

HAY DAY 2017

Wed, July 12th, 8am-3:30pm



BLUE VALLEY RANCH
5 miles South of Kremmling on Hwy 9

Agenda

- 8:00- Light Breakfast
8:30 & Registration
- 8:30- **Zach Schwalbe**
9:15 **CSU Climate Center**
CoAgMet
- 9:25- **Kelcey Swyers**
10:25 **Grassland Nutrition Consulting**
Beef Cattle & Horse Nutrition
- 10:35- **Max Schmidt**
11:05 **Orchard Mesa Irrigation Dist.**
Polyacrylamide (PAM)
- 11:15- **Joe Brummer**
12:15 **CSU Soil & Crops Sciences**
*Rotational Meadow Dryup,
Irrigation Management, Fertilizing*
- 12:15- **Lunch**
1:15 *Pulled Pork Sandwiches*
- 1:15- **Equipment**
3:30 **Demonstrations**

Please RSVP by
Wednesday, July 5th
(so we can get a head count for lunch)
Katlin: 970-531-0127
middleparkcd@gmail.com

A Collaboration Between:

- Middle Park Conservation District
- *North Park Conservation District*
- Routt County Conservation District
- **CSU Extension Service**

Sponsored By:

Blue Valley Ranch
Buffalo Brand Seed
Crop Packaging Specialists/Dennis Jones
Frontier Station
Granite Seed
Middle Park Cowbells
Middle Park Stockgrowers
Northwest Ranch Supply
Pawnee Buttes Seed
Ray Bros Seed
Rocky Mountain Machinery
Square Bale Spinner, LLC
US Tractor & Harvest
Ward Laboratories
West End Rental

**FREE &
INFORMATIONAL**

About BVR

For over 20 years Blue Valley Ranch (BVR) has been practicing land stewardship in Grand and Summit Counties of the North-Central Rocky Mountains of Colorado. The ranch spans 25,000 acres of lush shrublands, grasslands, aspen stands, coniferous forests, wetlands, and riparian areas along the Lower Blue River. Management of the ranch not only focuses on production agriculture (cattle, bison, and hay) but also on the plethora of wildlife that call the ranch home.

The ranch strives to be a leader in conservation and a model for what integrated resource management can accomplish on private lands in the Western United States. The ranch's legacy of land stewardship began with a conservation vision in 1994, and a focus on science-based, adaptive management principles has guided the ranch in building natural resource, wildlife, agriculture and recreation programs ever since. The successful integration of diverse programs is what makes Blue Valley Ranch unique among most ranching operations, while also presenting the single greatest challenge for management.

When ecological timescales in Western landscapes span decades to centuries, twenty years is only a moment in which to make a positive impact. By holding to a vision of conservation, however, positive actions today can continue to bear fruit for generations to come. This kind of long-term thinking requires vision and planning, which is exactly what has made the ranch the special place it is today. While making a good reputation even better will be a challenge, it is a challenge that the Blue Valley Ranch looks forward to implementing for decades to come.



Why these measurements?

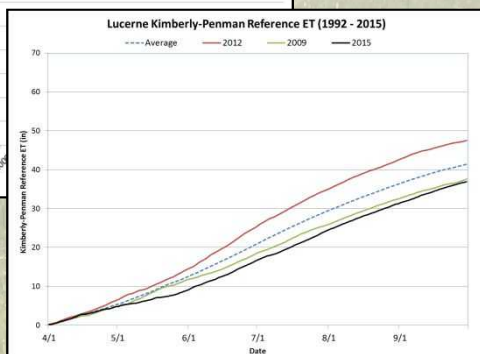
A long-term focus of CoAgMet is improving estimates of evapotranspiration (ET) from meteorological measurements.

Several models exist that vary by input data and complexity:

- Hargreaves
- Blaney-Criddle
- Penman-Monteith
- Kimberly-Penman
- Standardized ASCE Equation

The standard CoAgMet station collects the elements needed to quantitatively estimate evapotranspiration.

Reference ET Climatology can be developed.



Irrigation Scheduling Tools

WISE - Water Irrigation Scheduling for Efficient Application

Web-based, utilizes GIS and CoAgMet data, enables producers to more efficiently schedule irrigations.

<https://erams.com/>



Changes are coming to CoAgMet

Transitioning to the “Colorado Mesonet”

- Real-time data for broad applications such as improved local weather forecasts and warnings, public safety, transportation and recreation.
- More stations in data sparse areas.
- Year-round precipitation data for drought, flood and water supply monitoring.*
- Seeking stable long-term support.

**Current station gauges are only suitable for growing season precipitation.*

FOR MORE INFORMATION CONTACT:

COLORADO CLIMATE CENTER

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Colorado State University
1371 Campus Delivery
Fort Collins, CO 80523

CoAgMet

coagmet.colostate.edu



Colorado Agricultural Meteorological Network

High Quality Weather
Data for Agriculture and
Natural Resources
Application and Decision
Support



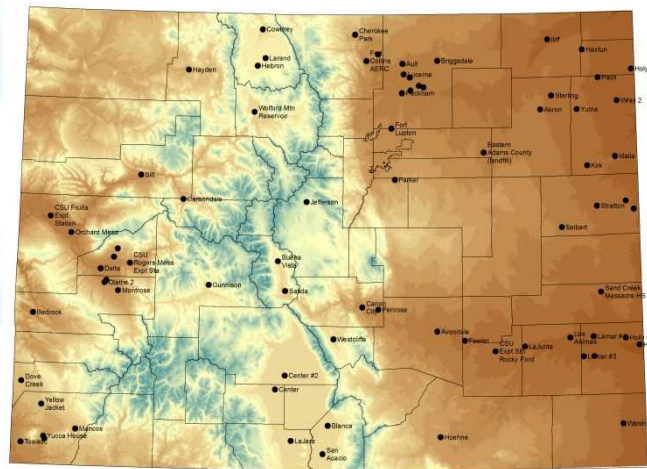
Colorado State University

What is CoAgMet?

The Colorado Agricultural Meteorological Network (CoAgMet) is a network of many nearly identical automated weather stations, primarily in rural areas of Colorado. Data consists of hourly and daily measurements of:

- Air Temperature
- Humidity
- Solar Radiation
- Warm Season Precipitation
- Wind Speed and Direction
- Soil Temperature
- Soil Moisture at selected sites

Each station measures meteorological variables used to calculate evapotranspiration needed for irrigation scheduling and more effective water use. The data are also useful for many other agricultural and natural resource applications.

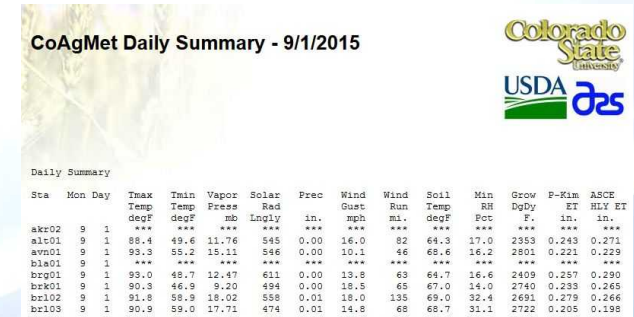


History of CoAgMet

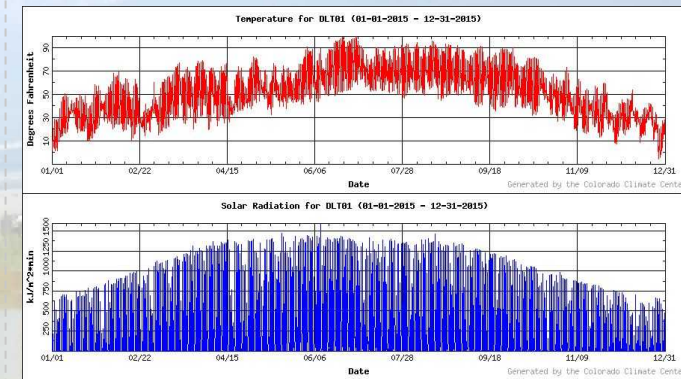
In the early 1990's, CSU Extension plant pathologists and USDA's Agricultural Research Service (ARS) Water Management Unit began collaborating to collect automated agricultural weather data. Plant pathologists used data for prediction of disease outbreaks and insect pests. ARS focused on irrigation scheduling recommendations and water conservation. Standard instruments and data collection platforms were selected, and a small network of stations were deployed in and near irrigated cropland. As interest grew and sponsors were found, more weather stations were added. The Colorado Climate Center (CCC) at Colorado State University took interest in this data resource and subsequently took over daily data collection and network management. CCC added internet delivery and a wide range of data delivery options. Improvements continue in response to a growing interest in these data. Recently, the Colorado Water Conservation Board and several Basin Roundtables have helped support the network, focusing on learning more about the consumptive use of irrigated crops and hay meadows.

