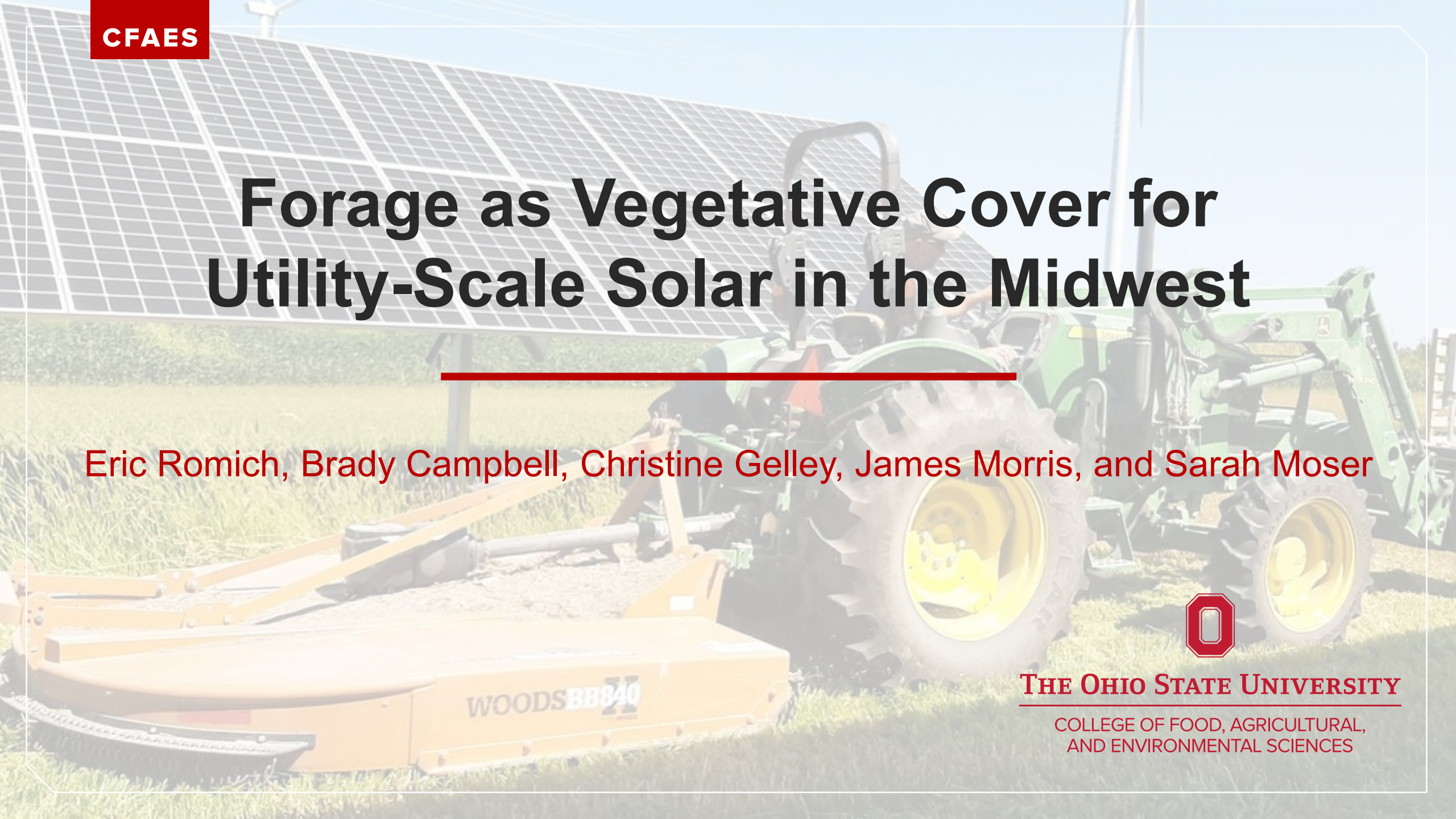
CFAES

Forage as Vegetative Cover for Utility-Scale Solar in the Midwest

Eric Romich, Brady Campbell, Christine Gelley, James Morris, and Sarah Moser



THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

CFAES

Program Overview

- Current Challenges
- OSU Fact Sheet - Forage as Vegetative Cover for Utility-Scale Solar
- Between the Rows Project Overview
- Project Objectives
- Layout of Test Plots
- Preliminary Data
- Next Steps

Current Challenges

- Photovoltaic solar is a technology with a low power density
- Vegetative groundcover will have both economic and environmental impacts
- Turfgrass – high maintenance cost, limited environmental benefit
- Pollinators – high establishment and maintenance cost, weed control
- Specialty crops – labor intensive
- Advanced Agrivoltaic solutions add additional racking cost
- Grazing – heard size, internal fencing and rotation
- **Solutions must be scalable!**

CFAES

Forage as Vegetative Cover for Utility-Scale Solar in Ohio

1. Turfgrass systems require frequent mowing and significant consumption of energy while providing limited benefit for the surrounding ecosystem.

2. Establishing a pollinator system can be expensive and the control of problematic weeds, which is legally required (Ohio Revised Code § 731.51 to § 731.53) is a severe challenge.

3. Cool-season grasses and legumes can be utilized for their abundant ground cover, pollinator benefits, and livestock forage. Legumes also fix additional nitrogen for plant uptake.

