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Department of Horticulture and Landscape Architecture
Arkansas Valley Research Center
Extension

Arkansas Valley Research Center 2008 Reports

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Cover: Dr. Ardell Halvorson reporting research results at the 2008 Field Day.

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TABLE OF CONTENTS

FIELD CROPS

VEGETABLE CROPS

SPECIAL PROJECTS

Alfalfa Variety Performance Test at Rocky Ford - 2008

Michael E. Bartolo, Abdel Berrada, and Jerry Johnson

Summary

The 2008 results of Colorado State University's alfalfa variety test at Rocky Ford are presented below in Table 1. Plots were planted on August 10, 2007 and data for 2008 are for the first year of a three-year testing period. The field was furrow irrigated and appropriate measures were taken to maintain the plots in a pest-free condition. The summer of 2008 was initially much cooler than normal and as a result, harvests were delayed. Normally, alfalfa is cut four times during the season in the Arkansas Valley. However, due to the lateness of the crop, a fourth cutting was not warranted in 2008.

Table 1. Forage yields of 15 alfalfa varieties at the Arkansas Valley Research Center in Rocky Ford in 2008.

Variety	Source	1st Cutting 6-12-08	2nd Cutting 7-22-08	3rd Cutting 9-2-08	Total 2008
		---------------- tons per acre ----------------			
FSG 5285F	Allied Seed	2.58	2.41	1.80	6.80
5454	Pioneer	2.47	2.27	1.85	6.61
Magnum VI	Dairyland Seed Co., Inc.	2.20	2.48	1.80	6.49
Masterpiece	JR Simplot Co	2.02	2.57	1.84	6.44
Medalist	Intermountain Farmers Assoc.	2.17	2.46	1.78	6.41
LegenDairy 5.0	Croplan Genetics	2.33	2.33	1.71	6.37
PGI 424	Producer's Choice	2.15	2.33	1.85	6.34
Oneida	Cornell University	2.23	2.32	1.78	6.34
WL 363HQ	W-L Research	2.16	2.34	1.83	6.34
Lariat	JR Simplot Co	2.11	2.24	1.87	6.22
Ameristand 407TQ	America's Alfalfa	2.31	2.20	1.80	6.22
Integra 8400	Wilbur-Ellis Company	2.17	2.29	1.75	6.22
CW 500	Producer's Choice	2.05	2.29	1.82	6.17
Vernal	USDA-WI AES	2.14	2.18	1.77	6.10
WL 343 HQ	W-L Research	2.15	2.21	1.67	6.03
Average		2.22	2.33	1.79	6.34
CV (%)		14.48	6.61	7.36	6.85
LSD (0.1)		0.38	0.18	0.15	0.51

Yields were calculated on an air-dry basis.

Site Information:

Elevation 4178 ft
Soil: Rocky Ford Silty Clay Loam
Precipitation - April 1, 2008 to Sept 30, 2008 = 7.92 inches
Last Spring Frost - May 4, 2008 / First Fall Frost – October 19, 2008

Winter Wheat Variety Trial

Abdel Berrada, Jerry Johnson, and Scott Haley

Variety	Yield	Test Weight	Height	Heading days different from trial average*
	bu/ac	lb/bu	inch	days +/- from 5/30/08
CO03W239	99.5	58.0	32	0
CO04575	96.7	61.3	32	-1
NuDakota	96.6	58.7	33	-1
Prairie Red	93.8	60.2	31	-1
TAM 111	91.9	60.5	34	2
Jagalene	90.3	60.4	32	2
CO04W210	89.7	58.9	31	1
CO03W054	89.4	59.0	33	1
CO04551	89.1	59.1	33	-1
CO04499	89.1	60.6	35	0
CO04549	88.9	60.4	32	-2
Keota	88.6	60.2	33	1
Bond CL	88.2	58.5	33	-1
TAM 112	88.0	61.2	33	-1
Hatcher	87.7	59.7	35	1
CO04448	85.4	59.3	34	2
Aspen	85.0	59.6	33	-1
Bill Brown	84.3	58.1	35	0
CO04W320	83.6	58.5	33	1
Hawken	81.6	60.5	33	0
CO04393	81.0	59.7	33	0
CO04W323	80.0	58.8	33	1
Yuma	79.6	57.4	33	0
CO04025	79.5	59.4	31	-1
CO04W369	79.4	58.5	33	1
CO03W139	79.3	58.1	32	-1
CO03064	78.0	57.3	33	1
Camelot	77.6	59.8	35	-1
OK05737W	76.8	59.1	33	0
Ok Rising	76.4	58.9	33	-1
Anton	75.9	60.7	33	0
CO02W237	73.3	58.4	33	1
Average	85.1	59.3	33	5/31
$LSD_{(0.30)}$	7.2	0.7	1	

Date of Planting: 9/20/2007 *Date of Harvest: 7/8/2008*

Irrigated Winter Canola Variety Trial at Rocky Ford, CO – 2008

Abdel Berrada, Jerry Johnson, and Jim Valliant
Arkansas Valley Research Center

Variety	Yield lbs/a	Yield % of test ave.	Winter Survival %	Fall Stand 0 - 10	Bloom day	Mat-urity day	Plant Ht. in	Shatter %	Moist. %	Test Wt. lbs/bu	Oil %
CWH095	2738	164	100	9.4	118	181	50	0.7	7.7	41.3	34.3
Kronos	2688	161	100	8.6	119	180	50	3.8	9.1	38.5	33.3
Dimension	2524	151	99	9.2	116	183	46	1.2	10.4	40.7	34.8
Hybrisurf	2497	150	100	9.0	115	181	46	1.5	8.7	40.5	39.0
CWH111	2249	135	100	8.9	115	187	45	0.8	12.0	38.4	33.3
HyClass 110W	2169	130	100	9.4	115	181	47	0.8	9.9	42.6	32.6
KS3254	2163	130	100	9.1	121	181	49	0.8	10.3	45.2	34.4
Ceres	2146	129	99	8.8	121	181	44	1.7	9.3	41.8	35.4
HyClass 115W	2110	126	100	9.0	115	180	48	0.8	10.4	40.7	33.0
ARC2180-1	2087	125	99	8.9	118	184	47	2.2	7.1	35.2	35.0
Sitro	1977	119	100	9.1	116	183	47	0.5	10.2	37.3	35.4
KS3302	1964	118	100	9.2	116	183	44	0.8	7.9	40.0	34.4
KS4158	1941	116	100	9.3	118	181	44	1.2	7.4	39.4	37.2
Visby	1934	116	100	9.0	115	181	45	0.5	7.5	40.0	34.2
Rally	1928	116	100	9.0	117	183	47	0.3	6.8	41.5	35.9
Hornet	1900	114	100	9.0	117	181	51	0.3	8.8	39.2	33.6
DKW13-69	1887	113	100	9.5	119	182	46	1.3	10.3	44.6	36.4
CWH081	1887	113	100	8.5	119	179	47	0.5	11.0	40.1	32.1
Wichita	1884	113	100	8.6	116	180	44	0.5	9.2	39.4	36.0
ARC97018	1873	112	100	9.3	119	179	50	0.8	9.7	43.2	34.2
DKW47-15	1851	111	100	9.0	117	181	46	0.5	8.6	41.9	36.4
DKW45-10	1846	111	100	9.0	115	180	44	1.0	8.0	44.6	34.4
KS3132	1767	106	100	8.9	119	180	48	0.7	8.7	39.1	34.3
KS9135	1761	106	100	8.9	118	179	50	1.0	9.8	40.4	33.7
Hybridgold	1744	105	100	8.8	115	185	43	0.7	11.9	39.9	35.4
HyClass 154W	1740	104	100	8.9	119	181	48	0.5	11.1	40.9	32.5
Flash	1680	101	96	9.2	118	184	46	0.3	6.6	38.4	35.6
Kadore	1659	99	100	9.3	119	182	41	0.8	9.2	37.2	34.0
KS4022	1650	99	100	8.4	118	181	43	0.7	8.3	38.8	34.8
KS7436	1611	97	100	9.3	119	181	44	0.7	8.7	42.4	36.8
ARC98015	1610	96	100	8.8	119	182	47	0.8	8.8	39.5	33.5
KS3037	1603	96	100	8.7	118	179	44	0.7	9.4	41.5	36.3
CWH116	1570	94	100	9.0	118	181	42	1.2	7.2	42.0	35.3
CWH633	1540	92	100	8.7	116	181	41	0.7	7.6	37.9	33.0
Safran	1534	92	100	8.7	117	183	44	0.3	8.7	40.8	34.1
ARC97019	1533	92	100	8.8	120	179	49	1.5	8.6	42.4	33.4

Variety	Yield lbs/a	Yield % of test ave.	Winter Survival %	Fall Stand 0 - 10	Bloom day	Mat-urity day	Plant Ht. In	Shatter %	Moist. %	Test Wt. lbs/bu	Oil %
Virginia	1504	90	100	9.3	120	178	44	0.3	8.3	42.2	32.3
DKW46-15	1474	88	99	9.0	117	178	45	0.5	8.4	41.6	34.9
Baldur	1462	88	100	8.6	115	182	46	1.3	8.1	40.0	33.3
Hybristar	1448	87	99	8.9	116	183	42	0.2	8.8	36.8	34.4
Abilene	1432	86	100	8.8	119	178	45	0.8	10.3	41.5	33.0
KS3018	1420	85	100	9.3	117	180	48	1.0	10.9	37.1	34.9
HyClass 107W	1419	85	100	8.3	119	186	43	0.7	8.9	38.6	32.3
Forza	1383	83	97	9.2	118	182	40	0.3	9.9	39.9	36.6
DSV07100	1377	83	100	9.3	118	185	45	0.8	7.7	43.1	34.6
BSX-501	1376	82	100	8.9	117	180	46	0.5	10.8	41.8	34.6
KS4085	1374	82	100	9.0	117	183	44	0.5	8.1	43.0	35.7
ARC98007	1367	82	100	8.5	119	183	46	0.8	6.9	40.6	35.6
Satori	1290	77	99	9.3	119	183	40	0.5	6.6	41.2	34.1
Summer	1258	75	99	7.8	115	182	40	1.3	9.1	38.9	34.4
BSX-567	1161	70	100	8.8	117	180	41	0.7	8.3	36.0	34.8
Taurus	1145	69	100	8.9	116	180	45	0.7	11.2	38.8	35.4
KS3074	1064	64	100	8.8	118	178	39	0.7	8.0	40.8	32.4
DKW41-10	1037	62	100	8.8	116	183	39	0.5	6.9	38.5	32.4
Jetton	1028	62	73	5.0	120	187	43	1.7	9.1	35.9	33.8
NPZ0791RR	823	49	99	8.8	115	186	38	0.7	10.3	40.0	32.9
Plainsman	125	7	78	3.3	123	190	46	2.2	13.6	39.8	32.1
MEAN	1668	-	99	8.7	118	182	45	0.9	8.9	40.1	34.4
CV	34	-	2	5.3	8	1	7	86.9	22.9	9.1	3.9
LSD	909	-	3	0.8	1	3	5	1.2	NS	NS	2.7

Bloom is recorded as the date after January 1 when 50% of plants have one or more open flowers. Maturity is recorded as the date after January 1 when 90% of plants have reached mature color.

Planted: 8/31/2007 at 5 lbs/a
Harvested: 7/21/2008
Herbicides: Trifluralin 1.5 pt/a, Poast 1.5 pt/a
Insecticide: Warrior 3.8 oz/a
Irrigation: 5 applications via gravity-flow furrows
Fertilizer: 84.5-78-0 lbs N-P-K in fall and 68-0-0 lbs N-P-K in spring

Irrigated Corn Variety Performance Test at Rocky Ford - 2008

Jerry Johnson, Michael E. Bartolo, and Jim Hain

Hybrid	Yield [2]	Grain moisture	Test weight	Plant height (top of the tassel)	Population density	Silking date[3]
	bu/ac	%	lb/bu	in	plants/ac	
Croplan 6818 VT-3	272.0	21.3	56.3	110	34122	198
Croplan 7505 VT-3	253.3	20.3	57.7	106	37026	198
Triumph 1536VT3	247.3	19.3	56.8	106	35574	198
Dyna-Gro Seed 57V07 VT3	244.4	19.4	56.4	107	35574	198
Dyna-Gro Seed 57B94 RR2/YGPL	243.5	19.2	57.0	102	33396	198
Mycogen Seeds 2T789	238.3	19.9	56.4	110	32670	199
Mycogen Seeds 2T804	236.1	17.5	57.0	103	29040	197
LG Seeds LG2619VT3	232.3	18.9	56.2	103	34122	199
Mycogen Seeds 2C727	232.3	17.4	56.4	102	33396	198
Mycogen Seeds 2K718	231.9	17.6	56.9	105	33396	199
Dyna-Gro Seed 57V21 VT3	230.5	19.3	56.3	103	26862	199
Croplan 6831 TS	221.0	19.1	57.2	105	32670	198
Triumph 1608VT3	220.4	19.6	55.5	106	29040	198
Dyna-Gro Seed CXO8514 YGCB	219.8	18.5	56.5	104	29766	199
LG Seeds LG2641VT3	218.8	18.1	55.7	104	34122	198
Croplan 6150 VT-3	200.2	17.7	58.3	106	29040	199
Average	233.9	18.9	56.7	105	32489	198
$LSD_{0.30}$	14.3					
$LSD_{0.05}$	27.7					

[1]Trial conducted at the Arkansas Valley Research Center; seeded 04/30/2008 and harvested 10/31/2008.

[2]Yields corrected to 15.5% grain moisture.

[3]Julian date, 70% silking.

Plot size: 5' x 30' with 30" spacing.

3 replications.

Irrigation: furrow.

Fertilization: 200 lbs of 11-52-0 acre^{-1}; 180 lbs of N acre^{-1} (as anhydrous ammonia).

Herbicide: Clarity at 16 oz acre^{-1} and Starane at 0.5 pt acre^{-1}.

Insecticide: Comite II at 36 oz acre^{-1}.

Corn Glyphostate Antagonism Trial

Michael Bartolo
Arkansas Valley Research Center
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Corn used for grain or silage is an important crop in the Arkansas Valley and other regions of the state. The majority of the corn grown in the Arkansas Valley is genetically-modified and often contains resistance to the herbicide glyphosate. Glyphosate-resistant or “Round-up Ready” corn has proven to be an important component of a successful weed control program. Although glyphosate is a valuable tool in corn production, there has been some concern that, under certain circumstances, glyphosate applications may depress yields. Because of this potential, this study was conducted to determine the effect of glyphostate applications on corn grain yield on two different corn hybrids. In addition, the effects of a commercially available foliar fertilizer, sprayed in conjunction with glyphosate, were also assessed.
Overall, there was not a significant (p=0.1) decrease in grain yield by the application of glyphosate compared to an unsprayed control. Conversely, the unsprayed controls had lower yields in both varieties. The addition of a commercially available foliar fertilizer did not improve yields when applied in combination with glyphosate. However, when sprayed alone, the foliar fertilizer did improve yield above the unsprayed control.

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 2008. The Center is located near Rocky Ford, Colorado. The plot area had previously been in corn during 2007. Two corn hybrids CROPLAN 6818 (114 days) and CROPLAN 4421 (100 days) were planted on April 30, 2008 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). Four spray treatments were applied to both varieties on June 11 and June 25 at the V3 and V7 stage of corn development, respectively. The treatments were:

1. Unsprayed control plus hand-weeding

2. Glyphosate (Cornerstone Plus) at 32 oz (1 lb A.I.) per acre plus Ammonium Sulfate-AMS (Class Act) at a rate of 2.5 gal/100 gal
3. Glyphosate (Cornerstone Plus) at 32 oz (1 lb A.I.) per acre plus Ammonium Sulfate-AMS (Class Act) at a rate of 2.5 gal/100 gal plus Max-IN ZnB at a rate of 3 pts per acre.
4. Max-IN ZnB at a rate of 3 pts per acre plus hand weeding.

All materials were applied with a hand-held sprayer (2 gal. capacity) in water (30 gal per acre). A randomized complete block design with 4 replications was used. Each plot was 4 beds wide (10 feet) and 36 feet long. The corn was harvested at full black layer maturity on October 31.

RESULTS

Treatment	Rate	Variety	% Grain Moisture at Harvest	Test Wt lb/bu	Yield bu/acre (adjusted to 15.5 % moisture)
Unsprayed Control Hand-weeded	-	6818	23.0	56.4	267.6
Unsprayed Control Hand-weeded	-	4421	13.7	57.1	204.3
Glyphosate (Cornerstone Plus) AMS (Class Act)	32 oz per acre 2.5 gal/100 gal	6818	22.7	57.0	280.5
Glyphosate (Cornerstone Plus) AMS (Class Act)	32 oz per acre 2.5 gal/100 gal	4421	13.2	57.8	215.9
Glyphosate (Cornerstone Plus) AMS (Class Act) Max-IN ZnB	32 oz per acre 2.5 gal/100 gal 3 pts per acre	6818	22.9	56.4	275.2
Glyphosate (Cornerstone Plus) AMS (Class Act) Max-IN ZnB	32 oz per acre 2.5 gal/100 gal 3 pts per acre	4421	13.7	57.9	212.8
Max-IN ZnB Hand-weeded	3 pts per acre	6818	23.2	56.6	270.2
Max-IN ZnB Hand-weeded	3 pts per acre	4421	13.6	57.8	227.1
lsd(0.1)					19.7

This work was generously supported by *Winfield Solutions* under the direction of Mr. Joe Bush.