Website Products

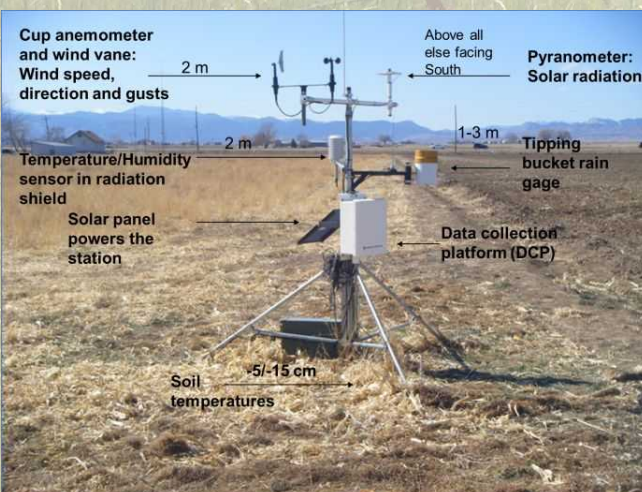
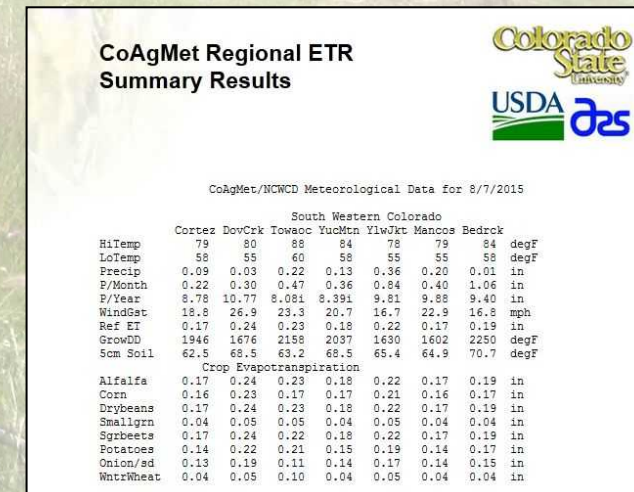
Daily Summary for All Stations



Hourly Data Tables and Graphs



Regional Etr Reports



Example of station and variables measured

The CoAgMET Network: Overview, History and How It Works



Colorado State University

Zach Schwalbe
CoAgMET Network Manager
Colorado Climate Center



First -- A short background of the Colorado Climate Center

- ▶ In 1973 the federal government abolished the "State Climatologist" program nationwide leaving Colorado without
- ▶ Later that same year, Colorado re-established the State Climate program with support through the Colorado Agricultural Experiment Station at Colorado State University.



Our Mission

- ▶ The Colorado Climate Center at CSU provides valuable climate expertise to the residents of the state through its threefold program of:
 - 1) **Climate Monitoring** (data acquisition, analysis, and archiving),
 - 2) **Climate Research**
 - 3) **Climate Services** (providing data, analysis, climate education and outreach)



Elements: temperature, precipitation, snow, wind, solar, evaporation, soil temperatures, humidity, clouds, etc.

Fort Collins CSU Historic Weather Station
Continuous monitoring since the 1880s

CoAgMET =

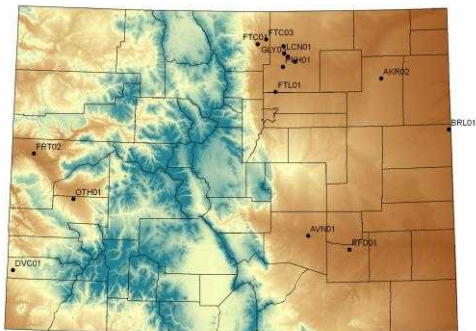
Colorado Agricultural Meteorological Network

CoAgMET History

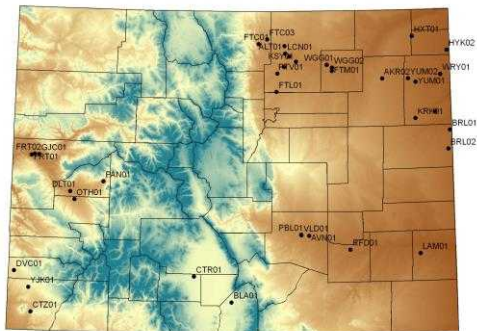
- ▶ In the early 1990's, CSU extension plant pathologists and ARS scientists decided to collaborate efforts to collect detail agricultural weather data.
- ▶ Standard instruments and data collection platform were selected and a small network of stations was deployed in fully irrigated agriculture.
- ▶ As the network grew, the Colorado Climate Center became increasingly interested in using the data; began daily data collection, quality control and built a web interface to distribute data and products to users across the state.



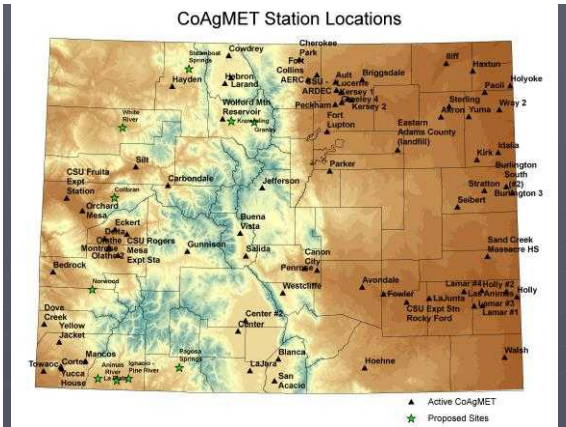
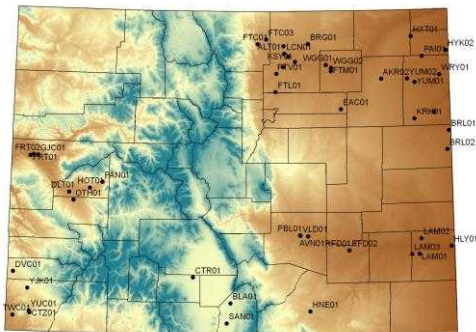
CoAgMet 1992



CoAgMet 1997

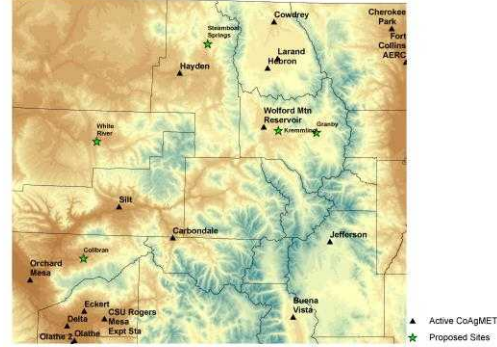


CoAgMet 2002



Northern Mountain CoAgMET Stations

3 New stations in your area coming this year!!



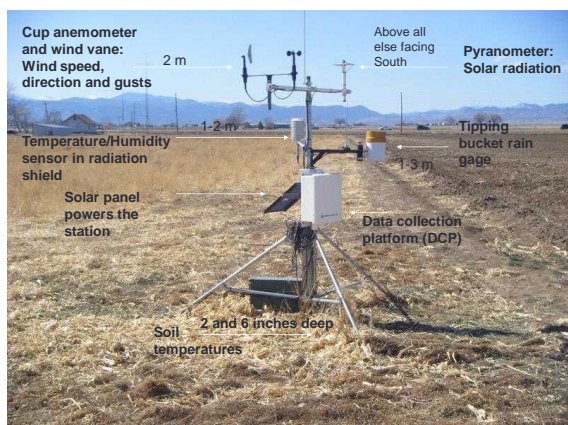
Overview of CoAgMET Network

- ▶ Currently there are 75 stations in primarily irrigated agriculture areas of the state
 - Soon to be 85
- ▶ Data are collected hourly, daily and introducing 5-minute. Data collected include: temperature, humidity, solar radiation, wind speed and direction, precipitation and soil temperatures.
- ▶ Data and graphics are available online: <http://coagmet.colostate.edu>

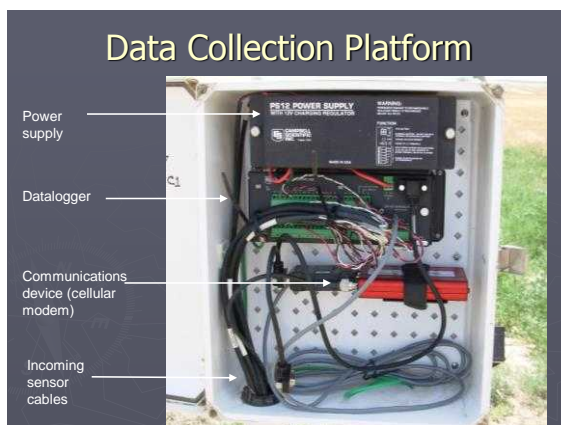
Routine Maintenance

- ▶ Our goal is to visit each station once a year to make sure the station is operating properly.
 - Sensor are swapped out once every 2 years.
- ▶ Due to the fact that CoAgMet is run by collaborations and operates on a limited budget, routine maintenance is difficult with such a large network.
- ▶ Our supported stations are usually our priority

Overview of CoAgMET MeasureR



Data Collection Platform



Why these measurements?

