Features from your Advisors

September 2020 (Volume 23 Issue 8)

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IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

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2021 Field and Vegetable Crops Guidelines
Cost: $40.00 for each
Available for purchase

Due to COVID-19 restrictions, our office is closed to the public. If you wish to purchase the Guidelines, you can mail in your check specifying which book(s) you wish to purchase. We will mail out the Guideline Book(s) you request along with the USB drive. OR You can call and make arrangements to stop by the office and purchase. We can only take a check or cash (exact cash). No Credit transactions. Hours for purchase are 10 am – 1 pm or 2 pm – 4 pm Monday through Thursday.

Make Check out to and mail to:

Imperial County Cooperative Extension
1050 Holton Road
Holtville, CA 92250
Hello,

This month examines a study looking at the effect of implants on Holstein steers in the feedlot on performance and circulating and meat E2.

If you have any comments, questions, recommendations, or know someone who would like to be included on the mailing list, please feel free to contact me.

Best wishes,

**Brooke Latack**  
Livestock Advisor  
UC Cooperative Extension – Imperial, Riverside, and San Bernardino counties  
1050 E Holton Rd  
Holtville, CA 92250  
442-265-7712  
bclatack@ucanr.edu  
http://ceimperial.ucanr.edu/Livestock/

While cooperative extension is working remotely for the time being, we are still available to help answer any questions you have. Feel free to contact me on my cell phone (269-313-2579) or through email.
EFFECT OF IMPLANTS ON HOLSTEIN STEER PERFORMANCE AND SERUM AND MEAT E\textsubscript{2} CONCENTRATION

Brooke Latack
Livestock Advisor

Introduction
Previous studies have found that hormone implants in beef cattle are effective in improving feedlot performance. Less research has been done regarding Holstein steer performance and circulating E\textsubscript{2} when using implants. This study aimed to determine the effect of implants on Holstein steer performance in the feedlot and quantify circulating E\textsubscript{2} concentrations.

Methods
70 Holstein steers (275 ± 6 kg) were sorted into two pens (35 steers/pen). Steers were fed for 186 days and harvested. Diet is shown in table 1. Two implant treatments were used:
1. Implanted with 80 mg trenbolone acetate (TBA) and 16 mg E\textsubscript{2} on day 0. Steers were re-implanted with 120 mg TBA and 24 mg E\textsubscript{2} on day 84.
2. No implant
Performance and carcass characteristics were recorded. Serum, muscle, and intramuscular fat estradiol-17β data was collected throughout the study.

Results and Implications
As expected, implanted cattle had an overall increase in final body weight (10.2%), average daily gain (20%), and dry matter intake (16.5) compared to non-implanted cattle. Implanted cattle also had an increase in hot carcass weight (11%) and LM area (6%) while decreasing KPH fat (11%) compared to non-implanted cattle. There was no difference between the two treatment groups in marbling score, measured KM fat, dressing percentage, yield grade, or quality grade.

Serum E\textsubscript{2} was greater for implanted cattle by d14 but did not differ from non-implanted cattle by d 84 after the first implant. A peak of serum E\textsubscript{2} was seen on d28 after the first implant. Following the second implant on d84, a peak of serum E\textsubscript{2} was seen on d98. Serum E\textsubscript{2} was greater for implanted cattle at the end of the study.

There was a 1.3 pg E\textsubscript{2}/g increase in the LM tissue in implanted cattle compared to non-implanted cattle. This increase is not anticipated to have any negative effect on consumer health due to the still low E\textsubscript{2} concentration compared to typical human production and consumption of E\textsubscript{2} (Hartman et al, 1997).
Table 1.

<table>
<thead>
<tr>
<th>Ingredient composition of experiment diet</th>
<th>Diet composition (% DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracked corn</td>
<td>65.8</td>
</tr>
<tr>
<td>Corn silage</td>
<td>17.0</td>
</tr>
<tr>
<td>DDGS</td>
<td>15.0</td>
</tr>
<tr>
<td>Urea</td>
<td>0.2</td>
</tr>
<tr>
<td>NEm</td>
<td>2.07</td>
</tr>
<tr>
<td>NEg</td>
<td>1.41</td>
</tr>
</tbody>
</table>

References
Building Our Local Foodshed: Gardening Webinar Series

Webinar #1 - Let's Get Started! Gardening in the Low Desert
When: Wednesday, September 9th, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Kristian Salgado, UCCE-Imperial Climate Smart Agriculture, Community Education Specialist, introduces the physical, mental, and environmental benefits of gardening and how to begin your very own garden at home this Fall. Useful videos, websites, and access to print material will be shared.

Webinar #2 - Water Wise: Gardening Water Management Practices
When: Wednesday, September 23rd, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Dr. Ali Montazar, UCCE Irrigation and Water Management Advisor, covers various water management and conservation practices to use water more efficiently in desert gardening.

Webinar #3 - Virtual Garden Kick-Off!
When: Wednesday, October 7th, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Chris Wong, UCCE - Community Education Specialist for the CalFresh program, will walk you through all the steps to keep your garden productive and healthy.

Webinar #4 - Organic Pest Management 101
When: Wednesday, October 21st, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Dr. Oli Bachie, UCCE-Agronomy and Field Crop Advisor, covers the most common pests you might experience growing food in Imperial County, such as how to control and prevent weeds, organic insect control and plant disease control all which reply on organic approaches and techniques.

Webinar #5 - Using Livestock in Your Garden and Food Safety
When: Friday, November 6th, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Brooke Latack, Livestock Advisor, will cover a variety of food safety topics, including how to incorporate and utilize livestock, like chickens, into your garden safely.