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

extension.osu.edu
comdev.osu.edu

Forage as Vegetative Cover for Utility-Scale Solar in Ohio

CDFS-4106
Community Development
Date: 06/24/2021

Christine Gelley, educator, agriculture and natural resources, Ohio State University Extension, Noble County
James Morris, educator, agriculture and natural resources and community development, OSU Extension, Brown County
Eric Romich, associate professor and field specialist, energy education and community development, OSU Extension

The Midwest has seen an increase in photovoltaic (PV) solar energy production over the past several years. Nowhere is this more evident than in Ohio. Traditional ground cover options for utility-scale solar projects includes stone, gravel, bare earth, and various types of turfgrass vegetation. However, as the buildout of utility-scale solar projects increases, many are exploring the feasibility of dual land-use strategies that incorporate agricultural and conservation practices with solar production. Popular examples include pairing solar production with specialty vegetable crop production, livestock grazing, and pollinator habitats. However, as the size of utility-scale projects in Ohio has evolved from 100 to 200-acre projects into projects that are 2,000 acres or more, widespread integration of these practices faces real, common challenges:

- Growing specialty crops is labor intensive, requiring access for many people within the utility-scale solar site.
- Raising livestock requires massive herds, frequent watering, and additional fencing to rotate the animals.
- Creating pollinator habitats requires expensive seed mixes and the control of noxious and invasive weeds.

This fact sheet provides developers and landowners information about alternative vegetative cover strategies—including forage crops—that prevent greenwashing opportunities while also offering legitimate benefits to the landowner and the solar developer over the project lifecycle. Topics include common vegetative cover strategies and how cool-season forage crops can provide the greatest environmental, social, and economic benefit. This fact sheet also summarizes the requirements of utility-scale solar vegetative cover, species selection, establishment, and site maintenance.

Solar Industry in Ohio

The 2020 (Q2) U.S. Solar Market Insight Report estimates more than 80 gigawatts of utility-scale PV solar capacity

ohioline.osu.edu

CDFS-4106

CFAES

Research Project Partnerships

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Preliminary Experimental Design

- **Control Plots-** Each forage type grown at the normally recommended seeding rate outside of the solar array.
- **Cover Crop Plots-** Summer annual followed by a winter annual within the array at varied seeding rates.
- **Alfalfa Plots-** Alfalfa within the array at varied seeding rates.
- **Hay Mix Plots-** Cool-season grass and legume mix within the array at varied seeding rates.

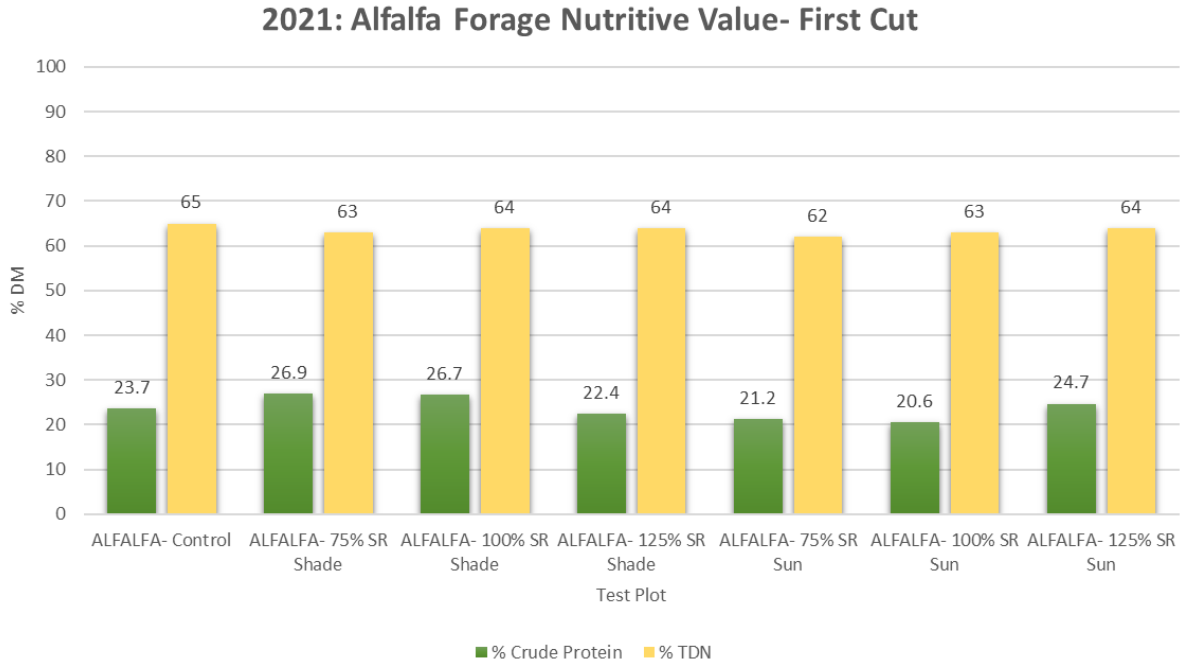
Control - Cool Season Hay Mix 100% Seeding Rate – (102g)	Control - Alfalfa 100% Seeding Rate – (61g)	Control - Teffgrass / Crimson 100% Seeding Rate (20g Tef / 123g Crim)
	Module Array / Row #4	
Teffgrass / Crimson Clover 75% Seeding Rate (15g Tef / 92g Crim)	Teffgrass / Crimson Clover 100% Seeding Rate (20g Tef / 123g Crim)	Teffgrass / Crimson Clover 125% Seeding Rate (26g Tef / 153g Crim)
	Module Array / Row #3	
Alfalfa 75% Seeding Rate – (46g)	Alfalfa 100% Seeding Rate – (61g)	Alfalfa 125% Seeding Rate – (77g)
	Module Array / Row #2	
Cool Season Hay Mix 75% Seeding Rate – (77g)	Cool Season Hay Mix 100% Seeding Rate – (102g)	Cool Season Hay Mix 125% Seeding Rate – (128g)
	Module Array / Row #1	