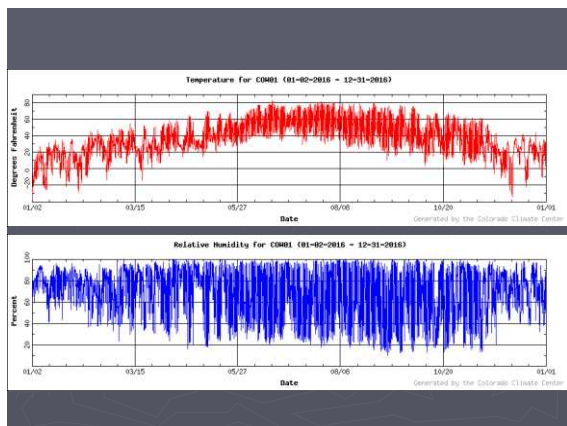
- ▶ The main goal of CoAgMET is to calculate evapotranspiration (ET) from meteorological measurements.
- ▶ Several models exist that vary by input data and complexity:
 - Penman-Monteith – physically based
 - Kimberly-Penman – physically based
 - Hargreaves – empirical temperature based
 - Standardized ASCE Equation – attempts to standardize calculations to make them more comparable
- ▶ The standard CoAgMet station collects the elements needed to calculate evapotranspiration.

Temperature/Humidity

Temperature: During the growing season, higher temperatures cause the plant stoma to open resulting in greater transpiration.

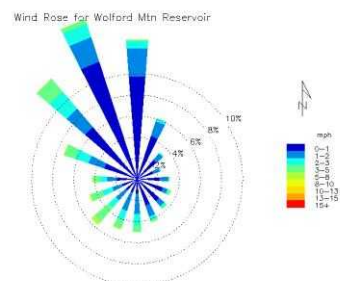
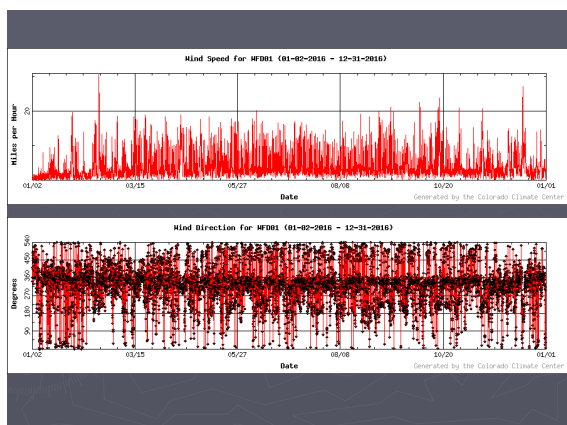
Humidity: The higher the humidity the less transpiration will occur (more transpiration occurs in dryer air)





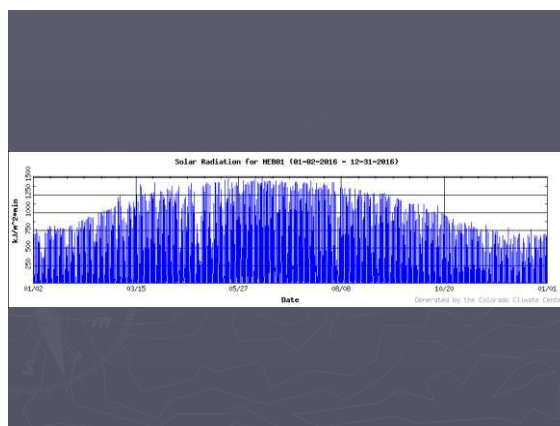
Wind Movement

- As air moves across plants it will cause more transpiration as saturated air (from transpiration) around the plant is mixed and dryer air can move in.



Solar Radiation

- Alfalfa and grass only reflects about 25% of incoming solar energy which leaves ample solar energy to drive ET rates.
- ET trends follow a similar pattern as seasonal solar radiation and air temperature.



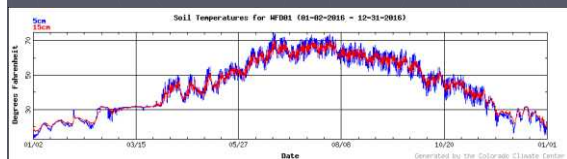
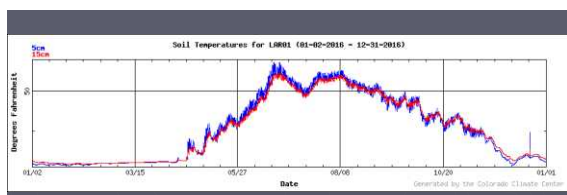
Precipitation

- ▶ While precipitation data is not explicitly used in the ET equations, it does provide an idea of soil moisture availability at the station.
- ▶ Precipitation also affects how much water needs to be put on crops.



Soil Temperatures

- ▶ Having the temperature of the soil aids in knowing when the soil has warmed enough to plant.
- ▶ Can also let us know if the ground is snow covered or bare.
- ▶ Soil temperature also gives an indication of the amount of ground cover at the station.



Ground cover and snow can greatly affect the soil temperature. Top graph is in North Park, bottom is Wolford Mtn where the station is on relatively bare ground and less snow.

Please note:

- ▶ CoAgMET instrumentation are high quality and the CoAgMET data are easily accessible

. . . . However

Problems happen

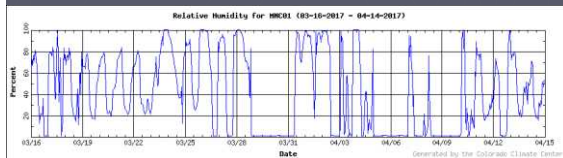
- ▶ Missing data
- ▶ Site exposure
- ▶ Funding problems
- ▶ Routine maintenance (somewhat lacking in early years – much better now)



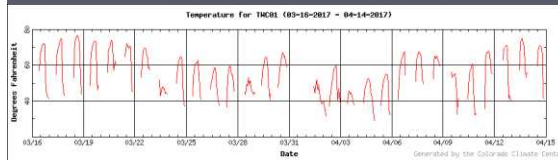
Missing/Questionable Data

- ▶ Due to various problems that occur to remote weather stations, missing data causes problems for everyone.
- ▶ Battery failure and communications problems are the most common.
- ▶ Even if the whole station doesn't fail, sensors go bad and can leave some elements missing until the station is serviced.

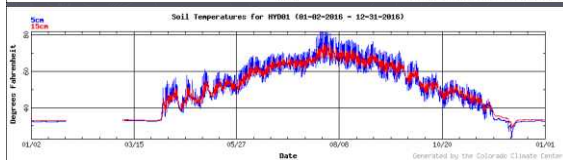
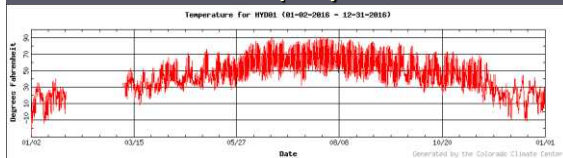
Bad Relative Humidity Sensor



Bad battery



And sometimes, the solar panel is covered up by snow!



Solutions!

- ▶ We now Quality Control the data daily to catch issues quickly.
 - Although we may not be able to get to a station quickly to fix issues, we are sure to have major issues taken care of by the growing season
- ▶ We are extremely thankful of our sponsors, collaborators and site hosts who are kind enough to help out.

Possible Solutions?

- ▶ We do our best with limited funds to keep a maintenance schedule but it is very difficult.
- ▶ Identification of more stable funding for the entire network.