Webinar #6 - Harvest to Table: Using Herbs in the Kitchen
When: Wednesday, Nov. 18th, 2020 10:00-10:30 AM PT
Where: Virtual Webinar via Zoom - Register Here!

This webinar, led by Farm Smart staff, Stacey Amparano and Stephanie Collins, will demonstrate how to use, infuse and preserve your home garden herbs.
EFFORTS AND CHALLENGES OF ONE DECADE WATER CONSERVATION PRACTICES IN THE IMPERIAL VALLEY

Ali Montazar, Irrigation & Water Mgmt Advisor, UCCE Imperial and Riverside Counties
Cherie Watte, Executive Director, Imperial Valley H2O
Brea Mohamed, Executive Director, Imperial County Farm Bureau

Introduction. There are likely to be significant shortfalls between water supply and demand in the Colorado River Basin in the upcoming decades. Therefore, implementing impactful agricultural water conservation tools and techniques for the resiliency of agricultural systems becomes a common concept among irrigation/water districts and growers in the low deserts of California. Knowing water related issues in the Colorado River Basin and to support environment and neighboring urban areas, Imperial Valley growers have been remarkably investing in water conservation measures over a decade, even years before initiating On-Farm Efficiency Conservation Program (OFECP) by Imperial Irrigation District (IID) in 2013.

The OFECP is being implemented to provide incentives to local growers to install and apply water-efficient irrigation measures in their farms. The program supports growers to achieve efficient conservation goals in their agricultural operations as well as IID to meet the QSA (Quantification Settlement Agreement) water transfer requirements. As part of the QSA and related agreements, IID agreed to a long-term transfer of water to the San Diego County Water Authority and the Coachella Valley Water District. Nearly two-thirds of IID’s water transfer obligations is planned to be accomplished by on-farm water efficiency and conservation practices.

On-farm water conservation is not an easy task. Technologies, tools, and management strategies along with incentive programs are required to accomplish a successful and impactful conservation program. The University of California Cooperative Extension - Imperial County (UCCE) partnered with the Imperial Valley Agriculture Community to document water conservation experiences in the Imperial Valley and to undertake an economic feasibility assessment of regional on-farm water conservation practices. As part of this ongoing study, this article presents some of the efforts and challenges of conservation measures implemented in the Imperial Valley over the last decade. The article particularly summarizes the findings of Imperial Valley Water User Survey conducted from April through July 2020.

Imperial Valley Water User Survey. The Imperial Valley Water User Survey was developed as a web-based survey questionnaire through the UC ANR Survey Tool. The survey aimed to document the overviews of
Imperial Valley growers and to explore the real-life values and adaptability of water conservation measures over the last decade. The survey can be found at this link:

https://ucanr.edu/survey/survey.cfm?surveynumber=29840

While the survey is still open to growers to provide information and share concerns, the results reported in this article are based on the information provided by 23 growers (agricultural operations). In this survey, information was collected regarding 10 specific on-farm water conservation practices and any other innovative practices performed by growers. The water conservation measures and the assigned names to each practice are provided in Table 1. Additional information was collected on growers’ investment in water conservation and efficiency improvement programs, where water conservation materials and equipment were purchased, number of jobs created from water conservation program, and potential changes in water conservation activities of the agricultural operations to accommodate the current OFECP solicitation.

Table 1. List of water conservation measures in this study.

<table>
<thead>
<tr>
<th>Water conservation practice</th>
<th>Assigned name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation Scheduling Technology (i.e. soil moisture sensors, ET*/weather stations)</td>
<td>WCP1</td>
</tr>
<tr>
<td>Surface Irrigation Optimization (land leveling, field reconfiguration)</td>
<td>WCP2</td>
</tr>
<tr>
<td>Sprinkler Irrigation (full season sprinkler system or sprinkler-flood system)</td>
<td>WCP3</td>
</tr>
<tr>
<td>Drip/Micro Irrigation</td>
<td>WCP4</td>
</tr>
<tr>
<td>Portable Tailwater Recovery System</td>
<td>WCP5</td>
</tr>
<tr>
<td>Permanent Tailwater Recovery System</td>
<td>WCP6</td>
</tr>
<tr>
<td>Cascading Tailwater Recovery System</td>
<td>WCP7</td>
</tr>
<tr>
<td>Automated Surface Irrigation</td>
<td>WCP8</td>
</tr>
<tr>
<td>Deficit Irrigation</td>
<td>WCP9</td>
</tr>
<tr>
<td>On-Farm Reservoir</td>
<td>WCP10</td>
</tr>
<tr>
<td>All other types of conservation methods (even if not currently recognized conservation method by IID’s OFECP)</td>
<td>WCP11</td>
</tr>
</tbody>
</table>

*ET stands for crop evapotranspiration.

Adopted water conservation practices by growers. The results illustrate that all water conservation measures presented in Table 1 were adopted by Imperial Valley growers over the last decade, while there is significant difference in the favorability of each practice (Figure 1). Surface irrigation optimization (WCP2) is the most common water conservation practice (adopted by 87% of the responders) followed by sprinkler irrigation (adopted by 73.9% of the responders) and irrigation scheduling technologies (adopted by 65.2% of the responders). Forty-three (43.5) % of the responders reported adopting drip irrigation, portable tailwater recovery system, and deficit irrigation. On-farm reservoir is recognized as a water conservation measure adopted by 34.8% of the responders followed by permanent and cascading tailwater recovery systems (adopted by 26.1% of the responders). Automated surface irrigation was the least adopted practice (8.7% of the responders), however,
there is an increasing interest among growers utilizing this irrigation technology specifically since gravity irrigation (surface irrigation) dominates irrigation systems in the low desert region and that it reduces labor cost. In addition, 26.1% of the responders implemented other innovative water conservation measures (WCP11) including sequential irrigation, switching alfalfa crop fields to low water use olive trees, reduce water use in fields through cutting off one acre-foot in each water order and educate irrigators on when to shut off water, conversion of aluminum sprinkler pipe to Certa-Lok PVC pipe with drain checks and regulators (leak proof), and utilizing soil amendments and water conditioning.