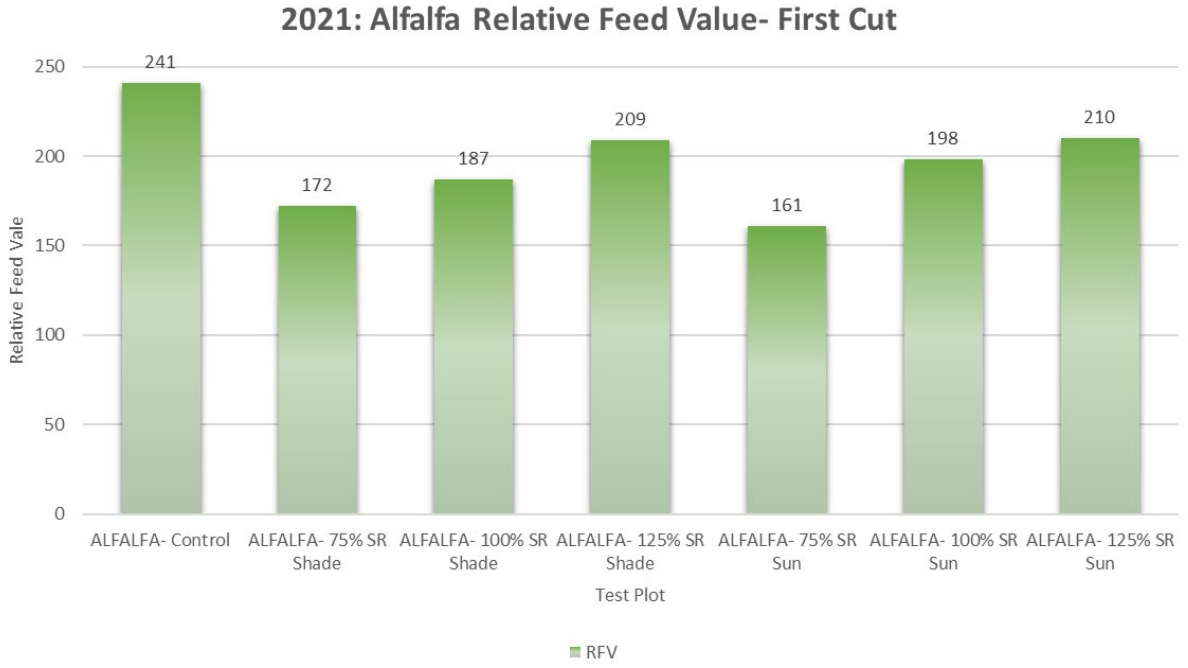
CFAES

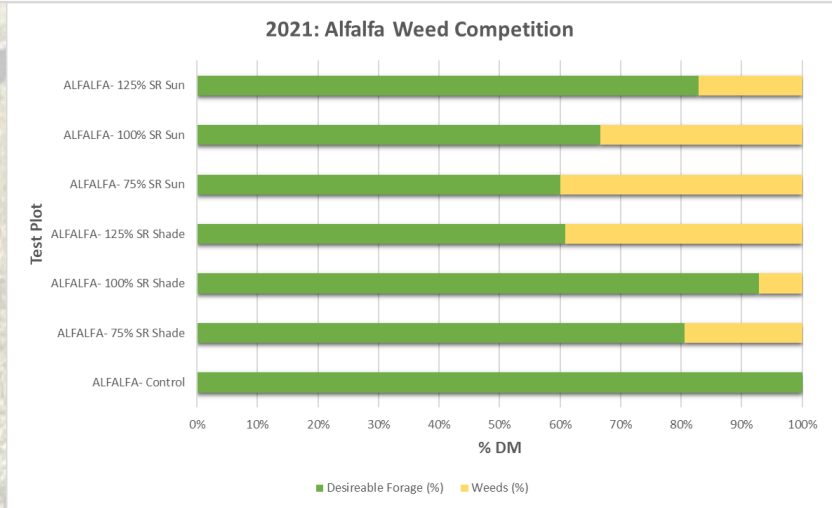
Results from 2021 & 2022

Photos from 2021

Forage Nutritive Value of Alfalfa- 2021





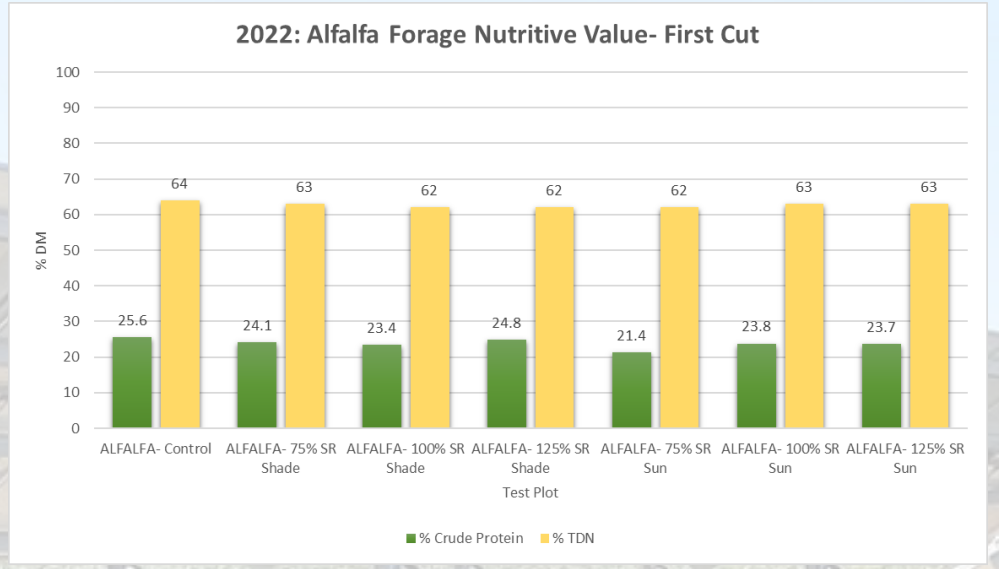


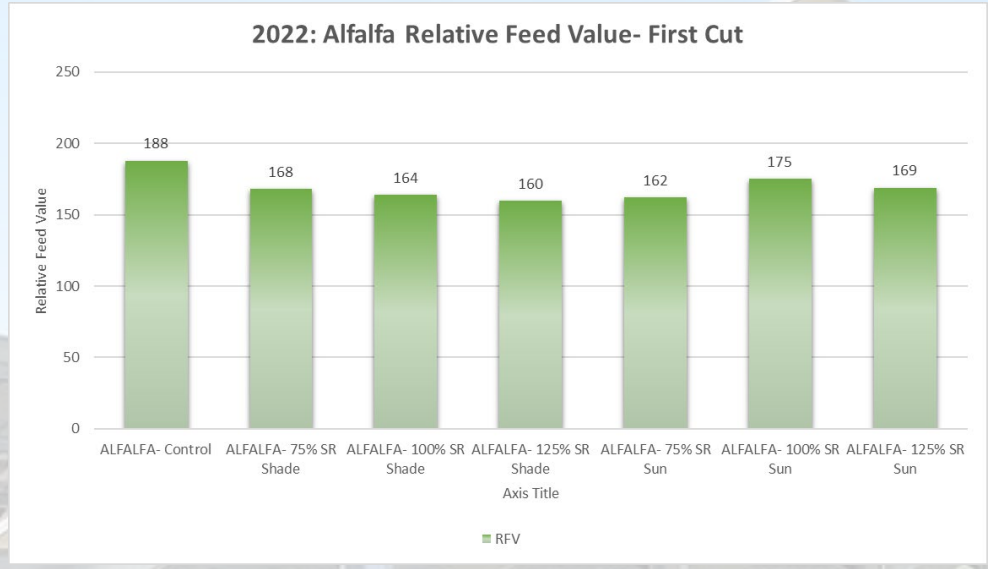
- **Plots were seeded on May 14, 2021.**
- **Fertilizer was applied according to soil test recommendations.**
- **Weed controls with herbicides were implemented as needed on alfalfa plots and under panels.**
- **After establishment one harvest event took place on Sept. 2, 2021.**
- **Despite noticeable weed pressure, the quality of the alfalfa samples tested well within the window of normal.**
- **CP > 18% = Good. CP > 22% = Prime.**
- **TDN > 58% = Good. TDN > 62% = Supreme.**
- **RFV > 150 = Good. RFV > 185 = Supreme.**