CoAgMET Website

It's not beautiful but it's fast and full of rich data

Station Index

CoAgMet Stations Details



ID: LAR01
 Name: Larand
 Location: 8 miles south of Walden
 Latitude: 42.5126
 Longitude: 106.3
 Elevation: 5252
 Num Daily Obs: 2342
 Num Hourly Obs: 7062
 First Observation: Jun 10 2009
 Last Observation: Jul 10 2017
 Irrigation type: full
 Comment: No description
 Owner: Colorado State University
 Sponsor(s): North Plate Basin Roundtable

Monthly Station Summaries

[Click Here](#)

- About CoAgMet**
A brief history of how CoAgMet came to be.
- CoAgMet factsheet** has useful information on using this page.
- CoAgMet Crop Water Use (ET) Access**
Page for obtaining crop and turf water use information (ET).
- CoAgMet Text Message Service**
Sign up for our SMS/email message service. You will be able to customize the messages sent to your cell phone (or email address).
- Evapotranspiration Reports**
ETRs are daily reports for selected stations by region.
- Station Description**
A description of a typical CoAgMet station.
- Station Index**
Metadata on all of the stations on the CoAgMet network.
- Monthly Summaries**
Interactive access to the daily data set for a particular station and selected months.
- Daily Summaries (all stations)**
Daily summary files are formatted to display selected parameters for all stations.
- Hourly Data Access**
Interactive access to the hourly data set for a particular station and selected days.
- Hourly Data Plots**
Plots of temperature, humidity and wind for all CoAgMet stations.
- Raw Data Access**
Direct access to the raw data. Select hourly or daily data from our archives.

CoAgMet Station Summary Access



These reports contain selected meteorological elements for a single CoAgMet station.

Select a Date:
 Defaults to current date if left unselected.

Select Stations:
 Use CTRL to select multiple stations.

Region: North
 Station: LAR01 - Larand

Select Growing Degree Start Date:
 Defaults to current date if left unselected.

Select Growing Degree End Date:
 Defaults to current date if left unselected.

Upper Threshold: 50
 Lower Threshold: 32

Monthly Station Summaries

Station: Hebron
 Location: 13 miles SW of Walden
 Elevation: 8170
 Longitude: 106.388
 Latitude: 40.5435

Summary for Hebron - 06/2017

Station	Year	Month	Temp	Precip	Wind	Humid	Cloud	ET	ET/ETmax	ET/ETmin
hebr01	2017	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2016	06	62.7	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2015	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2014	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2013	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2012	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2011	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2010	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2009	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2008	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2007	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00
hebr01	2006	06	62.5	0.00	11.0	65.0	10.0	10.0	0.00	0.00

Daily Climatic Summary

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Direct access to the raw data. Select hourly or daily data from our archives.

[Click Here](#)

CoAgMet Daily Summary Access



These reports contain selected meteorological elements for all CoAgMet station for a single day.

Select a Date:
 Defaults to current date if left unselected.

Year: 2017
 Month: January
 Day: 01

Daily Climatic Summary

Daily Summary

Sta	Mon	Day	Temp	Temp	Vapor	Solar	Prec	Wind	Wind	Soil	Hum	Grow	F-Km	ASCI
			Temp	Temp	Press	Rad	in.	dir.	dir.	Temp	Run	Run	Temp	IT
			degF	degC	mb	LangU	in.	mph	mi.	degF	Pct	F.	in.	in.
akr02	6	10	84.6	29.8	13.42	711	0.00	***	245	67.7	25.4	876	0.393	0.461
al101	6	10	87.7	31.5	10.83	878	0.00	23.2	259	66.4	19.6	889	0.404	0.584
am01	6	10	94.6	35.3	10.02	708	0.00	11.5	73	57.2	11.2	1048	0.539	0.588
bl01	6	10	***	Missing	***									
br01	6	10	83.6	29.2	6.65	734	0.00	24.5	139	52.4	8.4	851	0.364	0.458
brg01	6	10	89.9	32.7	11.82	649	0.00	23.9	158	63.7	20.9	897	0.528	0.499
br02	6	10	96.5	36.4	11.62	748	0.00	24.7	192	73.2	4.2	1196	0.476	0.658
br102	6	10	94.1	35.1	11.81	749	0.00	20.3	238	64.9	23.6	978	0.438	0.484
br103	6	10	91.3	33.5	14.78	688	0.00	22.8	259	63.4	23.7	938	0.421	0.478
cb01	6	10	85.2	30.1	5.46	455	0.00	27.4	200	55.8	10.4	788	0.361	0.452
cp01	6	10	84.2	29.6	9.05	688	0.00	19.5	139	64.3	13.9	724	0.327	0.418
cp01	6	10	86.4	30.8	9.93	565	0.00	19.8	111	59.6	7.9	1036	0.372	0.469
cow1	6	10	76.0	25.0	6.44	740	0.00	36.2	268	56.9	19.5	184	0.182	0.461
ctr01	6	10	83.6	29.2	6.65	734	0.00	22.8	197	64.6	7.2	878	0.364	0.461
ctr02	6	10	84.5	29.7	5.57	682	0.00	24.7	199	63.2	8.7	784	0.394	0.475
ctr01	6	10	86.5	30.8	5.26	683	0.00	23.4	117	59.7	5.8	1122	0.396	0.489
dl101	6	10	88.6	32.0	11.27	789	0.00	25.9	288	64.3	5.4	792	0.539	0.648
ec01	6	10	86.5	30.8	10.59	722	0.00	26.0	262	62.2	14.6	887	0.442	0.548
ek01	6	10	89.2	32.3	7.08	748	0.00	28.2	287	57.8	9.7	971	0.347	0.415
fr102	6	10	94.3	35.1	6.04	735	0.00	23.5	125	66.0	9.5	1139	0.434	0.528
fr01	6	10	87.2	31.2	12.42	627	0.00	17.8	79	59.1	20.6	857	0.288	0.357
fr003	6	10	85.8	30.9	18.82	455	0.00	19.8	153	66.1	14.8	831	0.393	0.534
fr101	6	10	93.7	34.8	11.69	488	0.00	26.1	196	64.7	18.4	1082	0.366	0.437
fr01	6	10	89.5	32.5	6.24	707	0.00	16.2	14	68.9	9.2	1108	0.368	0.434
g304	6	10	90.6	33.1	11.95	652	0.00	24.4	195	62.8	20.9	958	0.395	0.485
gun01	6	10	88.8	32.1	11.27	789	0.00	25.9	288	64.3	5.4	792	0.539	0.648
hb01	6	10	75.6	25.3	6.26	741	0.00	28.9	247	57.0	15.1	184	0.188	0.469
h201	6	10	89.9	33.3	11.52	679	0.00	22.2	185	69.5	9.9	1133	0.438	0.459
h202	6	10	100.8	38.2	12.79	732	0.00	20.3	187	69.8	9.6	1134	0.437	0.472
h001	6	10	95.9	35.5	8.23	707	0.00	16.2	92	64.8	11.3	1084	0.363	0.432
h002	6	10	89.5	32.5	6.56	878	0.00	16.9	84	64.9	4.4	957	0.345	0.428
h010	6	10	89.2	32.9	11.14	699	0.00	23.4	198	67.9	20.3	909	0.387	0.457
hy01	6	10	84.2	29.6	11.82	742	0.00	23.7	195	56.1	11.1	636	0.143	0.418
h302	6	10	93.7	34.8	11.73	693	0.00	23.8	207	68.2	24.9	954	0.382	0.473

Hourly Climate Data Plots

- About CoAgMet**
A brief history of how CoAgMet came to be.
- CoAgMet factsheet** has useful information on using this page.
- CoAgMet Crop Water Use (ET) Access**
Page for obtaining crop and turf water use information (ET).
- CoAgMet Text Message Service**
Sign up for our SMS/email message service. You will be able to customize the messages sent to your cell phone (or email address).
- Evapotranspiration Reports**
ETRs are daily reports for selected stations by region.
- Station Description**
A description of a typical CoAgMet station.
- Station Index**
Metadata on all of the stations on the CoAgMet network.
- Monthly Summaries**
Interactive access to the daily data set for a particular station and selected months.
- ETRs are daily reports for selected stations by region.**
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- Hourly Data Access**
Interactive access to the hourly data set for a particular station and selected days.
- Hourly Data Plots**
Plots of temperature, humidity and wind for all CoAgMet stations.
- Raw Data Access**
Direct access to the raw data. Select hourly or daily data from our archives.