Corn as a Nitrogen Scavenger Crop Following Onion in Rotation

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SUMMARY

In 2007, we evaluated the effectiveness of corn in recovering residual soil and fertilizer N resulting from N fertilizer application to onion crops in 2005 and 2006. Conservative N fertilizer rates (6 N rates, 0 to 120 lb N/a) were applied in 2007 to the second corn crop following the 2005 onion crop (N Management I study) and to the first corn crop following the 2006 onion crop (N Management II study). Corn grain yields and corn N uptake were measured, as well as residual soil N levels in the 0- to 6-ft depth of both studies. In the N Management I study, residual soil N levels in the 0- to 6-ft soil profile at corn planting in 2007 increased as the previous N rates increased, ranging from 27 to 85 lb N/a where furrow irrigation was used in 2005 and 31 to 186 lb N/a where drip irrigation was used in 2005. Corn grain yields in 2007 increased from 74 bu/a with no N applied to 237 bu/a with 120 lb N/a applied on the 2005 drip irrigated onion plots and from 69 bu/a with no N applied to 200 bu/a with the application of 120 lb N/a on the 2005 furrow irrigated onion plots. Thus, the second corn crop responded to the higher level of residual soil N present in the 2005 drip irrigated onion plots. Residual soil NO_3-N levels were relatively low in both the 2005 furrow and drip irrigated onion plots after harvest of the second corn crop in 2007. In the N Management II study, corn yields following the 2006 onions ranged from 195 bu/a with no N applied to 271 bu/a with 120 lb N/a applied in the 2006 drip irrigated onion plots and from 160 bu/a with no N applied to 255 bu/a with 120 lb N/a applied in the 2006 furrow irrigated plots. Residual soil NO_3-N levels in the 2006 onion plots following corn harvest in 2007 ranged from 28 to 248 lb N/a in the 2006 drip irrigated plots and 20 to 148 in the 2006 furrow irrigated onion plots. Therefore, corn will be grown on these same plots in 2008 to recover additional residual soil N. The N Management I and II studies showed that both the first and the second year of corn after onion effectively utilized the residual soil and fertilizer N from the root zone. 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.

INTRODUCTION

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, often without regard to soil testing for residual N levels. Vegetable crops generally have shallow rooting depths (< 3 ft) and require frequent irrigation to maintain yield and market quality. High N fertilization rates to shallow-rooted crops and high residual soil NO_3-N levels, shallow water tables, and frequent irrigation all contribute to a high NO_3-N leaching potential. Nitrogen management research is needed to develop improved N management practices for irrigated crops in the Colorado Arkansas River Valley. 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.

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., 2002). Residual soil N is often high in fields used for production of vegetable crops as a result of poor N use efficiency by vegetable crops and N management practices. In a four year study (Halvorson et al., 2005), residual soil N levels following alfalfa and watermelon were reduced to relatively low levels after four consecutive corn crops. On these same plots, chile pepper was grown in 2004 which maintained a low residual soil N level (Halvorson et al., 2007), while onion response to N fertilization (N rates of 0, 40, 80, 120, 160, and 200 lb N/a) was studied in 2005 (N Management I study), with the N plots being split to allow drip and furrow irrigation comparisons (Halvorson et al., 2006; 2008a). A similar onion study (N Management II) was repeated in an adjacent field that had been in soybean in 2005 (Halvorson et al., 2008b). In 2006 and 2007, the first crop of corn following onion was planted on these onion plots with conservative rates of N fertilizer applied (0 to 120 lb N/a) (Halvorson et al., 2008c). Our goal was to determine if one corn crop could effectively utilize the residual N fertilizer remaining in the soil from the previous onion crop. A second corn crop was grown in 2007 on the 2005 onion plots to reduce the residual soil N levels even further.

OBJECTIVES. The objectives of this research were to: 1) evaluate the use of corn as a N scavenger crop following onion in rotation to improve N fertilizer use efficiency; and 2) determine N fertilizer needs of furrow-irrigated corn following drip and furrow irrigated onions in rotation.

STUDY DETAILS. Corn (Var. Asgrow *RX752RR/YG*) was planted on both N studies on April 30, 2007 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 (N Management I study) and 2006 (N Management II study). Nitrogen rates of 0, 20, 40, 80,100, and 120 lb N/a were applied to the established N1, N2, N3, N4, N5, N6 plots on April 9, 2007, respectively. The N sources were urea a with nitrification and urease inhibitor (SuperU, produced by Agrotain International) on N Management I study, and a polymer-coated urea with a 30 to 60 day release period (ESN, produced by Agrium Inc., Calgary, AB) on N Management II study. The N fertilizer was broadcast and incorporated with a harrow before corn planting for both studies. A split-plot, randomized complete block design with four replications was used with N rate as main plots and 2005 or 2006 onion irrigation methods (drip or furrow) as subplots for both studies.

Herbicides were applied for weed control, with the plots being essentially weed free during the entire growing season. 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

2007, with about 34.5 inches of total water applied with about 11.9 inches measured running off the end of the field, resulting in a net application of 22.5 inches. Assuming a NO_3-N level in the irrigation water of 1.3 ppm based on 2006 analyses (NO_3-N not monitored in 2007), about 5.1 lb N/a may have entered the soil with the irrigation water. Growing season precipitation (April through October) amounted to 8.1 inches, with a rather dry July, September, and October. 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 37976 plants/a was attained in both N studies in 2007. On September 5^{th}, 15 plants were hand harvested for biomass yield. On October 9th the plots were harvested with a plot combine to determine grain yield.

RESULTS

The soil NO_3-N levels in the 0-6ft soil profile on April 10, 2007 are shown in Table 1 for N Management I study. The soil NO_3-N levels were similar for both the 2005 drip and furrow onion plots at the zero N rate but were about two fold greater at the highest N rate in the drip irrigated onion plots compared to the furrow irrigated onion plots before N fertilizer application for the 2007 corn crop. This shows that less leaching of soil NO_3-N occurred where drip irrigation was used in 2005 compared to furrow irrigation. Residual NO_3-N after corn harvest (10 Oct. 2007) in the 6-ft profile increased slightly with increasing N rate (Table 1).

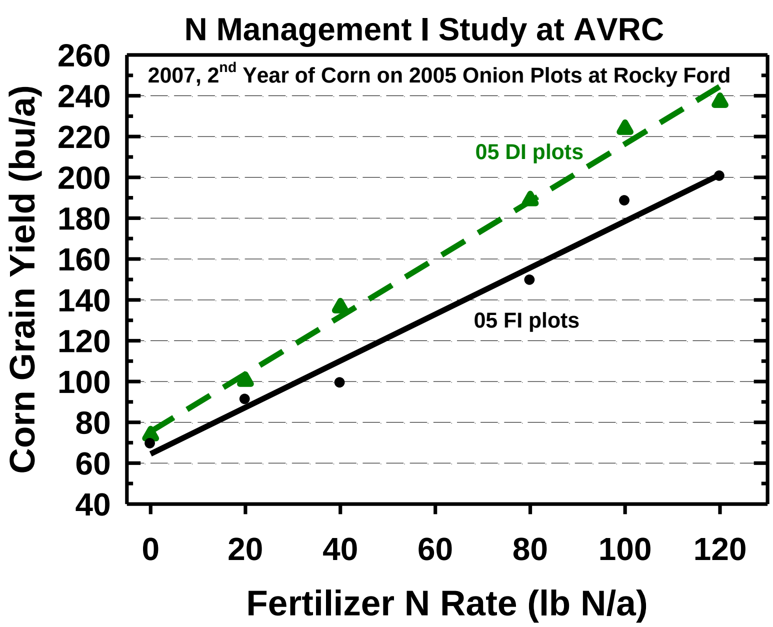

Fig. 1. Corn grain yields in 2007 as a function of N rate applied to 2005 drip (DI) and furrow (FI) irrigation onion plots.

Corn yields in 2007 in the N Management I study increased significantly (∀ = 0.05) with increasing N fertilization rate (Fig. 1). Averaged across N levels, grain yields were higher where drip irrigation (160 bu/a) was used in 2005 compared to furrow irrigation (133 bu/a). 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 2007 (Table 1) compared with the furrow irrigated treatments. These were excellent 2^{nd} year corn yields considering the relatively low rates of N fertilizer applied. Averaged across irrigation system, corn grain N removal was 49, 65, 73, 112, 151, and 165 lb N/a for the 0, 20, 40, 80, 100, and 120 lb/a N rates, respectively. Grain N removal in 2007 increased with increasing soil plus fertilizer N level with greater N removal from the 2005 drip irrigation plots (112 lb N/a) than from the 2005 furrow irrigation plots (93 lb N/a). Averaged over N treatments, 19 lb/a more N was removed in the grain from the 2005 drip irrigation plots than from the 2005 furrow irrigation plots. The N Management I study will be continued on the same plots in 2008 with chile pepper as the crop and N rates ranging from 0 to 150 lb N/a. Nitrogen fertilization effects on residual soil NO_3-N levels will be monitored.

In the N Management II study, soil NO_3-N levels in the 0-6ft soil profile on April 10, 2007 were greater in the drip irrigated onion plots than in the furrow irrigated 2006 onion plots (Table 1), with differences increasing with N rates (nearly two fold greater at the highest N rate in the drip irrigated plots compared to the furrow irrigated onion plots. This shows that less leaching of soil NO_3-N occurred where drip irrigation was used in 2006 compared to furrow irrigation. Residual NO_3-N after corn harvest (10 Oct. 2007) in the 6-ft profile increased with increasing N rate (Table 1). Residual soil NO_3-N levels were still high following harvest of the first corn crop in 2007.

Corn yields were increased significantly (∀ = 0.05) by N fertilization (Fig. 2). Grain yields were higher where drip irrigation (245 bu/a) was used in 2006 compared to furrow irrigation (224 bu/a). The higher grain yields with the 2006 drip irrigation treatments reflects the higher level of residual soil NO_3-N present in the soil at corn planting in 2007 (Table 1) compared with the furrow irrigated treatments. These were also excellent corn yields considering the relatively low rates of N fertilizer applied. Averaged across irrigation systems, grain N removal in the corn grain was 82, 110, 118, 140, 140, and 158 lb N/a for the 0, 20, 40, 80, 100, and 120 lb/a N rates, respectively. Averaged across N rates, grain N removal increased with increasing soil plus fertilizer N, with greater N removal from the 2006 drip irrigation plots (131 lb N/a) than from the 2006 furrow irrigation plots (119 lb N/a). Averaged over N treatments, 12 lb/a more N was removed in the grain from the 2006 drip irrigation plots than from the furrow irrigation plots. The N Management II study will be continued on the same plots in 2008 with another crop of corn to further reduce the residual soil N levels at the higher N rates. Nitrogen fertilization effects on residual soil NO_3-N levels will continue to be monitored.

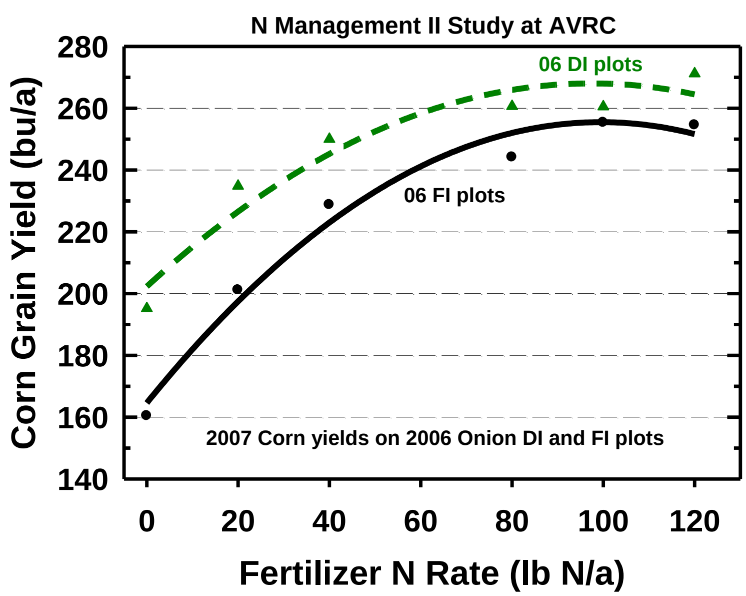

Fig. 2. Corn grain yields in 2007 as a function of N rate applied to 2006 drip (DI) and furrow (FI) irrigation onion plots.

The goal of this research is to demonstrate that N fertilizer use efficiency can be improved by using corn to recover fertilizer N applied to onion, and to lower the residual soil N levels following onion to reduce the potential for NO_3-N leaching and groundwater contamination. The study also points out that drip irrigation of onion would reduce NO_3-N leaching below the corn rootzone. Corn appears to be a good scavenger crop to recover residual fertilizer N applied to onion.

Table 1. Soil NO_3-N levels in 2007 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	2007 Corn fertilizer N rate (lb N/a)											
	0	20	40	80	100	120	0	20	40	80	100	120
	N1	N2	N3	N4	N5	N6	N1	N2	N3	N4	N5	N6
	10 April 2007						10 October 2007					
Ft	Residual Soil NO_3-N, lb N/a											
	2005 Drip Irrigation Onion Plots											
0-3	21	34	21	61	73	140	14	13	14	18	38	27
0-6	31	46	36	85	121	186	21	18	21	26	79	68
	2005 Furrow Irrigation Onion Plots											
0-3	21	28	26	37	64	61	19	15	14	23	22	34
0-6	27	35	32	53	78	85	28	20	19	36	33	52
	2006 Drip Irrigation Onion Plots											
0-3	54	75	90	105	111	159	21	21	20	30	44	106
0-6	79	121	152	170	172	259	28	29	44	84	119	248
	2006 Furrow Irrigation Onion Plots											
0-3	62	58	105	94	91	99	15	19	37	33	62	77
0-6	89	91	150	139	126	157	20	37	53	47	106	148

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The authors wish to thank Patti Norris, Brad Floyd, and Kevin Tanabe for their field assistance and analytical support in collecting the data reported herein. Thanks also to Agrium Inc. for providing the controlled release N fertilizer, ESN, and to Agrotain International for providing the stabilized N source, Super U, used in this study.

Corn Fallow Trial

Jim Valliant and Mike Bartolo
Arkansas Valley Research Center
Colorado State University

Water sales in the Arkansas River Valley of Colorado have been on a "Buy and Dry" basis for many years. Agricultural water rights have been sold to cities on the Front Range and the previously irrigated land removed from production. These lands revert to dry land production and, in the arid environment of Southeastern Colorado, have limited agricultural productivity. In many instances, these lands have serious erosion and weed problems.

An alternative to water sales is the temporary leasing of agricultural waters to the cities, particularly in times of drought. Water leases give the shareholders a new crop, "water", and provide additional revenue. In a leasing program, land is not permanently dried up but is fallowed or set aside from irrigation for a number of years, depending on the conditions of the lease.

Leasing of agricultural waters could improve the economic stability of the agricultural-dependent communities of the Arkansas Valley. Growers could keep much of their land under production, fallowing only the necessary acres to meet the needs of the leasing agreements. Several ditch companies have already leased water and others are looking at the possibility of leasing water collectively as a group (Super Ditch). At this time, however, it is not clear how fallowing will affect yields, nutrients needs, ability to come back into production, and overall economics. This study attempts to address those issues.

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) starting in 2007. The Center is located near Rocky Ford, Colorado. The plot area had previously been in corn during 2006. The corn hybrid RX752RR/YGPL (Dekalb) was planted in late April in each year. The crop was seeded at a rate of about 32,000 seeds per acre. A single line of corn was planted on top of a 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 trial was arranged in a complete block design with four replications. Starting in 2007, one treatment was planted to corn and the remaining three treatments were fallowed. In each subsequent year, one additional treatment was planted to corn. Fallowed treatments were managed to maintain low weed growth and prevent soil erosion. The sequence of treatments is described in the table below:

Treatment	2007	2008	2009	2010
1.	corn	corn	corn	corn
2.	fallow	corn	corn	corn
3.	fallow	fallow	corn	corn
4.	fallow	fallow	fallow	corn

Grain yields were collected in October or November of each season. Yield samples were taken within each treatment plot and assessed for total weight, moisture content, and grain bushel weight. In addition to yield, soil nutrient status was monitored via soil samples taken at depths of 0-8", 8-16", and 16-24". All production practices, including the practices and costs necessary to maintain the fallowed lands, were recorded.

Results

Table 1: Yield (bu/acre) of corn grown for grain following different fallowing periods. All yields were adjusted to a grain moisture content of 15.5%.

Treatment	2007	2008	2009	2010
		Yield Bu/acre		
1.	**187.1**	**232.8**	corn	corn
2.	*fallow*	**233.0**	corn	corn
3.	*fallow*	*fallow*	corn	corn
4.	*fallow*	*fallow*	*fallow*	corn
lsd(0.1)		*38.72*		

Discussion

Through the 2008 season, no significant yield differences have been realized as a result of either one or two years of fallowing compared to a continuously cropped treatment. After one year of fallowing, fertilizer applied during the 2007 season was still available for a crop grown in 2008.

Specific fertility and production costs data will be presented in subsequent reports.