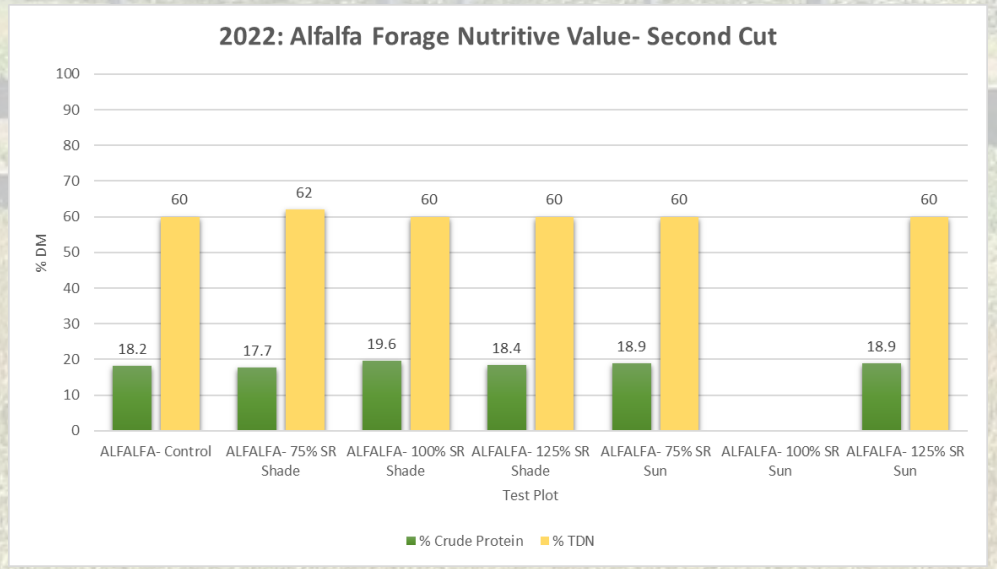
Forage Nutritive Value of Alfalfa- 2022

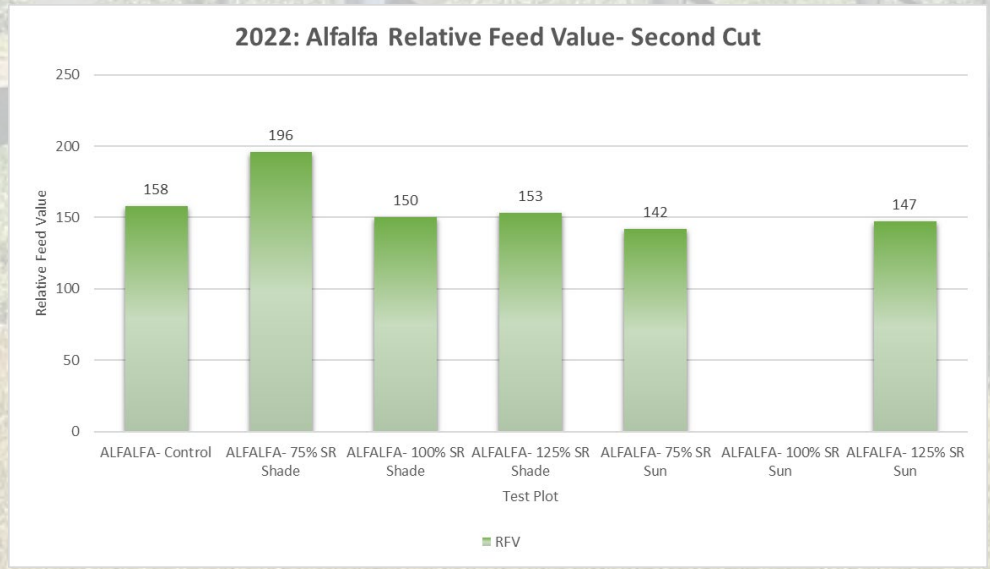
CFAES

- First Cut- May 20, 2022
- Second Cut- August 2, 2022



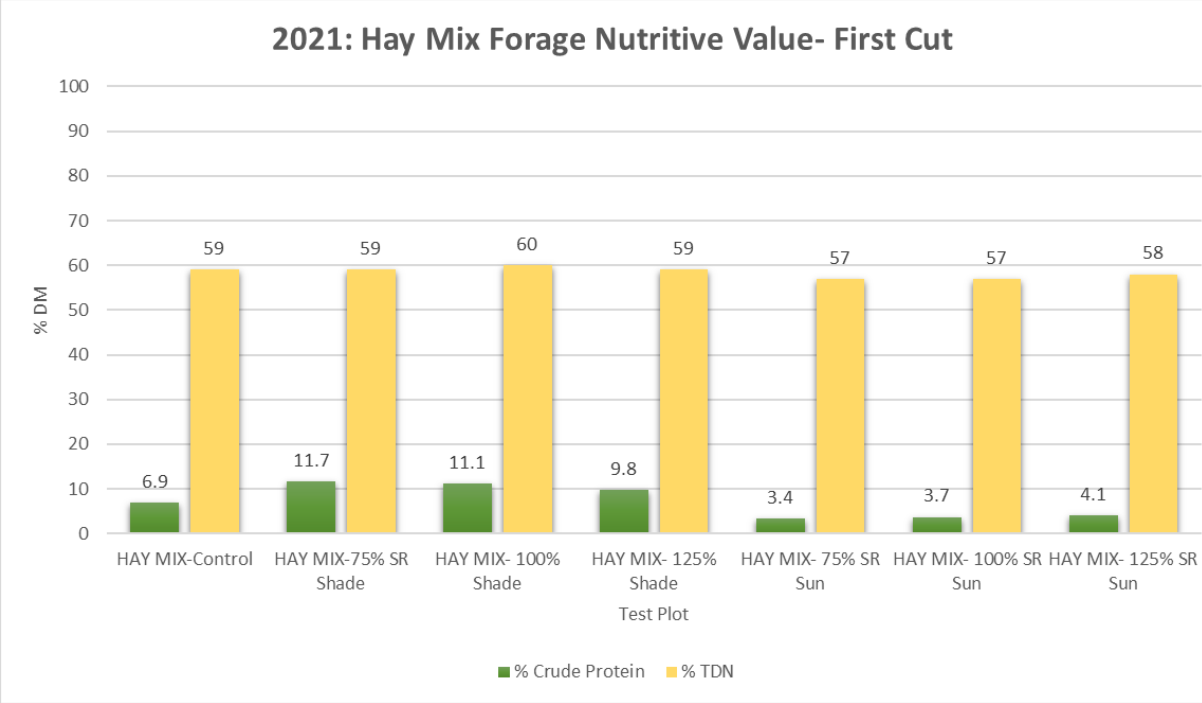


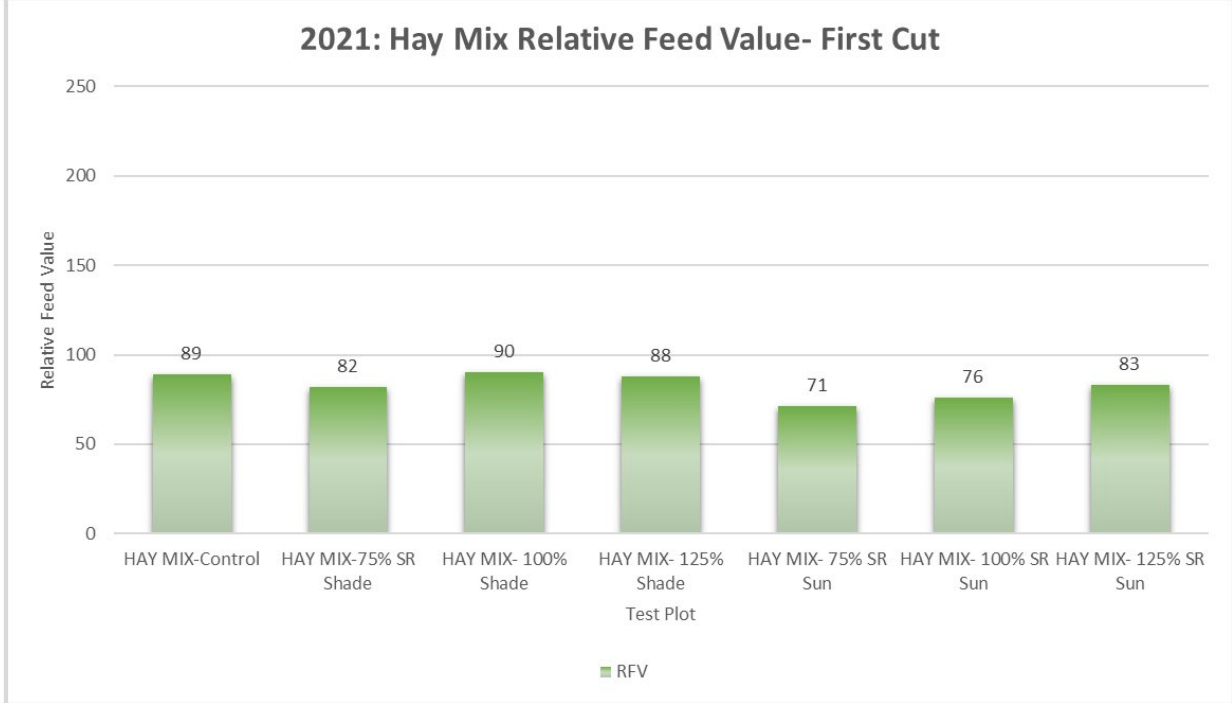


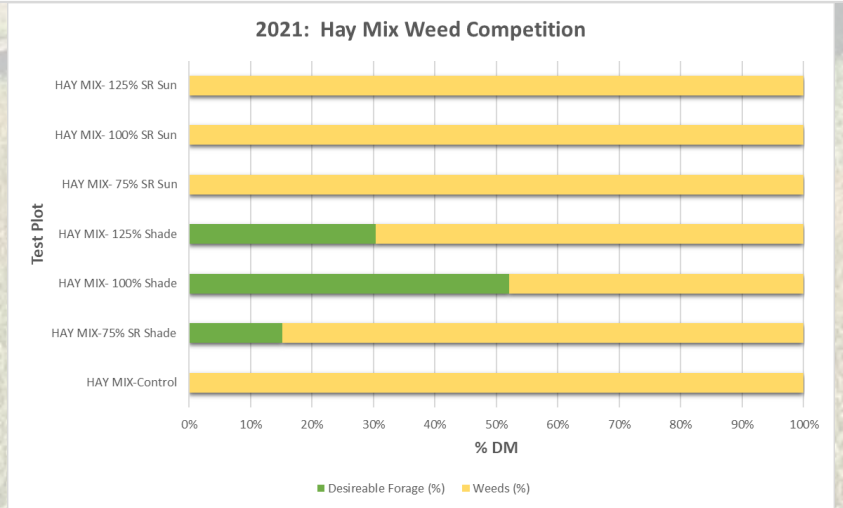


- CP > 18% = Good. CP > 22% = Prime.
