Final Technical Report

FCEB Project #4

FINAL Report AWD15783

Florida Cattle Enhancement Fund Application

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Project Title: **Animal performance and methane emissions of cattle grazing stockpiled 'Gibtuck' limpograss under different supplementation strategies in North Florida**
AWD15783

Project Start Date: Aug. 1st, 2023 Project End Date: June 1st, 2024

Project Summary:

The project assessed the effect of different supplementation strategies on animal performance and enteric methane emission of growing steers grazing stockpiled 'Gibtuck' limpograss. Animals were supplemented with one of the following: 1) commercial mixture of molasses, urea, and minerals (2.6 lb/hd/d) with 32% crude protein (CP); 2) Similar supplementation than 1 but offered at 5.2 lb/hd/d; 3) commercial protein (32%) cubes (2 lb/hd/d); or 4) No supplementation (control). All the supplements and orts were feed and removed daily. Animals were assigned in a randomized complete block design in different paddocks of 1 acre each. System was a continuous stocking with a variable stocking rate. Put and take animals were used to adjust the stocking rate based on herbage allowance. Variable response evaluated was average daily gain (ADG), stocking rate (SR), gain per area (GPA), forage nutritive value, herbage mass (HM), and enteric methane emission (data still pending). Average daily gain was greater for animals receiving 32%CP range cube supplementation (1.1 lb/hd/d) compared to control animals (0.5 lb/hd/d), with liquid feed supplementation of 2.6 lb/d resulting in ADG of 0.7 lb/hd/d. Stocking rate did not vary and averaged 2.8 steers/acre during the stockpiling period, resulting in gains per area up to 194 lb/acre for 84 days. Grazing stockpiled limpograss can reduce feeding costs in cattle production systems in Florida, strengthening the market position of Florida's Cattle Industry in the Nation.

Project objectives:

The general objective was to assess supplementation strategies for growing steers grazing stockpiled 'Gibtuck' limpograss in North Florida. Specific objectives included the assessment of the ideal supplementation strategy (molasses-urea, protein cubes, or no supplementation) on steer performance and methane emissions. Response variables included average daily gain, stocking rate, gain per area, forage nutritive value, herbage mass, herbage accumulation, and methane emission. These goals are aligned with the FCA research priorities 3, 4, and 5 and are also aligned with the specific appropriation language.

1. Significance

Limpograss (*Hemarthria altissima*) has been successfully adopted in South Florida by livestock producers. This unique grass grows well in flatwood soils and maintains its digestibility for longer periods than other warm-season grasses (e.g. bahiagrass and bermudagrass), making it a good candidate for stockpiling. Limpograss is also less sensitive to daylength than other grasses, growing during the cool-season, especially in mild-winter like most years in South Florida. After a frost, limpograss will usually be one of the first warm-season grasses to initiate the regrowth.

The potential of limpograss in North Florida, however, was not fully assessed. Although limpograss collections have been established in North Florida since mid-2000s (2005), a comprehensive evaluation including biomass productivity and nutritive value of the new cultivars was not performed in larger paddocks with grazing animals. The persistence of limpograss throughout these years, however, shows the possibility to grow this species in North Florida, despite the cooler temperatures compared to South Florida. Along the Florida Panhandle there are vast areas that can potentially be used with limpograss, especially along the Gulf coast. One of the concerns of growing limpograss in North Florida is the shorter growing season if compared to South Florida because of the earlier frost. Comprehensive evaluations are necessary to access these potential differences of limpograss performance in contrasting Florida environments.

Several supplementation studies in limpograss were performed in South Florida (Holderbaum et al., 1992; Newman et al., 2002; Arthington, 2005; Vendramini et al., 2010; Aguiar et al., 2015), however, no study was performed in the Florida Panhandle. Ecological conditions, especially temperatures, are different from South Florida to Florida Panhandle, and that can affect limpograss growth, heifer performance, and heifer response to supplementation.

Limpograss is becoming more important in North Florida since the arrival of Deseret Cattle and Timber Company. This new private operation will change the scenario of livestock production in the Panhandle and they plan to establish large limpograss acreage. This might also be the inducer to disseminate limpograss among other livestock producers along the Panhandle. Therefore, new information on limpograss management and supplementation strategies must be developed locally for the Panhandle region.

In this proposal we are assessing animal performance and methane emissions of cattle grazing 'Gibtuck' limpograss, a new cultivar released by UF IFAS. This data will be unique, since there is no data available of animal performance and methane emission from cattle grazing stockpiled 'Gibtuck' limpograss in North Florida. Stockpiled limpograss can fill the

Standard Error	269.58	0.2069
P Value	0.0003	0.0013

Treatment average of year 1 and year 2
$^{\delta}$Means followed by same letters within each column are not different according to PDIFF adjusted by Tukey (P > 0.05).