2008 VEGETABLE CROP REPORTS

Onion Variety Trial

Mike Bartolo
Arkansas Valley Research Center
Colorado State University

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". An area of 8 bed feet (8' X 2 rows) was harvested for yield determination. Water was supplied via drip irrigation. Each plot was replicated four times in the trial.*

Planted *- March 11th, 2008*

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 *- Roundup Ultra on April 5th ,Goal, Starane and Prowl on May 8th, Goal-Tender and Outlook on May 14th, Goal, Starane, Dual II, and Trigger on June 10th, hand-weeded 2X*

Insect Control *– None applied (Thrips tolerance was observed)*

Disease Control*- None applied*

Irrigation *– The plots were irrigated multiple times via drip. The amount of irrigation water applied was approximately 30 inches and seasonal precipitation was 8.3 inches.*

Harvest *– September 9th*

Grade *– September 29th*

Comments

The 2008 season was good for onion production with ample irrigation water and relatively normal growing conditions. No disease problems were detected. Specifically, there was no Iris Yellow Spot Virus or Xanthomonas detected in the plots. One hail storm, occurring one week before harvest, did minimal damage to the crop. Thrips populations were fairly high, but lower than in 2007. No thrips control measures were applied to help discern relative responses of the onion. 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, 2008

Variety	*Source*	*Maturity (% tops down) 9-1*	*Colossals ∃4" %*	*Jumbos 3"-4" %*	*Medium 2ȝ"-3" %*	*Pre-Pack 1 :"-2ȝ" %*	***Total Market. CWT/A***	*Culls %*	*Total Weight CWT/A*
OLY505-N5	Crookham	37	13.3	69.8	15.2	1.1	**807.5**	0.6	811.3
X-Y 201	Waldow	37	11.8	72.1	13.0	0.8	**769.9**	2.2	787.9
T-433	Takii	62	0.4	72.7	23.8	1.3	**759.6**	1.8	771.6
X-Y 202	Waldow	25	19.6	68.6	7.0	0.2	**756.3**	4.6	790.1
Mesquite	D. Palmer	27	5.5	70.3	22.6	1.7	**750.3**	0	750.3
OLYS03-207	Crookham	40	9.6	72.3	16.4	0.9	**743.8**	0.7	748.7
OLYS03-209	Crookham	50	4.8	64.1	27.7	2.0	**713.8**	1.4	723.1
Tequilla	D. Palmer	35	14.4	70.5	8.8	0.9	**702.9**	5.4	738.0
Charismatic	Seminis	62	0.9	65.3	31.2	2.3	**700.2**	0.4	702.9
Evolution	D. Palmer	37	4.4	75.5	17.6	1.2	**687.7**	1.3	697.5
Colorado 6	Burrell	25	1.2	60.4	32.8	2.2	**685.0**	3.4	708.4
The Rock	Crookham	20	14.8	79.3	5.5	0.5	**671.9**	0	671.9
Affirmed	Seminis	75	0	60.4	32.5	1.6	**663.7**	5.5	702.9
White Cloud (W)	Crookham	80	0	55.4	34.9	4.1	**653.9**	5.6	688.8
Arcero	Nunhems	52	3.4	64.2	30.5	1.5	**650.1**	0.5	652.9
Generation X	D. Palmer	52	0	65.6	29.4	1.7	**642.0**	3.3	664.8
Monarchos	Seninis	57	2.6	65.7	26.9	.5	**641.4**	4.3	667.6
Desparado	Bejo	67	1.2	54.3	41.0	2.6	**629.4**	0.9	634.9
Pandero	Nunhems	42	1.2	64.6	31.4	2.8	**626.2**	0	626.2
Ranchero	Nunhems	57	10.1	70.1	15	2.1	**616.9**	2.7	633.8

Variety	*Source*	*Maturity (% tops down) 9-13*	*Colossals ∃4" %*	*Jumbos 3"-4" %*	*Medium 2 3"-3" %*	*Pre-Pack 1 :"-2 3" %*	***Total Market. CWT/A***	*Culls %*	*Total Weight CWT/A*
OLYX06-25	Crookham	37	7.3	69.4	21.1	2.3	**604.9**	0	604.9
Vaquero	Nunhems	72	0	58.6	37.7	2.2	**600.0**	1.4	608.8
Granero	Nunhems	65	0	59.8	38.5	1.7	**598.9**	0	599.0
Cometa (W)	Nunhems	45	0	64.6	30.3	2.4	**596.2**	2.6	613.1
Joaquin	Nunhems	70	0	58.9	37.9	2.6	**590.8**	0.6	594.6
Legend	Bejo	65	1.4	43.5	49.6	3.7	**576.6**	1.9	588.1
Delgado	Bejo	55	0	67.0	27.0	2.1	**563.6**	3.8	586.4
Calibra	Bejo	77	0	43.7	49.7	6.6	**496.0**	0	496.0
Abilene	Seminis	72	0	52.6	43.5	2.9	**454.7**	1.0	459.0
Marquette	Seminis	72	0	46.3	42.3	6.0	**401.3**	5.5	426.9
Crockett	Bejo	45	0	37.1	54.4	3.2	**389.9**	5.3	413.3
Talon	Bejo	82	0	11.5	75.7	12.8	**384.4**	0	384.4
Gunnison	Bejo	80	0	3.0	79.7	17.0	**361.5**	0.3	362.6

lsd (0.1) = **114.7**

(W) = white-skinned, (R) = red-skinned, all other yellows

Onion Disease Trials -2008

Arkansas Valley Research Center, Rocky Ford, CO

Howard Schwartz – Department of Bioagricultural Sciences and Pest Management
Michael Bartolo – Arkansas Valley Research Center

Summary: The objective of this project was to determine the effects of different disease and insect control measures on the incidence of bacterial (Xanthomonas) and viral (Iris Yellow Spot Virus) diseases in onion. These studies were conducted on a calcareous Rocky Ford silty clay loam soil at the Arkansas Valley Research Center (AVRC) in 2008. A split-plot, randomized complete block design with 4 replications was used. All materials were delivered via a CO_2 pressurized back-pack sprayer. Onions (var. X-202; Waldow Seeds) were direct-seeded on March 13, 2008 at a seeding rate of about 130,000 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 plot was 25 feet long and one bed (5 feet) wide. Irrigation water was delivered via drip lines. There were two drip lines per bed, spaced 12 inches apart and at a depth of 4 inches. The onions were harvested on September 15, 2008. Onions were graded for yield and quality. Marketable onion sizes were colossal (<4" diameter), jumbo (3 to 4" diameter), and medium (2 to 3" diameter).

Bactericide Trials		Plot Weight (lbs) - 20 sq. ft.							%Storage Rot	
Treatment*	**AVRC**	Colossal	Jumbo	Medium	Prepack	Col + Jum	Total	% Xanth	15-Oct	14-Nov
1. Control		2.35	21.98	8.60	0.13	24.33	32.93	5.0 a	12.50	17.50
2. Actigard @ 0.75 oz		4.18	25.93	5.70	0.78	30.10	35.81	1.0 b	17.50	7.50
3. A 6001 @ 20 fl oz		0.68	21.45	6.18	0.25	22.13	28.30	1.0 b	13.75	17.50
4. Actigard + A16001		5.03	25.05	5.18	0.28	30.08	35.25	1.0 b	18.75	16.25
5. Kocide 3000 @ 1 lb		5.93	21.05	4.73	0.23	26.98	31.70	1.0 b	20.00	8.75
6. Actigard + Kocide		2.18	20.70	7.43	0.28	22.88	30.30	1.0 b	12.50	13.75
	CV	99.21	19.12	38.07	106.68	20.54	10.92	0	73.91	75.74
	Prob	0.2828	0.4249	0.2528	0.9511	0.1894	0.0646	0.0001	0.8916	0.601
	LSD 0.05	n.s	n.s	n.s	n.s	n.s	n.s	0	n.s.	n.s.

* Trt 2-6 with Kinetic @ 0.125%v/v in 25 gal/Acre Onion 'X 202' planted 03/13, harvested 09/15

IYSV Trials

Treatment*	AVRC Pre-bulb	Plot Weight (lbs) - 20 sq. ft. Col	Jum	Med	Pre	Col + Jum	Total	Storage Rot - % bulbs rotted 15-Oct	14-Nov		17-Dec
1. Control	0	3.43	20.80	5.03	0.28	24.23	29.25	6.25	7.50	bc	16.25
2. Actigard @ 0.75 oz	6,5,4,3	2.48	22.05	7.15	0.45	24.53	31.68	12.50	2.50	c	22.50
3. Actigard + W @ 3.84 oz + L @ 1.5 oz	6,5,4,3	0.00	18.20	8.53	0.28	18.20	26.73	10.00	11.25	ab	15.00
4. Actigard + W + L	6,4,2	1.45	18.53	8.43	0.25	19.98	28.40	5.00	5.00	bc	11.25
5. Actigard + A16001 @ 20 oz + W + L	6,5,4,3	1.05	18.38	8.60	0.33	19.43	28.03	12.50	16.25	ab	17.50
6. Warrior + Lannate	6,5,4,3	1.70	24.13	4.48	0.15	25.83	30.30	15.00	8.75	bc	11.25
7. Actigard / Warrior + Lannate	6,5,4,3	1.05	17.60	5.60	1.05	18.65	24.25	8.75	7.50	bc	18.75
	CV	152.44	25.81	37.41	131.71	30.27	18.09	80.24	68.38		65.38
	Prob	0.5657	0.5184	0.1293	0.2919	0.4822	0.522	0.5763	0.0714		0.8777
	LSD 0.05	n.s	n.s	n.s	n.s	n.s	n.s	n.s.	7.037		n.s.

* Trt 2-7 with Kinetic @ 0.125%v/v in 25 gal/Acre; W = Warrior, L = Lannate; Onion 'X202' seeded 03/13, narvested 09/15

<u>Trt Dates</u>: 06/09, 06/17, 06/23, 06/30, 07/07; trace IYSV noted on 08/19/08

Validation and Demonstration of COAGMET for Improved Irrigation and Pest Management

H. F. Schwartz Update 09/26/07

During the 2007 growing season, we monitored 5 onion fields during June to early September for the initiation of foliar infecting bacterial diseases such as Xanthomonas Leaf Blight in relation to local environmental conditions as measured by the nearest COAGMET (Campbell CR-10) and in-field (Spectrum Watchdog 450) dataloggers. The COAGMET data are summarized in Table 1, data from the Spectrum units is being analyzed.

Onion field sites:
XAN1 38.01382N / 103.65601W Swink – drip irrigated field of Don Mameda
XAN2 38.00093N / 103.65672W Swink – sprinkler irrigated field of Don Mameda
XAN3 38.13489N / 104.02251W Fowler – furrow irrigated field of Phil Jensen
XAN4 38.04053N / 103.69450W Rocky Ford – drip irrigated field, AVRC
XAN5 38.21312N / 104.30959W Avondale – sprinkler irrigated field of Tom Rusler

Nearest COAGMET Stations:
RFD01 38.0385N / 103.695W CSU - AVRC Rocky Ford
FWL01 38.1351N / 104.032W Fowler
AVN01 38.2166N / 104.341W Avondale
VLD01 38.2235N / 104.461W Vineland

Plant Disease Report:
These 5 monitoring sites and additional onion fields in the Arkansas Valley were periodically scouted for the presence of foliar diseases such as Xanthomonas Leaf Blight. This disease has not caused serious damage in the Valley in recent years during hot, dry conditions, so disease carryover was considered to be low at the beginning of the 2007 season. Some suspicious disease-type brown lesions were observed during early July surveys, but no sample was positive for the bacterial pathogen or other pathogens after isolation in the laboratory. We concluded that the trace damage was due to an abiotic cause, possibly related to previous herbicide practices and/or environmental stress such as scalding. No other bacterial or fungal disease problems were noted during July and August surveys; other than scattered infection by the *Iris yellow spot virus* which is transmitted by onion thrips with damage aggravated by environmental stress (moderate to high heat and drought conditions).

In conclusion, 2007 is considered to be a baseline year in which bacterial disease pressure was low in relation to the relatively dry growing season which was not conducive for survival, dissemination and infection of the pathogen in the Arkansas Valley region that was monitored. This study will be continued in 2008.

Onion Thrips Tolerance Trial

Whitney Cranshaw
Mike Bartolo
Colorado State University

Trials were conducted at the Arkansas Valley Research Center in Rocky Ford, CO. Individual plots consisted of 50-row ft of seeded onions in 4-row beds at 5-ft centers. Each cultivar was replicated four times in a randomized complete block design. Subplots were established within each plot, so that one half of the area was treated to control thrips, the other half remaining untreated. Thrips treatments consisted of a mixture of fipronil (Regent) and spirometrastat (Movento), which had been identified as the most effective treatments at that site in previous season. Applications were made 12 June, repeated 3 July. Excellent control (>5 thrips/plant) was maintained on these treated plots through the end of July when last observations were made (July 24).
Two counts of thrips were made (table below), each by counting the number of thrips on 10 plants in the center of untreated areas.

	19 June*	10 July*	
1. Cometa	133.5 ab	243.5 abc*	Original means presented
2. White Wing	132.0 ab	202.3 abcd	Analysis used log transformation
3. Salsa	136.5 a	339.25 ab	
4. Red Bull	120.0 ab	303.5 abc	
5. Red Wing	138.0 a	316.75 ab	
6. Talon	104.0 abc	353.75 a	
7. Tioga	91.0 abc	206.75 abcd	
8. Gunnison	100.0 abc	259.0 abcd	
9. Arcero	99.5 abc	153.0 abcde	
10. Ranchero	105.0 abc	166.50 abcd	
11. Calibra	127.0 ab	126.25 abce	
12. X-202 (Tequila)	103.5 abc	103.75 bcde	
13. Sedona	135.3 a	234.75 abc	
14. OLYSOS5N5	100.3 abc	64.25 de	
15. Colorado 6	114.3 ab	51.25 e	
16. T-433	64.5 bc	78.25 de	
17. Tamara	63.0 c	91.00 cde	
18. Granero	129.3 ab	155.25 abcde	
19. Oro Blanco	140.5 a	47.25 e	
20. Vaquero	106.0 abc	101.0 bcde	

Onion Yield Response to Full (Spray) or No Thrips Control

Variety	*Spray Treatment*	*Colossals > 4" %*	*Jumbos 3"-4" %*	*Medium 2¼"-3" %*	*Pre-Pack 1¾"-2¼" %*	***Total Market. Weight CWT/A***	*Culls %*	*Total Weight CWT/A*
Cometa	Spray	0	80.2	17.2	0	**485.6**	2.5	496.5
	None	0	85.9	12.7	0.1	**410.0**	1.2	414.3
White Wing	Spray	0	28.1	63.4	4.3	**397.4**	4.0	412.1
	None	0	24.4	68.1	3.9	**466.6**	3.5	486.2
Salsa	Spray	0	26.7	64.2	3.2	**394.7**	5.6	417.6
	None	0	14.9	70.8	10.8	**402.3**	3.2	414.3
Red Bull	Spray	0	35.1	53.2	4.2	**354.4**	7.3	383.80
	None	0	6.8	76.6	14.3	**276.0**	2.2	282.0
Red Wing	Spray	0	30.4	62.0	5.6	**364.2**	1.7	370.2
	None	0	2.8	82.0	10.3	**280.9**	4.7	295.1
Talon	Spray	0	36.5	59.3	3.3	**374.0**	0.7	377.3
	None	0	15.1	79.9	4.9	**344.6**	0	344.6
Tioga	Spray	4.1	76.7	13.8	0.4	**481.3**	4.7	502.5
	None	0	63.1	32.6	1.4	**435.6**	2.7	448.1
Gunnison	Spray	0	24.0	70.0	5.4	**427.9**	0.3	429.0
	None	0	5.4	82.1	12.2	**306.0**	0.2	306.5
Arcero	Spray	0	40.7	55.9	2.6	**515.0**	0.5	517.8
	None	1.4	47.4	47.0	2.5	**511.8**	1.5	519.4

Variety	*Spray Treatment*	*Colossals > 4" %*	*Jumbos 3"-4" %*	*Medium 2¼"-3" %*	*Pre-Pack 1¾"-2¼" %*	***Total Market. Weight CWT/A***	*Culls %*	*Total Weight CWT/A*
Ranchero	Spray	0	70.8	28.1	1.0	**719.2**	0	719.2
	None	0	62.8	34.9	1.0	**637.6**	1.0	644.1
Calibra	Spray	0	54.6	40.5	2.0	**503.1**	2.7	514.0
	None	0	35.5	60.2	3.3	**472.6**	0.8	476.9
Mesquite (X-202)	Spray	5.0	76.1	16.2	0.5	**662.6**	1.9	675.1
	None	4.5	67.6	25.8	1.2	**685.5**	0.7	690.9
Sedona	Spray	0	59.6	34.3	2.8	**487.3**	3.0	502.0
	None	0	49.3	47.2	1.2	**515.0**	2.1	526.5
OLYSOS5N5	Spray	0	62.6	35.5	1.0	**737.2**	0.6	742.1
	None	0	56.7	41.8	1.3	**676.2**	0	676.2
Colorado 6	Spray	0	55.3	39.5	4.6	**632.7**	0.5	635.9
	None	1.0	60.5	32.1	4.1	**646.3**	2.1	661.0
T-433	Spray	0	4.2	70.6	24.7	**521.0**	0.4	522.7
	None	0	10.1	69.7	19.4	**537.9**	0.6	542.3
Tamera	Spray	0	0	13.5	86.4	**285.8**	0	285.8
	None	0	0	10.1	89.8	**307.6**	0	307.6
Granero	Spray	0	81.2	18.3	0.4	**698.0**	0	698.0
	None	0	42.8	51.9	4.9	**504.2**	0.3	505.2
Oro Blanco	Spray	1.3	60.3	19.6	2.3	**545.5**	16.3	653.4
	None	0	67.8	16.5	4.1	**425.2**	11.3	480.2
Vaquero	Spray	1.7	71.1	25.8	0.3	**723.0**	0.8	727.9
	None	0	45.3	50.0	1.4	**515.0**	3.1	533.6

Insecticide Evaluation Trial – AVRC - 2007

Dr. Whitney Cranshaw, Department of Bioagricultural Sciences and Pest Management
Dr. Michael Bartolo, Arkansas Valley Research Center

This trial was established 30 March, by seeding (cv. 'X-202'), at the Colorado State University Arkansas Valley Research Center (AVRC) in Rocky Ford, CO. Individual plots involved a single quadruple-row bed, 5-ft width, 15-ft in length and the field was drip irrigated. Experimental design was completely randomized with four replications.