- TDN > 58% = Good. TDN > 62% = Supreme.
- RFV > 150 = Good. RFV > 185 = Supreme.

Forage Nutritive Value of Cool-Season Hay Mix- 2021





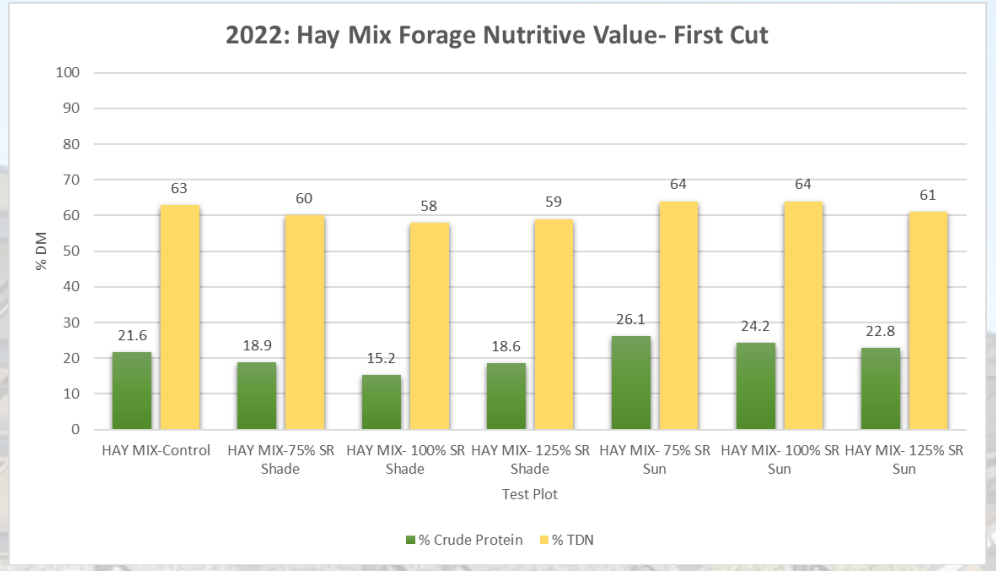


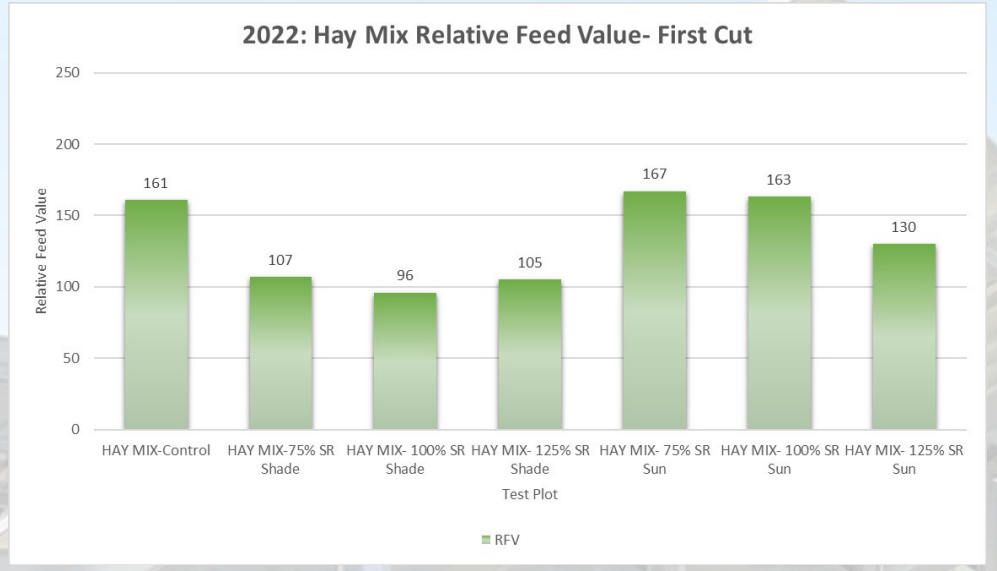
- Plots were seeded on May 14, 2021.
- Fertilizer was applied according to soil test recommendations.
- Weed control with herbicides were implemented as needed under panels.
- After establishment, one harvest event took place on Sept. 2, 2021.
- Dramatic weed pressure greatly influenced the quality of the hay mix, However, digestibility values were still acceptable for some classes of livestock.
- CP > 13% = Good. CP > 19% = Prime.
- TDN > 58% = Good. TDN > 62% = Prime.
- RFV > 86 = Good. RFV > 150 = Prime.