Figure 1. Percentage of the responders who adopted different water conservation practices. There are growers who adopted several conservation measures in their agricultural operations.

**Water conservation practices over time.** The survey results demonstrate that growers continuously conducted various water conservation practices over the last decade (Table 2). Insignificant or no change in some practices was reported by the responders, for instance, in automated surface irrigation, cascading tailwater recovery system, deficit irrigation, and on-farm reservoir. Utilizing sprinkler and drip irrigation systems; and portable tailwater recovery systems have increased in terms of the total acreage and the number of growers who adopted these measures since 2013. There was an average increase of 13% for growers who adopted these three technologies over the period of 2013-2019 when compared with the period before 2013. However, reductions were observed in sprinkler irrigation and portable tailwater recovery systems in 2020 compared to the period of 2013-2019. The reductions observed in sprinkler irrigation in 2020 could be due to the reduced IID OFECP payment and/or the COVID-19 pandemic. Slight increase of adopting permanent tailwater recovery system has been occurred since before 2013.
Table 2. Percentage of the responders who adopted different water conservation practices in various period since before 2013 (See Table 1 for descriptions for water conservation practices)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WCP1</td>
<td>43.5</td>
<td>47.5</td>
<td>52.2</td>
<td>52.2</td>
</tr>
<tr>
<td>WCP2</td>
<td>73.9</td>
<td>78.3</td>
<td>78.3</td>
<td>65.2</td>
</tr>
<tr>
<td>WCP3</td>
<td>52.2</td>
<td>52.2</td>
<td>69.6</td>
<td>56.5</td>
</tr>
<tr>
<td>WCP4</td>
<td>30.4</td>
<td>43.5</td>
<td>39.1</td>
<td>39.1</td>
</tr>
<tr>
<td>WCP5</td>
<td>21.7</td>
<td>30.4</td>
<td>34.8</td>
<td>30.4</td>
</tr>
<tr>
<td>WCP6</td>
<td>17.4</td>
<td>17.4</td>
<td>17.4</td>
<td>21.7</td>
</tr>
<tr>
<td>WCP7</td>
<td>13.0</td>
<td>13.0</td>
<td>13.0</td>
<td>13.0</td>
</tr>
<tr>
<td>WCP8</td>
<td>8.7</td>
<td>8.7</td>
<td>8.7</td>
<td>8.7</td>
</tr>
<tr>
<td>WCP9</td>
<td>34.8</td>
<td>34.8</td>
<td>34.8</td>
<td>30.4</td>
</tr>
<tr>
<td>WCP10</td>
<td>26.1</td>
<td>30.4</td>
<td>30.4</td>
<td>30.4</td>
</tr>
<tr>
<td>WCP11</td>
<td>13.0</td>
<td>21.7</td>
<td>30.4</td>
<td>30.4</td>
</tr>
</tbody>
</table>

**Growers’ investment in water conservation program.** The 23-surveyed agricultural operations invested a total of nearly $25 million on their water conservation programs over the last decade ranging from less than $100,000 to greater than $5,000,000 per agricultural operation. There was a wide range in the grower’s contribution in each of the investment categories (Figure 2). For instance, 21.7% of the respondents invested less than $100,000 in their water conservation programs. However, 4.3% of the respondents invested in each of the category from $750,000-$1,000,000, $4,000,000-$5,000,000 to greater than $5,000,000. The percentage of the respondents who invested $250,000-$499,999 and $1,000,001-$2,000,000 was the same (17.4%). Similarly, 8.7% of respondents invested for the categories either $500,000-$749,999 or $2,000,001-$3,000,000. A 13.0% of the surveyed farms invested $100,000-$249,000 in their water conservation programs.

The average annual investment in water conservation program for all surveyed agricultural operations was about $165,000 over the study period. The average annual investment of the surveyed farms varied from $20,000 to $650,000 per year.
Figure 2. Percentage of the responders who invested in different investment categories (capital investment) for their water conservation program. Other expenses, such as system operating, maintenance, and labor costs were not included in this investment analysis.

**Purchased water conservation materials and equipment.** The survey shows that 78.3% of the responders purchased all their water conservation materials and equipment within Imperial County. While 17.4% of the agricultural operations purchased the majority of their water conservation supplies and equipment needs within the County, the remaining 4.3% of the responders purchased about half within the County and half outside of the County (Table 3). The survey results clearly indicate that water conservation practices implemented in the Imperial Valley have had a significant contribution into the marketing of irrigation-water supplies over years.

<table>
<thead>
<tr>
<th>Where the responders purchased water conservation materials/equipment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>All purchased within Imperial Valley</td>
<td>78.3</td>
</tr>
<tr>
<td>Majority purchased within Imperial Valley</td>
<td>17.4</td>
</tr>
<tr>
<td>About half purchased within Imperial Valley and half outside of Imperial Valley</td>
<td>4.3</td>
</tr>
<tr>
<td>Majority purchased outside Imperial Valley</td>
<td>0.0</td>
</tr>
<tr>
<td>All purchased outside Imperial Valley</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Jobs created from water conservation programs. The number of additional jobs created through water conservation programs varied among surveyed farms (Figure 3), ranging from no job created (34.8% of the responders) to more than 20 jobs created (8.7% of the responders). About 65.2% of the agricultural operations reported creating additional jobs in their farms over the study period. A total of nearly 125 jobs were created by the surveyed farms to implement and manage water conservation programs.