Insecticide applications were made 20 June and 4 July in a volume of 75.6 gal/A, allowing thorough wetting and penetration into the neck of the plants. In addition, a straw mulch treatment was included that involved spreading 1/4 bale of straw/plot on 20 June. Evaluations were made by counting the number of thrips on 10 plants in the center of each plot. The thrips species present at this site were predominantly *Thrips tabaci* (onion thrips), but 10%+ of the thrips at this site on certain dates were *Frankliniella schultzei*.

	Thrips/10 plants[a]			
Treatment	**26 June**	**10 July**	**3 July**	**17 July**
Untreated Check	173.3 ab	206.3 b	83.0 b	92.75 a
8330 (5 fl oz) + 0.25% Destiny	134.8 b	60.0 d	87.0 b	42.0 bc
8330 (5 fl oz) + 0.25% Destiny + 1 qt/A UAN	198.0 ab	73.0 d	69.5 b	34.75 ab
8330 (8 fl oz) + Destiny 0.25%	190.5 ab	48.0 d	52.75 b	48.25 bc
8330 (5 fl oz) + 0.25% Activator 90	141.5 b	57.5 d	64.75 b	42.5 bc
8330 (5 fl oz) + 0.25% Activator 90 + 1 qt/ A UAN	156.0 ab	45.5 d	66.25 a	35.0 a
8330 (5 fl oz)	169.5 ab	72.0 d	91.25 b	43.5 bc
Lannate LV 1.5 pt	139.8 b	107.3 cd	65.5 b	108.5 a
Warrior 3.84 fl oz	270.0 a	260.0 a	332.75 a	127.25 abc
Carzol 0.5 lb/A	206.0 ab	142.5 c	67.0 b	77.25 abc
Agri-Mek 6 fl oz	174.3 ab	107.0 cd	101.0 b	92.75 ab
Straw mulch (June 20 application)	107.0 b	96.0 cd	67.75 b	89.25 abc

[a] Numbers within a column not followed by the same letter are significantly different (P > 0.05) by SNK.

Onion Yield Response to Insecticide Treatments

Treatment	**Marketable Yield (cwt/acre)**
Untreated Check	671.3 bcd
8330 (5 fl oz) + 0.25% Destiny	635.4 cd
8330 (5 fl oz) + 0.25% Destiny + 1 qt/A UAN	811.8 a
8330 (8 fl oz) + Destiny 0.25%	727.4 abcd
8330 (5 fl oz) + 0.25% Activator 90	726.3 abcd
8330 (5 fl oz) + 0.25% Activator 90 + 1 qt/ A UAN	734.5 abcd
8330 (5 fl oz)	802.6 ab
Lannate LV 1.5 pt	733.4 abcd
Warrior 3.84 fl oz	627.8 d
Carzol 0.5 lb/A	692.0 abcd
Agri-Mek 6 fl oz	762.8 abc
Straw mulch (June 20 application)	713.8 abcd

LSD (0.1) = 131.9

Insecticide Evaluation Trial – AVRC - 2008

Dr. Whitney Cranshaw, Department of Bioagricultural Sciences and Pest Management
Dr. Michael Bartolo, Arkansas Valley Research Center

This trial was established March 12 by seeding (cv. 'X-202' aka 'Mesquite'), at the Colorado State University Arkansas Valley Research Center (AVRC) in Rocky Ford, CO. Individual plots involved a single quadruple-row bed, 5-ft width, 25-ft in length. The field was drip irrigated. Experimental design was completely randomized with four replications. Applications were made using a CO_2 compressed air sprayer delivering 46 gal/A. For most treatments applications were made on four dates (June 12, 19, July 3, 10). A schedule of all applications follows:

Treatment and Rate	Application Schedule
Movento 5 fl oz + 0.25% Dyne- Amic	June 12, June 19, July 3, July 10
Movento 5 fl oz + 0.25% Activator + 1 qt/A UAN	June 12, June 19, July 3, July 10
Movento 5 fl oz	June 12, June 19, July 3, July 10
Regent 4SC 5 fl oz + 0.25% Dyne-Amic	June 12, July 10
Warrior 3.84 fl oz + Dyne-Amic	June 12, June 19, July 3, July 10
Carzol 0.5 lb/A + Dyne-Amic	June 12, June 19, July 3, July 10
Tick-Ex 30 oz/A + Dyne-Amic	June 12, June 24, July 3, July 10
Assail 70WP 1.7 oz/A + Dyne-Amic	June 12, June 19, July 3, July 10

Evaluations were made by counting all thrips on 10 plants in the center of each plot. Thrips populations present were determined to be predominantly (ca 95%) *Thrips tabaci* (onion thrips). *Frankliniella occidentalis* (western flower thrips) (ca 3-4%) and *F. schultzei* (ca 1%) were also present.

Significant control of thrips for at least some period was effected by Movento, Carzol and Regent treatments. The addition of adjuvants (Dyne-Amic, Activator + UAN) appeared to improved effectiveness of Movento. Warrior and Tick-Ex (*Metarrhizium anisopliae*) were ineffective and Assail caused and increase in thrips numbers on plants compared to the untreated check.

	Thrips/10 plants[a]				
Treatment	**19 June**	**24 June**	**3 July****	**10 July****	**17 July**
Untreated Check	135.3 ab	218.8 a	202.0 a	120.5 bc	152.3 bc
Movento 5 fl oz + 0.25% Dyne- Amic	125.0 abc	89.5 cd	48.5 b	28.0 d	113.3 c
Movento 5 fl oz + 0.25% Activator + 1 qt/A UAN	123.3 abc	96.0 cd	48.5 b	52.8 cd	123.5 bc
Movento 5 fl oz	144.5 ab	140.3 bc	101.3 ab	130.0 bc	126.0 bc
Regent 4SC 5 fl oz + 0.25% Dyne-Amic	77.8 bc	120.0 bc	108.0 ab	246.3 ab	195.5 b
Warrior 3.84 fl oz + Dyne-Amic	88.3 bc	122.0 bc	218.0 a	109.0 bc	193.3 b
Carzol 0.5 lb/A + Dyne-Amic	55.2 c	65.3 d	90.0 ab	125.3 bc	132.3 bc
Tick-Ex 30 oz/A + Dyne-Amic	180.8 a	210.8 a	257.3 a	104.0 bc	192.8 b
Assail 70WP 1.7 oz/A + Dyne-Amic	133.3 ab	165.8 b	273.5 a	282.5 a	307.0 a

[a] Numbers within a column not followed by the same letter are significantly different (P > 0.05) by SNK.
June 19 DF 8; F=5.44; Pr > F, 0.0004
June 24 DF 8; F = 16.40; Pr > F, <0.0001
July 3 DF 8; F = 3.16; Pr > F, 0.0117
July 10 DF 8; F = 6.09; Pr > F, 0.0002/Transformed data F = 9.94; Pr > F, <0.0001
July 17 DF 8; F = 12.24; Pr > F, < 0.0001
** Data log transformed for analysis; non-transformed thrips numbers presented in table.

Insecticide Rotation Trial – AVRC - 2007

Dr. Whitney Cranshaw, Department of Bioagricultural Sciences and Pest Management
Dr. Michael Bartolo, Arkansas Valley Research Center

This trial was established 30 March, by seeding (cv. 'X-202'), at the Colorado State University Arkansas Valley Research Center (AVRC) in Rocky Ford, CO. Individual plots involved a single quadruple-row bed, 5-ft width, 25-ft in length and the field was drip irrigated. Experimental design was completely randomized with four replications.

Insecticide applications were made 12, 20 June and 4, 11 July in a volume of 45.3 gal/A, allowing thorough penetration of the plants. Treatments involve an alternation of insecticides; on the first and third applications one insecticide was applied, alternated with another insecticide treatment on the second and fourth applicaton.

Evaluations of control were made by counting the number of thrips on 10 plants in the center of each plot. The thrips species present at this site were primarily *Thrips tabaci* (onion thrips), but 10%+ of the thrips at this site on certain dates were *Frankliniella schultzei*.

Insecticide Treatments[a]		*Thrips/10 plants*[b]			
Initial Treatment	Rotation	20 June	26 June	10 July	17 July
Untreated Check		302.0 a	252.3 a	111.5 bc	160.8 a
Lannate	Lannate	246.5 a	286.3 a	114.5 bc	99.8 b
Lannate	Agri-Mek	286.0 a	274.6 a	74.8 c	124.5 ab
Lannate	Warrior	262.8 a	315.0 a	215.0 ab	72.8 b
Agri-Mek	Agri-Mek	327.0 a	377.3 a	133.3 bc	106.0 b
Agri-Mek	Lannate	306.5 a	320.8 a	116.5 bc	96.5 b
Agri-Mek	Warrior	305.3 a	347.0 a	330.3 a	84.5 b
Warrior	Warrior	363.8 a	431.8 a	293.0 a	91.8 b
Warrior	Agri-Mek	368.3 a	359.3 a	218.3 ab	88.3 b
Warrior	Lannate	270.0 a	330.0 a	236.0 ab	80.0 b

[a] Treatments included Lannate LV (16 fl oz/A), Agri-Mek (6 fl oz/A), or Warrior with Zeon Technology (3.84 fl oz/A). Four applications were made. Initial applications were applied on 12 June and 4 July. Rotation treatments were applied on 20 June and 11 July.
[b] Numbers within a column that are not the same are significantly different ($P > 0.05$) by SNK.

June 20 DF 9; $F = 0.96$; $Pr > F$ 0.4931
June 26 DF 9; $F = 1.18$; $Pr > F$ 0.3450
July 10 DF 9; $F = 9.14$; $Pr > F$ <0.0001
July 17 DF 9; $F= 3.36$; $Pr > F$ 0.0059

Agri-Mek Adjuvant Trial – AVRC - 2007

Dr. Whitney Cranshaw, Department of Bioagricultural Sciences and Pest Management
Dr. Michael Bartolo, Arkansas Valley Research Center

This trial was established 30 March, by seeding (cv. 'X-202'), at the Colorado State University Arkansas Valley Research Center (AVRC) in Rocky Ford, CO. Individual plots involved a single quadruple-row bed, 5-ft width, 15-ft in length and the field was drip irrigated. Experimental design was completely randomized with four replications.

A single foliar insecticide application was made, 11 July, in a volume of 75.6 gal/A, allowing thorough wetting and penetration into the neck of the plants. Evaluations of thrips control were made 17 July by counting the number of thrips on 10 plants in the center of each plot. The thrips species present at this site were predominantly *Thrips tabaci* (onion thrips), but 10%+ of the thrips at this site on certain dates were *Frankliniella schultzei*

Treatment[a]	**Thrips/10 plants**[b]
Untreated	88.5 a
Agri-Mek 5 fl oz	111.5 a
Agri-Mek + 0.25% Destiny	99.5 a
Agri-Mek + 0.25% Activator 90	101.0 a
Agri-Mek + 1 qt/A UAN	103.0 a
Agri-Mek + 0.25% Destiny + 1 qt/A UAN	71.0 a

[a] Applications made 11 July. All Agri-Mek treatments were applied at a rate of formulated material of 5 fl. oz./A.
[b] Treatments were not significantly different (P = 0.05).

Effect of Water Quality on Cantaloupe Yield and Quality

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Cantaloupe is is an important vegetable crop grown in the Arkansas Valley of Colorado. In the past decade, much of the cantaloupe produced in the Valley have been grown with intensive production practices like drip irrigation and plastic mulches. To facilitate the use of drip irrigation, growers have relied upon ground water pumped from shallow alluvial wells as the source of irrigation water. Unlike surface waters, ground water is relatively free of particulates and is available on a more timely and reliable basis. Unfortunately, ground waters also contain much higher amounts of dissolved salts making the electrical conductivity (EC_w) of ground water approximately 3 times higher than that of surface waters.

The purpose of this study was to determine how the use of ground water affects the yield and quality of cantaloupe grown with intensive production practices. Crop, water, and soil characteristics were monitored in treatments irrigated with both surface and ground waters.

Materials and Methods

This study was conducted at the Arkansas Valley Research Center (AVRC) in Rocky Ford. Beds, 45 inches wide and 60 inches between centers, were shaped in early April. Drip lines were placed 1-2 inches from the center of the bed at a depth of 3 inches. The beds were covered with black embossed plastic mulch on April 29th using a one-bed mulch layer.

The study was designed as a randomized complete block with four replications. The test site irrigation system was plumbed so that four plots would receive water derived from a surface source (Rocky Ford Ditch) and four plots would receive water from a shallow alluvial well located at the AVRC. Throughout the experiment, both water sources were delivered to the test site in equal quantities and the timing of each application was identical (Table 1). An irrigation event was initiated based on soil moisture content (feel method) and evapotranspiration data based on an adjacent automated weather station.

On May 14th, the cantaloupe variety *Athena*, a slightly sutured eastern shipping type, was sown in holes in the plastic mulch down the center of the bed at an in-row spacing of 18 inches. Cantaloupes were harvested starting on August 4th and ending on August 22nd. At harvest, the soluble solid content (% brix) of four randomly selected watermelons was sampled from each plot using a digital refractometer. Cantaloupe were considered marketable if they weighed over 3 lbs and were free of any physical defects.

In addition to fruit and water characteristics, changes in soil salinity were monitored in the treatments. Soil samples were taken at depths of 0-6", 6-12", 1-2', 2-3', and 3-4' before irrigation commenced (May 2nd), mid season (July 9th), and after harvest (October 10th). Samples were taken in the middle of the bed (seed-row). Salinity of the saturated paste extract was estimated using a 1:1 (w:w) extract of the soil using distilled water. Specifically, 50 g of soil was mixed with with 50 g of distilled water. The mixture was placed on a rotary shaker overnight and filtered the next day (Whatman 1). The conductivity of the resulting filtrate (EC_f) was measured and converted to the conductivity of the saturated paste extract (EC_e) using the following predetermined equation:

$[EC_e = (EC_f)(2.104) + 0.0039]$.

Results and Discussion

Irrigation water from the shallow alluvial well had 2-3 times higher electrical conductivity and individual chemical components than irrigation water derived from a surface source (Table 3). Despite these differences, there was not a significant difference in yield or fruit quality (as measured by percent brix) between cantaloupe that were irrigated with the two different water sources. Although, average fruit size and number were slightly greater in cantaloupe irrigated with the surface water, these differences were not statistically significant (P>.05).

As anticipated, soil salinity (EC_e) was greater in the treatment irrigated with well water (Figures 1-3). Salinity was generally greater in the surface layers.

Table 1: *Timings and amounts of irrigation water delivered to treatments. Plots irrigated with surface and well waters were irrigated at the same time and received the same volumes.*

Irrigation Date	gal/acre	ACRE-IN Applied	Irrigation Date	gal/acre	ACRE-IN Applied
13-May	15,300	**0.56**	3-Jul	31,150	**1.15**
19-May	20,764	**0.76**	7-Jul	29,860	**1.10**
27-May	10,279	**0.38**	10-Jul	31,779	**1.17**
4-Jun	6,348	**0.23**	14-Jul	21,219	**0.78**
9-Jun	17,307	**0.64**	17-Jul	28,626	**1.05**
13-Jun	14,036	**0.52**	21-Jul	36,526	**1.34**
17-Jun	15,045	**0.55**	24-Jul	37,953	**1.40**
19-Jun	17,519	**0.65**	28-Jul	26,458	**0.97**
23-Jun	26,452	**0.97**	31-Jul	16,466	**0.60**
26-Jun	22,901	**0.84**			
30-Jun	26,976	**0.99**	**SEASON TOTAL**		**16.65**

Table 2: *Yield, yield components, and quality (% brix) of cantaloupe grown with surface and ground water.*

Treatment Water Source	% Brix	Fruit Number per acre	Average Fruit Weight	Marketable Yield (lbs/acre)
Surface	11.48	11,126	5.04	56,076
Well	12.17	10,998	4.89	53,782
lsd(.1)	0.63	ns	ns	ns

Table 3: *Chemical characteristics of ground and surface waters*

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

* Analysis at AVRC, ** EPA analysis at Rocky Ford Ditch diversion at the Arkansas River, Specific Conductance represents an average for the growing season.

