than with the furrow system (Table 1), with no significant N rate x irrigation system interaction. This would suggest that N rates for onion could be reduced considerably following soybean in rotation from the 200 lb N/a rate that is a common practice in the Arkansas Valley area.

Nitrogen uptake by the onion tops at harvest did not vary with N rate but was greater with drip irrigation (16.8 lb N/a) than with the furrow irrigation system (11.5 lb N/a) on August 30, 2006. Nitrogen uptake by the bulbs was also not influenced by N application, but was greater with drip irrigation (85.3 lb N/a) than with the furrow irrigation system (76.9 lb N/a). The N rate x irrigation system interaction was not significant for N uptake. Total N uptake (tops + bulbs) was greater with the drip system (102.1 lb N/a) than with the furrow system (88.4 lb N/a).

Analysis of soil samples collected on Sept. 5, 2006 after onion harvest shows that residual soil NO_3-N levels in the 0- to 6-ft soil profile increased with increasing N rate, but there was no significant difference between irrigation systems and no significant N rate x irrigation system interaction. Averaged across the two irrigation systems, residual soil NO_3-N levels after onion harvest were 45, 66, 113, 113, 185, and 209 lb N/a for the 0, 40 80 120, 160, and 200 lb/a N rates, respectively. With greater N uptake by the onion bulbs and tops with the drip system compared to the furrow irrigation system, the drip system appears to improve N use efficiency when compared with the furrow irrigation system.

The 2005 and 2006 onion studies demonstrate that economic returns can be maintained by using the more efficient drip irrigation system for onion production rather than the less efficient furrow irrigation system. With the drip system, onion yields were maximized with a lower rate of N fertilizer in 2005 and 72% and 56% less irrigation water in 2005 and 2006, respectively, than with the furrow irrigation system. Less NO_3-N was possibly lost from the soil profile with the drip system compared with the furrow irrigation system due to less water applied. Visually, soil erosion was also less with the drip system than with the furrow irrigation system.

ACKNOWLEDGMENT

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Table 1. Onion yield and estimated economic value on August 30, 2006 at Rocky Ford, Colorado for the drip and furrow irrigated systems.

Yield	**Drip†**	**Furrow**	**Difference Drip-Furrow**
Total Marketable Onion Fresh Yield (cwt/a)	722.0	648.7	73.3
Colossal size onion (cwt/a)	8.9	0.8	8.2
Jumbo size onion (cwt/a)	603.6	394.8	208.8
Medium size onion (cwt/a)	159.5	253.1	-93.6
Packers (discards) (cwt/a)	4.9	9.1	-4.2
Economics			
Total Gross Market Value ($/a)	$17,288	$13,547	$ 3,741
Colossal size value ($/a) @$28/cwt	$ 250	$ 22	$ 228
Jumbo size value ($/a) @$24/cwt	$14,487	$ 9,476	$ 5,011
Medium size value ($/a) @$16/cwt	$ 2,552	$ 4,050	$ -1,498

†Note: No significant response to N fertilization, no significant N rate x irrigation interaction. All differences between irrigation systems were significant.

Onion Variety Trial

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PRODUCTION INFORMATION

Plots - *Planted 20' long X4 rows on beds spaced 60" on centers. Rows were spaced 12" apart on top of the bed with an in-row spacing between plants of ~3". Harvested 8 bed feet (8' X 2 rows) for yield determination. Water was supplied via drip irrigation. Each plot was replicated four times in the trial.*

Planted *- March 13th , 2006*

Fertilizer *- 104 lbs. P_2O_5/A and 22 lbs N/A as 11-52-0 - preplant. ~ 100 lbs. N/A residual and 12 lbs N supplied via drip system.*

Weed Control *- Prowl 3.3E + Roundup Ultra on April 3rd*
-Goal 2 and Outlook on May 8th
-Goal 2 + Dual II + Select on June 12st (all ground applications)
-Hand weeded 2 times

Insect Control *– Warrior + Lannate on June 14th*

Disease Control *– Dithane + Top Cop on July 5th (ground application), Dithane and Copper July 14th and July 25th (aerial applications)*

Irrigation *– The plots were irrigated 28 times via drip. The amount of irrigation water applied was 23.1 inches and season precipitation was 10.5 inches.*

Harvest *– August 29th*
Grade *– November 15th*
Comments

The 2006 season was good for onion production with no disease problems or damaging storms. Late season rains impeded harvest but did not result in any significant damage. Thrips populations were fairly high and may have contributed to some yield losses. There was no Iris Yellow Spot Virus detected in the plots. Please contact Mike Bartolo at the Arkansas Valley Research Center (719-254-6312) for additional information

ONION VARIETY TRIAL– Arkansas Valley Research Center, Colorado State University, Rocky Ford, Colorado, 2006