Forage Nutritive Value
In vitro digestible organic matter (IVDOM) was affected by evaluation (P<0.0001) and ranged from 54.3 to 39.5% from evaluation 1 to evaluation 5. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were also affected by the evaluation (P<0.0001). NDF ranged from 81.7 % to 73.8%, and ADF ranged from 47 % to 34.3 % in the average from both years (Table 4). All three variables presented expected results due to an increase of the grass maturity.

Table 4: In vitro digestible organic matter (IVDOM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) of 'Gibtuck' limpograss in different evaluation dates at UF IFAS NFREC Marianna

Evaluation	IVDOM (%)	NDF (%)	ADF (%)
1	54.3 A$^{\delta}$	73.8 D	35.1 D
2	51.9 B	76.2 C	34.3 D
3	50.4 C	77.4 C	37.1 C
4	42.4 D	79.9 B	44.8 B
5	39.5 E	81.7 A	47.0 A
Standard Error	0.3679	0.3311	0.3170
P Value	P < 0.0001	P < 0.0001	P < 0.0001

Treatment average of year 1 and year 2
$^{\delta}$Means followed by same letters within each column are not different according to PDIFF adjusted by Tukey (P > 0.05).

In vitro digestible organic matter (IVDOM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) were also affected by treatment (P<0.0001). The highest concentration of IVOMD was found in the upper leave fraction (54.3%), and the lowest concentration was found in the lower canopy (lower stem + lower leave), 42.1%. NDF follows a different path, and the highest concentration was found in the lower stem of the plant (82.2 %), and the lowest concentration was in the upper leave (71 %). ADF was similar as NDF and the highest concentration was in the lower stem (42.2%), and the lowest concentration was in the upper leave (35.8%). Results are described in Table 5.

Table 5: In vitro digestible organic matter (IVDOM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) of 'Gibtuck' limpograss in different canopy layers at UF IFAS NFREC Marianna

Layers	IVDOM (%)	NDF (%)	ADF (%)
Upper Leave	54.3 A$^{\delta}$	71.0 F	35.8 E
Lower Leave	51.7 B	73.9 E	38.6 D
Upper Stem	49.2 C	80.6 B	40.5 C
Lower Stem	46.5 D	82.8 A	42.2 A

Upper canopy	45.1 E	76.5 D	38.7 D
Lower canopy	42.1 F	80.5 BC	41.2 B
Whole Plant	46.0 D	79.2 C	40.4 C
Standard Error	0.2821	0.2901	0.2191
P Value	P < 0.0001	P < 0.0001	P < 0.0001

Treatment average of year 1 and year 2
$^{\delta}$Means followed by same letters within each column are not different according to PDIFF adjusted by Tukey (P > 0.05).

Crude protein results are partially presented. In the first year, crude protein concentration was affected by evaluation (P=0.0007) and ranged from 6.3 % to 5.4 % (Table 6), which is expected due to increased grass maturity. Crude protein concentration was also affected by the canopy layer (P<0.0001) and ranged from 8.3 % to 3.8% (Table 7).

Table 6: Crude protein of 'Gibtuck' limpograss in different evaluation dates at UF IFAS NFREC Marianna

Evaluation	**CP (%)**
1	6.3 A$^{\delta}$
2	6.0 AB
3	5.7 AB
4	5.6 B
5	5.4 B
Standard Error	0.1757
P Value	0.0007

Results from year 1

Table 7: Crude protein of 'Gibtuck' limpograss in different canopy layers at UF IFAS NFREC Marianna

Layers	**CP (%)**
Upper Leave	8.3 A$^{\delta}$
Lower Leave	7.6 B
Upper Stem	4.5 EF
Lower Stem	3.8 F
Upper canopy	6.3 C
Lower canopy	4.9 DE
Whole Plant	5.4 D
Standard Error	0.1807
P Value	P < 0.0001

Results from year 1

4. Anticipated outcomes and their potential benefits

forage gap in North FL and allow 365 days of grazing per year. Data is needed to provide evidence of this system.

2. Approach:

Experimental site, treatments, and design

This grazing experiment was conducted at UF IFAS NFREC Marianna Experimental Station in Jackson County, FL. Steers weaned in August 2022 grazed stockpiled 'Gibtuck' limpograss pastures for 84 days, from 20 October 2022 to 14 January 2023 (First year) and 20 October 2023 to 14 January 2024 (Second year). Treatments consisted of four supplementation strategies: 1) commercial mixture of molasses, urea, and minerals (2.6 lb/hd/d) with 32% crude protein (CP) and 70% TDN; 2) similar supplementation strategy than 1 but supplied at 5.2 lb/hd/d; 3) commercial protein cubes (2 lb/hd/d) with 32% CP and 70% TDN; or 4) No supplementation. Animals from each treatment were assigned to different paddocks (1 acre each), in a randomized complete block design. Each treatment will be replicated two times (two blocks).