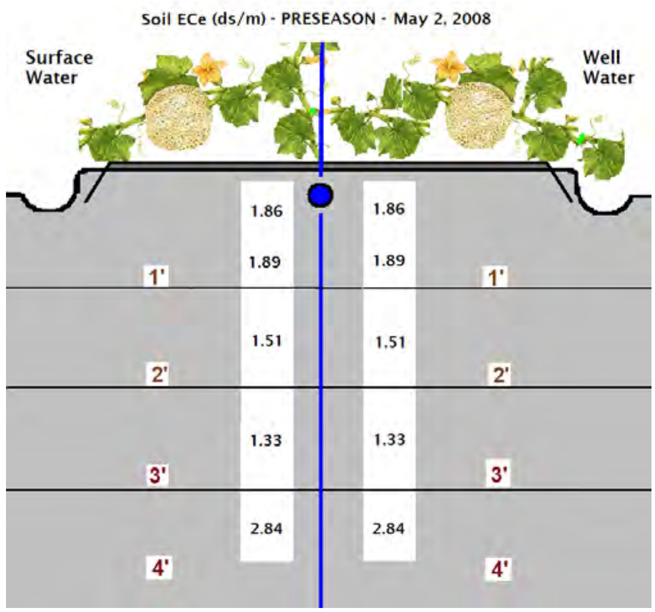


Figure 1: *Estimated salinity of the saturated paste extract (EC_e) prior to the initiation of irrigation (May 2, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.*

Figure 2: Estimated salinity of the saturated paste extract (EC_e) at mid-season (July 9, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.

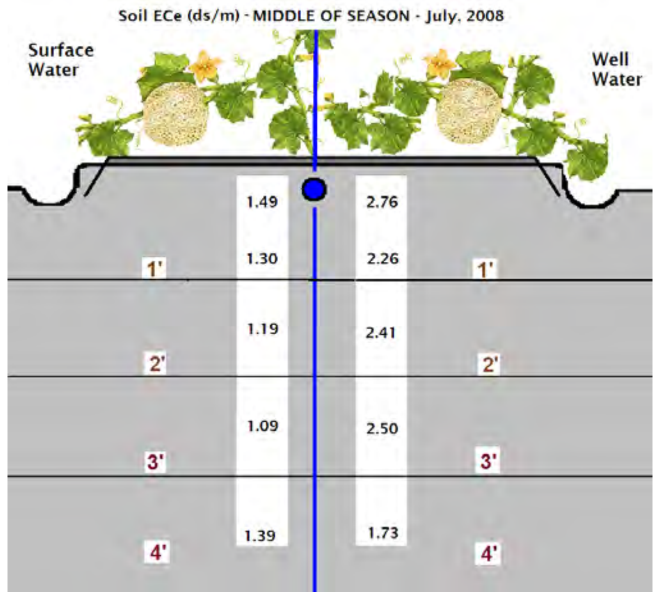
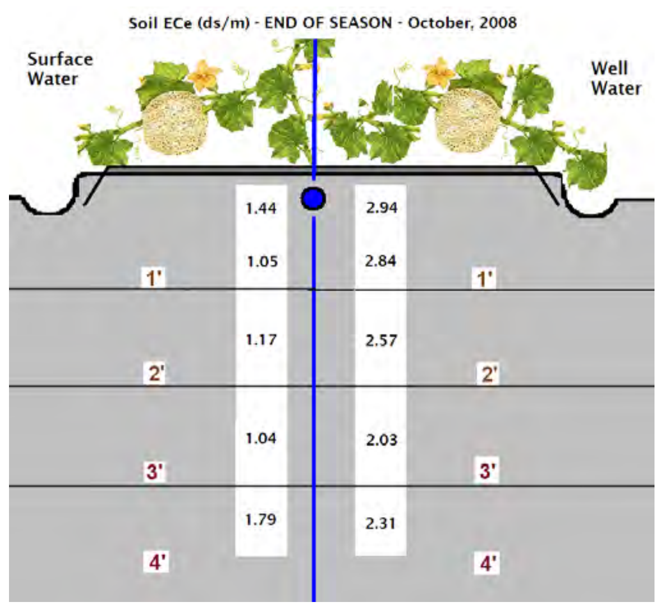


Figure 3: Estimated salinity of the saturated paste extract (EC_e) at the end of the growing season (October 10, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.



Effect of Water Quality on Watermelon Yield and Quality

Mike Bartolo
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Watermelon is an important vegetable crop grown in the Arkansas Valley of Colorado. In the past decade, much of the watermelons produced in the Valley have been grown with intensive production practices like drip irrigation and plastic mulches. To facilitate the use of drip irrigation, growers have relied upon ground water pumped from shallow alluvial wells as the source of irrigation water. Unlike surface waters, ground water is relatively free of particulates and is available on a more timely and reliable basis. Unfortunately, ground waters also contain much higher amounts of dissolved salts making the electrical conductivity (EC_w) of ground water approximately 3 times higher than that of surface waters.

The purpose of this study was to determine how the use of ground water affects the yield and quality of watermelon grown with intensive production practices. Crop, water, and soil characteristics were monitored in treatments irrigated with both surface and ground waters.

Materials and Methods

This study was conducted at the Arkansas Valley Research Center (AVRC) in Rocky Ford. Beds, 45 inches wide and 60 inches between centers, were shaped in early April. Drip lines were placed 1-2 inches from the center of the bed at a depth of 3 inches . The beds were covered with black embossed plastic mulch on April 29th using a one-bed mulch layer.

The study was designed as a randomized complete block with four replications. The test site irrigation system was plumbed so that four plots would receive water derived from a surface source (Rocky Ford Ditch) and four plots would receive water from a shallow alluvial well located at the AVRC. Throughout the experiment, both water sources were delivered to the test site in equal quantities and the timing of each application was identical (Table 1). An irrigation event was initiated based on soil moisture content (feel method) and evapotranspiration data based on an adjacent automated weather station.

On May 14th, the watermelon variety *Stars and Stripes*, an elongated seeded type, was sown in holes in the plastic mulch down the center of the bed at an in-row spacing of 3 feet . Watermelons were harvested starting on August 1st. At harvest, the soluble solid content (% brix) of four randomly selected watermelons was sampled from each plot using a digital refractometer. Watermelons were considered marketable if they weighed over 12 lbs and were free of any physical defects.

In addition to fruit and water characteristics, changes in soil salinity were monitored in the treatments. Soil samples were taken at depths of 0-6”, 6-12”, 1-2’, 2-3’, and 3-4’ before irrigation commenced (May 2nd), mid season (July 9th), and after harvest (October 10th). Samples were taken in the middle of the bed (seed-row). Salinity of the saturated paste extract was estimated using a 1:1 (w:w) extract of the soil using distilled water. Specifically, 50 g of soil was mixed with 50 g of distilled water. The mixture was placed on a rotary shaker overnight and filtered the next day (Whatman 1). The conductivity of the resulting filtrate (EC_f) was measured and converted to the conductivity of the saturated paste extract (EC_e) using the following predetermined equation:

$[EC_e = (EC_f)(2.104) + 0.0039]$.

Results and Discussion

Irrigation water from the shallow alluvial well had 2-3 times higher electrical conductivity and individual chemical components than irrigation water derived from a surface source (Table 3). Despite these differences, there was not a significant difference in yield or fruit quality (as measured by percent brix) between watermelons that were irrigated with the two different water sources. Although, average fruit size and number were slightly greater in watermelons irrigated with the surface water, these differences were not statistically significant ($P>.05$).

As anticipated, soil salinity (EC_e) was greater in the treatment irrigated with well water (Figures 1-3). Salinity was generally greater in the surface layers.

Table 1: *Timings and amounts of irrigation water delivered to treatments. Plots irrigated with surface and well waters were irrigated at the same time and received the same volumes.*

Irrigation Date	gal/acre	ACRE-IN Applied	Irrigation Date	gal/acre	ACRE-IN Applied
13-May	15,300	**0.56**	3-Jul	31,150	**1.15**
19-May	20,764	**0.76**	7-Jul	29,860	**1.10**
27-May	10,279	**0.38**	10-Jul	31,779	**1.17**
4-Jun	6,348	**0.23**	14-Jul	21,219	**0.78**
9-Jun	17,307	**0.64**	17-Jul	28,626	**1.05**
13-Jun	14,036	**0.52**	21-Jul	36,526	**1.34**
17-Jun	15,045	**0.55**	24-Jul	37,953	**1.40**
19-Jun	17,519	**0.65**	28-Jul	26,458	**0.97**
23-Jun	26,452	**0.97**	31-Jul	16,466	**0.60**
26-Jun	22,901	**0.84**			
30-Jun	26,976	**0.99**	**SEASON TOTAL**		**16.65**

***Table 2**: Yield, yield components, and quality (% brix) of watermelon grown with surface and ground water.*

Treatment Water Source	% Brix	Fruit Number per acre	Average Fruit Weight	Marketable Yield (lbs/acre)
Surface	10.95	4,719	17.0	80,233
Well	10.89	4,353	16.8	73,128
lsd(.1)	ns	ns	ns	ns

***Table 3**: Chemical characteristics of ground and surface waters.*

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

* Analysis at AVRC, ** EPA analysis at Rocky Ford Ditch diversion at the Arkansas River, Specific Conductance represents an average for the growing season.

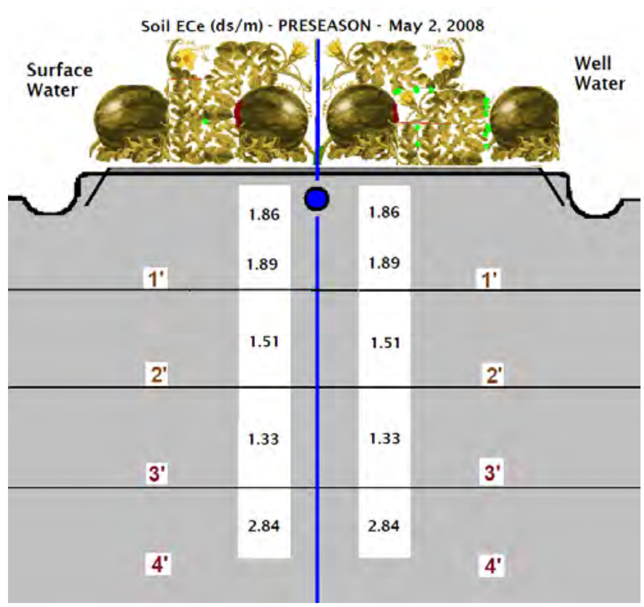


***Figure 1**: Estimated salinity of the saturated paste extract (EC_e) prior to the initiation of irrigation (May 2, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.*

Figure 2: *Estimated salinity of the saturated paste extract (EC_e) at mid-season (July 9, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.*

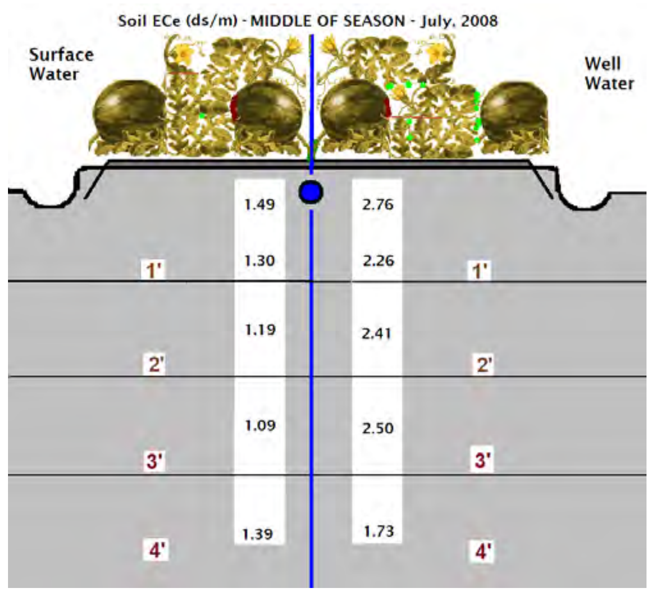
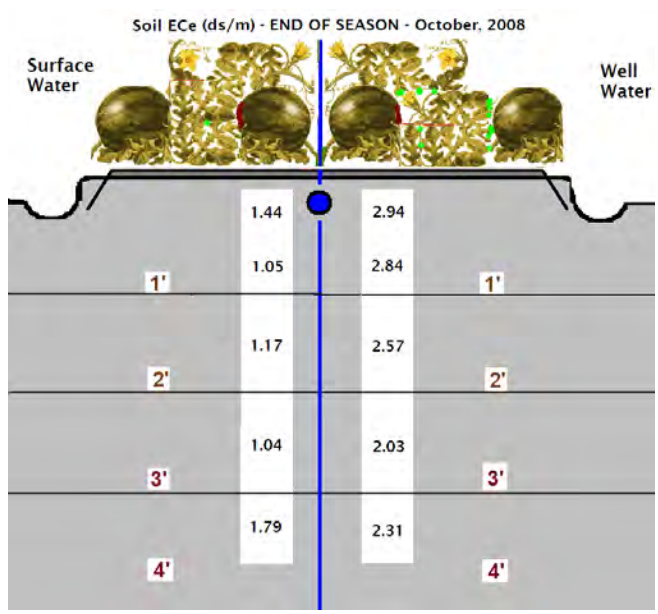


Figure 3: *Estimated salinity of the saturated paste extract (EC_e) at the end of the growing season (October 10, 2008). Soil samples were taken at depths of 0-6", 6-12", 1-2", 2-3', 3-4'. Samples were taken in the center of the production bed, adjacent to the drip line.*



Chile Pepper Response to Nitrogen Fertilization

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SUMMARY

In 2008, we evaluated the effects of N fertilization (6 N rates) on chile pepper fresh yield and biomass accumulation following two years of continuous corn production. A polymer-coated urea, ESN® (Environmentally Smart Nitrogen), N fertilizer source was used. Fresh chile pepper yields increased with increasing N rate up to the highest rate. A hail storm on August 29 resulted in severe damage to the pepper plants and developed peppers, resulting in reduced fresh chile pepper yields in 2008 compared to yields obtained in 2004 (Halvorson et al., 2007). Estimated gross economic returns reflected the fresh chile pepper yield. Total plant biomass production increased with increasing N rate. Plant size (stems + leaves) had maximized by about the August 26 sampling date while pepper yield continued to increase until final harvest. Total N uptake increased from 66 lb N/a with no N fertilizer applied to 126 lb N/a with 150 lb/a of fertilizer N applied (highest N rate), resulting in an estimated N fertilizer use efficiency (NUE) of about 40%. Residual soil NO_3-N levels were relatively low in the spring before planting chile pepper with residual soil NO_3-N levels tending to be even lower after chile pepper harvest. This may indicate that chile pepper was effective in utilizing soil residual N from the root zone or that the residual N was leached out of the root zone by the frequent irrigations.

PROBLEM

High nitrate-N (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. Relatively high rates of N fertilizer are used to optimize crop yields and quality, generally without regard to soil testing for residual N levels (Halvorson et al., 2005). Vegetable crops generally have shallow rooting depths (< 3ft) and require frequent irrigation to maintain yield and market quality (Halvorson et al., 2008b). High residual soil NO_3-N levels, high N fertilization rates to shallow-rooted crops, shallow water tables, and excess water application to control soil salinity all contribute to a high NO_3-N leaching potential.

Little information is available on the response of chile pepper to N fertilization in the Arkansas River Valley in Colorado (Halvorson et al., 2007). 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 (Halvorson et al., 2008b). We completed a two year continuous corn production study in 2007 following an onion N fertility study in 2006 (Halvorson et al., 2008a). Two years of corn were required to reduce residual soil N levels to relatively low levels in the plot area. This provided an opportunity to evaluate the response of chile pepper to N fertilization in 2008 without having high levels (>60 lb N/a) of residual soil N in the profile. Nitrogen management research is needed to develop improved NUE and N management practices for furrow irrigated crops in this area. Improved N management practices for crops in the Arkansas River Valley should optimize crop yields while minimizing N fertilizer impacts on groundwater quality.

Objective of this research was to determine N fertilizer needs for optimizing furrow-irrigated chile pepper yields in the Arkansas River Valley, and evaluate the influence of N fertilizer application rate on residual soil NO_3-N following chile pepper and the potential for groundwater contamination.

Study Details. Chile pepper (Sonora) was planted on April 23, 2008 at a rate of about 130,000 seeds/a 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). The plot area was previously cropped to corn for two years (Halvorson et al., 2008a). Six N rates (0, 30, 60, 90,120, and 150 lb N/a or N1, N2, N3, N4, N5, N6, respectively) were applied on April 1. The N source was polymer-coated urea, ESN, (a controlled-release N fertilizer), which provided about a 60 - 90 day release period from time of N application. The N fertilizer was broadcast and incorporated with a harrow before chile pepper planting. A randomized complete block design with four replications was used.

Table 1. Soil NO_3-N levels with soil depth for each N rate treatment before planting and after harvest of the chile peppers.