Variety	*Source*	*Maturity (% tops down) 8-15*	*Colossals ∃4" %*	*Jumbos 3"-4" %*	*Medium 23"-3" %*	*Pre-Pack 1:"-23" %*	***Total Market. Weight 50 lb bags/A***	*Culls %*	*Total Weight 50 lb bags/A*
OLYS03-207	Crookham	15	0.0	77.1	19.8	2.7	**1450.5**	0.4	1457.0
Sweet Perfection	Crookham	30	1.4	64.8	29.5	3.9	**1354.7**	0.4	1360.1
X-202	Waldow	25	1.6	62.5	31.2	4.1	**1353.6**	0.6	1363.4
Tequilla	D. Palmer	17	1.3	57.6	38.4	2.7	**1347.0**	0.0	1347.0
X-201W	Waldow	20	2.4	65.5	27.0	3.4	**1338.3**	1.7	1362.3
NUN7004	Nunhems	20	0.0	68.4	28.6	2.8	**1330.7**	0.2	1334.0
OLYS05N5	Crookham	10	0.0	70.1	28.0	1.9	**1324.2**	0.0	1324.2
Ranchero	Nunhems	27	2.6	72.4	22.0	2.6	**1318.7**	0.4	1324.2
X-Y201H	Waldow	20	1.7	65.3	27.0	4.5	**1317.6**	1.5	1338.3
X-Y202W	Waldow	10	0.0	62.3	29.4	3.7	**1295.9**	4.6	1356.8
NUN7008	Nunhems	25	0.9	74.0	22.6	2.2	**1286.1**	0.3	1290.4
T-433	Takii	25	1.6	50.2	42.1	6.1	**1261.0**	0.0	1261.0
Monarchos	Seminis	25	0.0	70.9	26.3	2.8	**1259.9**	0.0	1259.9
Affirmed	Seminis	52	0.0	56.6	39.5	3.9	**1254.5**	0.0	1254.5
DPSX1406	D. Palmer	15	0.0	72.5	23.9	3.6	**1251.2**	0.0	1251.2
X-201	Waldow	30	2.9	69.0	24.7	3.4	**1243.6**	0.3	1247.9
Charismatic	Seminis	42	1.4	66.3	28.2	3.4	**1210.9**	0.7	1219.6
Orizaba (W)	Seminis	45	0.0	43.3	49.9	5.9	**1206.6**	0.9	1218.5
Harmony	Crookham	25	0.0	63.2	28.5	3.3	**1205.5**	5.0	1269.7
Granero	Nunhems	45	1.6	55.6	39.9	2.9	**1203.3**	0.0	1203.3
X-Y202H	Waldow	12	0.0	57.5	34.0	5.3	**1194.6**	3.2	1237.1
Mesquite	D. Palmer	15	0.0	63.7	28.5	5.1	**1191.3**	2.7	1224.0

Variety	*Source*	*Maturity (% tops down) 8-15*	*Colossals ∃ 4" %*	*Jumbos 3"-4" %*	*Medium 23"-3" %*	*Pre-Pack 1 : "-23" %*	***Total Market. Weight CWT/A***	*Culls %*	*Total Weight 50 lb bags/A*
Vaquero	Nunhems	50	2.3	53.4	39.8	4.5	**1191.3**	0.0	1191.3
Pandero	Nunhems	27	0.0	56.2	39.5	4.3	**1187.0**	0.0	1187.0
Delgado	Bejo	20	0.0	47.2	49.6	3.2	**1187.0**	0.0	1187.0
Gold Spike	Seminis	90	0.0	54.9	40.8	4.3	**1156.5**	0.0	1156.5
Cometa (W)	Nunhems	20	1.4	55.6	37.5	4.9	**1146.7**	0.6	1154.3
Colorado 6	Burrell	10	0.0	63.0	34.9	2.1	**1104.2**	0.0	1104.2
DPSX 1405	D. Palmer	12	1.9	61.1	34.3	2.7	**1104.2**	0.0	1104.2
NUN8000 (W)	Nunhems	37	0.0	36.8	57.7	4.7	**1094.4**	0.8	1104.2
Sedona	Bejo	22	0.0	34.9	59.4	5.6	**1093.3**	0.2	1096.6
7106 (W)	Seminis	20	0.0	40.0	53.9	4.5	**1043.2**	1.6	1060.6
Calibra	Seminis	60	0.0	39.6	53.4	7.0	**1029.1**	0.0	1029.1
Salsa (R)	Nunhems	32	0.0	19.1	73.0	7.1	**964.8**	0.8	973.5
Caveat	Seminis	85	0.0	26.4	67.0	6.6	**939.8**	0.0	939.8
Damascus	Seminis	65	0.0	28.1	63.1	8.8	**932.1**	0.0	932.1
Gunnison	Bejo	52	0.0	14.3	76.1	9.6	**914.7**	0.0	914.7
Talon	Bejo	62	0.0	9.5	81.1	9.4	**886.4**	0.0	886.4
Red Bull (R)	Bejo	17	0.0	15.9	68.1	12.1	**870.1**	3.9	907.1
Crockett	Bejo	12	0.0	24.7	64.0	10.9	**869.0**	0.4	873.3
Safrane	Seminis	47	0.0	15.2	75.1	8.9	**837.4**	0.8	846.1
Citation	Bejo	90	0.0	21.3	69.1	9.2	**825.4**	0.4	829.8
Tamera	Seminis	37	0.0	17.5	73.7	8.8	**820.0**	0.0	820.0
XP7011	Seminis	67	0.0	10.8	72.5	16.7	**813.4**	0.0	813.4
DPSX 3052 (R)	D. Palmer	15	0.0	21.5	67.8	9.1	**754.6**	1.6	765.5
Nobility	Crookham	45	0.0	1.5	76.4	22.1	**669.7**	0.0	669.7

Onion Response to Different Water Qualities

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ABSTRACT

Onions are one of the highest value and most-widely grown crops in Colorado. Onions are also one of the most salt sensitive crops and are susceptible to water deficits due to the shallow nature of their root system. In Colorado and other rapidly urbanizing western states, the competition for water resources is dramatically increasing. Growers are having to use alternative water sources that often have lower quality than the sources they have historically used from streams and rivers.

In 2006, a study was conducted to characterize the response of three commonly-grown onion cultivars (Ranchero, Cometa, and Red Bull) to irrigation waters having an electrical conductivity (EC) of 1.0 dS.m-1 (low EC river water) or 2.8 dS.m-1 (high EC groundwater). The timings and amounts of irrigations were the same for both water treatments throughout the growing season and all irrigations were delivered via a drip system.