Click Here

Plots can be made with a variable time axis (1-366 days)

Select an ending Date:

Year: 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017

Month: January, February, March, April, May, June, July, August, September, October, November, December

Day: 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12

Select a Station:

CTR02 - Center #2
CT201 - Center
OLY01 - Olathe
DVC01 - Dove Creek
EAC01 - Eastern Adams County (landfill)
EKT01 - Eckart
FR01 - CSU Fruita East
FR101 - CSU Fruita East Station
FR201 - Fort Collins HDRC
FR301 - CSU - ARS/CC
FTL01 - Fort Lupton
FTM01 - Fort Morgan
FWL01 - Fowler
GL01 - Grand Junction
GLV01 - Greeley
GLT04 - Greeley 4
GUN01 - Gunnison

HEB01 - Helderberg
HLY01 - Holly #2
HNE01 - Huerfano
HCT01 - CSU Rogers Mesa Expt Sta
HRT01 - Hartsburg
HRT01 - Harton
HY01 - Hayden
HWK02 - Holyoke
IDL01 - Idalia
JEF01 - Jeff
JNF01 - Jefferson
KNO01 - Kona
KSY01 - Karsay 1
KSY02 - Karsay 2
LAM01 - Lamar #1
LAM02 - Lamar #2

Number of Days to Plot: 30

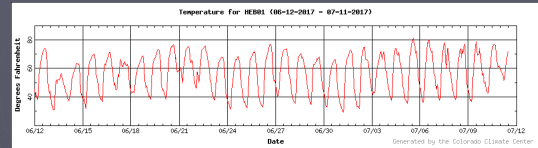
Plot which Elements?
 Temperature
 Relative Humidity
 Wind Speed
 Wind Direction
 Soil Temperatures
 Solar Radiation

Graph Size?
Medium (250x300)

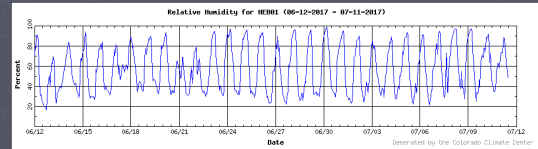
Submit Reset

Hourly Climate Data Plots

Temperature

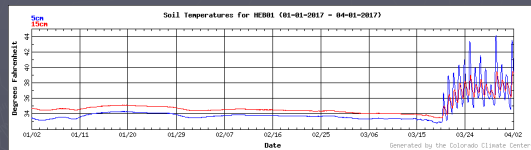


Relative Humidity



Hourly Climate Data Plots

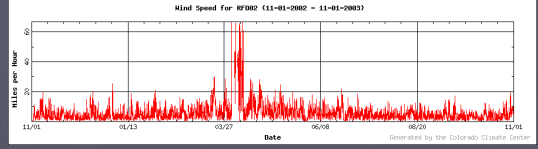
Soil Temperature at 2" and 6"



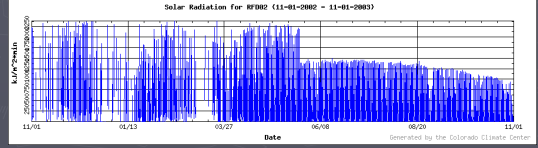
Can you see the difference between when the ground was snow covered and when it was free of snow?

Inferior Data Do Exist

Wind Speed



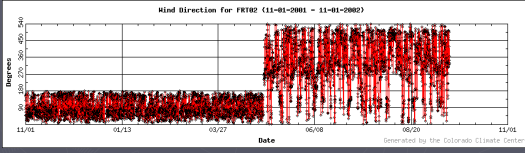
Solar Radiation



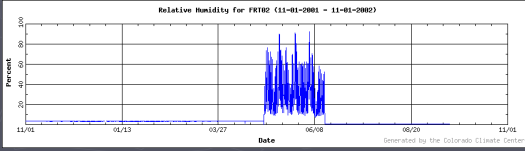
But the graphics make it obvious

FRT02 Fruita Nov 1, 2001 through Oct 31, 2002

Wind Direction



Relative Humidity

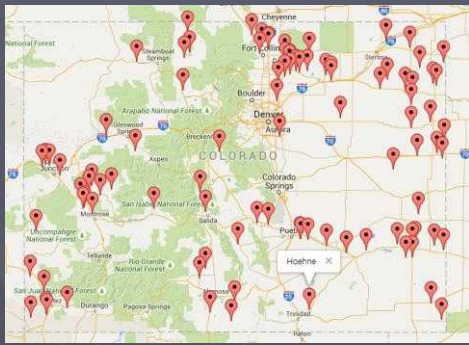


Map of CoAgMet Stations

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- Hourly Data Plots**
Plots of temperature, humidity, and wind for all CoAgMet stations.
- Raw Data Access**
Direct access to the raw data. Select hourly or daily data from our archives.
- Web Services**
Access to a variety of data including CoAgMet. Web Services are especially useful to those who are using scripts to access data.
- Map of CoAgMet Stations**
A Google Maps based map showing CoAgMet station locations. Access current data, metadata and images.
- Miscellaneous Tools**
Miscellaneous tools and analyses.
- Other Climatic Data**
The Colorado Climate Center maintains a database of historical climatic data for many weather stations throughout Colorado.

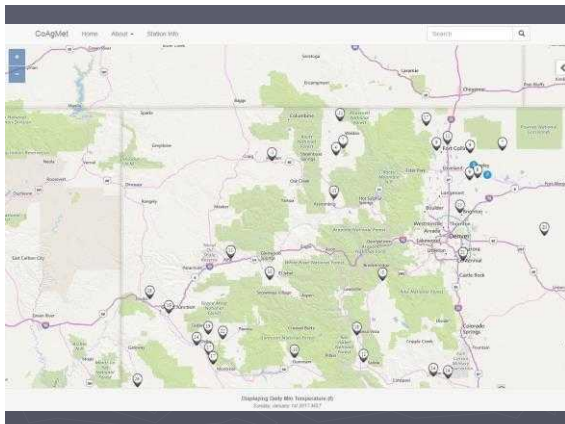
Click Here

Map of CoAgMet Stations



NEW!! Mapping tool maps data!

- Map of CoAgMet Stations**
A Google Maps based map showing CoAgMet station locations. Access current data, metadata and images.
- Miscellaneous Tools**
Miscellaneous tools and analyses.
- Other Climatic Data**
The Colorado Climate Center maintains a database of historical climatic data for many weather stations throughout Colorado.



Mapping tool

- ▶ Maps all variables from station in 5-minute, hourly and daily time steps. Calculates hourly and daily ET rates
- ▶ Ability to view historical graphs and maps
- ▶ View annual pictures
- ▶ View annual maintenance logs and station metadata

Miscellaneous Tools Wind Summaries

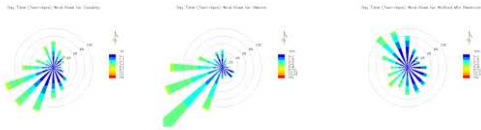
Wind Roses

Select 8 or 16 point, daytime, night time or both

Cowdrey

Hebron

Wolford Mtn



16 point daytime selected for all three examples above

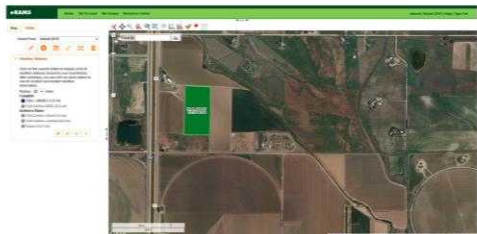
WISE Irrigation Scheduler

Welcome to the WISE (Water Irrigation Scheduler for Efficient Application) home page. WISE is an award winning cloud-based tool for irrigation scheduling.



WISE features an easy-to-use interface where users can quickly map their fields and set up cropping situations (planting date, etc.)

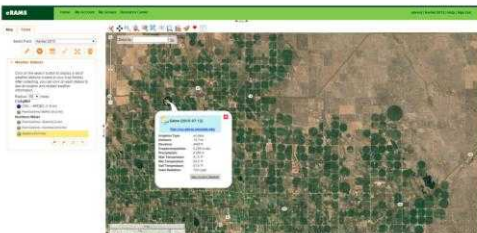
<http://wise.colostate.edu/>



WISE is an ET-based, water balance irrigation scheduling program with accompanying phone apps. Its web-based technology utilizes internet browsers so software or downloads are not required to use the program.



WISE is an excellent irrigation water management record keeping tool with a variety of reporting functions.



Weather data from nearby stations in the CoAgMet and Northern Colorado Water Conservancy District networks are gathered and used to calculate crop ET.