Soil Depth	2008 Fertilizer N Rate (lb N/a)						2008 Fertilizer N Rate (lb N/a)					
	0	30	60	90	120	150	0	30	60	90	120	150
	N1	N2	N3	N4	N5	N6	N1	N2	N3	N4	N5	N6
	1 April 2008						23 September 2008					
Ft	Soil NO_3-N, lb N/a											
0-2	16	18	19	24	27	28	11	9	18	23	19	15
0-3	19	22	22	27	32	36	13	12	22	27	25	21
0-6	27	32	28	35	41	64	20	27	35	40	40	38

Herbicides were applied for weed control, with the plots being relatively weed free during the study period. Soil NO_3-N levels in the 0-6 ft profile were monitored in the spring before planting and N fertilizer application and in the fall after chile pepper harvest. The plots were hand thinned on June 19 to about 33,000 plants/a. An average harvest stand of 32,489 plants/a was determined to be present on July 15 following the thinning operation. The peppers were sampled bi-weekly starting on June 3 until final harvest (September 23) for total biomass determination. Peppers on each plant, when present, were separated from the stems and leaves at each biomass harvest. On September 23, two rows 10 feet long were hand harvested to determine marketable peppers. Fresh weight of the peppers was recorded. On October 30 the remaining plant material was removed with a forage chopper leaving only a small portion of the stem remaining prior to fall plowing.

The plots were irrigated eleven times in 2008, with an average of about 4.1 inches of water applied each time with an average nitrate-N concentration of 1.1 ppm. Assuming a 50% irrigation efficiency, about 5 lbs N/a may have entered the soil and been available to the crop with the irrigation water.

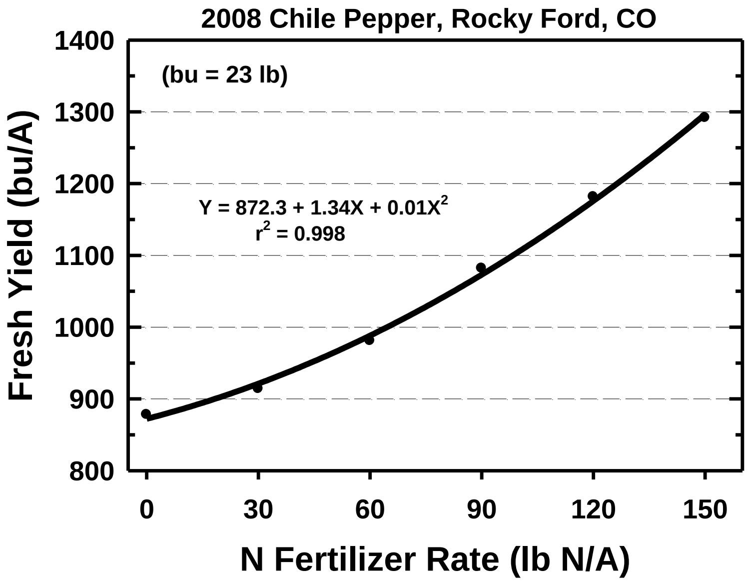

Figure 1. Fresh chile pepper yield at final harvest as a function of N rate.

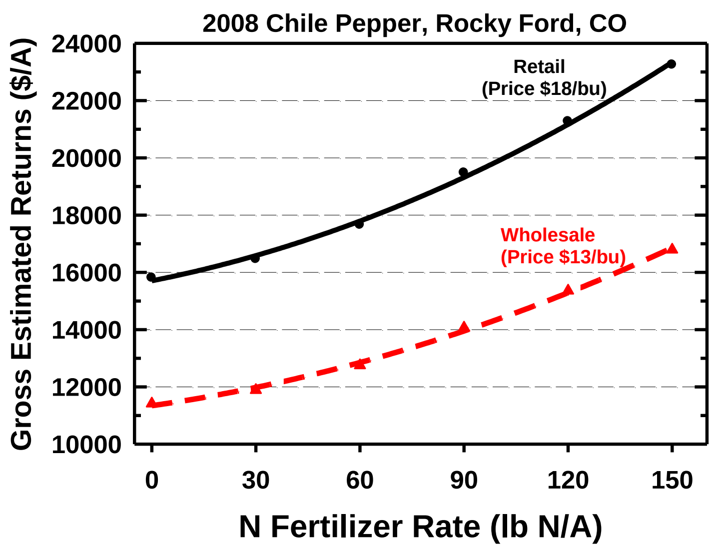

Figure 2. Estimated gross economic returns for each N rate on the day of harvest.

RESULTS

On April 1, 2008, the soil NO_3-N in the profile was concentrated in the 0-3 ft soil depth, with fairly low levels of NO_3-N at deeper depths (Table 1). The total amount of residual NO_3-N in the 6-ft profile increased slightly with increasing N rate. Residual soil NO_3-N levels after chile pepper harvest for each N rate in 2008 are also reported in Table 1. Residual soil NO_3-N levels were very low following chile pepper harvest which was consistent with that observed following the 2004 chile pepper crop. This may indicate that some residual soil and fertilizer N was lost from the root zone due to leaching with the frequent irrigations.

The chile pepper fresh yields were considerably lower in 2008 than they were in 2004. A severe hail storm on August 29 shredded leaves from the plants and damaged the developed chile peppers. This resulted in a loss in fresh chile pepper yield from all plots, especially at the higher N rates with the larger developed peppers. The fresh weight yield assumes a bushel weight of 23 lb (Figure 1). Fresh pepper yields increased with increasing N rate. Fresh pepper yields in 2008 were not maximized with the application of 150 lb N/a as they were in 2004. This may be the result of the hail damage.

The gross economic return for each N fertilization rate is shown in Figure 2, assuming a retail value of $18/bu and a wholesale value of $13/bu on the day of harvest (September 22, 2008). The gross returns were near $21,000/a based on a retail price and $17,000/a based on a wholesale price for the peppers. Although fresh chile pepper yield was lower in 2008 than 2004, the gross return per acre was higher.

Average biomass yield and pepper yield averaged over N rates are shown in Figure 3. Biomass accumulation was very slow until early July, when the plants started to grow more rapidly. Total biomass yields increased with increasing N rate (data not shown). Biomass (stems plus leaves) accumulation was near maximum at the August 26 sampling date, while the weight of the peppers continued to increase at a rapid rate until harvest. Biomass accumulation patterns were similar for each N rate, but biomass accumulation increased with increasing N rate (data not shown).

Based on the chile pepper N uptake data, total N uptake (stems+leaves+peppers) increased with increasing N rate with a total N uptake level of 66, 72, 83, 104, 105, and 126 lb N/a for the N1, N2, N3, N4, N5, and N6 treatments, respectively. A N fertilizer use efficiency of about 40% was estimated for the N6 treatment.

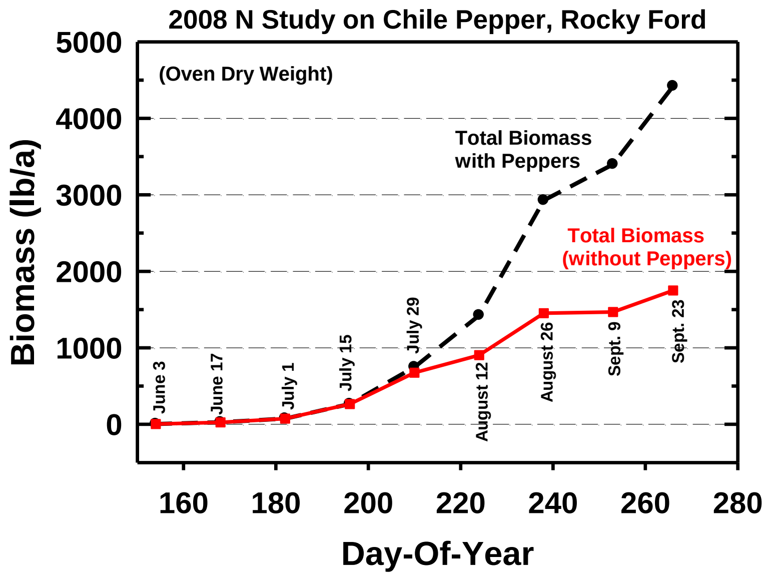

Figure 3. Biomass yield with and without developed peppers as a function of harvest date.

Based on the low soil NO_3-N levels following chile pepper harvest (Table 1), the total N uptake by the plant, and assuming an effective rooting depth of 3 ft, some of the fertilizer N may have been leached beyond the root zone in this study, considering the quantity of irrigation water applied (44.8 in/a).

A new N study will be continued on these same plots in 2009 with corn as the crop. We will determine the effectiveness of two enhanced efficiency N fertilizers (ESN and SuperU) in maximizing corn grain yields at lower N rates than required when utilizing urea as the N fertilizer source. Nitrogen fertilization effects on residual soil NO_3-N levels will continue to be monitored.

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ACKNOWLEDGMENT

The authors wish to thank Patti Norris, Brad Floyd, Robert D'Adamo, and Kevin Tanabe for their field assistance and analytical support in collecting the data reported herein.

Pepper Foliar Nutrient and Growth Regulator Trial

Michael Bartolo
Arkansas Valley Research Center

Chile peppers are an important specialty crop in the Arkansas Valley and improving the yield and quality is a constant goal of producers. In earlier studies, foliar-applied growth regulators and macro and micronutrients enhanced pepper yield and quality. This study was conducted to examine the response of peppers to several experimental and commercially available products.

Overall, AGM 06018, applied at 3 pints per acre, significantly improved yields compared to an untreated control. Other products or combination of products had less of an effect on total yield, pod number, and pod weight.

MATERIALS AND METHODS

An established long green chile pepper (var.Sonora) field direct-seeded on April 23, 2008 was used in this study. The furrow-irrigated field was located at the Arkansas Valley Research Center in Rocky Ford, Colorado. Standard cultural practices were applied during the course of the season. Peppers were treated three times, on the following dates: 7-23-08, 8-5-08, and 8-20-08. Applications were in the form of a foliar spray (in 27 gal/acre water). The crop was harvested on 9-22-08. Fresh weights and pod characteristics were taken at harvest.

<table>
<tr><th>Treatment</th><th>Rate</th><th>Plant Stage Application-1 7-23-08</th><th>Plant Stage Application-2 8-5-08</th><th>Plant Stage Application-2 8-22-08</th></tr>
<tr><td>Untreated Control</td><td>-</td><td rowspan="7">4-6 leaves. Above ground biomass ~ 450 lbs per acre</td><td rowspan="7">Above ground biomass ~ 1200 lbs per acre</td><td rowspan="7">Above ground biomass ~2800 lbs per acre</td></tr>
<tr><td>AGM 06018</td><td>3 pints per acre</td></tr>
<tr><td>AGM 06018 plus Grainer 0-54-32</td><td>3 pints per acre
5 lbs per acre</td></tr>
<tr><td>AGM 06023</td><td>2 pints per acre</td></tr>
<tr><td>AGM 08005</td><td>6.4 oz/acre</td></tr>
<tr><td>AGM 08005 plus AGM 06018</td><td>6.4 oz/acre
2 pints per acre</td></tr>
<tr><td>Max-IN ZnB</td><td>3 pints per acre</td></tr>
</table>

RESULTS

Yield and pod characteristics of long green chile peppers (var. Sonora) treated with foliar supplements.

Treatment	Pod Number per Acre	Average Pod weight (grams)	Yield per Acre (lbs)
Untreated Control	167,706 a	75.60 ab	27,932.8 bc
AGM 06018	195,475 a	76.46 a	32,887.8 a
AGM 06018 plus Grainer 0-54-32	188,941 a	76.45 a	31,744.3 ab
AGM 06023	174,784 a	70.84 bc	26,952.7 c
AGM 08005	173,695 a	71.49 abc	27,170.5 c
AGM 08005 plus AGM 06018	184,041 a	69.59 c	28,368.4 bc
Max-IN ZnB	175,329 a	73.32 abc	28,314.0 bc
lsd(0.1)	ns	5.04	4,262.1

This work was generously supported by *Winfield Solutions* under the direction of Mr. Joe Bush.

Tools and Management Practices to Conserve Water and Nitrogen Fertilizer in the Arkansas River Valley of Southeastern Colorado[1]

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Introduction:

Irrigation water is the lifeline of the lower Arkansas River Valley (Ark Valley), which extends from Avondale (east of Pueblo) to the Colorado-Kansas border. Without it, agricultural production will be greatly diminished and the valley's economy as a whole would suffer. Unfortunately, irrigation water availability in the Ark Valley has and will likely continue to decline due to droughts and to water leases, sales, and transfers (often for M&I usage) within and outside the Arkansas River Basin. Moreover, water quality concerns such as high salt, selenium, and nitrate concentrations may negatively impact agricultural profitability and pose a threat to human and animal health.

Water quantity and quality issues are exacerbated by inefficient irrigation. The majority of crop land in the Ark Valley is furrow irrigated, which results in substantial water losses[3], mostly through runoff and deep percolation. As water moves across the field or through the soil, it dissolves and transports salts and other pollutants. Furthermore, deep percolation raises water table levels, which in turn contributes to soil salinity through capillary movement and evapotranspiration. Salt concentrations in the Ark Valley generally increase from east to west. Other potential pollutants include selenium and nitrate-nitrogen.

Options to conserve water and reduce leaching of salts, nitrate, selenium, and other pollutants include efficient irrigation systems and sound water management. In Colby, KS where extensive research on subsurface drip irrigation (SDI) has been done, optimum corn yields were obtained with 75% of full irrigation and the injection of 160 lb N/acre, out of a total of 190 lb N/acre, through SDI (http://www.oznet.ksu.edu/sdi/Reports/2006/Lamm06S17.pdf).

Objectives:

1. Demonstrate improved irrigation and nitrogen fertilizer management tools and practices.

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[1] This was part of the NRCS Conservation Innovation Grant entitled 'Conserving water and minimizing leaching of salts and nitrate-nitrogen in the Arkansas Valley through enhanced irrigation and nutrient management', June 2006-June 2009.

[2] Collaborators included Troy Bauder, Michael Bartolo, and James Valliant of Colorado State University and Lorenz Sutherland of the regional NRCS office in La Junta, CO.

[3] Up to half of the water applied to a field with furrow irrigation may be lost through runoff or deep percolation. Some of the 'unused' water helps refill the valley's aquifers or flows back to the river, but it is generally of lower quality than the applied water.

2. Document the effects of these practices on crop yield, water conservation, and nitrogen fertilizer use.
3. Communicate the project results to the public.

Methodology:

Demonstrations and measurements were carried out at four farmers' fields and at the Arkansas Valley Research Center (AVRC). Field selection was based on existing information, accessibility, and growers' interest. Crops grown were alfalfa (2 fields) and corn (4 fields). The following parameters were monitored in 2007 and 2008:

- Soil moisture: Watermark sensors were installed at farmers' fields and at two fields at AVRC to monitor soil moisture status during the growing season. The sensors were connected to a data logger (Hansen Monitor AM400), which integrates soil moisture data in centibars every eight hours and displays it on a graph. Cooperators were shown how to access and interpret the data. A table giving the equivalent available soil moisture in inches of water per foot of soil and the readings at which irrigation is recommended was prepared and attached to each data logger. The sensors and data loggers were checked regularly.
- Crop Evapotranspiration (ET_c): ET_c is an estimation of crop water consumption and varies with crop species, growth stage, and weather conditions such as temperature, wind speed, solar radiation, and humidity. ET_c data were obtained from the nearest Colorado Agricultural Meteorological (CoAgmet) station and emailed[4] to each cooperator weekly.
- Irrigation application timing and depth, using flow meters (SDI) and Parshall flumes (furrow irrigation). Rainfall amount was also recorded.
- Nitrate-N and salt concentration in 0 to 3-ft soil depth. This was usually done in the spring before fertilizer application and in the fall after crop harvest.
- Corn grain yield in bu/acre. Corn yield and irrigation depth were measured at AVRC only.

  Field trials were carried out at AVRC to compare:

  - Subsurface drip irrigation (SDI) and furrow irrigation (FrI)
  - Full and deficit irrigation
  - Nitrogen fertilizer application rates
  - Pre-plant N fertilizer application versus N fertilizer application through SDI

[4] ET data was emailed to cooperators by Troy Bauder, Extension Specialist at Colorado State University.

Results:

1. **Soil moisture and crop ET:**

Examples of Watermark sensor readings and crop ET data are shown in Figures 1-4. Watermark sensors operate on the same principle of electrical resistance as the gypsum blocks. They contain two electrodes imbedded in an insoluble granular material. The resistance to the electrical current flowing between the two electrodes is highly correlated to soil water potential or the energy required to extract (example: by plant roots) water from the soil. Watermark sensors do not measure soil water content directly but provide a good indication of soil wetness or dryness. The lower the readings are, the higher soil water content is and vice-versa. Readings usually go down after each irrigation application or rainfall event, particularly at the shallower soil depths.

Figures 1 and 2 show Watermark sensor readings in a furrow-irrigated corn field in 2007 and 2008. The missing data in Fig. 1 was due to a damaged cable early in the season. In 2007, Watermark sensor readings exceeded the manageable allowable depletion (MAD) starting in August (30-in depth) or September (6- and 18-in depths), probably due to low precipitation. This resulted in relatively low corn yields (150 bu/acre). MAD was estimated at 60 centibars (cb) but could be higher. Water should be applied when MAD is reached to avoid water stress and consequent yield loss, particularly during the critical growth stages, which for corn extends from V15 (pre-tassel) through R2 (blister).

Water was applied more frequently in 2008. In addition, over 2.0 inches of rain fell in August. The readings were below MAD throughout most of the irrigation season (Fig. 2). Greater corn grain yield was obtained in 2008 (around 200 bu/acre) than in 2007.