Total marketable yield was lowered slightly (3.5%) but not significantly, when the yellow variety, 'Ranchero', was irrigated with the high EC water. The white (Cometa) and red (Red Bull) variety had a 19.8% and 19.2% decrease in total marketable yield, respectively, when irrigated with the high EC water. In most cases, the proportion of jumbo class onions (>3" in diameter) was significantly reduced. As a result, economic losses were realized for all onion varieties when irrigated with the high EC water.

INTRODUCTION

Growers in the Arkansas Valley of Colorado face increasing pressure to conserve water along with other natural resources. Recent droughts and heightened competition for water from rapidly growing urban areas have compelled many growers to adopt more efficient irrigation methods like drip.

In Colorado, irrigation water derived from the Arkansas River and its shallow alluvial aquifer can be of poor quality. The Arkansas River, for example, is one of the most saline rivers for its size in the country (Miles, 1977). Furrow irrigation can aggravate salt accumulation in the root zone and can lessen the quality of water that is returned to the river (Bartolo et al., 1995; Halvorson et al., 2002). Applied properly, drip irrigation can successfully manage water that is high in salt content (Hartz, 1994). Many Colorado growers adopting drip irrigation rely on systems that are designed to use groundwater rather than surface water. In contrast to surface water, groundwater is free of sediment and is available on a more timely and reliable basis, making it ideal for drip irrigation. Unfortunately, groundwater often contains 2-3 times the amount of salt than surface water.

Onions are one of the more salt-sensitive crops. Yield reductions can occur when the electrical conductivity (EC) of the saturated soil paste extract reaches 1.2 dS.m-1 or the EC of irrigation water reaches 0.8 dS.m-1. Yield reductions of 50% can be realized when the EC of irrigation waters are as little as 2.9 dS.m-1 (Ayers, 1977). Some research, however, suggests that yield reductions due to salinity may vary with onion cultivar and may not be as severe if salinity is due to calcium and sulfur-containing salts rather than sodium-containing salts (Doss et al, 2003)

This study was conducted to characterize the response of three commonly-grown onion cultivars to irrigation waters having an EC of 1.0 dS.m-1 (river/surface water) or 2.8 dS.m-1 (groundwater). The derived information will help growers manage their diminishing water resources more efficiently and economically.

MATERIALS AND METHODS

This field study was conducted on a Rocky Ford silty clay loam soil at Colorado State University's Arkansas Valley Research Center (AVRC) in Rocky Ford, Colorado. The plot area had been in soybeans in 2005. Two irrigation water sources were examined as the main plots: surface water diverted from the Arkansas River and groundwater derived from a shallow (25-30 feet deep) alluvial aquifer on the AVRC site. The surface water varied slightly in salinity during the course of the season but had an average electrical conductivity (EC) of approximately 1.0 dS.m-1. The groundwater had an EC of 2.8 dS.m-1. Other characteristics of the water sources are noted in Table 1.

Component	Groundwater*	Surface**
Calcium	283 ppm	111 ppm
Sodium	133 ppm	64 ppm
Hardness - CaCO3	1022 ppm	420 ppm
Sulfate	1053 ppm	365 ppm
Specific Conductance	2.77 ds/m	1.00 ds/m
TDS	1764 ppm	720 ppm
pH	7.5	7.4

Table 1: Chemical characteristics of ground and surface waters.* Analysis

at AVRC, ** EPA analysis at Arkansas River

Three commonly-grown onion varieties were selected as the subplots. The varieties were ‘Ranchero’ (Nunhems), a yellow-skinned type, ‘Cometa’ (Nunhems), a white-skinned type, and Red Bull (Bejo), a red-skinned type. Onions were direct-seeded on March 15, 2006 at a seeding rate of about 130,00 seeds per acre. Four rows of onion were planted on beds with 60 inches between centers. Onion rows were spaced 12 inches apart and in-row spacing between onions seeds was approximately 3.1 inches. Each sub-plot was 25 feet long and one bed (5 feet) wide. Borders beds were placed on each side of the sampling areas to avoid any cross contamination from irrigation treatments.

Irrigation water was delivered via drip lines (Netafim-8 mil,12” emitter-.16 gph). There were two drip lines per bed, spaced 12 inches apart and at a depth of 4 inches. Each drip line was equidistance from two onion rows (Figure 1). Throughout the season, both water sources were delivered in the same quantity and at the same time.

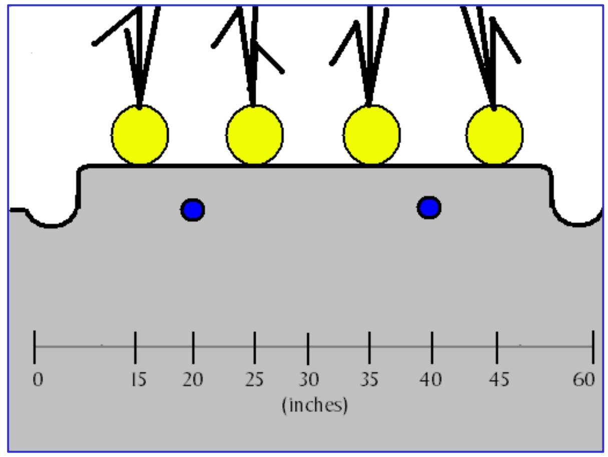

Figure 1: Planting and drip line configuration

A total of 28 irrigation events delivered 23.1 inches of water (depth per unit area) during the course of the season (Figure 2). Rainfall for the growing period was 10.5 inches. Irrigation timing and duration was based on weather data collected from a nearby electronic weather station, the need to enter fields for cultural operations, and estimated soil moisture content. All cultural practices were consistent with others used in Colorado (Schwartz and Bartolo, 1998) Soil samples were taken prior to planting, near bulbing (July 13th) and after harvest. Each time, samples were taken at two locations in

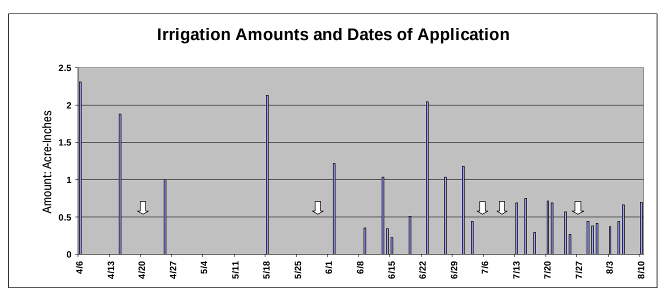

Figure 2: Irrigation amounts and dates of application of water delivered via drip. Arrows indicate rainfall events over 0.5 inches.

the bed: below the inside seed-row and in the middle of the furrow between the raised beds. Samples were taken at depths of 0-6", 6-12", 1-2', and 2-3'. Soil salinity was estimated by developing a curve comparing the saturated pasted extract with a 1:1 soil-water extract.

Onions were harvested August 29th and held in storage until grading on October 17. Marketable onion sizes were colossal (<4" diameter), jumbo (3 to 4" diameter), and medium (2 to 3" diameter). Onion yields were expressed as bags (one bag = 50 lbs) of fresh onion weight per acre.

RESULTS

Total marketable yield was lowered slightly (3.5%) but not significantly, when the yellow variety, 'Ranchero', was irrigated with the high EC water. The white (Cometa) and red (Red Bull) variety had a 19.8% and 19.2% decrease in total marketable yield, respectively, when irrigated with the high EC water (Figure 4). For 'Ranchero' and 'Cometa', the proportion of jumbo class onions (>3" in diameter) was significantly reduced. 'Red Bull' was comprised primarily of medium class onions (2-3" in diameter).

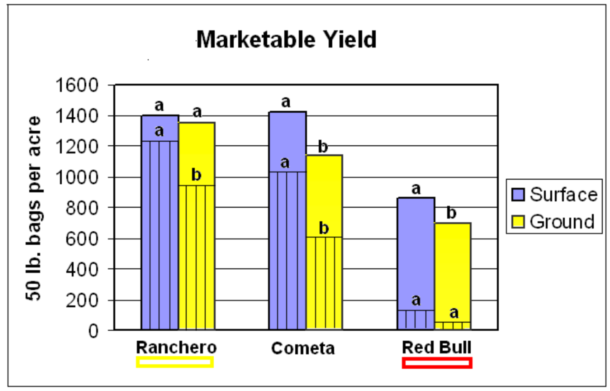

Figure 4: Total market (full bars) and jumbo class (hatched segments) yield of onion varieties grown with surface and well water. (DMRT: $p<0.1$)

Soil salinity was measured at three different times (prior to planting, near bulbing, and after harvest), two different locations in the production bed (furrow and inner seed row), and at four different depths (0-6", 6-12", 1-2', 2-3'). The soil salinity was generally uniform over the plot area prior to planting. Prior to planting, there were some areas of elevated salinity at depths of 2-3 feet. This phenomenon was likely due to previous cropping practices. Nonetheless, salinity was generally low (less than 1.5 ds.m-1) in the onion root zone (0-1 foot depth) prior to planting.

Near bulbing (July 13th), there were different levels of salinity in the production bed. Salinity levels generally reflected the salt content of the water sources (Figure 5). The highest salinity levels were detected at the surface layers and at outside of the production bed (furrow), near the edge of the wetting front.

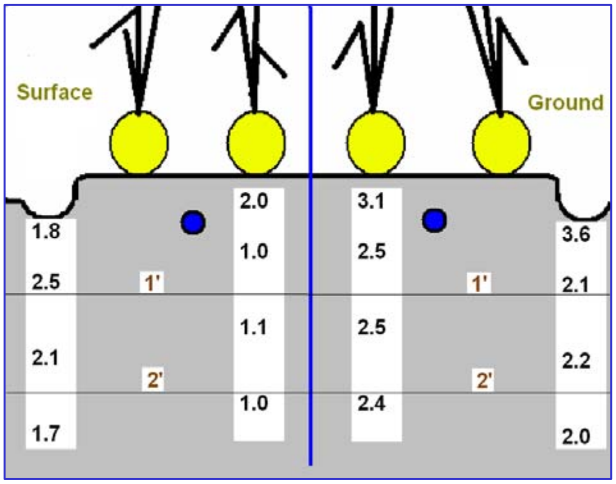

Figure 5: Electrical conductivity (in dS.m-1) of the saturated past extract (EC_e) of the soil measured at depths of 0-6", 6-12", 1-2', and 2-3" below the seed row and bed furrow. Samples were taken on July 13th.

CONCLUSIONS

As seen in past studies, onion response to high salinity in the Arkansas Valley of Colorado may not be as severe as those predicted by other studies; studies conducted with soils and waters more influenced by the presence of sodium salts. As a result, growers using groundwater may be able to manage salinity by choosing varieties that are more tolerant of salinity and irrigating with a sufficient volume of water to prevent excessive build-up of salt in the soil profile.

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Onion Insecticide Rotation Trial 2006

Whitney Cranshaw and Mike Bartolo

The trial was established at the Colorado State University Arkansas Valley Research Center (AVRC) at Rocky Ford, CO. Onions ('Cometa') were seeded to quadruple-row beds at 5-ft centers and individual plots consisted of a single bed 15-ft in length. Experimental design was a completely randomized design with 4 replications.

Treatments involved repeat applications of one of three insecticides (Agri-Mek, 10 fl oz/A; Lannate LV 3 pts/A, Warrior with Zeon Technology, 3.84 fl oz/A) in continuous sequence or alternated with another insecticide. Applications were made with a hand-operated compressed air sprayer delivering ca 51 gal/A. Four applications were made May 23, May 31, June 12 and June 23. Evaluations following the first application consisted of counting the number of thrips from 50 plants collected from plots treated with either Agri-Mek, Lannate, Warrior or the untreated check and washing the thrips from the plants in ethanol for species determination. Subsequent evaluations were made by counting all thrips on 10 plants in the center of each plot. In each of the latter 3 evaluations a sample of 25 plants was collected from the plots with continuous Agri-Mek, Warrior, Lannate or the check plots to determine the species present.

	Ratio of *Thrips tabaci*: *Frankliniella schultzei*			
	30 May	13 June	23 June	7 July
Agri-Mek each treatment period	86:14	62:38	20:80	96:4
Lannate each treatment period	78:22	20:80	0:100	92:8
Warrior each treatment period	85:15	66:34	66:34	93:7
Untreated Check	85:15	54:46	66:34	94:3

Insecticide Treatment Schedule[2]	Thrips/ 50 plants 30 May	Thrips/10 plants[1] 12 June	Thrips/10 plants[1] 23 June
Agri-Mek each treatment period	180	135.3	61.0 b
AgriMek-Lannate- AgriMek - Lannate		131.0	56.8 b
AgriMek-Warrior-AgriMek-Warrior		78.5	60.3 b
Lannate each treatment period	146	111.8	42.3 b
Lannate-AgriMek-Lannate-AgriMek		111.8	41.3 b
Lannate-Warrior-Lannate-Warrior		120.8	40.3 b
Warrior each treatment period	71	117.5	51.8 b
Warrior-Lannate-Warrior-Lannate		107.5	58.5 b
Warrior-AgriMek-Warrior-AgriMek		99.3	73.8 b
Untreated Check	186	138.0	160.3 a

[1] Numbers in a column not followed by the same letter are significantly different (P = 0.05) by SNK (12 June - F = 0.68; Pr > F 0.7177; 23 June - F = 9.05, Pr > F < 0.001).

[2] Rate of use were Agri-Mek, 10 fl oz/A; Lannate LV 3 pts/A, Warrior with Zeon Technology, 3.84 fl oz/A). Applications were made May 23, May 31, June 12 and June 23.

Onion Insecticide Trial 2006

Whitney Cranshaw and Mike Bartolo

Trials were established at the Arkansas Valley Research Center in Rocky Ford, Colorado on seeded onions ('Cometa') established in 4-row beds on 60-in centers. Plots were single bed, 15-ft in length and plots were arranged in completely randomized design with 4 replications. Initial treatments were applied May 31. Foliar treatments were applied in a compressed air sprayer delivering 49.8 gal/A. Straw mulch was applied at a rate of approximately 1/8 bale/plot (72.6 bales/A). Foliar treatments were reapplied June 13 after the initial evaluation. Evaluations were made by counting thrips on 10 plants in the center of a plot. The thrips species present in adjacent untreated onions were a mixture of *Thrips tabaci* and *Frankliniella schultzei* in approximate ratio of 54:46 and 66:34 on the two evaluation dates.

		Thrips/10 plants[1]		
Insecticide and Rate	Adjuvant	13 June	23 June	19 July
Untreated Check		134.3	157.3 a	66.8
Warrior 3.84 fl oz		85.0	60.0 b	
Mustang Max 4 fl oz		95.3	77.3 b	
Lannate LV 1.5 pts		137.8	61.5 b	
BYI - OD 8 oz	0.1% v:v Kinetic	90.8	55.3 b	
BYI - OD 12 oz	0.1% v:v Kinetic	85.8	61.0 b	
BYI - SC 5 oz	0.25% MSO	119.2	76.8 b	
BYI - SC 5 oz	0.2% Activator	84.8	73.5 b	
BYI-SC 5 oz	0.1% Kinetic	101.8	84.3 b	
Assail 70W 1.5 oz		134.5	107.0 ab	
Mulch - straw 1/8 bale per plot		71.8	87.2 b	76.3
Success 10 fl. oz.		143.3	74.3 b	
Carzol 80SP 1.0 lb		88.0	36.0 b	
Agri-Mek 10 fl oz		120.8	61.5 b	
BYI - OD 12 fl. oz		101.8	144.8 a	

1 Numbers in a column not followed by the same letter are significantly different (P = 0.05) by SNK (June 13 F = 1.71; Pr > F 0.0866; June 23 F = 4.30, Pr > F < 0.0001).

Effect of AgriBlend (Polymer) Treatment on Drip-Irrigated Onions

Jim Valliant and Mike Bartolo
Colorado State University, Arkansas Valley Research Center, Rocky Ford, CO

Irrigation Method	Treatment	Jumbos 3" - 4" %	Mediums 2 ¼" – 3 "	Total Market Weight CWT/A
Drip Irrigation	Control	76	24	737.3
	AgriBlend	77	23	775.9
LSD = 0.1	NS	NS	NS	NS
Agriblend is a combination of 40 % Cross-linked Polymer, 60% Zeolite				

Plots – Each plot was two beds wide (5 feet) and 25 feet long. Each bed had two rows spaced 10 inches apart on top of the bed with in-row spacing between plants of ~ 3 inches. Eight bed feet (8 feet x 1 row) was harvested for yield and grade. Each treatment had four replications.

AgriBlend Application – The polymer/Zeolite blend was broadcast in a band over the seed row on March 2, 2006, prior to planting, at the rate of 30 pounds per acre and incorporated with a cultivator.

Planted – Ranchero – Nunhems Seeds variety was planted March 3, 2006 on both the untreated control plots and the AgriBlend plots.

Drip-Irrigation System – All plots had a drip line placed 4-5 inches below the surface in the middle of the bed. Both the untreated control and the AgriBlend treated received equal amounts of irrigation.

Harvested and Grade- September, 2006

Discussion – These results indicate there was no effect on onion yield or quality when AgriBlend was incorporated into the soil in the seed row just prior to planting as compared to the untreated control.

Effect of AgriBlend (Polymer) Treatment on Furrow-Irrigated Onions under Full and Limited Irrigation.

Jim Valliant and Michael Bartolo
Colorado State University, Arkansas Valley Research Center, Rocky Ford, CO

Irrigation Method	Treatment	Jumbos 3" - 4" %	Mediums 2 ¼" – 3 "	Total Market Weight CWT/A
Full Irrigation	Control	62	38	644.7
	AgriBlend	58	42	560.3
Limited Irrigation	Control	56	44	614.2
	AgriBlend	59	41	612.0
LSD = 0.1		NS	NS	NS
AgriBlend is a combination of 40% Cross-linked Polymer, 60% Zeolite				

Plots – Each plot was two beds wide (5 feet) and 25 feet long. Each bed had two rows spaced 10 inches apart on top of the bed with in-row spacing between plants of ~ 3 inches. Eight bed feet (8 feet x 1 row) was harvested for yield and grade. Each treatment had four replications.

AgriBlend Application – The polymer/Zeolite blend was broadcast in a band over the seed row on March 2, 2006, prior to planting, at the rate of 30 pounds per acre and incorporated with a cultivator.

Planted – Ranchero (Nunhems Seeds), a yellow-skinned onion variety was planted March 3, 2006 on both the Full and Limited Irrigation areas.

Harvested and Grade- September, 2006

Discussion – Both the Full and Limited irrigation were irrigated the same until late in the growing season and then above average rainfall was received during August. There was still some reduction in yield on the limited irrigation area because of the elimination of the late season irrigation. There was no significant difference in the yield of onions due to the application of AgriBlend in this trial.

Tomato Virus Control Trial

Mike Bartolo and Whitney Cranshaw
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In the Arkansas Valley and other parts of Colorado, tomatoes often face pest pressure that can severely reduce fruit yield and quality. In recent years, extremely high incidences of viral diseases have severely reduced tomato stands. Some growers have reported over 50% stand losses. Several viral diseases have been known to infect tomatoes in the state. Probably the most common is *Curly Top,* with the curly top virus (CTV) as the causal agent. The CTV is vectored by the beet leafhopper which has numerous hosts in addition to tomato. In other parts of the country, conventional insecticide applications have not been effective in controlling the beet leaf hopper and subsequently, the spread of the CTV.

This study was conducted to determine the effect of alternative measures for the control of CTV. The percentage of plants showing disease infection was recorded at fruit maturity.

During the 2006 season, insect infestation and disease pressure were extremely low. Overall, there were no significant differences in treatments. Nonetheless, application of the systemic insecticide, *Admire*, via the transplant plug tray proved to be a relatively easy and low cost way to provide in-field protection to the tomato seedlings. The plant defense activator, *Actigard*, and *methyl jasmonate* caused moderate to severe phytotoxic effects, respectively, when applied to the foliage of transplants while still in the plug tray. A reflective silverized mulch (ReflecTec) did not have any negative effects on plant growth and development relative to a conventional black plastic mulch.

Methods

This study was conducted at the Arkansas Valley Research Center in Rocky Ford. Beds, 45 inches wide and 60 inches between centers, were shaped in early April. Drip lines were placed down the center of the bed at a depth of 2 inches. The beds were covered with black embossed plastic mulch (Mechanical Transplanter) or a silverized-reflective mulch (ReflecTec) on May 8th using a one-bed mulch layer.

Six-week-old transplants were set through holes in the plastic mulch in a single row down the center of the bed on May 23rd . The distance between plants was 18 inches. Each plot was three beds wide (15 feet) and 27 feet long and was replicated four times. There were a total of 54 plants in each plot.

The experiment was designed as a randomized complete block with the following nine treatments:

1. Untreated control tomatoes grown in black plastic mulch.
2. Tomatoes grown in “Repelgro” silverized reflective mulch (Reflec Tec).
3. Tomatoes treated with Admire (Bayer Corp.) insecticide. Insecticide was drenched around the base of the transplants 3 days prior to transplanting at a rate of 2 fluid ounces per acre.
4. Tomatoes treated one time with Actigard 50WG (Syngenta Crop Protection). . Product was applied to the transplants in the plug tray with a foliar mister until run-off occurred. Application rate 0.5 oz per acre and was applied 3 days prior to transplanting.
5. Tomatoes treated one time with methyl jasmonate . Material was applied to the transplants in the plug tray with a foliar mister until run-off occurred. Application rate concentration was 10mM and was applied 3 days prior to transplanting.
6. Conventional application of *Provado* insecticide applied June 1.
7. Conventional application of *Asana* insecticide applied June 1.
8. Tomatoes treated with *Admire* (Bayer Corp.) insecticide. Insecticide was drenched around the base of the transplant on June 12th at a rate of 24 fluid ounces per acre. Each plant received 100 ml of drench solution.
9. Combination of Treatments 2 and 3.