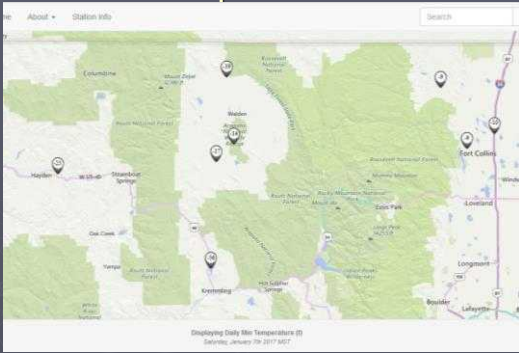
Soils data are also pulled in from NRCS.

What have we learned with the stations in North Park, Wolford Mountain and Hayden?

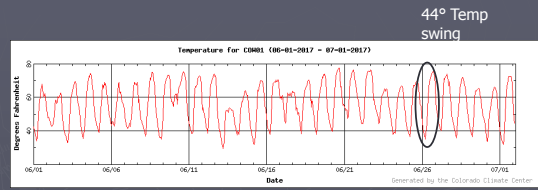


These mountain valleys have fascinating weather!

Minimum temperature variations!



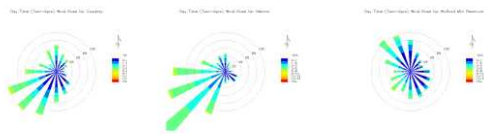
Huge daily Temperature swings



And still getting to 32°F in June

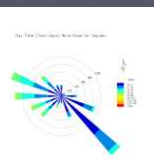
Variations in Wind

Cowdrey Hebron Wolford Mtn



We can't wait to see what these look like along the Colorado River!

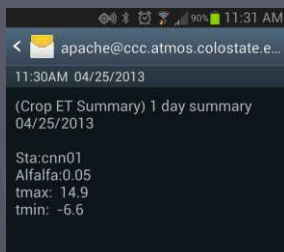
Hayden



Crop ET Text Messages!

A screenshot of the 'Crop ET Text Messages!' web interface. It shows a list of stations with columns for 'Station Name', 'Start Date', and 'Frequency of Messages'. The interface includes various settings for station selection, message frequency, and time of day. A URL is provided at the bottom: http://ccc.atmos.colostate.edu/cgi-bin/text_request.pl

Crop ET Text Messages!



Example text message for C3001: AlfalfaET, Tmax and Tmin

- User customized CropET as well as meteorological parameters.
- Select as many stations as you wish.
- Customize the frequency and time of the Text reporting.
- Get ET reports in the field without a need for a laptop or smartphone!

CoAgMet web access:



<http://coagmet.colostate.edu>

So not **My question is**
"Do you have a rain gauge?"



1) If you are interested in the variations in precipitation, please join the Community Collaborative Rain, Hail and Snow Network
<http://www.cocorahs.org>
 We are hoping to get at least 1 precipitation gauge within 1 mile of all CoAgMET stations to help verify precipitation amounts.

CoCoRaHS (Community Collaborative Rain, Hail and Snow) – A simple but effective way to help scientists track our climate

<http://www.cocorahs.org>

We Even Measure Eto and the water balance

Mapping our water as it lands:
-The Value of Volunteers with Gauges

Daily Precipitation (inches, x.XX), for the 24 hour period ending 7:00 am
 USA 9/2015

Join Us! Tell others!
 We need rural observers
<http://www.cocorahs.org>

CONTACTS:

- Zach Schwalbe, CoAgMET Manager
 - Zach.Schwalbe@colostate.edu
 - (970) 491-8140
- Nolan Doesken, Colorado State Climatologist
 - Nolan.Doesken@colostate.edu
 - (970) 491-8545

Colorado Climate Center for all your past Colorado
Weather Questions:
<http://climate.colostate.edu/>

"Everything you ever wanted to know about pasture management, hay analysis, and cow (and horse) nutrition crammed into 60 minutes!" ☺



Kelcey Swyers, PhD, PAS
Owner / Private Nutritionist
Nutrition Consulting
Hay Day, Summer 2017

Most Common Mistakes

- Overgrazing Pastures
- Overstocking the ranch, such that a "purge" is necessary during drought years
- Feeding hay that is WAY TOO GOOD
- Spending money in the wrong places on mineral program (or no mineral program)
- Spending money in the wrong way on winter protein supplementation
- Buying whatever the "feed sales rep convinces them of" and not what they *really* need
- Reading too much "stuff" on the internet

Cows will tell on you if you cut too many corners...

Bad vs Good Nutrition



What is typical BW for a mature beef cow?

Rule of Thumb:



Correct Body Condition





Wrong Body Condition



Wrong Body Condition



Pones



Do you have enough forage to maintain her?

Winter and Mid - Late Gestation

- DMI ~1.5% BW
- 1400 lb bred cow x 0.02 = 28 lbs DMI
- Hay is ~90% DM
- 28 lbs DMI / 0.90 = ~31 lbs as-fed
- ~10-11% Protein and ~55% TDN
- Protein supplementation often increases DMI

Spring & Summer Peak Lactation and Rebreeding

- DMI ~2.0% BW
- 1300 lb open cow x 0.025 = 32.5 lbs DMI
- Grass is ~30% DM
- 32.5 lbs DMI / 0.30 = ~108 lbs as-fed
- ~11-12% Protein and ~60-64% TDN
- Cows should reach top BCS for breeding = FLUSH

Plant Maturity

"Diet Hay"	Average	"Rich!"
1 st Cutting	2 nd Cutting	3 rd Cutting
Late Bloom (mature)	Mid-Bloom	Early Bloom (younger plants)
Stemmy (sharp)	Avg stem to leaf ratio	Leafy (soft)
Hot temps and lots of water	Warm temps and mild precip.	Cool temp or drought
↓ADF, ↓RFV, ↓TDN, ↓CP, ↓DE (calories)	↓ADF, ↑RFV, ↑TDN, ↓CP, ↓DE (calories)	↓ADF, ↑RFV, ↑TDN, ↑CP, ↑DE (calories)



Dairy One			
Sampled	Recvd	Printed	ST/CO
06/15/17	06/16/17		
Analysis Results			
Components		As Fed	DM
% Moisture		11.5	
% Dry Matter		88.6	
% Crude Protein		20.4	23.0
% Adjusted Crude Protein		20.4	23.0
% ADF		26.9	30.4
% NDF		34.1	38.6
% NFC		23.4	26.4
% TDN		53	60
NEL, Mcal/Lb		.56	.63
NEM, Mcal/Lb		.52	.58
NEG, Mcal/Lb		.29	.32
Relative Feed Value			157
Horse DE, Mcal/Lb		.99	1.12
ENERGY TABLE - NRC 2001			
Mcal/Lb		Mcal/Kg	
DE, 1X	1.28	2.82	
ME, 1X	1.09	2.40	
NEL, 3X	0.62	1.37	
NEM, 3X	0.65	1.44	
NEG, 3X	0.39	0.86	
TDNIX, %	60		

What about Horses?

- Horses should have forage-based diet
- Goal: maximize forage intake
 - Dry matter intake (DMI) requirement:
 - Maintenance: 1.5-2% of BW
 - Lactating Mares: 2.5 to 3% of BW
 - Ex: for a typical 1100 lb (500kg) horse
 - 1100 x .015% = 16.5 lbs of forage (dry matter)
 - = 18 lbs as-fed of hay (30-40% of a typical small square)
 - = 55 lbs as-fed of green pasture



Pastures are our most VALUABLE resource...
...don't cross over-grazing stress with drought stress!