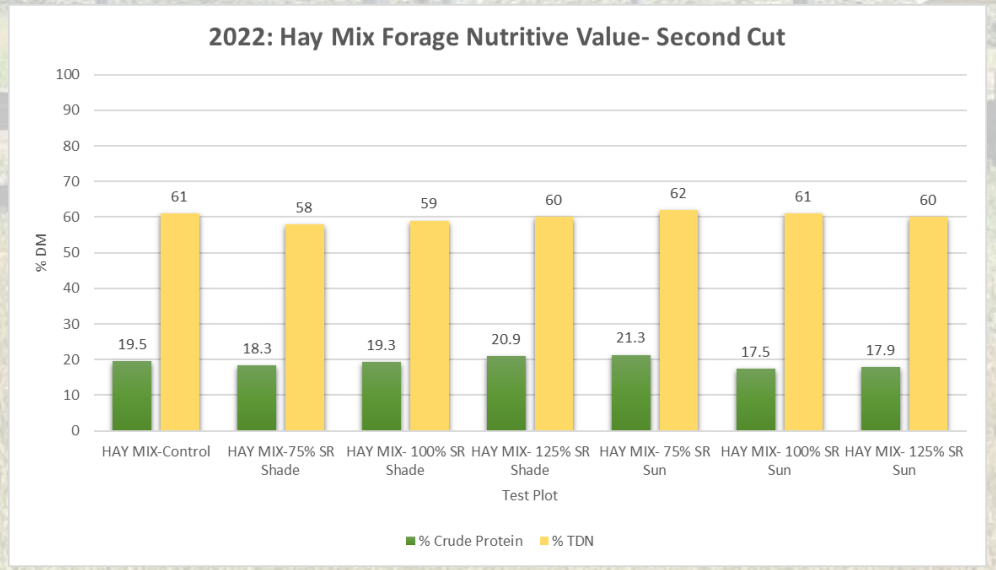
Forage Nutritive Value of Cool-Season Hay Mix- 2022