Disease symptoms were evaluated on August 15th . Plant infection was categorized as having slight infection (some leaf curling but still somewhat healthy plant) or obvious infection (severe leaf curling, plant yellowing, and stunting). It should be noted that the symptoms of “slight infection” are similar to those caused by other environmental stresses.

Percent tomato plants exhibiting signs of infection with Curly Top Virus on August 15th observation date.

Treatment	% Plants Showing Slight Infection	% Plants Showing Obvious Infection
1. Control	6	1
2. Silver Mulch	7	<1
3. Admire: Transplant Drench	<1	<1
4. Actigard	3	<1
5. Methyl Jasmonate*	5	2
6. Provado	5	<1
7. Asana	5	2
8. Admire: In-Field Drench	5	0
9 . Silver Mulch + Admire	6	1

* Plants treated with methyl jasmonate were of poorer quality for the entire season. They did not fully recover from the initial treatment.

Pepper Growth Regulator Trial

Michael Bartolo
Arkansas Valley Research Center
Colorado State University

Chile peppers are an important specialty crop in the Arkansas Valley and improving the yield and quality is a constant goal of producers. In some instances, growth regulators have been shown to enhance yields and quality by altering plant metabolism and architecture. This study was conducted to examine the response of peppers to commercially available formulation of growth regulators.

Overall, the applied materials did not significantly improve yields compared to an untreated control. In addition, there was no effect on quality as measured by average pod weight.

MATERIALS AND METHODS

An established long green chile pepper (var.Sonora) field located at the Arkansas Valley Research Center was used in this study. Peppers were treated three times, on the following dates: 8-8-06, 8-22-06, and 9-5-06. Applications were in the form of a foliar spray (in 30 gal/acre) water. The crop was harvested on 10-3-06. Fresh weights and pod characteristics were taken at harvest.

RESULTS

Treatment	Rate Per Acre	Average Weight of Pods (oz)	Fresh Weight Yield lbs per acre
AGM 04013	1 qt.	3.32 a	13,576 a
AGM 06018	1 qt.	3.24 a	12,153 b
AGM 04024	3.2 oz	3.53 a	13,387 ab
AGM 06016	3.2 oz	3.56 a	13,953 a
AGM 04035	2 oz.	3.34 a	12,835 ab
AGM 04027	8 oz.	3.34 a	12,763 ab
AGM 04013 + AGM 04024	1 qt. + 3.2 oz	3.39 a	13,706 a
AGM 06018 + AGM 06016	1 qt. + 3.2 oz	3.32 a	13,300 ab
Untreated Control	-	3.52 a	13,605 a
lsd(0.1)		0.34	1,386

This work was generously supported by Agriliance LLC under the direction of Mr. Joe Bush.

Processing Crops Trial

Mike Bartolo
Arkansas Valley Research Center
Colorado State University

These studies were conducted to examine the yield and quality of peas and green beans grown for commercial processing in the Arkansas Valley. Both crops were grown on conventional 30 inch rows and were irrigated via gravity-flow furrows. Other cultural practices are denoted below:

PEAS

Planting Date: April 10, 2006

Seeding Rate: 100 lbs per acre

Variety: "Recruit" (Pureline Seeds)

Irrigation Dates: April 10, May 1, May 17, June 5

Pesticide Applications: None

Harvest Date: June 15, 2006

Yield and pod characteristics of processing-type peas

Weight (lbs) of Fresh Pods per Acre	Weight (lbs) of Shelled Peas per Acre	Average Number Peas per Pod
9111	4936	6.95

* Average of three replications

Percentage of shelled peas per sieve size.

Sieve Size	**1**	**2**	**3**	**4**	**5**	**6**
Percent	6.7	31.1	56.6	5.5	0.0	0.0

GREEN BEANS

Planting Date: June 13, 2006

Seeding Rate: 80 lbs per acre

Variety: "Igloo" (Pureline Seeds)

Irrigation Dates: June 15, June 25, July 18, August 1

Pesticide Applications: None

Harvest Date: August 24, 2006

Weight (Lbs) of Fresh Beans per Acre
17,859

* Average of three replications

Percentage of green beans per sieve size.

Sieve Size	1	2	3	4	5	6
Percent	3.0	3.8	40.1	44.2	7.9	0

Confectionary Crops Trial

Mike Bartolo and John Pepe
Arkansas Valley Research Center and
Frontier Seeds

These studies were conducted to examine the growth characteristics, yield, and quality of sunflower, flax, edamame, pumpkin seeds, and peanuts as specialty crops for the confectionary market. All crops, with the exception of pumpkins, were grown on conventional 30 inch rows and were irrigated via gravity-flow furrows. The pumpkins were grown on 60 inch beds and were irrigated via drip lines. Other cultural practices are denoted below.

Sunflower

Planting Date: June 13, 2006

Plant Population: ~ 27,000 plant per acre

Varieties: 777C, 767C, 707CLS (Triumph Seeds)

Irrigation: Via furrows every-other row (4 X)

Pesticide Applications: None

Harvest Date: September 28, 2006

Variety	% Moisture	Bu wt (lbs.bu)	Yield (bu/a)
767C	5.62	24.9	213.9
707CLS	5.54	21.8	183.6
777C	5.58	23.5	164.9

* Average of five replications

Flax

Planting Date: April 10, 2006

Seeding Rate/ Configuration: ~ 50 lbs per acre
2 rows seeded on a 30" bed

Varieties: Carter, Omega, York, Pembrina

Irrigation: 5 times via 30" furrows

Pesticide Applications: None

Harvest Date: September 14, 2006

Variety	% Moisture	Bu wt (lbs.bu)	Yield (bu/a)
Carter	9.74	53.12	26.8
Omega	9.78	54.42	18.9
York	9.92	53.3	23.0
Pembrina	9.78	50.9	23.8