Rotate: Allow for "Rest"
During Growing Season



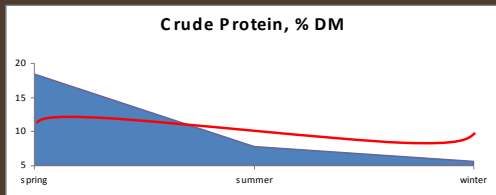
Fat Cow, Mineral Deficient

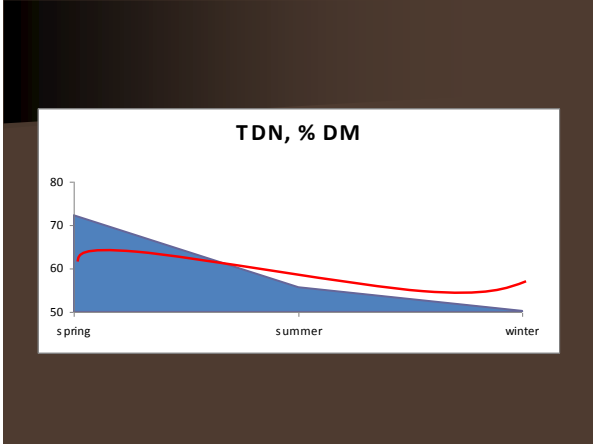


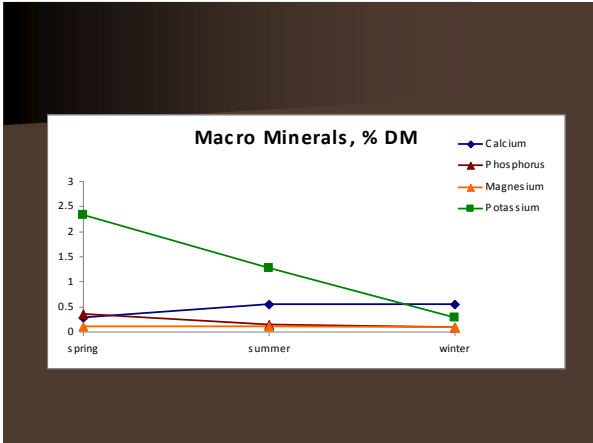
How the pasture changes...

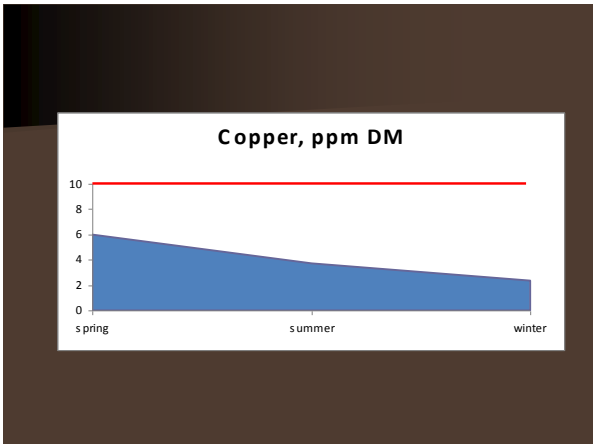


Case Study

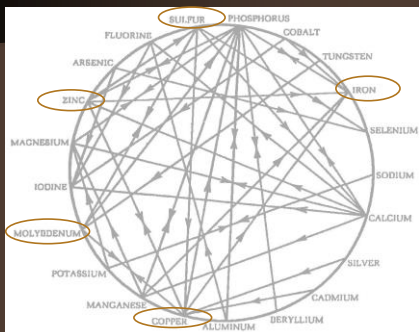








Mineral Antagonism



Summer Pasture

Balance with Summer 12-6 Mineral w/ Mag

Dry-matter	Lactating Cow MINIMUM Requirement	Early Summer Pasture (early maturity)	Summer Pasture + 12-6 Mineral w/ Mag
CP %	11.0-12.0	14.0	14.0
TDN %	60-64	62	62
Ca %	0.40	0.58	0.68
Phos %	0.20	0.27	0.32
Ca : Phos	2 : 1	2 : 1	2 : 1
Mag %	0.15	0.12	0.20
K %	0.60	2.36	2.36
Zn ppm	45	22	60
Cu ppm	15	5	20

Winter Pasture

Balance with Winter 12-12 Mineral

What are we still short on?

Dry-matter	Last 1/3 Gestation Cow Requirement	Winter Pasture (dormant)	Winter Pasture + 12-12 Mineral
CP %	10.0	5.5	5.5
TDN %	55	50	50
Ca %	0.40	0.50	0.60
Phos %	0.20	0.10	0.20
Ca : Phos	2 : 1	5 : 1	3 : 1
Mag %	0.12	0.08	0.15
K %	0.60	0.28	0.85
Zn ppm	45	13	60
Cu ppm	15	2	20

Questions?



Kelcey Swyers, PhD, PAS

Owner/Private Nutritionist
Grassland Nutrition Consult.
Wellington, CO
kelcey@grasslandnutrition.com
970.535.2153



FORAGE TESTING LABORATORY
DAIRY ONE, INC.
730 WARREN ROAD
LYEBROOK, NEW YORK 14850
607-257-1272 (fax 607-257-1350)



Mountain Meadow Management Fertility, Irrigation, and Rotational Dry Up



Dr. Joe Brummer
Extension Forage Specialist
Colorado State University
Fort Collins, CO 80523
970/491-4988
joe.brummer@colostate.edu

Why Fertilize?

- Increase forage yield
 - Do you need more hay or pasture to meet the livestock demands of your own operation?
 - Do you have a market for any extra hay that you produce?

Soil Fertility

- Must be considered in overall management plan
- All meadows should be periodically soil tested to determine nutrient status
- Generally, nitrogen and phosphorus are the only nutrients of concern for meadows

Nitrogen General Considerations

- Virtually all meadows are nitrogen deficient and will respond to N fertilization
- All plants use nitrogen
 - Legumes fix N from the air
 - Grasses are heavy users and need additional N to be productive, also become extremely competitive
- Need to test soil phosphorus levels
 - N response can be limited by inadequate P

Drawbacks to Nitrogen Fertilization

- Must be applied annually
- Potential for runoff, leaching, or volatilization if not properly applied
- System can crash if N fertilization is discontinued??

Nitrogen Sources

- Most common
 - Urea (46% N)
 - Urea-Ammonium Nitrate solution (28-32% N)
- A pound of N is a pound of N
 - Given that the N actually reaches the plant in an available form

Problem with Urea

- Susceptible to ammonia volatilization
 - Higher the temperature + the longer the fertilizer lays on the surface = greater losses
 - Leads to inconsistent yield responses from year-to-year
 - Must pay attention to management to minimize losses

Mountain Meadow Fertility/Interseeding Trial

- Blue Valley Ranch
 - South of Kremmling, Colorado
- Plots established in May 2011
- Interseeding Treatments:
 - Alfalfa
 - Birdsfoot Trefoil
 - Mix of Mammoth Red (3.5 lbs) and Alsike Clover (2.5 lbs)
 - Seeded with John Deere Powr-till drill at 6 lbs PLS/acre, May 2011

Mountain Meadow Fertility/Interseeding Trial

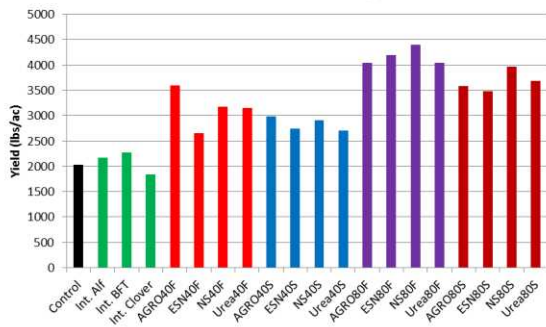
- Fertilizer Treatments:
 - Fertilizers:
 - Urea (Uncoated)
 - ESN polymer coated urea
 - Nutrisphere-N coated urea
 - Urease + nitrification inhibitor
 - Agrotain coated urea
 - Urease inhibitor
 - Rates:
 - 40 or 80 lbs N/acre
 - Timing of Application:
 - Fall and Spring

Year Main Effect

2011 = 3700 lbs/acre
 2012 = 2340 lbs/acre
 2013 = 4090 lbs/acre
 Avg. = 3380 lbs/acre

2011 – Cool, wet spring, slow growth
 2012 – Hot, dry, drought, 3 short irrigations
 2013 – Normal growing conditions/irrigation

Three Year Yield Avg



Agrotain only tested in 2012 and 2013

Fertilizer Main Effect

Type	2011	2012	2013	Avg
Control	2330	1490	2250	2020
Agrotain	NA	2310	4790	3550
ESN	3730	2240	3830	3270
Nutrisphere	3860	2720	4250	3610
Urea	3840	2320	4010	3390



Rate Main Effect

Rate	2011	2012	2013	Avg
0	2330	1490	2250	2020
40	3330	2090	3560	2990
80	4290	2710	4880	3960

Average efficiency

25 lbs forage/lb N in 2011 at both rates
 15 lbs forage/lb N in 2012 at both rates
 33 lbs forage/lb N in 2013 at both rates

Timing Main Effect

Timing	2011	2012	2013	Avg
Control	2330	1490	2250	2020
Fall	3940	2810	4580	3780
Spring	3680	2600	3860	3380