Experimental management and response variables

Limpograss pastures in the first semester were used as nursery to supply planting material for North FL livestock producers. By late-August (18 Aug 2023), pastures were deferred and fertilized with 60 lb N, 30 lb P_2O_5, 60 lb K_2O, and 12 lb S per acre. Grass was stockpiled until 20 October 2023, when the grazing trial started. This is typically the season when shortage of forages occurs. Stocking rate was adjusted based on the herbage allowance, using put and take animals. Herbage allowance was similar for all treatments within each block, and target herbage allowance was 3 lb DM/lb of body weight. Therefore, each paddock had two tester animals that stayed in the paddock during the entire experimental period, and the put-and-take animals were used when needed based on the herbage allowance. Adjusting stocking rate is crucial to estimate the accurate animal performance per unit area.

We measured average daily gain, stocking rate, gain per area, forage nutritive value, and herbage mass. Steers were weighed at the beginning of the trial, after a 16-h fasting period. This procedure was repeated every 21 d throughout the experimental period (84 d). Average daily gain was calculated by weight difference between weighing periods. Stocking rate was a function of total grazing days, which is the number of animals (testers and put-and-takes) that grazed a giving paddock during each evaluation period (Table 1). Gain per area was calculated based on average daily gain and stocking rate.

Pastures were assessed every 21 d. Herbage responses included herbage mass, herbage nutritive value (CP and IVOMD), and botanical composition. Herbage assessment started at 12 Oct 2023 every 21 d, until the end of the trial. We measured methane emission from cattle using the SF_6 technique. Methane and SF_6 concentrations in collection canisters will be analyzed by gas chromatography (Agilent 7820A GC; Agilent Technologies, Palo Alto, CA). A flame ionization detector and electron capture detector will be used for CH_4 and SF_6 analysis, respectively, with a capillary column (Plot Fused Silica 25m by 0.32mm, Coating Molsieve 5A, Varian CP7536; Varian Inc. Lake Forest, CA). Injector, column, and detector temperatures for CH4 analysis will be 80, 160, and 200°C, respectively. For SF6, temperatures will be 50, 30, and 300°C for the injector, column, and detector, respectively. The carrier gas for CH4 and SF6 will be N2 (Henry et al., 2015). Data still pending.

Individual animal intake was estimated using Cr_2O_3 as external marker, which was dosed at 10 g per day for 9 consecutive days, with fecal grab sampling occurring twice a day (morning and afternoon) after the 5^{th} day of the protocol. Concentration of Chromium was determined using an X-Ray fluorescence spectroscopy (XRF). Briefly, fecal samples were scanned by a Delta Premium portable X-ray fluorescence (PXRF) spectrometer (Olympus Scien-tific Solutions Americas Inc., Waltham, MA, USA) using the Geochem Mode. The PXRF spectrometer was calibrated by a 316 stainless steel calibration check reference before scanning. The Geochem Mode operates for a duration of 60 s in a two-beam configuration at 40 and 10 keV, respectively (Zhang and Hartemink, 2019). Fecal output was estimated dividing the amount of chromium dosed divided by concentration of chromium in the fecal sample. Data still pending.

Project goals are to extend the grazing season and reduce feeding costs of beef cattle, meeting performance goals of 1.5 lb/d. This will be the first time that methane emission is measured on grazing cattle using stockpiled limpograss. This information will allow us to perform a life cycle assessment of beef cattle systems in North Florida. Stockpiled limpograss is a way to reduce carbon footprint of beef cattle systems because of the reduced off-farm input. These goals are aligned with the FCA research priorities 3 and 5 and are also aligned with the specific appropriation language. Grazing stockpiled limpograss will reduce feeding costs in cattle production systems in Florida, strengthening the market position of Florida's Cattle Industry in the Nation as we move towards more sustainable production systems in the Country and Globally.

Data analyses

Grazing trials will follow a randomized complete block design, with two blocks. Data will be analyzed as repeated measure using proc mixed from SAS. Fixed effects include supplement type and evaluation date. Year and blocks are considered random effect. Means will be compared using a PDIFF procedure adjusted by Tukey.

Table 1: Evaluation description

Evaluation	Description
1	Middle October
2	Early November
3	Late November
4	Middle December
5	Early January

3. Preliminary Results

Animal Performance
The average daily gain of growing steers was affected by treatment (P = 0.0296 Table 2). Animals receiving 32%CP Range Cube supplementation gained on average 1.11 lb/d, which was higher than all other treatments. Liquid feed supplied at 2.6 lb/hd/d had an intermediate ADG of around 0.70 lb/hd/d. Steers grazing only stockpiled limpograss gained almost 0.5 lb/hd/d during this 84-d period from both years. The stocking rate was not affected by treatments (P=0.1174).

Table 2: Average daily gain, stocking rate, and gain per area of growing steers grazing stockpiled 'Gibtuck' limpograss under different supplementation strategies at UF IFAS NFREC, Marianna.

	Average daily gain (ADG), lb/hd/d	**Stocking rate, steer/acre**	**Gain per area, lb/acre**
Control	0.5 B$^{\delta}$	2.77	112.50 B
32% CP Liquid feed, 2.6 lb/hd/d	0.70 AB	2.83	166 AB
32% CP Liquid feed, 5.2 lb/hd/d	0.78 AB	2.95	194.50 AB
32% CP Range Cube, 2 lb/hd/d	1.11 A	2.83	264 A
Standard Error	0.06234	0.1174	16.6264
P value	0.0296	0.8115	0.0382

Treatment average of year 1 and year 2
$^{\delta}$Means followed by same letters within each column are not different according to PDIFF adjusted by Tukey (P > 0.05).

Canopy Characteristics
Herbage mass and herbage allowance were both affected by evaluation. Herbage mass at the beginning of the grazing trial was 4,789 lb DM/acre, and herbage allowance was 5.6, which is considered a lenient condition because of excess of forage compared to the stocking rate (Table 3). However, the strategy was to be conservative to allow the stockpiled biomass to last until mid to late January of both years. In fact, in late January herbage mass was 2,094 and herbage allowance 1.9, which are still satisfactory conditions for grazing animals to apprehend the forage without quantity limitation. Therefore, this strategy worked well for the North Florida environment. There was no difference across treatments for both HM and HA, indicating the correct use of the put-and-take technique to adjust the stocking rate.

Table 3: Herbage mass and herbage allowance from stockpiled 'Gibtuck' limpograss grazed with steers receiving different supplementation strategies at UF IFAS NFREC, Marianna.

Evaluation	**Herbage Mass (lb/acre)**	**Herbage Allowance (lb Herbage Mass/lb BW)**
1	4789 B$^{\delta}$	5.6 A
2	6552 A	3.6 B
3	4713 B	3.5 B
4	4000 B	3.4 B
5	2094 C	1.9 C

Standard Error	269.58	0.2069
P Value	0.0003	0.0013

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Results from year 1

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Whole Plant	5.4 D
Standard Error	0.1807
P Value	P < 0.0001

Results from year 1

4. Anticipated outcomes and their potential benefits

The data obtained in this project will provide a quantitative basis for assessing advantages and disadvantages of supplementing growing cattle on limpograss pastures in North Florida. Results of this proposal will be disseminated in field days organized at each location. We will also deliver the results in extension reports and scientific articles in peer-reviewed journals.

References:

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Invoice Period:	03/01/2024 - 07/31/2024
Principal Investigator:	Batista Dubeux Jr.,Jose Carlos
Award Begin Date:	10/30/2023
Award End Date:	07/31/2024
UF FEIN:	59-6002052

Sponsor Award ID:	4
Award Title:	Animal performance and methane emissions of cattle grazing stockpiled 'Gibtuck' limpograss under different supplementation strategies in North Florida ? YEAR 2
Award Amount:	$61,455.00

Invoice #	I000130470
UF Award #	AWD15783
Primary Project #	P0324551
Primary Department:	60770000
Current Invoice Amount:	$33,584.77

Description	Current	Cumulative
Personnel - Salary	$14,575.98	$26,110.56
Personnel - Fringe Benefits	$3,034.89	$4,839.77
Materials and Supplies	$8,946.23	$10,947.57
Contractual Services	$3,292.50	$7,470.50
Animal	$0.00	$4,536.00
Publication Costs	$100.00	$100.00
Other Expenses	$36.80	$71.30
Direct Cost	$29,986.40	$54,075.70
Facilities and Administrative Costs	$3,598.37	$6,489.10
Total	$33,584.77	$60,564.80

For billing questions, please call 352.392.1235
Peterson,Nathan Kyle npeterson82@ufl.edu
Please reference the UF Award Number and Invoice Number in all correspondence

By signing this report, I certify to the best of my knowledge and belief that the report is true, complete, and accurate, and the expenditures, disbursements and cash receipts are for the purposes and objectives set forth in the terms and conditions of the federal award. I am aware that any false, fictitious, or fraudulent information, or the omission of any material fact, may subject me to criminal, civil, or administrative penalties for fraud, false statements, false claims or otherwise. (U.S Code Title 18, Section 1001 and Title 31, Sections 3729-3730 and 3801-3812).

Payment History	
Cumulative Invoices:	$60,564.80
Payments Received:	$26,980.03
Outstanding Balance:	$33,584.77
Note: Outstanding balance includes current invoice amount	

Nathan Peterson

Certifying Official

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Project ID	Deptid	Department Name	Current	Cumulative