UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources | UC Cooperative Extension

Imperial County Agricultural Briefs

April 2024 (Volume 27 Issue 4)

Features from your Advisors

Table of Contents

APPLICATION OF HIGH NITROGEN FERTILIZER AND IRRIGATION MAY NOT NECESSARILY YIELD HIGH FORAGE BIOMASS OF SUDANGRASS

Oli Bachie, Ali Montazar, and Brooke Latack, UCCE Imperial County Advisors

Background

The Imperial Valley is the major Sudangrass (*Sorghum sudanense)* producing region of California. Being a C4 grass, sudangrass thrives well in the low desert. Sudangrass acreage in the Imperial Valley has ranged from 42,000 (1990) to 49,164 (2022) and generated $63.1M in revenue, in 2022 (*Dessert*, *2022*). Nitrogen (N) is the most limiting nutrient in sudangrass production (Armah-Agyeman, et al., 2002). Sudangrass responds very well to supplemental fertilizer input, having extensive root systems, sudangrass can effectively take up and store excessive soil nitrogen (Hirel, et al., 2011) into its tissue.

The recommended fertilizer dose for quality sudangrass production in the low desert is about 100lb N as pre-plant (considering no fertilizer residues in the field) and 50-60lb N applied to the crop after each cutting (Bachie, 2021), with a seasonal nitrogen (N) requirement of 320 to 400 lbs actual N per acre throughout its growing season. In anticipation to maximize hay production, growers of the low desert commonly apply large quantities of N fertilizers in the production of sudangrass hay, at rates varying from 150 to over 800 lbs N/acre during its growing cycle. Excess fertilizer supply could result in erosion or leaching beyond crop root zones and cause environmental pollutions and become a severe damage to the ecological zones and aquatic life. In addition to supplemental fertilization, irrigation water could move out the fertilizer from crop root zone through either erosion or leaching, exacerbating environmental pollutions. High levels of supplemental fertilizer could also result in higher sudangrass tissue nitrate concentration and/or prussic acid concentration, making the hay toxic to livestock. Hay importers often complain about excessive nitrate levels in sudangrass hay.

This research project is conducted to assess effects of supplemental fertilization and irrigation water on biomass and hay quality of Sudan grass. The study is being conducted at the UCANR Desert Research and Extension Center (DREC), in Holtville, California.

Approaches / methods

Three fertilizer rates (sub plots) consisting of (1) lower rate of 50lbs of fertilizer N / acre at each cutting, (2) medium rate conventional N fertilizer rates of 80lbs of fertilizer N / acre, and (3) high N fertilizer at 100lbs N / ac at successive cuttings were used as fertilizer treatments. Three irrigation strategies (main plots) are: (1) 80% ET, (2) 100% ET, and (3) 120%ET. A split plot design with 4 replications per treatment was used for this study. Initial fertilizers were applied as pre-plant for initial crop establishment. Sprinkler irrigation was used during initial crop establishment across all treatments and later converted into a farrow irrigation controlled by gated pipes. Preplant soil samples were taken from four soil profiles (0-1, 1-2, 2-3, and 3-4 ft.) from 4 sites of each plot and composited to determine soil characteristics and nutrient compositions (Table 1). As shown in Table 1, soil of the experimental field was predominantly silty loam although there are variations with depth. The soil is generally low in organic matter, nitrogen (except at the topsoil surface) and phosphorus, but high in Potassium. The deeper the soil sample, the lower is the organic matter and soil N. Soil pH of the research field was alkaline. Crops were sampled for forage biomass production and forage nutrient compositions.

Table 1. Major soil components for pre-fertilizer & pre-plant soil samples at four soil depths, 0-1, 1-2, 2-3, and 3-4 ft, respectively

Type	Soil Depth				Optimum Levels	
	0 - 12"	12 - 24"	24 - 36"	36 - 48"	Low	High
Total N, *Combustion/%*	0.02	0.01	0.01	0.01	-	-
Org. Matter, *Combustion/%*	0.30	0.18	0.23	0.20	-	-
NO3-N, *OLSEN/PPM*	53.1	12.4	6.3	12.7	25.0	50.0
PO4-P, *OLSEN/PPM*	16.3	7.1	2.0	2.2	10.0	20.0
K, *OLSEN/PPM*	262	157	114	86	80	160
Soil Texture / estimate	Loam; Sl. Lloam	Loam; Sl. Lloam	Loam; Sl. Lloam	Sandy Loam	-	-
pH, *Saturation Paste / Units*	7.98	8.11	8.14	8.04	6.50	7.50

Preliminary Results

Average field fresh biomass productivity of sudangrass for pre-plant fertilizer supply was 11.4 t/ac with forage moisture content of 44.7% and 76% greenness at harvest (data not shown). This level of biomass productivity could serve as a baseline / benchmark to compare treatment effects relative to a no after every cutting fertilizer treatment.