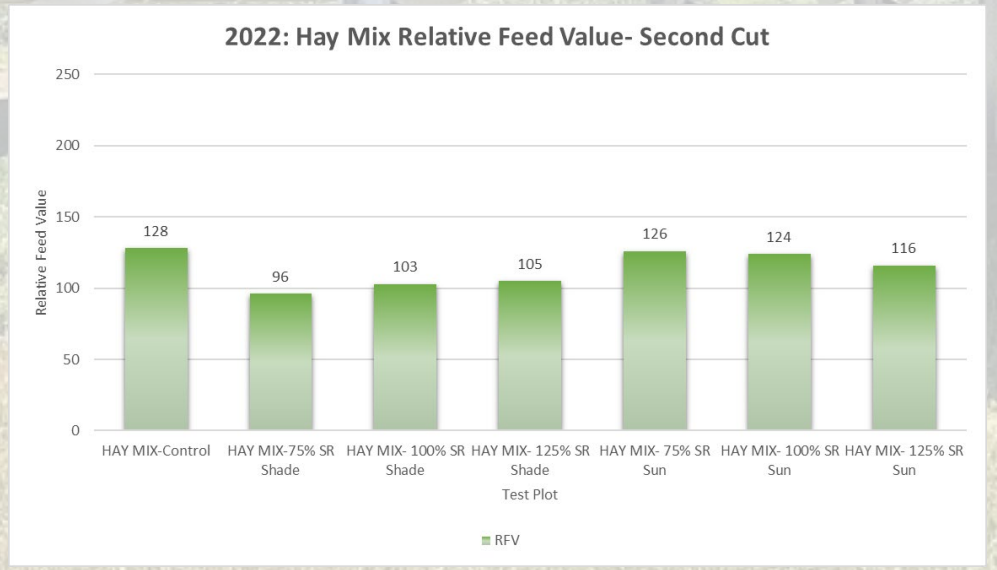
CFAES

- First Cut- May 20, 2022
- Second Cut- August 2, 2022



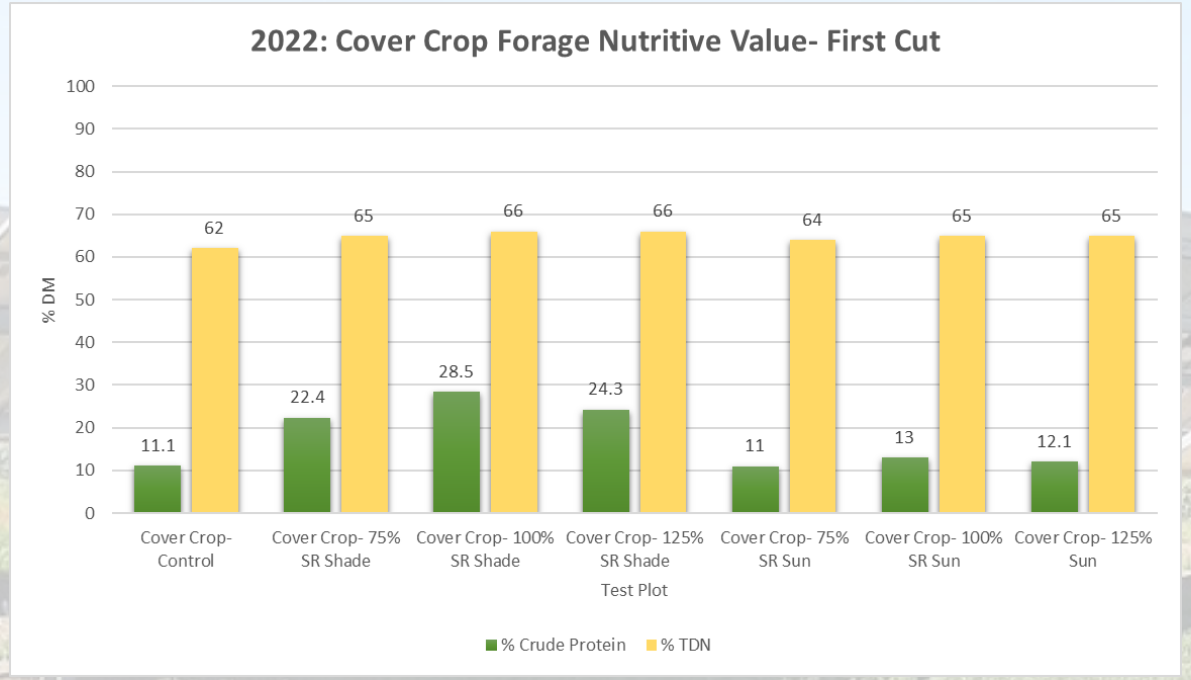


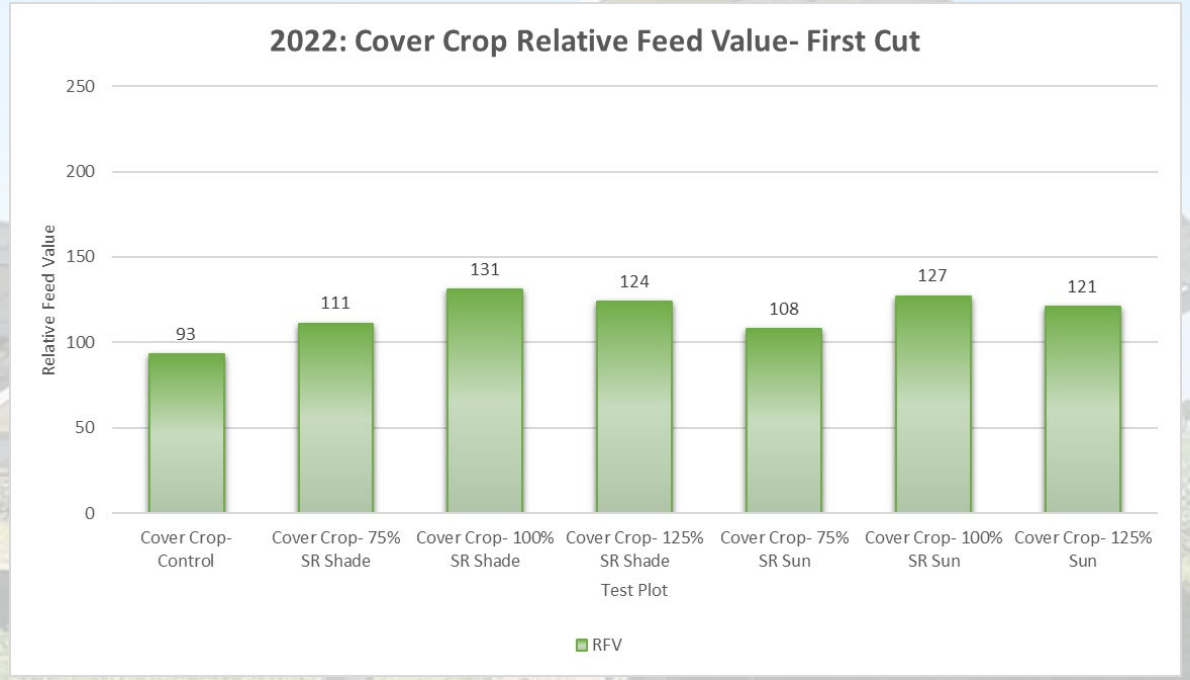




- CP > 13% = Good. CP > 19% = Prime.
- TDN > 58% = Good. TDN > 62% = Prime.
- RFV > 86 = Good. RFV > 150 = Prime.

Forage Nutritive Value of Cover Crop- 2022





- **Plots seeded on May 14, 2021 were unsuccessful. However, regrowth of a previously used cover crop (winter wheat) came up in Spring 2022 and produced the data displayed above. After the winter wheat forage was harvested, crimson clover was planted on Aug. 18, 2022 and will be evaluated for performance in Spring 2023.**
- **Fertilizer was applied according to soil test recommendations.**
- **One harvest event took place on May 20, 2022.**
- **The potential use of cover crops to assist with site preparation for forage production will continue to be studied moving forward.**

CFAES

Photos from 2022

Photos from 2022

Summary – Next Steps

- Plans are underway to expand our study to a utility scale solar facility with research beginning in 2023.
- Monitoring and data collection will continue at our original BTR site with the small plots.
- Our full-scale project will seek answers on how to manage forage crops, integrate complimentary grazing management strategies, maximize soil health using soil remediation techniques, and utilize precision agriculture technology to manage crop production.

CFAES

Hay and grazing at the same time?

CFAES

Hay and grazing at the same time?

CFAES

Hay and grazing at the same time?

CFAES

Thank You!

Eric Romich
romich.2@osu.edu

Sarah Moser
smoser@savionenergy.com

Christine Gelley
gelley.2@osu.edu

James Morris
Morris.1677@osu.edu

Brady Campbell
campbell.1279@osu.edu

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES