Agronomic Responses to Partial and Full Season Fallowing of Alfalfa and Grass Hayfields

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Dr. Perry Cabot (Western Regional Water Specialist)
Study Purpose/Objectives

• Purpose:
  – Assess the agronomic feasibility of partial and full season hay fallowing as part 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 pursing as a method to free up water to meet compact obligations and/or other uses

• Objectives:
  – Determine the impacts to forage yield and quality and associated recovery period for fallowed and partially-fallowed alfalfa and grass hayfields in different regions of Western Colorado
  – Refine our understanding of the amount of water that might be available for leasing through fallowing of hayfields in Western Colorado
Methods

- Three alfalfa and six grass hayfield sites were selected in Western Colorado to test fallowing practices likely to be used for generating conserved water for a future water bank.
- Testing of practices were side-by-side with a control treatment (i.e. no or partial season irrigation treatments next to “fully irrigated”)
Treatments

• Alfalfa sites
  – Fully irrigated (Control)
  – Stop irrigation after 1st cutting
  – Stop irrigation after 2nd cutting
  – Above treatments were repeated on same plots in 2014

• Grass sites
  – Fully irrigated (Control)
  – Fallowed one whole season (Non-irrigated)
  • Both plots were fully irrigated in 2014 and will be in 2015 to document recovery
Test Sites

• Grass hayfield sites:
  – Hayden, CO (Carpenter Ranch - 6,337 ft)
    • Upper Yampa
      • 6 ac irrigated, 6 ac fallowed
  – Steamboat Lake, CO (Fetcher Ranch - 8,200 ft)
    • Upper Yampa
      • 3 ac irrigated, 6.5 ac fallowed
  – Gunnison, CO (Trampe Ranch - 7,703 ft)
    • Upper Gunnison
      • 3 ac irrigated, 2 ac fallowed
  – Kremmling, CO (Blue Valley Ranch - 7,364 ft)
    • Upper Colorado
      • 4 ac irrigated, 2.5 ac fallowed
  – Cimarron, CO (Western Rivers Conservancy - 7,385 ft)
    • Gunnison
      • 5 ac irrigated, 1 ac fallowed
  – Gunnison, CO (Peterson Ranch-Razor Creek - 8,110 ft)
    • Upper Gunnison
      • 16 ac irrigated, 9 ac fallowed (drought)
Test Sites

• Alfalfa hayfield sites:
  – Eckert, CO (Kehmeier Farm - 5,568 ft)
    • Lower Gunnison
    • ~5 ac per treatment
  – Fruita, CO (Western CO Research Center – 4,528 ft)
    • Lower Colorado
    • ~⅓ ac per treatment
  – Yellow Jacket, CO (Southwestern CO Res. Center 6,900 ft)
    • San Juan/Dolores
    • ~5 ac per treatment
Measurements

- Measurements taken include:
  - Yield
  - Species composition at grass sites
  - Ground cover at grass sites
  - Plant density at alfalfa sites
  - Forage quality
    - Crude protein, neutral detergent fiber (NDF), and in vitro digestibility
  - Soil analyses
    - Assess changes in soil nutrient status
    - May release nutrients and decrease amount of fertilizer needed
  - Evapotranspiration
    - Anometers were installed at each site to estimate potential ET
    - Ambient temperature readings were recorded and will be used to estimate ET using the Blaney-Criddle or other temperature-based equations
    - Three sites have complete weather stations to estimate ET using the modified Penman or Penman-Monteith equations
  - Precipitation
Carpenter Ranch (Hayden)

• Date Sampled:
  - July 2, 2013

• Yield (First harvest)
  - Irrigated: 4,460 lbs/ac
  - Fallowed: 3,410 lbs/ac

• 24% yield reduction

• Producer did not contact us before harvesting second cutting (no samples)
Carpenter Ranch (Hayden)

- Date Sampled:
  - First: July 3, 2014
  - Second: August 26, 2014
- Yield (First harvest)
  - Irrigated: 6,500 lbs/ac
  - Fallowed: 3,340 lbs/ac
  - 49% yield reduction
- Yield (Second harvest)
  - Irrigated: 1,420 lbs/ac
  - Fallowed: 1,500 lbs/ac
  - No yield reduction
- Yield (Total)
  - Irrigated: 7,920 lbs/ac
  - Fallowed: 4,840 lbs/ac
  - 39% yield reduction
Trampe Ranch (Gunnison)