Soil moisture sensors indicated that there were variations in irrigation water availability following irrigation treatments. The soil water content (SWC) or soil moisture is the amount of water present in the soil and influences plant growth, soil temperature, and transport of chemicals and nutrients. The total soil-water potential is the amount of work done per unit quantity of water in order to transport isothermally and reversibly a quantity of water from a pool of water to the soil water (Zied Haj-Amor, ... Ruediger Anlauf, 2023). As shown in Figure 3, the 80ET irrigation had relatively less soil water availability (higher soil water potential) over the growing period and may pose some crop water stress. There was better water availability in both the 100ET and 120ET irrigation levels (Figure 1).

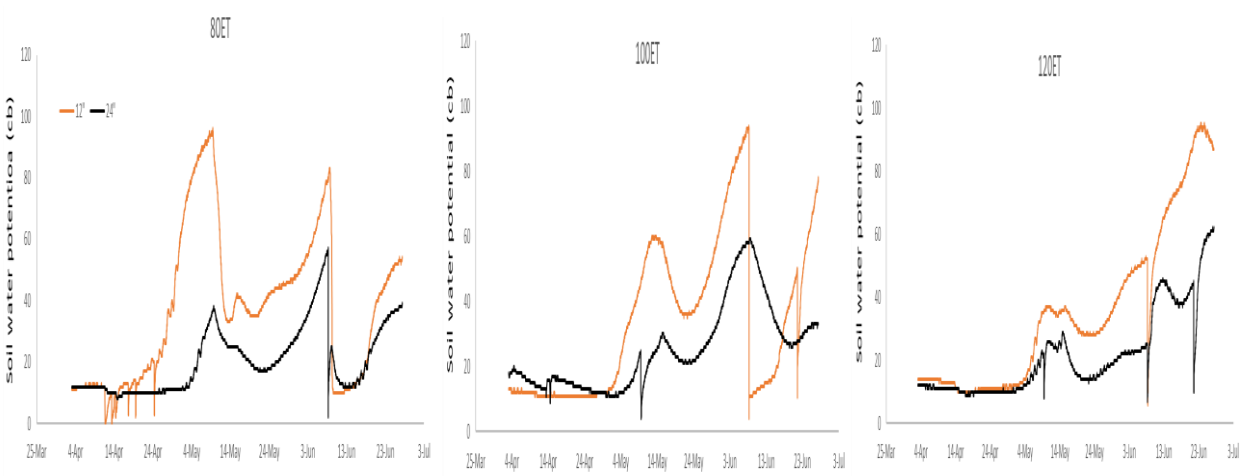

Figure 1: Soil water potential under the 3 irrigation schedules, 80ET (left), 100ET (middle), and 120ET (right) at 12 and 24 inches of soil depth.

Sudangrass fresh biomass

Sudangrass is usually harvested when the crop had 10 to 20% flowers, following growers' common practices. The duration it may take to this level of growth is variable and depends on seasonal crop growing conditions. A typical Sudan grass production in the Imperial Valley involves 3 to 4 cuttings if the crop is planted in early spring (March-April). Two cuttings were used to evaluate sudangrass response to applied treatments. Sudangrass biomass production for the two subsequent cuttings were not significantly different (statistically) between fertilizer application rates ($Pr > 0.8577$) or irrigation treatments ($Pr > 0.3411$) (Figure 2). Similarly, mean fresh biomass yield were not statistically different among fertilizer rates (Pr > 0.8577) or irrigation treatments (*Pr > 0.3411*), or fertilizer * irrigation interactions (*Pr > 6689*) (Figure 3). The results suggest that pushing for higher fertilizer level beyond 50lb/ac per cutting or irrigating at irrigation level above 80ET does not necessarily increase sudangrass forage biomass production. It also suggests that sudangrass can be safely stressed to 80%ET irrigation supply and produce desired biomass without significant reduction in yield. More data needs to effectively determine the benefit / economics of stressing the crop relative to the amount of yield / revenue as a result of reduced irrigation water supply.

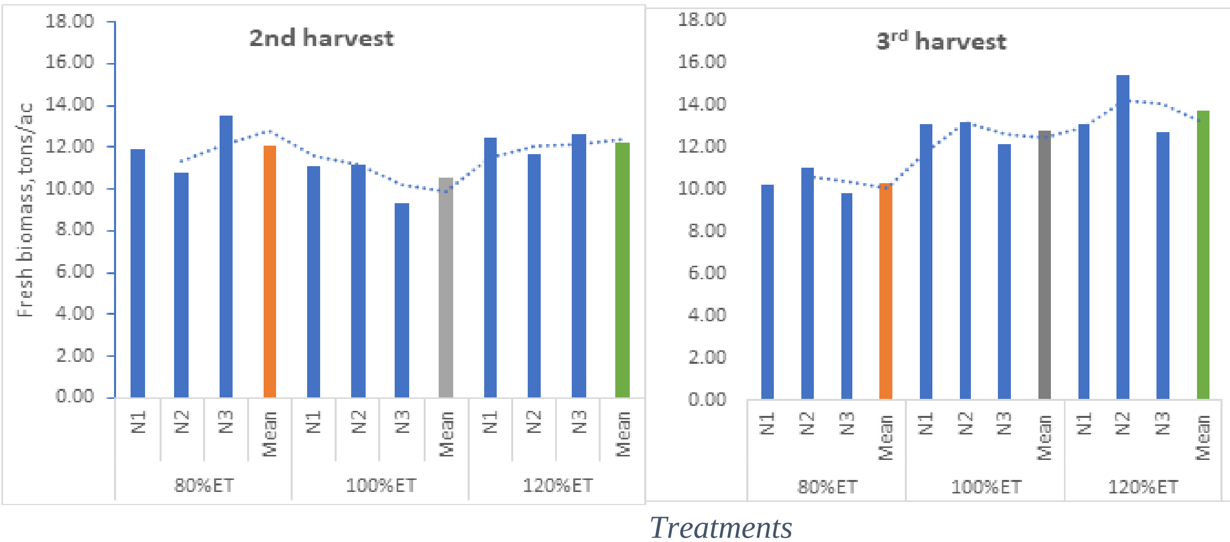

Figure 2: Fresh biomass, tons /ac of crop under 3 fertilizer (N1, N2, and N3) and 3 irrigation rates for the second cutting (left) and third cutting (right) with no significant biomass differences between fertilizer (Pr > 0.8577) or irrigation (*Pr > 0.3411*) treatments, or fertilizer * irrigation interactions (*Pr > 6689*).

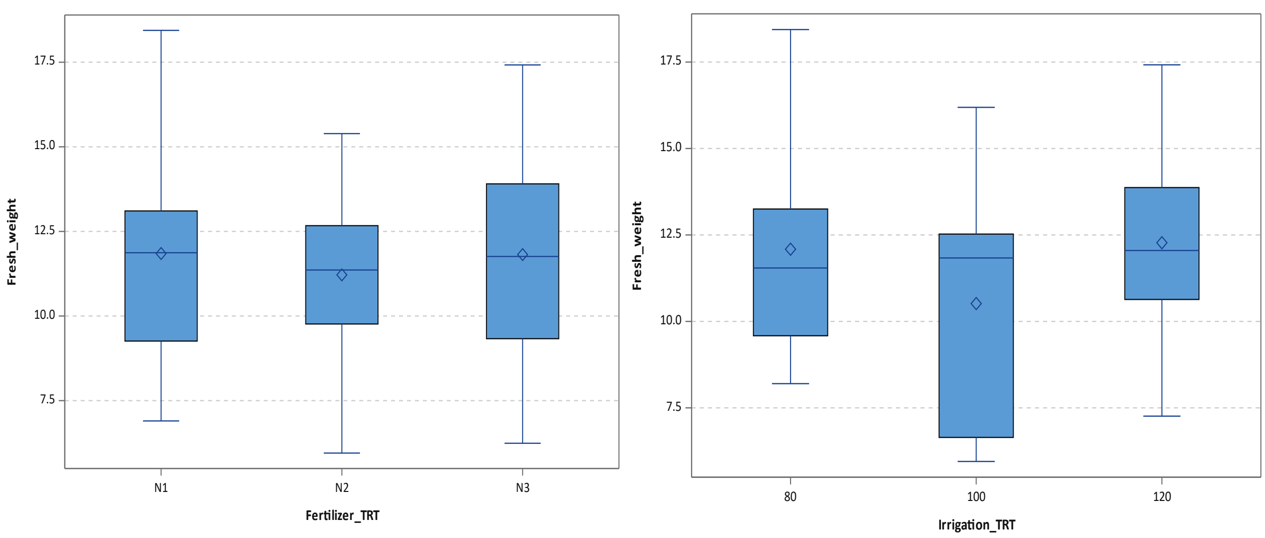

Figure 3: Mean fresh biomass, tons /ac of crop under 3 fertilizer (left) and 3 irrigation levels (right). No significant differences were observed between fresh biomass (fertilizer, *Pr > 0.8577* and irrigation, Pr > 0.341).