![Figure 3. Percentage of the responders associated with different additional jobs created from water conservation programs.](image)

Potential changes in water conservation activities in the future. A 35% of the agricultural operations declared that if they knew about 2019 OFECPS solicitation (the payment rate drops from 285/acre foot to $125/acre foot), they would have changed their conservation practices. These desired changes were clearly observed in water conservation practices suggested by the surveyed farms for the 2020 OFECPS solicitation (Table 4). An 80% of the agricultural operations reported that they will keep their existing conservation practices without implementing previously planned practices. Several other changes are performed by growers to accommodate the current OFECPS solicitation including cancelling any planned purchases (60% of the responders), divesting conservation equipment and sold previously purchased conservation materials (13.3% of the responders), decreasing the amount of time spent on irrigation scheduling and management (40% of the farm surveyed), and reducing hours of employees (53.3% of the responders). A 13.3% of the responders seek other ways to address the economic complications created by the current OFECPS solicitation.
Table 4. Percentage of the responders associated with the different changes made to water conservation practices due to the current OFECP solicitation. Each grower uses multi-approaches to address the economic complications created by the recent OFECP solicitation.

<table>
<thead>
<tr>
<th>Changes made to water conservation practices</th>
<th>% of the responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kept existing conservation practices, but did not implement previously planned practices</td>
<td>80.0</td>
</tr>
<tr>
<td>Stopped all conservation practices</td>
<td>6.7</td>
</tr>
<tr>
<td>Cancelled planned purchases</td>
<td>60.0</td>
</tr>
<tr>
<td>Divested conservation equipment/Sold previously purchased conservation materials (sold pipe, etc.)</td>
<td>13.3</td>
</tr>
<tr>
<td>Decreased amount of time spent on irrigation scheduling and management</td>
<td>40.0</td>
</tr>
<tr>
<td>Reduced hours of employees</td>
<td>53.3</td>
</tr>
<tr>
<td>Other</td>
<td>13.3</td>
</tr>
</tbody>
</table>

**Conclusions.** Most surveyed farms participated in IID’s OFECP for 2 to 8 years. The survey results revealed that 78% of the surveyed agricultural operations have proposed and implemented conservation measures through this program. Consequently, the findings from this study represent both the experiences of the Imperial Valley Agriculture Community with water conservation measures recognized by OFECP and conducted voluntarily beyond the program. The following conclusions are made from this study:

- While various water conservation measures were adopted by Imperial Valley growers over the last decade, surface irrigation optimization, sprinkler irrigation, and irrigation scheduling technologies have been the most commonly adopted practices. Drip irrigation and portable tailwater recovery systems, and deficit irrigation management strategies with a similar adaptation rate were adopted latter.
- The number of agricultural operations that adopted surface irrigation optimization, sprinkler irrigation, and irrigation scheduling technologies over the period of 2013-2019 increased by an average of 13%, when compared with pre- 2013 practices. In the meantime, acreage of sprinkler irrigation systems in 2020 was considerably reduced (by about 14%) compared to the period of 2013-2019. Reductions observed in sprinkler irrigation in 2020 could be due to the reduced IID OFECP payment and/or the COVID-19 pandemic.
- The average capital investment in water conservation programs from surveyed agricultural operations was about $165,000 per year over the last decade. The average annual investment of the surveyed farms varied from $20,000 to $650,000. Other expenses, such as system operating, maintenance, and labor costs were not included in this investment analysis.
- Most surveyed agricultural operations (95.7%) purchased all or majority of water conservation materials and equipment within Imperial County.
• A 65.2% of the agricultural operations reported creating additional jobs because of continuous water conservation activities. Nearly 125 jobs were created by the surveyed farms to implement and manage water conservation programs.

• The findings of this study illustrate that the current OFECP solicitation has brought significant concerns to Imperial Valley growers who remarkably invested in water conservation measures for more than one decade. The Imperial Valley agriculture community sees the current OFECP solicitation as a new challenge in the coming years. Most growers are seeking for better approaches to address the economic complications created by the recent OFECP solicitation.

• Changes in water conservation activities are expected to accommodate the current OFECP solicitation by growers including keeping existing conservation practices, but not implementing previously planned practices, cancelling planned purchases, divesting conservation equipment and sold previously purchased conservation materials, decreasing the amount of time spent on irrigation scheduling and management, and reducing hours of employees.

• Incentive programs may enhance successful conservation programs in the low desert region. The incentives provide the support required by agricultural operations for capital investment of costly water conservation measures. The findings of this survey clearly demonstrate the importance of a study highlighting the cost of generating conserved water and the economic multiplier of farm community efforts, specifically to assess the economic feasibility of water conservation measures under current and future OFECP solicitations.

Acknowledgments: The authors would like to gratefully acknowledge the Imperial Valley Agriculture Community for providing thoughts and supports. Our special thanks to agricultural operations that completed the water user survey.

Note: If you have any question or concern about this article and/or this ongoing study, please feel free to contact Ali Montazar at (442) 265-7707 or amontazar@ucanr.edu.

Jairo Diaz¹, Roberto Soto², Daniel Geisseler³
¹UC ANR Desert Research and Extension Center. ²Universidad Autónoma de Baja California, Instituto de Ciencias Agrícolas
³UC Davis, Department of Land, Air and Water Resources.