- **Date Sampled**: July 29, 2013
- **Fallowed site** was irrigated twice
- **Yield**
  - Irrigated: 3,790 lbs/ac
  - Fallowed: 2,450 lbs/ac
  - **35% yield reduction**
Trampe Ranch (Gunnison)

- Date Sampled:
  - July 17, 2014
- Trts reinitiated in 2014
  - Irrigated = fallowed
  - Fallowed = irrigated
- Yield
  - Irrigated: 4,680 lbs/ac
  - Fallowed: 870 lbs/ac
- 81% yield reduction
Fetcher Ranch (Steamboat Lake)

- Date Sampled:
  - August 16, 2013
- Water only available through June
- Yield
  - Irrigated: 2,520 lbs/ac
  - Fallowed: 895 lbs/ac
- 64% yield reduction
Fetcher Ranch (Steamboat Lake)

- **Date Sampled:**
  - August 26, 2014

- **Yield**
  - Irrigated: 2,650 lbs/ac
  - Fallowed: 1,500 lbs/ac

- **43% yield reduction**
Blue Valley Ranch (Kremmling)

• Date Sampled:
  – August 29, 2013

• Yield
  – Irrigated: 5,830 lbs/ac
  – Fallowed: 1,730 lbs/ac
  • 70% yield reduction
Blue Valley Ranch (Kremmling)

- Date Sampled: August 29, 2014

- Yield
  - Irrigated: 6,830 lbs/ac
  - Fallowed: 3,150 lbs/ac

- 54% yield reduction
Western Rivers Conservancy (Cimarron)

- Date Sampled: August 6, 2014
- As part of water change case, entire ranch dried up in 2014
- Yield
  - Irrigated: 6,610 lbs/ac
  - Fallowed: 435 lbs/ac
- 93% yield reduction
Peterson Ranch-Razor Creek (Gunnison)

• Dates Sampled:
  – August 4, 2012 (Drought)
  – September 2, 2014

• Yield (2012)
  – Irrigated: 2,920 lbs/ac
  – Fallowed: 390 lbs/ac
  • 87% yield reduction

• Yield (2014)
  – Irrigated: 5,070 lbs/ac
  – Fallowed: 5,150 lbs/ac
  • Fully recovered
Kehmeier Farm (Eckert)

<table>
<thead>
<tr>
<th>Cutting</th>
<th>Treatment</th>
<th>Sample Date</th>
<th>Lbs/acre DM</th>
<th>Sample Date</th>
<th>Lbs/acre DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Fully Irrigated</td>
<td>6/17/2013</td>
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<td>Stop after 2nd Cutting</td>
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<td>1,820</td>
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<td>2,330</td>
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<td>4,225</td>
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<td>3,110</td>
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<tr>
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<td>Stop after 1st Cutting</td>
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<td>1,285</td>
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<td>1,800</td>
</tr>
<tr>
<td>Third</td>
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<td>2,510</td>
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<tr>
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<td>Stop after 1st Cutting</td>
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<td>N/A</td>
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<td>1,320</td>
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<td>Total</td>
<td>Fully Irrigated</td>
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<td>10,840</td>
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<td>10,825</td>
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<td>Stop after 2nd Cutting</td>
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<td>7,775 (-28%)</td>
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<td>7,770 (-28%)</td>
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<td></td>
<td>Stop after 1st Cutting</td>
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<td>3,615 (-67%)</td>
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<td>4,890 (-55%)</td>
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</table>
Kehmeier Farm (Eckert)