Discussion and conclusions

Our findings suggest that increased fertilizer supply more than 50lbs/ ac per cutting and higher irrigation levels beyond 80ET do not necessarily increase forage biomass productivity in sudangrass. While there was relatively lower response of crop biomass to N at the third cuttings under the lower irrigation level (a potential water stress and poor transport of fertilizers to crop roots), the differences are not statistically justified. Many researchers showed evidence that there is little chance of yield increase at N applications greater than 70lbs / acre per growth period, indicating that nitrogen use efficiency (NUE) is reduced with increasing fertilizer inputs. Arregui and Quemada (2006) suggested that increasing nitrogen use efficiency (NUE) should be an agronomic, economic, and environmental priority for crop production. In many cases of crop yield analysis, nitrogen use efficiencies are typically less than 50%, indicating that 50% of applied N fertilizer is not used for increased crop yields. Nitrogen that is not taken up by plants can contribute to environmental problems such as greenhouse gas emissions, eutrophication, or lost by leaching (Asghari and Cavagnaro, 2011), contaminating surface and groundwater. Nitrate (NO3-) and urea CO(NH2) are very soluble and can run off into the surface water or flow into the groundwater (Hirel, et al., 2011). Thus, using optimum level of fertilizer that matches efficient crop nutrient use not only maximizes profitability, but also help farmers to reduce environmental impacts of food production. Over-irrigation that does not necessarily benefit increased yield is also another increased cost to growers without an economic increase in production (Datta et al., 2018). In summary, higher supplemental fertilizer levels and irrigation water within our treatment levels did not affect biomass production of sudangrass. Since this is preliminary research finding, caution must be taken to adopt the findings. The research is ongoing and is expected to make final determination at the end of the project cycle.

While we have also conducted an analysis of hay quality between low and high fertilizer and irrigation levels, this finding is to be published in the upcoming AgBriefs newsletter. This analysis of quality will look at crude protein, acid detergent fiber, neutral detergent fiber, TDN, nitrate and prussic acid contents of the sudangrass forage as an important determination of forage quality and toxicity to the livestock.

References

Asghari, H.R. and T.R. Cavagnaro. 2011. Arbuscular mycorrhizas enhance plant interception of leached nutrients. Funct. Plant Biol. 38: 219-226.

Armah-Agyeman G., et al. 2002. Sudangrass. Oregon State university. Cooperative Extension. https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em8793.pdf

Bachie O. 2021. UCCE Imperial County Field Crop production guidelines. 47 pages

Datta S. et al. 2018. Understanding Soil Water Content and Thresholds for Irrigation Management. BAE-1537

Dessert J. 2022. Imperial County Agricultural Crop and Livestock Report. Imperial county Agricultural Commissioner Sealer of Weights and Measures. 15 pages.

Hirel, B., et al. 2011. Improving Nitrogen Use Efficiency (NUE) in Crops for Sustainable Agriculture. Sustainability 3: 1452-1485)

Zied Haj-Amor, ... Ruediger Anlauf. 2023. Soil-water modeling as a tool for sustainable soil resources management. In Water, Land, & Forest Susceptibility & Sustainability, Volume 2.

DISEASE NOTES: ONION DOWNY MILDEW

Ana M. Pastrana, Plant Pathology Advisor Imperial, San Diego, and Riverside counties

Problem Description: Over the past few weeks, starting in mid-February, downy mildew lesions have been spotted in most processing onion fields in the Imperial Valley region.

Onion downy mildew symptoms. Photos were captured in a commercial conventional onion field in Holtville, CA in March 2024. Photo credit: Pastrana, A. M.

- ➔ When it comes to downy mildew in onions, one thing that might puzzle growers about the effectiveness of treatments is the long incubation period of the disease. Here's what happens: the infection takes hold, and symptoms start to show up later. But by the time treatments are applied, a lot of disease has already developed. This means that even though treatments are done, there's still a lot of disease lingering because the ideal time for treatment was actually earlier.