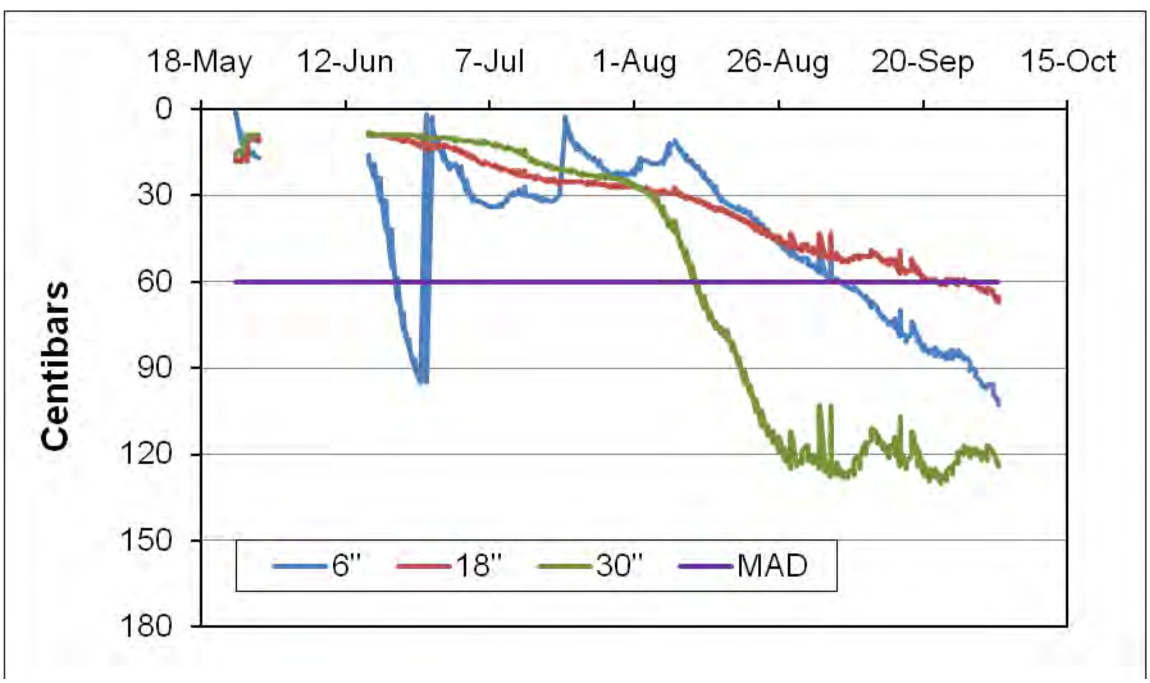

Figure 1. Watermark sensor readings in centibars from 24 May through 3 October 2007. Corn field #1

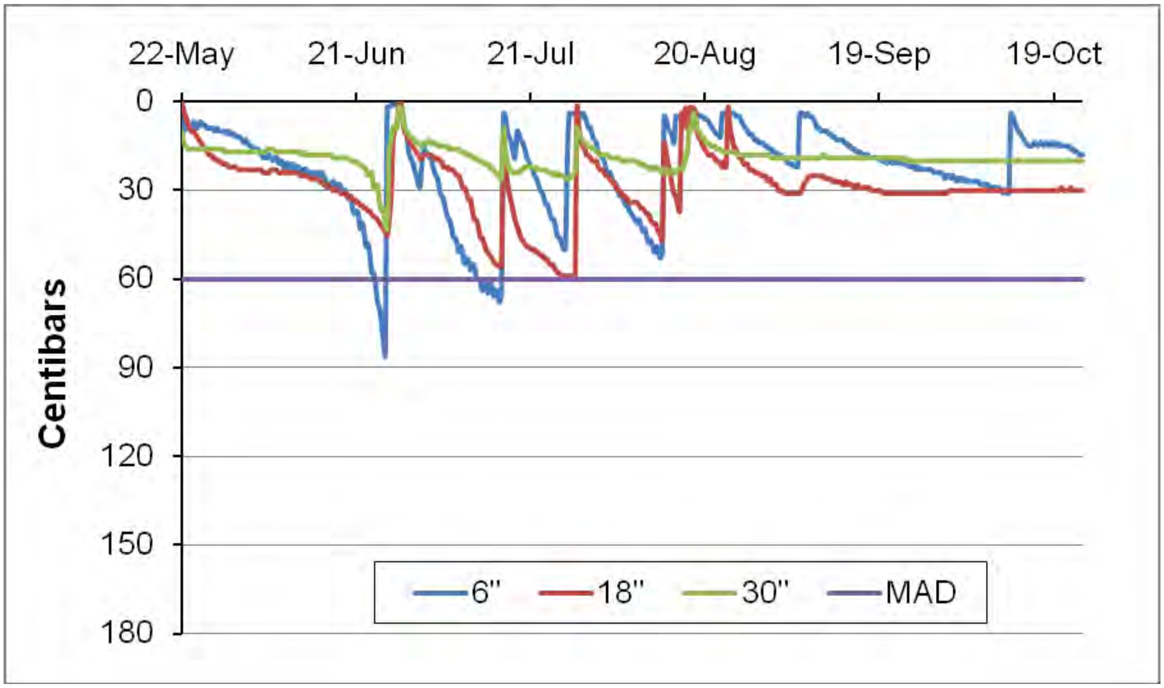

Figure 2. Watermark sensor readings from 22 May through 9 October 2008. Corn field #1.

Watermark sensor readings in Fig. 3 are from a corn field that was drip-irrigated. Irrigation was ceased at the end of August due to substantial rainfall. Figure 4 shows the cumulative precipitation (irrigation and rainfall) from May through August. Crop ET matched precipitation closely.

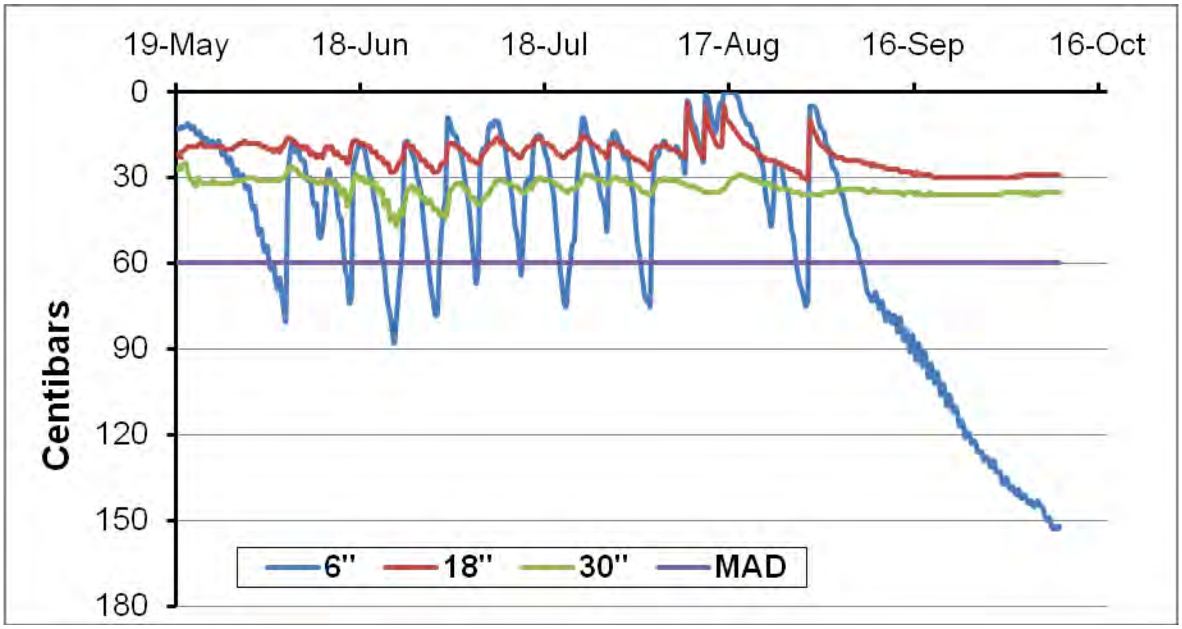

Figure 3. Watermark sensor reading from 19 May through 3 October 2008. Corn field #2/SDI

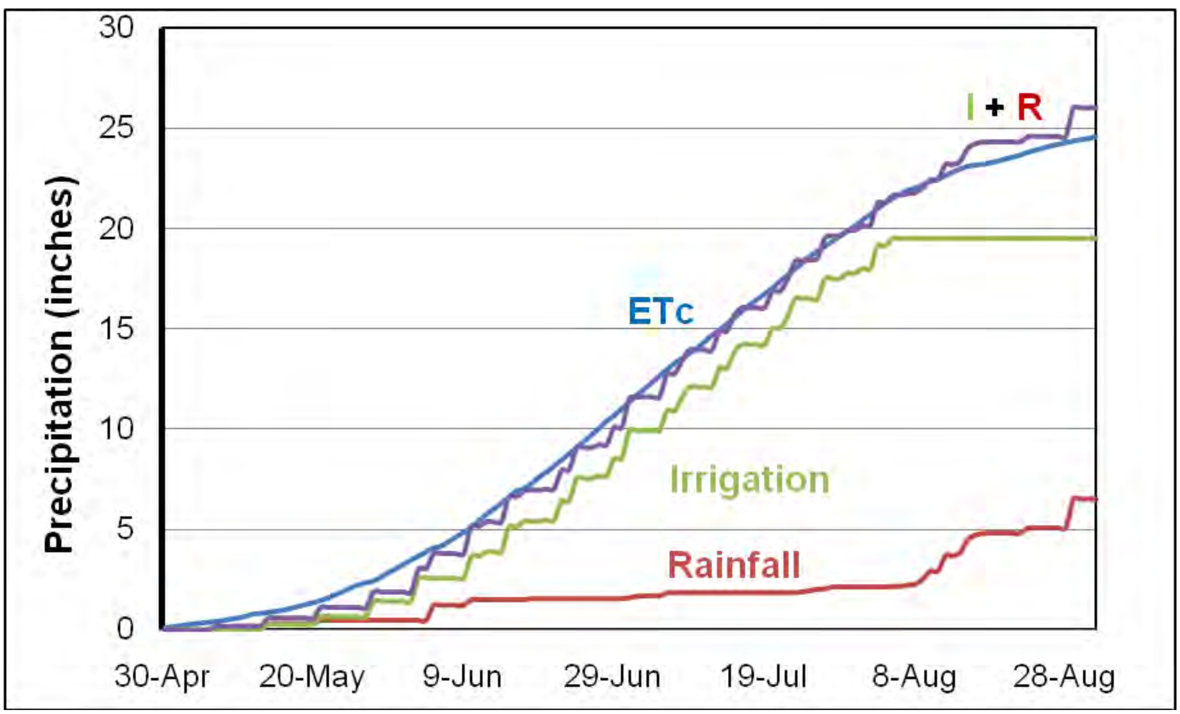

Figure 4. Cumulative precipitation and crop ET in 2008 in field #2.

2. Comparison of subsurface drip irrigation (SDI) and furrow irrigation (FrI):

An existing field trial comparing SDI and FrI was continued in 2007 at AVRC. Drip tapes were installed in the middle of 60-in beds at about eight inches below the soil surface.

Corn was planted on either side of the dripline. A total of 31.4 inches of irrigation water was surface-applied in every other furrow, compared to 16.4 inches with SDI (Fig. 5). The SDI total includes 3.8 inches which were surface-applied early in the season to ensure uniform germination and emergence. Corn grain yield averaged 189 bu/acre[5], with no statistically significant difference between SDI and FrI. This confirmed the 2005 and 2006 results, which also showed no significant difference between the two irrigation systems (Fig. 6).

3. Comparison of full and deficit irrigation:

In addition to comparing SDI and FrI, two irrigation regimes were tested: full (FI) and deficit irrigation (DI). Precipitation amounts are shown in Figure 5. Water was withheld from the deficit irrigation treatment once or twice during the vegetative growth and after physiological maturity. The difference in corn between FI and DI was significant in 2005 but not in 2006 and 2007 (Fig. 7).

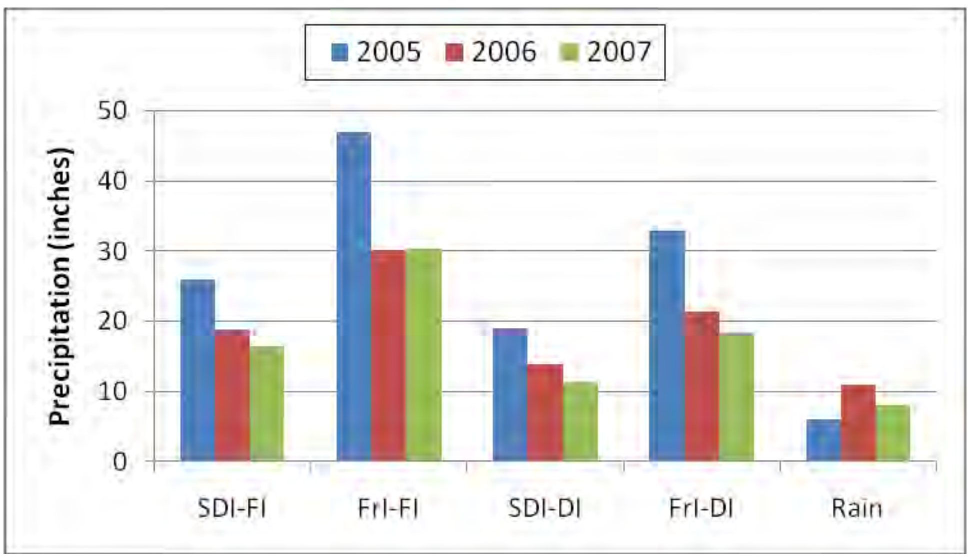

Figure 5. Precipitation amounts (irrigation and rain) applied to a corn field #3 in 2005 to 2007. 'FI' is full irrigation and 'DI' is deficit irrigation.

[5] No nitrogen fertilizer or manure was applied in 2007. Corn was grown on residual nitrogen from the 2005 and 2006 seasons.

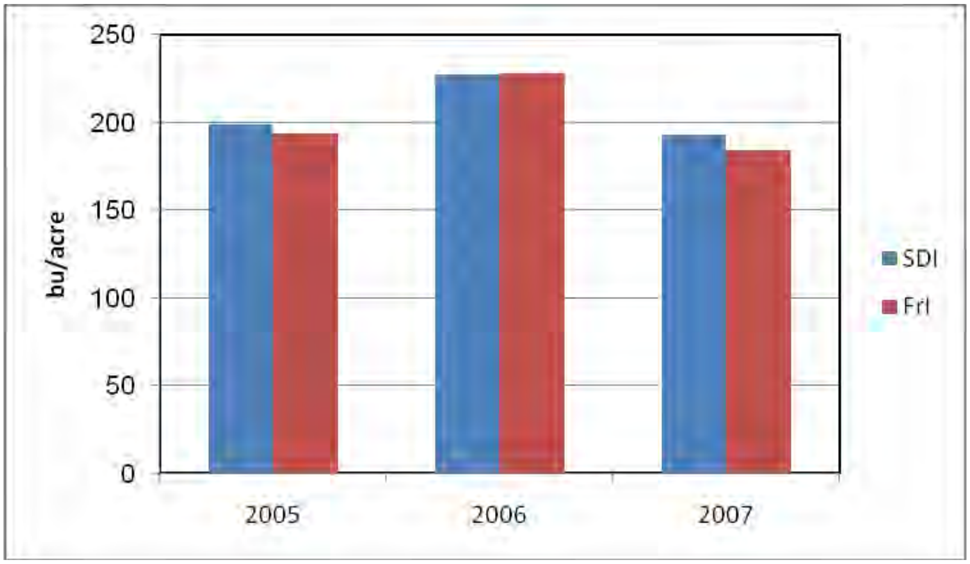

Figure 6. Grain yields of furrow (FrI) and drip-irrigated (SDI) corn field #3 in 2005 to 2007.

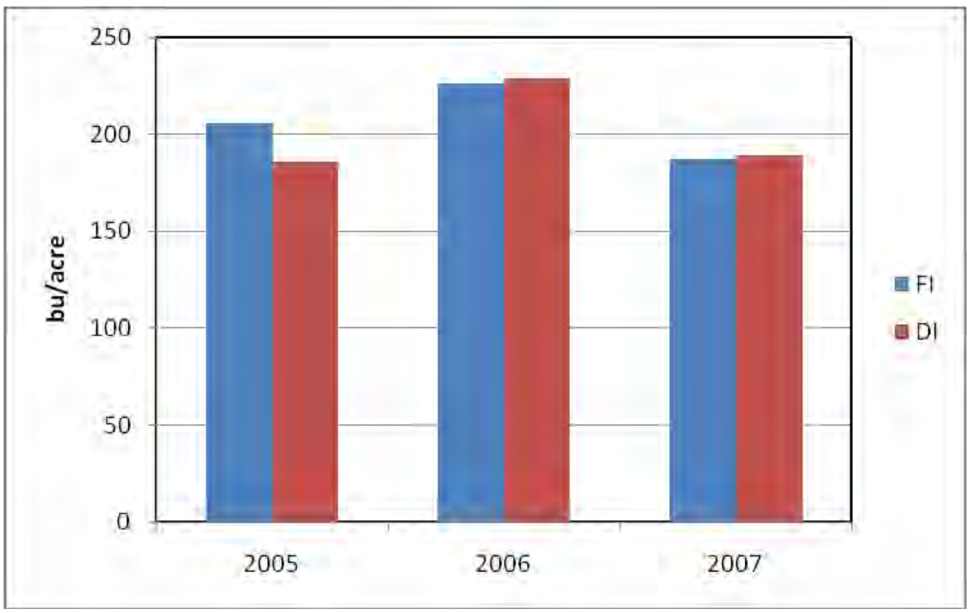

Figure 7. Corn grain yields of full (FI) and deficit (DI) irrigation in corn field #3 in 2005 to 2007.