* Average of four replications

Edamame

Planting Date: June, 13 2006

Seeding Rate/ Configuration: ~ 80 lbs/acre
Single line/30" bed

Varieties: Early Hakucho, SE-4, Midori Giant

Irrigation: 5 times

Pesticide Applications: None

Harvest Date: September 20, 2006

Variety	% Moisture	Bu wt (lbs.bu)	Yield (bu/a)
Early Hakucho	10.1	55.9	30.4
SE-4	11.3	56.3	44.4
Midori Giant	14.5	54.5	53.1

* Average of four replications

Notes: Estimated shattering at harvest was accounted for in yield and was an indicator of harvest maturity. (Early Hakucho= 50%, SE-4 = 25%, Midori Giant = 10%)

Pumpkin

Planting Date: June, 13 2006

Seeding Rate/ Configuration: 2 seeds/hill, hills spaced 3' apart on top of 60" beds. (Some reseeding due to poor germination)

Varieties: Triple Treat (vine), Snack Jack (bush)

Irrigation: Multiple times via drip

Pesticide Applications: *Asana* for squash bug and cucumber beetle

Harvest Date: September 22, 2006

Variety	Fruit # per plant	Seed lbs / fruit	Seed lbs / plant	Yield bu/a*
Triple Treat	2.60	0.051	0.131	18.2
Snack Jack	2.88	0.073	0.208	29.0

Averaged over 46 plants (TT) and 145 plants (SJ), * 40 lbs per bushel

Peanut

Planting Date: April 25, 2006

Varieties: Valencia A, Valencia C, Valencia 136, Pronto, TAM Span-90

Irrigation: 7 times

Pesticide Applications: None

Harvest Date: October 20, 2006

Variety	Plot Yield (lbs)	Yield (lbs/a)
Valencia A	16.5	4791.6
Valencia C	17.7	5140.0
Valencia 136	16.4	4762.5
Pronto	16.4	4762.5
TAM Span-90	18.9	5488.5

* Average of three replications

Update on the Construction of the Weighing Lysimeter in the Arkansas Valley

Mike Bartolo, Dale Straw, and Bret Schafer

In 2004, plans were implemented to construct a large weighing lysimeter in the Arkansas Valley. Ultimately, the lysimeter will address the longstanding issues raised in Kansas v. Colorado over crop water use. More specifically, the lysimeter will be used to validate the Penman-Monteith method for assessing crop evapotranspiration and develop crop coefficients for various crops grown in the Valley.

To insure that the lysimeter was successfully designed, constructed and put into use, the Colorado Division of Water Resourses, Colorado State University, and USDA-ARS formed a multi-person team to bring the project to fruition. Thomas Marek, Texas A&M University, designed the lysimeter based on others that were operating in Texas.

The actual design and construction of the lysimeter involved a number of activities, most notably, the hard work and dedication of many individuals. This report is intended to highlight a few of the steps in the construction process.

One of the first tasks of the lysimeter project was to choose a site that was representative of the Arkansas Valley. A logical choice was CSU's Arkansas Valley Research Center, centrally located one mile east of Rocky Ford. At the Research Center location, a large enough field was needed (10 acres minimum) to adequately allow for a crop border around the lysimeter. Once the field and site location were determined, a thorough evaluation of the soil structure and depth to ground water was conducted (Figure 1).

Figure 1

One of the more critical phases of the entire project was the design and construction of the metal housing components (inner and outer tanks) of the lysimeter. Fabrication of the large metal structures was primarily done at the USDA-ARS shop in Fort Collins. Once completed, the components were transported to Rocky Ford for further assembly and installation.

The acquisition of the monolith (filling the inner tank with soil) was a major step that involved first, securing anchors to the bedrock and second, pushing the tank into the soil via heavy duty hydraulic jacks (Figure 2). This technique was employed to maintain the integrity of the existing soil structure. Notably, the acquisition site was located several hundred feet from the final lysimeter site to avoid excessive soil compaction.

Figure 2

Once the monolith was acquired, pipes were bored beneath the inner tank (Figure 3) to hold the soil in place and

Figure 3

secure the tank for lifting. The inner tank, now weighing 45 tons, was then lifted and inverted (Figure 4) so that a drainage system could be installed (Figure 5).

Figure 4

Figure 5

Figure 6

At the actual site of the lysimeter, the foundation that would seat the outer tank was secured and poured (Figure 6). Once in place, the outer tank was fitted and secured to the foundation and the scale (Figure 7) and other interior components installed.

Figure 7

Next, using heavy duty cranes, the monolith was re-inverted, transported to the lysimeter site, and carefully placed inside the outer tank (Figure 8). Other

Figure 8

fitted metal components, collectively termed the “top hat”, were welded in place to complete the tank structure and make it watertight (Figure 9). Electricity and communication lines were run to the site and inside the lysimeter. Then, electrical outlets, phone

Figure 9

lines and data loggers (Figure 10) were installed. After additional groundwork, the load cell on the lysimeter scale was calibrated (Figure 11) using a series of weights. As of November of 2006, the lysimeter was recording data.

Figure 10

Figure 11

During the upcoming fall and winter, additional ground preparation will take place. In spring 2007, the lysimeter and surrounding field will be planted with a spring grain and thereafter, fall-seeded alfalfa. The current plan is to maintain the alfalfa for three to four years during which time a second smaller "reference" lysimeter will be constructed and planted to a reference crop (alfalfa). Eventually, other crops will be grown on the main lysimeter and their respective crop coefficients determined.

North-Facing View of Lysimeter