The main goal of this project is to evaluate the response of onion to drip irrigation and regimes and compare onion production under different N fertilizer application rates. Methods and preliminary results of 2019-2020 season are shown in this newsletter.

Methods

<table>
<thead>
<tr>
<th>Trial Location</th>
<th>Desert Research and Extension Center, Holtville, CA. Clay soil.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onion Variety</td>
<td>Terena – a main-maturing, globe, short-day, yellow hybrid onion. Coated seed.</td>
</tr>
<tr>
<td>Research Unit</td>
<td>Four, 40-inch bed by 50 ft. Four onion rows per bed. Harvests were done on a 10-ft long bed per research unit.</td>
</tr>
<tr>
<td>Growing Period</td>
<td>October 24, 2019 to May 1, 2020.</td>
</tr>
<tr>
<td>Plant Density</td>
<td>117,612 plants per acre at harvest.</td>
</tr>
<tr>
<td>Study Design</td>
<td>Split plot design with irrigation treatments in the main plots and 4 fertilization rates at the subplot level. Four replications.</td>
</tr>
</tbody>
</table>

Irrigation Treatments:

- Four irrigation levels were tested: 40, 70, 100, and 130% of crop evapotranspiration (ETc).
- Daily ETc was estimated by using reference ETo from the CIMIS weather station at DREC (meloland # 87) and onion crop coefficients.
- Drip tape: 0.27 gph, 8 in spacing, and installed at 3/4-4 in depth.
- Pre-plant fertilizer: 300 lbs/ac of 11-52-0 and 20 gal/ac of 10-34-0.

Fertilizer Treatments:

- Four fertilizer treatments were assessed: pre-plant plus 0 lbs N per acre; pre-plant plus 75 lbs N per acre; pre-plant plus 150 lbs per acre; and pre-plant plus 225 lbs per acre.
- In-season fertilizer program started at bulb initiation.

Statistical Analysis:

Analysis of variance was performed with SAS. Tukey test at 5% level was used to find any significant difference between treatment means.

Water Management

- Fourteen sprinkler irrigations were performed for all treatments from planting to 3-4 true leaves (10/24/2019 to 12/17/2019) with a total water applied of 8.86 in.
- Irrigation treatments were converted to drip irrigation in January 2020.
- Total applied irrigation water (sprinkler and drip systems) for the growing season ranged from 10.74 in (40% ETc) to 18.90 in (130% ETc). Total rain during the growing season was 4.67 in.
From the beginning of bulbing to harvest, average plant available water (PAW) was 69% in the top one foot of 130% and 100% ETc irrigation treatments. A decreasing trend in PAW in the top one foot was observed for 70% and 40% ETc treatments. The 40% ETc irrigation treatment clearly showed lack of water availability (35 days PAW was zero at 6-in depth) for optimal plant growth.

**Nitrogen Management**
- Pre-plant mineral N concentrations in the 1st, 2nd, and 3rd foot of the profile were: 69, 59, and 37 lb/ac, respectively.
- Across all irrigation treatments, the mid-season mineral N concentration in the top foot of the profile significantly increased with increasing N application rate.
- After harvesting, the amount of mineral N left in the soil significantly increased with increasing N application rate and significantly decreased with increasing irrigation applications. The interaction between N and irrigation treatments was not significant.

**Yields and Size Distribution**
- Average yields from irrigation treatments ranged from 34.4 (40% ETc) to 52.4 (130% ETc) ton/acre (Figure 1). The total yield reductions by 40%, 70%, and 100% ETc compared to 130% ETc were 34%, 22%, and 3%, respectively. Yields from 100% and 130% ETc treatments were greater than growers’ yield expectations (45 ton/ac) in the region.
- Reduction in irrigation rates significantly impacted onion size distribution and total yield (Figure 1).
- Onion size distribution and total yield did not respond to nitrogen rates (Figure 2). There were no significant irrigation rate x nitrogen rate interactions for bulb size distribution and total yield.

![Figure 1. Average yields by irrigation treatment. Irrigation treatments I1 to I4 correspond to water applications of 40, 70, 100, and 130% of ETc. Onion bulbs were categorized as prepack (less than 2\(\frac{1}{2}\) in), medium (2\(\frac{1}{2}\) to 3\(\frac{1}{4}\) in), jumbo (3\(\frac{3}{4}\) to 4\(\frac{1}{4}\) in), colossal (4\(\frac{1}{4}\) to 4\(\frac{3}{4}\) in), and super colossal (greater than 4\(\frac{3}{4}\) in) based on bulb diameter.](image)
Figure 2. Average yields by nitrogen fertilization treatment. Nitrogen treatments N1 to N4 correspond to in-season N application rates of 0, 75, 150, and 225 lb/ac.

Highlight Results

**Water:** 21-24 in needed this season for highest yields. Irrigations were scheduled every other week since bulb initiation.

**Nitrogen:** pre-plant mineral N (PMN) in the top 1 foot can be a significant source of N. Adjust nitrogen applications based on PMN.

**Total Yields:** 51-52 ton/ac.

**Jumbo/Colossal Yields:** 31-32/10-13 ton/ac.

**Super Colossal Yields:** 2-3 ton/ac.

Acknowledgments

Funding is provided by CDFA’s Fertilizer Research and Education Program. We thank UC ANR Desert REC staff, local growers, seasonal labor, and students for their support. Thanks to The Toro Company for drip tape donation.