4. Irrigation scheduling trial:

Additional demonstrations were conducted at AVRC in 2007 and 2008 to compare the effects of increasing irrigation application rates on corn yield. Irrigation amounts were as follows: 50%, 75%, 100%, and 125% of corn ET or ET_c. Water was delivered through drip tapes spaced 60 inches apart and buried six inches below the soil surface. SDI was used instead of furrow irrigation for accurate water measurements. Precipitation amounts are shown in Fig. 8.

More water was applied in 2008 than in 2007 (Fig. 8), which resulted in greater corn yields in 2008 (Fig. 9). Drip irrigation was started late in 2007 and it was not possible to apply water as often as needed. There was a somewhat linear increase in corn yield in 2007 as the water application rate increased. Statistically, the ranking in corn yield was as follows: 125% ET_c = 100% ET_c, 100% ET_c = 75% ET_c > 50% ET_c, 125% ET_c > 75% ET_c > 50% ET_c.

In 2008, corn yield dropped as irrigation application rate increased from 100 to 125% ET_c. With sound irrigation scheduling (e.g., proper irrigation timing to meet crop demand), it would not be wise to apply more than 100% of crop evaporative demand, except for example to flush salts out of the root zone. Water application amount and timing should be adjusted for rainfall and soil water reserve.

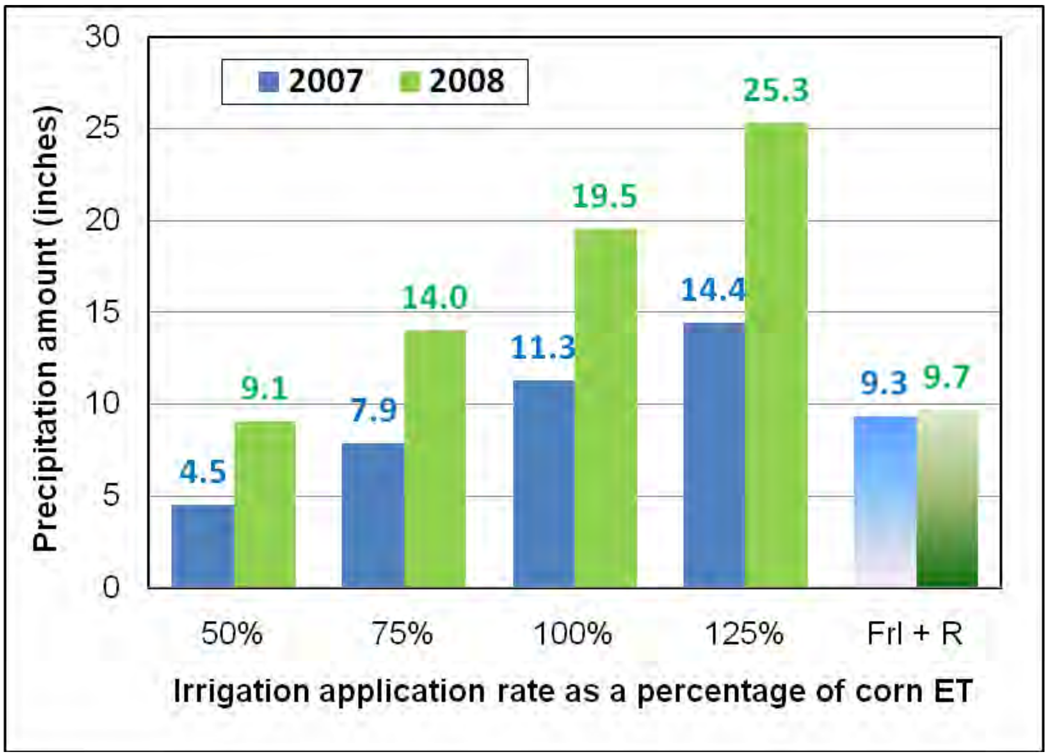

Figure 8. Precipitation amounts for corn field #4 in 2007 and 2008. 'FrI + R' represents total rainfall plus the depth of the first irrigation, which was surface-applied (furrow irrigation) to ensure uniform germination and emergence.

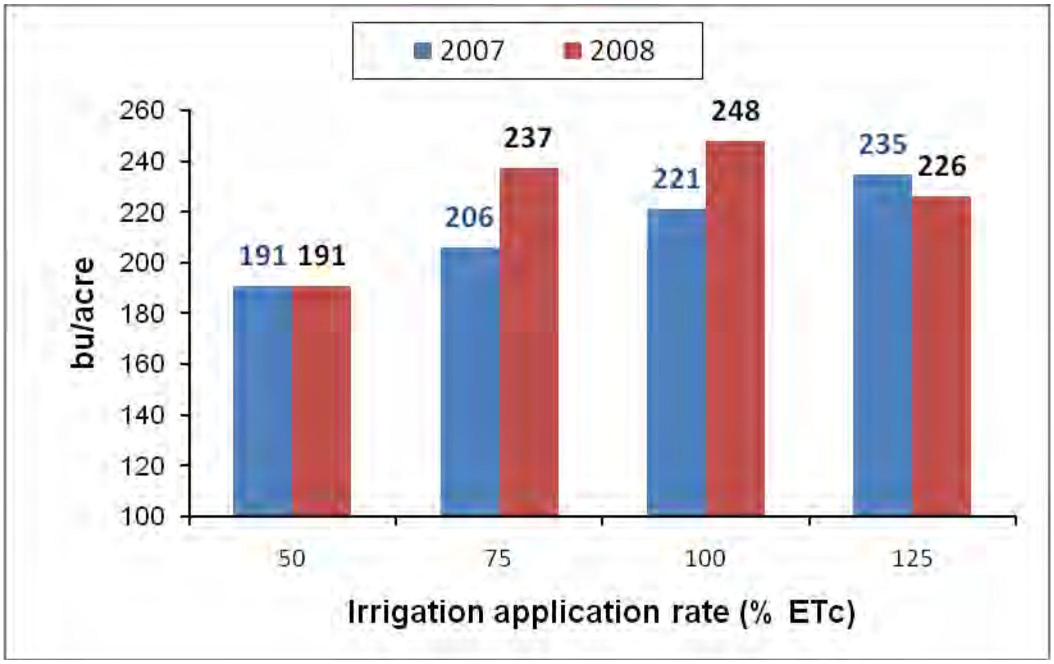

Figure 9. Corn yield as affected by irrigation application rate in 2007 and 2008.

5. Nitrogen fertilizer management:

In order to demonstrate the benefit of sound nitrogen management, two nitrogen fertilizer rates and/or application methods were tested in 2007 and 2008.

	Nitrogen fertilizer rate (N lb/acre)		
Year	Check	Recommended rate[1]	Other
2007	NA	120 PPBI	240 PPBI
2008	0	143 PPBI	30 PPBI 60 Injected

[1] N fertilizer rate based on soil test results and yield goal. PPBI: Pre-plant broadcast incorporated.

The target corn yield was 200 bu/acre in 2007 and 300 bu/acre in 2008. In 2008, 60 lb N/acre were injected through the sprinkler irrigation system in three applications (20 lb N/application). The timing of N application was determined with the use of the SPAD 502 Chlorophyll Meter. Another 30 lb N/acre was applied PPBI. Thus, by splitting N fertilizer application and injecting some of it (two thirds in this case) through the irrigation system, 53 lb N/acre were saved. In addition, N availability and use efficiency were enhanced as evidenced by corn yield (Fig. 10).

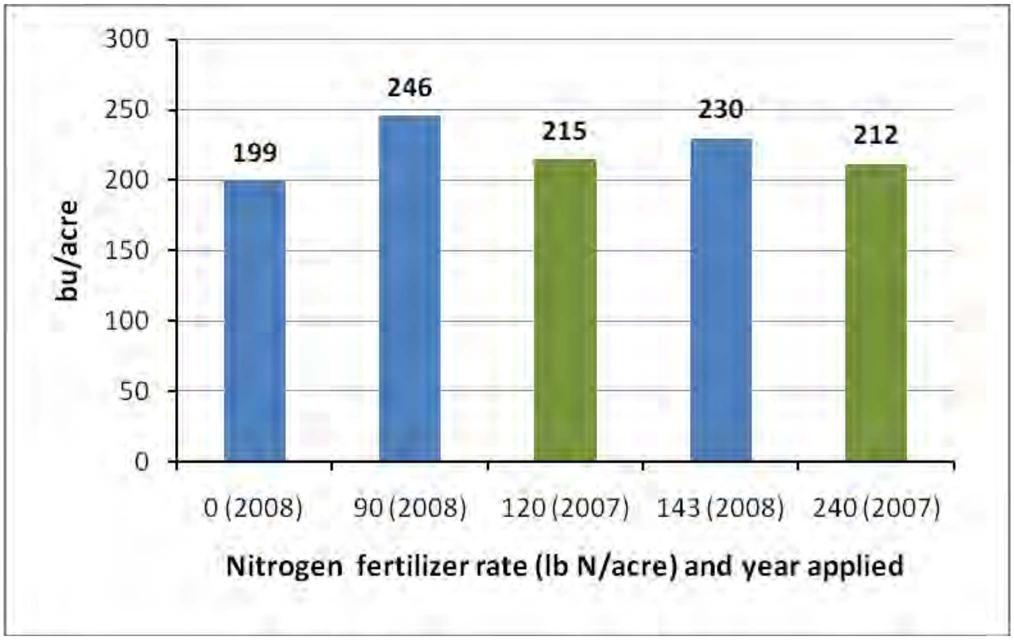

Figure 10. Corn grain yield as affected by N fertilizer rate in 2007 and 2008 at AVRC.

In 2007, there was practically no difference in corn yield between the recommended rate of 120 lb N/acre and the rate of 240 lb N/acre (Fig. 10). Furthermore, there was nearly twice as much residual nitrate nitrogen in the top three feet of soil in the high-N rate (146 lb/acre at 100% ET_c) than in the recommended N rate (76 lb/acre), in the fall of 2007. Less nitrate nitrogen (26 lb/acre on average at 100% ET_c, regardless on N application rate) remained in the soil after the 2008 season, probably due to higher corn yield (data not shown).

Conclusions:

This project illustrated best management practices to conserve water and nitrogen fertilizer in the Ark Valley. It also confirmed the results of several years of research at AVRC (See list of publications below). Managing water in ways that preserve or enhance agricultural production in the Ark Valley, within the legal boundaries of the Arkansas River Compact, is a must due to the erratic nature of precipitation and the increased competition for agricultural water. In this project, we demonstrated that:

- Simple tools such as Watermark sensors and crop ET estimates from CoAgmet stations can be used effectively to schedule irrigation.
- Substantial amounts of water (example 43% compared to furrow irrigation over a three-year period) can be saved by using efficient irrigation systems such as drip irrigation. Drip irrigation can also reduce the amount of salts leached into the ground water (Berrada, 2007).

- Additional water savings can be achieved by scheduling irrigation so that sufficient water is applied at critical crop growth stages while less water may be applied at less critical stages.
- Nitrogen fertilizer rates can be reduced substantially by taking into account residual N in the soil and crop yield goal. Further reductions in nitrogen fertilizer rate can be achieved by applying N when the crop needs it, example by injecting it through the irrigation system. Work by Halvorson et al. (2008) further illustrates this point. By applying the correct (agronomic) amount of N fertilizer, more of it will be used by the crop, thus minimizing potential leaching below the root zone.

These results and other relevant information were presented at the 2007 and 2008 field days and advisory board meetings at AVRC, the Great Plains Soil Fertility Conference on March 5, 2008 in Denver, and the Irrigation and Nutrient Management workshop in Rocky Ford on January 30, 2008.

Related publications:

Berrada, A., A.D. Halvorson, M.E. Bartolo, and J. Valliant. 2007. The effects of drip irrigation and fertilizer rate on corn yield and soil salinity in the Arkansas River Valley. p. 6-12 In Agric. Exp. Sta. Tech. Rep. TR07-14, Colorado State Univ., Ft. Collins, CO.

Halvorson, A.D., M.E. Bartolo, C.A. Reule, and A. Berrada. 2008. Nitrogen effects on onion yield under drip and furrow irrigation. Agron. J. 2008 100: 1062-1069.

Berrada, A. 2007. The effects of drip irrigation on corn yield and soil salinity in the Arkansas Valley. *From the Ground Up Agronomy News*, 26 (1): 12-13. Cooperative Extension, Colorado State Univ., Ft. Collins, April 2007.

Large Lysimeter Summary - 2008

Lane Simmons, Research Associate, Arkansas Valley Research Center

Crop: Alfalfa
Planting Date: August 9, 2007
Seeding Rate: 19 lbs/acre
Varity: Genoa Alfalfa
Irrigation: Flood-Furrow

Harvest

Four cuttings of alfalfa hay, for a dry weight total of 38.4 lbs, or an equivalent 8.63 tons/acre. The hay was weighed immediately after harvest, allowed to air dry in a greenhouse, and then re-weighed to determine the reported dry weight. The harvests occurred on 6/11, 7/21, 9/2, and 11/3.

Water Budget for April 1, 2008 – November 5, 2008

Seven Irrigations: 39.87 inches
Precipitation: 10.11 inches
Lysimeter Measured ET: 52.47 inches
Deficit from Soil Moisture: 2.49 inches

Soil Moisture

Soil moisture, inside and outside of the lysimeter, was monitored at ten different depths using a neutron moisture meter. Twelve NMM measurements were taken during the season.

Crop Condition

Crop height was monitored during the season. The alfalfa was considered to be in reference conditions at a height of 50cm (19.7 inches). The crop was also monitored for weed and pest pressure.

Evapotranspiration (ET)

During the season, there was an ongoing comparison between ET values computed by the ASCE Standardized Penman Monteith equation and ET values directly measured by the large lysimeter. These two values, and any differences between the two, were analyzed against corresponding wind speed, relative humidity, solar radiation, and air temperature.

The following are automatically measured and recorded on a datalogger:

Wind speed at 2 and 3 meters, Wind Direction, Precipitation, Temperature, Relative Humidity, Crop Temperature, Incoming and Reflected Solar Radiation, Barometric Pressure. Solar Radiation making its way through the plant canopy, Lysimeter soil temperature at 10mm, 40mm, 0.5m, 1m, and 2m, External soil temperature at 0.5m, 1m, and 2m, Heat Flux at 100mm. Changes in lysimeter monolith weight, Drainage from lysimeter.

Notes

- A 3.8 acre portion of the 14-acre large lysimeter field was re-planted in the spring of 2009 because of stand quality and weed problems.

- An area of stunted growth appeared in a small circle surrounding the lysimeter. This circle is approximately the same shape as the excavated construction area.

Reference Lysimeter Summary - 2008

Lane Simmons, Research Associate, Arkansas Valley Research Center

In 2008, construction began on the second weighing lysimeter at the AVRC, termed the reference lysimeter. This lysimeter's inner tank, which contains the soil monolith, or soil core, has a surface area of 5'x 5', which is smaller than the 10'x 10' surface area of the original lysimeter, termed the large, or crop lysimeter. Both lysimeters have an 8' monolith depth. The primary purpose of this new reference lysimeter will be to directly measure the evapotranspiration (ET) of alfalfa hay, the reference crop in Colorado.

Construction Summary

- Major components of the lysimeter were fabricated at the USDA-ARS shop in Fort Collins, CO.
- Personnel from the Colorado Division of Water Resources performed a field survey on the proposed lysimeter field and the anticipated lysimeter installation site.
- Helical anchors were installed. The helical anchors served to facilitate the soil core/monolith acquisition, or pull-down process, and also serve as part of the lysimeter's foundation system.
- The soil core/monolith acquisition was completed.
- Using a crane, the monolith, contained by the steel inner tank, was inverted so the actual bottom of the monolith was oriented upwards. This was done in order to install the drainage system and bottom plate.
- The site was excavated for construction of the lysimeter's concrete foundation. The foundation was then formed and poured. Finish surface elevations were checked.
- The steel outer tank was delivered by the Colorado State Forest Service and set into place with a crane. The outer tank was attached to the foundation by wielding the tank to steel hold-downs embedded in the concrete.
- Back-fill began. Back-fill was done in several stages, and the soil was water-packed after each stage.
- Any bare or exposed metal was painted with an Ameron Amerlock, two part painting system.
- The outer tank has hollow steel columns, or pedestals, that are designed to be part of the scale and monolith/inner tank base. These pedestals were filled with concrete. Steel top plates were positioned and attached to the top of each column, upon which the Cardinal model FS-4 lysimeter scale was installed.
- The exterior instrumentation support pipe and weather head mast were installed.
- The access hatch top hat was sealed and bolted to the outer tank. This allowed installation of the lysimeter access ladder to begin.
- Four safety piers, designed to support the monolith in the event of a scale failure and provide support during scale maintenance, were finish welded, painted, and installed.
- The scale frame was painted and installed on the scale. Using a crane, the inner tank/ monolith was turned right-side-up and set inside the outer tank, and on the scale frame.
- Trenches were dug for electrical and communication lines.