Breakeven Yield Increases

- Assumptions:
 - Additive adds from \$0.05 to \$0.12 per lb N
 - Agrotain the cheapest, ESN most expensive
 - At 80 lbs N/ac, costs additional \$4.00 to \$9.60/ac
 - Current price of mountain meadow hay
 - \$125/ton or \$0.0625/lb
- Breakeven for 80 lb N application rate
 - 64 lbs additional hay/ac for Agrotain
 - 154 lbs additional hay/ac for ESN

Take-Home Messages

- Yield responses were consistently higher when fertilizer was applied in the **fall**
- On average, nitrogen use efficiency was similar between 40 and 80 lb rate
 - Significantly affected by growing conditions
 - 15 to 33 lbs of forage per lb of N applied
- Nutrisphere and Agrotain both showed positive yield benefits compared to straight urea, especially when applied in the fall
 - Response affected by growing conditions
 - Need minimal yield increases to pay added expense
 - 64 to 90 lbs additional forage per acre
- ESN releases too slow, not worth the expense

Potential Advantages of Early Season Irrigation



Potential Advantages of Early Season Irrigation

- What happens when water is spread in a thin layer across the soil surface?
 - Acts like a lens
 - Quickly warms
 - Starts to raise soil temp
 - Irrigate frost out of the ground!!
- What happens at night as that water continues to flow across the surface?
 - Stays above freezing
 - Insulates soil and plants
 - Keeps soil surface from freezing and having to thaw the next day



Potential Advantages of Early Season Irrigation

- What is the end result?
 - Can jump start growth by 2 weeks or more
 - Earlier spring grazing
 - Earlier haying
 - More fall regrowth for grazing



Agronomic Responses of Grass to No Competition Part of a Potential Colorado Western Slope Water Bank

Joe Brummer, Lyndsay Jones, Perry Cabot, Calvin Pearson, and Abdel Berrada
Colorado State University
Fort Collins, Colorado



Issue

- Reduced water supply
- Increasing demand
- Colorado River Compact- 7 states
 - Upper Basin: Colorado, Wyoming, Utah, New Mexico
 - Lower Basin: Arizona, California, Nevada
 - If flows fall below 75 MAF in any rolling 10-year period (annual average of 7.5 MAF), water curtailments will be imposed on upper basin states
- Primary water use - irrigated agriculture

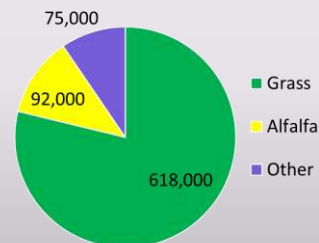


Western Slope Water Bank

- Owners of pre-compact water rights temporarily lease water
- Irrigators compensated to reduce irrigation use
- Saved water is available to the water bank
 - Meet compact obligations
 - Municipal, industrial, or other agricultural uses
- Minimize economic and environmental impacts
 - Short-term
 - Done on a rotational basis
 - Crop selection



Acres of Major Irrigated Crops on the West Slope



- Forage crops may be ideal for inclusion in a water banking system

- Availability
 - Over 90% of irrigated crops
- Primary user of water
 - Grass CU = 1,069,759 AF/yr
 - Alfalfa CU = 178,750 AF/yr
- Tolerance to reduced irrigation

Objectives

- Purpose:
 - Assess the agronomic feasibility of withholding irrigation for one season on grass hayfields in support of a Western Slope Water Bank
 - Provide adequate information for hay producers as well as proponents of water banking to confirm if this approach is worth pursuing as a method to free up water to meet compact obligations and/or other uses
- Objectives:
 - Determine the impacts of reduced irrigation to forage yield and quality and associated recovery period of grass hayfields in different regions of Western Colorado

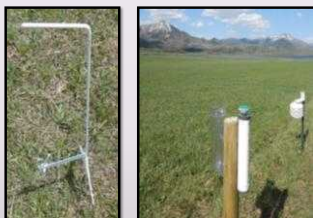
Grass Hayfields

- Hayden, CO
 - Carpenter Ranch – 6,340 ft
 - Upper Yampa
- Steamboat Lake, CO
 - Fetcher Ranch – 8,200 ft
 - Upper Yampa
- Kremmling, CO
 - Blue Valley Ranch – 7,365 ft
 - Upper Colorado
- Gunnison, CO
 - Trampe Ranch – 7,700 ft
 - Upper Gunnison
- Cimarron, CO
 - 6,900 ft
 - Gunnison
- Doyleville, CO
 - Razor Creek Ranch 7,600 ft
 - Upper Gunnison

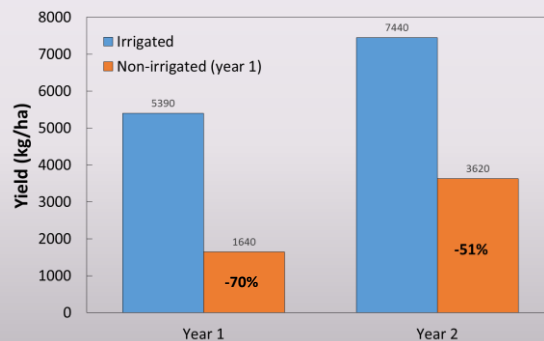


Treatments and Measurements

- Side by side plots
- Year 1
 - Fully Irrigated (Control)
 - Not Irrigated
- Year 2
 - Both fully Irrigated
- Measurements
 - Yield
 - Quality
 - Crude protein (CP), neutral detergent fiber (NDF), and *in-vitro* true digestibility (IVTD)
 - Ground cover and species composition
 - ET, temperature, and precipitation

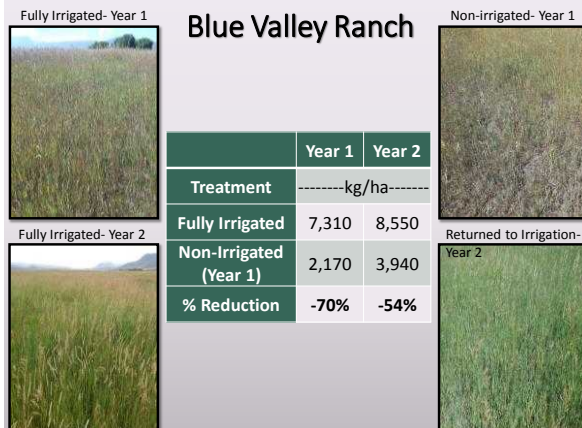


Grass Dry Matter Yield



Grass Forage Quality

Treatment	CP (%)	NDF (%)	IVTD (%)
Year 1			
Irrigated	7.6	54.9	73.5
Non-irrigated	10.8	51.9	75.4
Year 2			
Irrigated	8.6	58.0	74.7
Non-irrigated	8.0	53.3	74.4

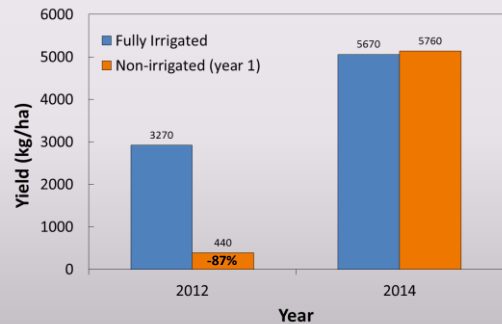


Razor Creek

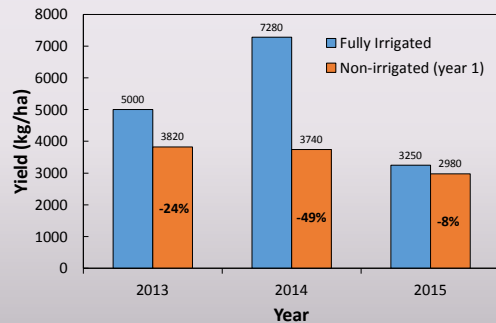
- Data collected in 2012
 - Severe drought conditions resulted in producer withholding irrigation on half of the field
- Resampled in 2014 after 2 years of normal irrigation



Razor Creek Dry Matter Yield



Carpenter Ranch Dry Matter Yield



Conclusions - Grass Hayfields

- Withholding irrigation for one season on high-elevation grass hayfields:
 - Improved forage quality in year 1 (↑CP and ↓NDF)
 - Significantly reduced yields (average reduction of 70%)
 - Yields did not fully recover when returned to full irrigation the following season (average reduction of 50%)
 - The severity of yield reductions measured in this study may limit potential participation in a water bank program
 - Producers would need to be compensated for reduced yields the year of withholding irrigation and for at least the first recovery year
 - Based on limited data, it appears that yields will recover to near normal by the second year of full irrigation (within about 10%)