Contact Information

For more onion irrigation and nutrient management information contact Jairo Diaz, at 760-791-0521 or jdiazr@ucanr.edu.
UNIVERSITY OF CALIFORNIA (UCCE) IMPERIAL COUNTY ONLINE PROGRAMS PROVIDE SUPPORT ON HEALTHY LIVING AND YOUTH DEVELOPMENT

Yu Meng, Ph.D, Youth, Family, and Community Advisor, UCCE Imperial County

Starting a new school year with distance learning can be stressful for students, parents and teachers. Students are jumping from one online class to another; teachers are scrambling to navigate new technologies; parents are stretched thin to find the work and life balance. However, the world we live in is an increasingly competitive society in which chance and challenge coexist. The challenges we face today makes us more prepared for the future.

UCCE, Imperial County Cooperative Extension has explored the best ways to help our students, parents, teachers, and communities support distance learning, healthy living, and help deliver meaningful learning activities. During the past few months, we collaborated with other counties and provided online educational camps including 4-H Coding Camp and 4-H Grown at Home, novel virtual programs on Epidemiology and Mindful Me, nutrition and physical activity classes implementing age appropriated curriculum, and social media posts to engage youth in developing cooking skills. Using these resources and the experiences we developed, we want to support the new school year and help parents, teachers, and organizations. Here are some of the ways our programs could help.

1. **Technology training/workshops:** Zoom is a widely used program. We anticipate providing training/resources on the following topics, including valuable tips to engage youth in zoom learning.
   a) Zoom Best Practices
   b) Avoid Zoom bombers
   c) Manage Participants
   d) Avoiding Zoom fatigue
   e) Zoom Basics
   f) Zoom training resources
Please email Dr. Yu Meng uc meng@ucanr.edu for scheduling or requesting these resources.

2. **Nutrition and Physical Activity Classes:** CalFresh Healthy Living, University of California, Imperial team and the Farm Smart have been working with schools, community centers, and the food bank for years in providing evidence-based Nutrition and Physical Activity curriculum. Our programs continue to provide online education to preschool to high school ages, from families with 0-5 years old to seniors with appropriate and relevant curriculum topics. UCCE wants to continue to partner with teachers and community centers to help enrich their classes and promote healthy eating and physical activity. Such educational approaches would prevent obesity and combat chronic diseases. Featured outreach programs we offer in this particular area are:

![Direct Nutrition Education and Physical Activity for K-12 online classes; Adult classes covering child feeding skills, healthy eating on a budget, and cooking.](image1)

![Gardening programs offer intergenerational support on gardening and nutrition that aims to increase children’s knowledge and behavior related to healthy eating. We are planning to provide free garden kits to families to support home gardens. Please follow @uccalfreshimperial and @UCfarmsmart on Facebook to stay tune!](image2)
3. **After School Programs:** Imperial County 4-H programs offer club members with a variety of projects (http://4h.ucanr.edu/Projects/), as well as county wide events (@ImperialCounty4H), and school/organization partnerships where youth of other organizations can experience 4-H curriculum without needing individual enrollments. UCCE welcomes organization/school partners with IC 4-H, and supplement them with extra curriculum that could enrich your program. For example, STEM activities, Animal Science Presentation, Teens as Teachers, Career Day, and Youth Financial Management offered in a form of workshops are some of our extra curriculum that may benefit the community.

If you are interested in any of the after school programs, please email IC 4-H at ucmeng@ucanr.edu or fill out this survey (click this link) and let us know your interests: https://ucanr.co1.qualtrics.com/jfe/form/SV_805TPNgehDgFUVv. You may also call the UCCE Imperial county office at (442)265-7700
BIOMASS PRODUCTIVITY AND FORAGE QUALITY COMPARISON OF NEW AND EXISTING FORAGE CROPS FOR THE LOW DESERT ENVIRONMENT

Oli Bachie, Agronomy Advisor, UCCE Imperial, Riverside, and San Diego Counties
Brooke Latack, Livestock Advisor, UCCE Imperial, Riverside, and San Bernardino Counties

ABSTRACT

The objective of this study was to quantify the yield (hay productivity of the forage crops) and nutritive value of Moringa, Klein grass (KG), Bermuda grass (BG), Teff, and Rhodes grass (RG) grown under the same agricultural practices and evaluate the potential of the new crops as a livestock feed compared to existing forage crops. Moringa and Teff are relatively new and fast-growing crops known for human and animal consumption. Although all crops were grown under uniform agronomic maintenance and soil conditions, there are variations in biomass yield. Among all crops, Rhodes grass produced the highest biomass while teff was the least productive. Moringa plants did not tolerate the heat and hence was terminated early without any yield evaluation. Crude protein content of all varieties ranged from 12.8 (RG) to 15% (both KG and Teff). BG, KG, and Teff had similar ADF and aNDF while RG values were slightly higher.

INTRODUCTION

Rhodes Grass (Chloris gayana Kunth, C. abyssinica Hochst. ex A. Rich (synonym) is a perennial grass native to Africa that produced high yields of excellent quality hay. Rhodes grass is closely related to Bermuda grass and can grow in many environments. It is tolerant of moderately saline and alkaline soils. An important feature of Rhodes grass is drought and salt tolerance. Salt tolerance may be beneficial to farmers who have salinity problems in their soil, as is the case of most Imperial Valley soils.

Teff (Eragrostis teff), is an annual grass species of love grass native to Ethiopia. As an edible seed, it has an attractive human nutrition profile, providing protein and calcium and high in dietary fiber and iron. It is similar to millet and quinoa in cooking, but the seed is much smaller. Teff is adapted to environments ranging from drought stress to waterlogged soil conditions. It is now grown in Idaho, Nevada and California (Blythe and Imperial County). Teff is drought tolerant, due to its efficient water conserving capabilities pertinent to its C4 photosynthetic pathway. In previous work in Blythe, Teff was grown with limited water supply and yields were only moderately affected by deficit conditions (Putnam, personal communication). It grows well in most areas, except that it is overwhelmed by winter grass weed.
**Bermuda grass**, *Cynodon dactylon*, is widely grown in the Imperial Valley. Fourteen to 16 irrigations may be needed during the growing season. Three irrigations will generally produce a crop between cuttings; four irrigations will increase yield but decrease forage quality.