Recommendations to address the ongoing issue as of today's date:

1. Avoid prolonged irrigation and limit watering to the morning hours until around three in the afternoon.
2. Refrain from entering fields when leaves are wet to minimize the spread of disease.
3. Take care to avoid injuring the crop with herbicides or other materials.
4. Manage thrips populations effectively as their damage can weaken plant cells, increasing susceptibility to downy mildew infection.
5. Avoid over-application of nitrogen, as excessive leaf growth can promote disease.
6. Ensure adherence to the UC IPM-endorsed fungicide program, rotating with fungicides from different mode-of-action groups to mitigate the risk of resistance development (https://ipm.ucanr.edu/agriculture/onion-and-garlic/downy-mildew/). Adequate foliage coverage is essential for effective downy mildew control. Fungicides should be applied on a 7-day schedule, strictly following label instructions, or until weather conditions are favorable for disease.

What are favorable conditions for the disease?

Araújo et al. (2017) conducted a study where Daily Severity Values (DSV) were calculated using Table 1. In this two-year experiment, DSVs were determined every 24 hours based on temperature and relative humidity combinations outlined in the table. Fungicide applications were made when the cumulative DSV fell within the ranges of 6–11 (without reaching 12), 12–17 (without reaching 18), or equal to or exceeding 18, and were compared with normal weekly applications. Several products were compared throughout the study.

<u>Example of DSV Calculation</u>:

- April 3rd, 2024: DSV = 1
- April 4th, 2024: DSV = 3
- April 5th, 2024: DSV = 2
- April 6th, 2024: DSV = 2
- April 7th, 2024: DSV = 1
- April 8th, 2024: DSV = 2 (cumulative DSV = 11)
- April 9th, 2024: DSV = 3
- April 10th, 2024: DSV = 3 (cumulative DSV = 17)

Table 1. Combinations of temperature ranges and relative humidity to estimate the daily severity values used by Aráujo et al., 2017.

	Daily Severity Values (DSV) [1]			
	1	**2**	**3**	**4**
Temperature range (°C) / (ºF)	**Hours with relative humidity ≥90%**			
8 - 13.9 / 46.4 - 57.02	12	13-15	16-18	22-24
14 - 21 / 57.2 - 69.8	9	10-12	13-15	19-24
22 - 29 / 71.6 - 84.2	15	16-18	19-21	24

Results showed that compared with weekly spraying, Araújo et al. (2017) were able to reduce the number of sprays both in 2014 (one less, using DSV 6–11 as the critical range) and in 2015 (a reduction of 20%, using DSV 12–17 as the critical range), without experiencing yield losses.

Implications of the Study:

Araújo et al. (2017) demonstrated reduced spray frequency without yield losses, indicating potential cost savings. However, the feasibility of implementing these findings should be assessed considering factors such as acreage, fungicide costs, and onion prices. This study provides valuable insights into DSV accumulation for effective downy mildew management when combined with systemic fungicides.

Study Context:

The research was conducted in Brazil's Ituporanga-SC region, characterized by onion monoculture and frequent downy mildew epidemics. Decision support systems like these require continual updates to reflect changes in control efficiency, cultivars, and production areas.

Be cautious:

It's crucial to note that sensor placement may affect humidity and temperature measurements.

seeds *for* bees®

Project *Apis m.*

2024 APPLICATION NOW OPEN!

Project Apis m.'s Seeds for Bees program awards cover crop seed to farmers and beekeepers within the state of California.
The program's seed mixes are designed to bloom at strategic times of the season, providing critical pollinator forage and multiple soil health benefits.

Seeds for Bees is a multi-year program:

- 1st year participants qualify for up to $2,500 in free seed
- 2nd year participants qualify for up to $1,500 in free seed
- Returning participants (3 or more years) qualify for discounted seed prices and free shipping

Apply and get more information

For assistace with your application

anaresendiz@ucanr.edu

IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

Ali Montazar, Irrigation and Water Management Advisor, UCCE Imperial, Riverside, and San Diego Counties

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 are 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 include 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 April 1st to June 30th 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 inch per day

Station	April		May		June	
	1-15	16-30	1-15	16-31	1-15	16-30
Calipatria	0.22	0.25	0.27	0.29	0.31	0.32
El Centro (Seeley)	0.24	0.28	0.29	0.31	0.34	0.36
Holtville (Meloland)	0.23	0.27	0.29	0.31	0.33	0.34

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/.