Photos taken Sept. 21, 2013

Full Irrigated

Stop after 2nd

Photos taken Aug. 30, 2014

Stop after 2nd

Stop after 1st

Stop after 1st
<table>
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<tr>
<th>Cutting</th>
<th>Treatment</th>
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<th>Lbs/acre DM</th>
<th>Sample Date</th>
<th>Lbs/acre DM</th>
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<tbody>
<tr>
<td>First</td>
<td>Fully Irrigated</td>
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<td>3,380</td>
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<td>3,380</td>
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<td>Complete Fallow</td>
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<td>910</td>
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<td>N/A</td>
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<td>Second</td>
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<td>3,060</td>
<td>7/24/2014</td>
<td>2,510</td>
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<tr>
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<td>Stop after 2\textsuperscript{nd} Cutting</td>
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<td>3,100</td>
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<td>100</td>
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<td>Complete Fallow</td>
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<td>N/A</td>
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<td>2,410</td>
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<td>930</td>
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<td>Stop after 1\textsuperscript{st} Cutting</td>
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<td>760</td>
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<td>450</td>
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<td>Complete Fallow</td>
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<td>Total</td>
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<td>8,880</td>
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<td>7,790</td>
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<td>Stop after 2\textsuperscript{nd} Cutting</td>
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<td>8,890 (0%)</td>
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<td>7,510 (-3.6%)</td>
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<td>Stop after 1\textsuperscript{st} Cutting</td>
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<td>5,155 (-42%)</td>
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<td>2,095 (-73%)</td>
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<tr>
<td></td>
<td>Complete Fallow</td>
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<td>2,010 (-77%)</td>
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SWCRC (Yellow Jacket)

Photos taken Sept. 20, 2013

Photos taken Aug. 14, 2014

Fully Irrigated

Stop after 1st

Stop after 2nd

Stop after 1st
<table>
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<tr>
<th>Cutting</th>
<th>Treatment</th>
<th>Sample Date</th>
<th>Lbs/acre DM</th>
<th>Sample Date</th>
<th>Lbs/acre DM</th>
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<tbody>
<tr>
<td>First</td>
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<td>5/20/2013</td>
<td>3,000</td>
<td>5/22/2014</td>
<td>5,240</td>
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<td>Stop after 1st Cutting</td>
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<td>2,070</td>
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<td>Second</td>
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<td>6/24/2013</td>
<td>1,800</td>
<td>7/3/2014</td>
<td>5,120</td>
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<td>Stop after 2nd Cutting</td>
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<td>5,060</td>
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<tr>
<td></td>
<td>Stop after 1st Cutting</td>
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<td></td>
<td>350</td>
</tr>
<tr>
<td>Third</td>
<td>Fully Irrigated</td>
<td>7/30/2013</td>
<td>5,770</td>
<td>8/6/2014</td>
<td>3,480</td>
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<td>1,960</td>
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<td>1,650</td>
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<td>Stop after 1st Cutting</td>
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<td>280</td>
</tr>
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<td>Fourth</td>
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<td>9/20/2014</td>
<td>2,610</td>
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<td>1,150</td>
<td></td>
<td>430</td>
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<tr>
<td></td>
<td>Stop after 1st Cutting</td>
<td></td>
<td>840</td>
<td></td>
<td>310</td>
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<tr>
<td>Total</td>
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<td></td>
<td>13,370</td>
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<td>16,450</td>
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<td>Stop after 2nd Cutting</td>
<td></td>
<td>6,110 (54%)</td>
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<td>10,020 (39%)</td>
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<tr>
<td></td>
<td>Stop after 1st Cutting</td>
<td></td>
<td>3,840 (71%)</td>
<td></td>
<td>3,010 (82%)</td>
</tr>
</tbody>
</table>

(2013 yield reduction excludes 2nd cutting)
Fully Irrigated
Stop after 2nd cut
Photo taken 7/29/2013

Fully Irrigated
Stop after 1st cut
Photo taken 9/20/2014

Stop after 1st cut

Stop after 2nd cut
Summary

• Grass sites
  – Yield reductions ranged from 24% to 70% in 2013
  – Yields reduced 81 to 93% in fields fallowed in 2014
  – Yields still 39 to 54% below fully irrigated after one year of recovery
  – Following 2 years of recovery, the one field was back at full productivity

• Alfalfa sites
  – Yield reductions
    • Stop after 2nd cutting ranged from 0% to 54% in 2013 and 4 to 39% in 2014
    • Stop after 1st cutting ranged from 42% to 71% in 2013 and 55 to 82% in 2014
    • Complete fallow in 2013 = 77%