**Kleingrass** (*Panicum coloratum*, L.) is bunch grass that grows 24 to 60 inches tall. It is a warm season perennial grass, native to Africa. Klein grass is moderate salinity tolerant, but poor cold tolerant plant.

**Moringa**, *Moringa oleifera*, is fast growing crop native to the subtropical regions of Pakistan and India. It is grown in West, East and South Africa, tropical Asia, Latin America, the Caribbean, Florida and the Pacific Islands. It is a drought resistant tree that does well in neutral to slightly acidic, well-drained sandy or loamy soil, but does not tolerate freezing or frost well. It can be grown on marginal lands with high temperatures and low water availability and where it is difficult to cultivate other agricultural crops (Nouman, 2014). According to FAO sources ([http://www.fao.org/traditional-crops/moringa/en/](http://www.fao.org/traditional-crops/moringa/en/)), Moringa is a genus of shrubs and trees with multi-purpose uses: its leaves, roots and immature pods are consumed as a vegetable. All parts of the moringa tree (bark, pods, leaves, nuts, seeds, tubers, roots, and flowers) are edible. Although Moringa has been well documented for human consumption, its forage quality for livestock consumption has not been explored with high producing livestock in the US, but has been shown to be beneficial in improving milk production and growth in cattle in South America (Sanchez et al, 2006). Previously there have been studies on forage production within and outside the Imperial Valley, but none of those was done using identical growing conditions for all forages and compare quality and productivity of the crops.

Rhodes grass, Teff, Bermuda grass, Klein grass, and Moringa are either widely grown or recently introduced into the Imperial Valley. Most are similar, in that they are forage or potential forage crop. However, they may have variations in adaptability, yield, forage quality, and resource use efficiencies. Moringa, specifically has yet to be tested as a potential forage crop under low desert conditions. The objective of our research was to evaluate competitive yield and quality of Rhodes grass, Teff, Bermuda grass, Klein grass, and Moringa crops under uniform environment, growing season and input provision. We aim to effectively disseminate our findings to growers and the public.

**MATERIALS AND METHODS**

The above four forage crops and Moringa were grown following recommended seeding rates for each of the varieties. All varieties were planted during the second week of April 2019, on the same soil and cultural
practices (irrigation water, fertilizer, and pest management). The trial was laid out in a Completely Randomized Block Design with 4 replications for each crop. Sprinkler irrigation will be used for stand establishment and then switched to flood or surface irrigation. While three to five surface irrigations were conducted to establish stands, 14 irrigations were used during the season for all varieties. Fertilizers were applied at about 120 kg/ac N as a pre-plant and at subsequent cuttings. Pre-plant PK were applied at 40-50 kg/ac. Split applications, each of 50-100 kg/ha N, were used. All plots received about 550 pounds of nitrogen units per acre for the growing season. Pre-planting herbicides were used to minimize weed effects during stand establishment. Timing of forage hay harvests were determined by plant growth characteristics, primarily plant height and maturity standards. The project was planned for three consecutive years but was terminated during the second year due to the covid-19 pandemic.

Representative sub-samples were taken from the center of plots (weighed at fresh) and later dried in forced-air oven at 55°C for dry biomass weight determination. Forage crop establishment (visual density and vigor rating), crop water and fertilizer deficiency symptoms were evaluated. The crops were also evaluated for greenness (using NDVI), height attainments at harvest (sample 4 best growing sample areas of each plot). Three sub-samples were collected from each variety for three consecutive cuttings and analyzed crude protein (CP), organic matter digestibility (OMD), fibers (NDF, ADF), Ash, lignin, and major mineral elements. We harvested the middle 3 rows for yield comparison.

RESULTS AND DISCUSSION

Results presented in this article for all yield and nutrition quality comparisons are based on row data and mean comparisons, no statistical analysis. A test of significance will be included in the future peer-review publication. Table 1 shows harvest dates for all cuttings. Biomass yield of all crops varied depending on cutting cycle (season) for all varieties (Figure 1). The length between harvest cycles was also variable and depended on the rate of growth until maturity. All crop productivity plunged to the lowest during the second and fourth cuttings. Teff only survived until the 4th cutting. Biomass yield of teff at any of the cutting cycles was the least (Figure 1), indicating that it is the least productive crop when grown under uniform growing conditions. Rhodes grass was the most productive in terms of hay yield at all cuttings, except at the 2nd cutting (Figure 1). Biomass yield of Bermuda and Klein grass was very similar for all cutting cycles. For the overall annual yield productivities were highest for Rhodes grass (23.5 t/ac) followed by KG (20 t/ac) and Bermuda (18.3 t/ac) and least for teff (10.5 t/ac). Teff was overwhelmed by water grass, particularly at its latter growth cycles. Biomass yields of
these forage crops are less while gown in normal grower fields compared to the small research field in this experiment.

Plant growth parameters observed at the fourth and fifth cutting cycles were variable (Table 2). Crop greenness was highest for spring cuttings (5th cutting) than the winter cuttings (4th cutting) for all crops. RG was the greenest (65-75%) and greenness was lower for Bermuda grass (42-65%). RH grass plants were consistently taller (20 – 26 inches) than the other crops (Table 2), due to its high dry mass production. Spring harvested plants were generally taller than winter harvested crops.

Table 2: Greenness and height of plants (measured at harvest)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Greenness - Winter (%)</th>
<th>Plant height - Winter (in)</th>
<th>Greenness - Spring (%)</th>
<th>Plant height - Spring (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG</td>
<td>0.65</td>
<td>20</td>
<td>0.73</td>
<td>26</td>
</tr>
<tr>
<td>BG</td>
<td>0.42</td>
<td>11</td>
<td>0.65</td>
<td>18</td>
</tr>
<tr>
<td>KG</td>
<td>0.53</td>
<td>15</td>
<td>0.69</td>
<td>22</td>
</tr>
<tr>
<td>Teff</td>
<td>0.53</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crude protein (CP) content of the forage crops is shown in Table 3. RG had the lowest CP content of the four varieties (12.8%). The 3rd cutting for BG, KG, and Teff contained the lowest concentration of CP compared to the other cuttings.

Table 1: Harvest dates of each cutting cycles

<table>
<thead>
<tr>
<th>Harvest cycles (cuttings)</th>
<th>Harvest dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25-Jun-19</td>
</tr>
<tr>
<td>2</td>
<td>12-Aug-19</td>
</tr>
<tr>
<td>3</td>
<td>23-Sep-19</td>
</tr>
<tr>
<td>4</td>
<td>23-Dec-19</td>
</tr>
<tr>
<td>5</td>
<td>14-Apr-20</td>
</tr>
</tbody>
</table>

Figure 1: Forage crop dry biomass yield for five cutting schedules
Acid detergent fiber (ADF) and neutral detergent fiber (aNDF), related to the quantity of cell wall components of the plant, increased with each cutting for all crops (Table 4; Table 5). Overall, BG, KG, and Teff had similar ADF and aNDF while RG values were slightly higher.

CONCLUSIONS

When grown under similar cultural practices and resources, RG yielded the greatest amount of biomass, but contained the lowest CP concentration and highest ADF and aNDF values compared to any other of the grass forage crops. This indicates that RG has a higher concentration of poorly digestible cell wall components and lower available energy compared to the other crops, which can affect both dry matter intake and performance of livestock. The higher yield of biomass by RG may be related to its prolific growth, more greenness, and grass heights that can suppress potentially competitive weeds. Bermuda and Klein grass tend to yield uniform biomass and CP concentrations. Teff yields the least biomass, producing about half the biomass compared to the other forage crops. However, teff had one of the higher CP concentrations of the four varieties.

For ultimate comparisons of crop quality and economic viability, other crop quality parameters need to be considered. For example, although teff produces the least biomass, the structural qualities of the crop may have positive impacts on livestock palatability and digestion. These other crop quality parameters may help growers of low desert make a more informed decision about the type of forage they choose to produce. Additionally,
livestock operators will have the opportunity to assess the quality of forages they feed the livestock and see the potential of the new forages. A repeated year of similar trial is necessary to provide full productivity comparisons and recommendations. These findings, productivities, and nutritional comparisons of the forage crops will be presented at the upcoming grower’s meetings and workshops.

ACKNOWLEDGEMENT

This research was conducted with funding obtained from the Imperial County, through the Ag Benefits funding. We sincerely thank the county for the funding. We thank all those who generously donated seeds for the many varieties tested in the trial. We also thank UCCE Imperial county staff, Jesie Lui, Jorge Celis and Levi Durant for the valuable field data collection and laboratory crop sampling for biomass and nutrient analysis.

If you any questions on the nature of this trial and findings, please contact Oli Bachie (obachie@ucanr.edu) or Brooke Latack (blatack@ucanr.edu) or call our office at (442)265-7700. For more information, you may also refer to the following reading materials.

REFERENCES

The reference evapotranspiration ($ET_o$) is derived from a well-watered grass field and may be obtained from the nearest CIMIS (California Irrigation Management Information System) station. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California. The network was designed to assist irrigators in managing their water resources more efficiently. CIMIS ET data is a good guideline for planning irrigations as bottom line, while crop ET may be estimated by multiplying $ET_o$ by a crop coefficient ($K_c$) which is specific for each crop.

There are three CIMIS stations in Imperial County including Calipatria (CIMIS #41), Seeley (CIMIS #68), and Meloland (CIMIS #87). Data from the CIMIS network are available at: http://www.cimis.water.ca.gov. Estimates of the average daily $ET_o$ for the period of September 1 to November 30 for the Imperial Valley stations are presented in Table 1. These values were calculated using the long-term data of each station.

Table 1. Estimates of average daily potential evapotranspiration ($ET_o$) in inches per day

<table>
<thead>
<tr>
<th>Station</th>
<th>September</th>
<th></th>
<th>October</th>
<th></th>
<th>November</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1-15</td>
<td>16-30</td>
<td>1-15</td>
<td>16-31</td>
<td>1-15</td>
</tr>
<tr>
<td>Calipatria</td>
<td>0.26</td>
<td>0.23</td>
<td>0.21</td>
<td>0.18</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>El Centro (Seeley)</td>
<td>0.26</td>
<td>0.25</td>
<td>0.22</td>
<td>0.18</td>
<td>0.14</td>
<td>0.12</td>
</tr>
<tr>
<td>Holtville (Meloland)</td>
<td>0.26</td>
<td>0.24</td>
<td>0.20</td>
<td>0.16</td>
<td>0.13</td>
<td>0.11</td>
</tr>
</tbody>
</table>

For more information about ET and crop coefficients, feel free to contact the UC Imperial County Cooperative Extension office (442-265-7700). You can also find the latest research-based advice and California water & drought management information/resources through link below: http://ciwr.ucanr.edu/.
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