Final Technical Report

FCEB Project #13

FINAL Report AWD15775

Florida Cattle Enhancement Fund Application

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Project Title: **: Strategies to overseed forage legumes on limpograss in the summer and stockpiling period**

Exp 1: Project Start Date: 06/09/2023 Project End Date: 6/30/24
Exp 2: Project Start Date: 08/25/2023 Project End Date: 6/30/24

Project Summary:

This project assessed strategies to overseed forage legumes on limpograss pastures in the summer and stockpiling period. The summer study (**Exp. 1**) will test two legumes (aeschynomene and sunn hemp) and three seeding rates (8, 16, and 24 lb/acre), in a factorial combination. In addition, two control treatments will be added (limpograss + 50 lb N/acre and limpograss without N fertilizer). The Fall study (**Exp. 2**) assessed legume options for the stockpiling period, starting in late August. 'Gibtuck' limpograss will be staged in late August and overseeded with one of the following: 1) winter pea; 2) vetch; 3) crimson clover; 4) white clover. In addition, two control treatments will be added (limpograss + 50 lb N/acre and limpograss without N fertilizer). In both studies, we measured herbage responses, canopy characteristics, nutritive value, legume persistence, and biological nitrogen fixation. The objective of this project was to select the best strategies to overseed forage legumes on limpograss in different seasons of the year. Integrating forage legumes into limpograss pastures might reduce N fertilizer input and improve cattle performance. These goals are aligned with the FCA research priorities Ecosystem Services of Grazing lands and Pasture and Forage Management and are also aligned with the specific appropriation language. This report contains preliminary information. Most of the data is still being collected and processed.

Project objectives:

Our overall objective was to test strategies to integrate forage legumes into limpograss pasture. In trial 1, our objective was to assess the effect of summer overseeding of two legumes (sunn hemp and aeschynomene) and three seeding rates (8, 16, 24 lb/acre), plus two controls (limpograss + 50 lb N/acre and unfertilized limpograss), on canopy characteristics of Gibtuck limpograss. In trial 2, our objective was to assessed legume options for the stockpiling period (late August overseeding). We will test the following legumes: 1) winter pea; 2) vetch; 3) crimson clover; 4) white clover, plus two controls (limpograss + 50 lb N/acre and unfertilized limpograss). Response measurements will include herbage responses, biological nitrogen fixation, persistence, and nutritive value of both the limpograss and overseeded legumes.

1. Significance

Limpograss (Hemarthria altissima) is a stoloniferous C4 warm season grass that has been well adopted in South Florida because of its tolerance to flatwood soils, superior cool season grow, and maintenance/slower decline of its digestibility for longer periods if compared with other warm season grasses (e.g., bahiagrass and bermudagrass). Limpograss is not as light sensitive as bahiagrass or bermudagrass, and it is one of the first warm season grasses to regrow after a frost. During fall and early spring, this grass will produce more biomass than other warm season grasses in Florida. Stockpiled limpograss is an alternative to fill the forage fall gap and allow 365 days of grazing in North Florida. Limpograss has a reasonable digestibility during the stockpiling period (50-55%), however, its crude protein concentration is low. Forage legumes could be a potential option to improve protein supply for grazing livestock, both in the summer and stockpiling period. In addition, legumes can add nitrogen to the system via biological nitrogen fixation (BNF). The cost of protein supplementation and nitrogen fertilizer has been steadily increasing in the last decade and it is predicted to continue to do so in the years to come. Therefore, the establishment of forage legumes in a limpograss pasture is going to help to increase the nutritive value in the diet and reduce dependence on N fertilizer.

Although limpograss has been established since 2005 in North Florida, biomass productivity and nutritive value was not fully assessed in mixture with legumes. Thus, more studies are required to provide data on mixtures of limpograss and different legumes species, both in the summer and fall during the stockpiling period.

Limpograss is becoming an important warm season grass in North Florida, especially in the Panhandle, since the arrival of Deseret Cattle and Timber Company. This private operation is establishing large limpograss acreage in the Panhandle and this is an inducer to disseminate limpograss among farm producers. The UF IFAS NFREC Marianna has also been organizing field days to distribute limpograss planting material for producers (2022 and 2023). New information about limpograss management, mixture pasture and stockpiled limpograss must be developed to provide evidence of this system in North Florida.

In this proposal our main objective is to assess herbage responses and nutritive value of 'Gibtuck' limpograss overseeded with legumes during the summer/fall (June to October) and 'Gibtuck' limpograss stockpiled overseeded with legumes during the fall/winter period (August to January). Since 'Gibtuck' Limpograss is a new hybrid cultivar released by UF IFAS in 2014, this data will be unique, since there is no data of herbage responses and nutritive value in limpograss and limpograss stockpiled in a mixture pasture in North Florida.

2. Approach:

Experimental site, treatments, and design

This project was conducted at UF IFAS North Florida Research and Education Center in Marianna, FL. There were two studies addressing overseeding of legumes in the summer/fall (study 1) and fall/winter (study 2) periods.

For study 1, there was eight treatments including the factorial arrangement of two legume species (sunn hemp and aeschynomene) and three seeding rates (8, 16, and 24 lb/acre), and two controls (limpograss + 50 lb N/acre and unfertilized limpograss.

For study 2, there was six treatments (four legume species and same controls as study 1) and four stockpiling periods (8, 12, 16, 20 weeks). Both studies will be allocated in a randomized complete block design.

Treatments for both studies are described on Table 1. On study 2, stockpiling periods will be allocated as a split-plot and forage/management combination will be allocated to the main plot. Stockpiling period will start in late August and the four periods will be Oct. (8 weeks), Nov. (12 weeks), Dec. (16 weeks), and January (20 weeks).

Table 1. Experimental treatments for Studies 1 and 2

Study 1 **Warm Season (June – October)**	**Study 2** **Fall gap (October – January)**
Aeschynomene 8 lb/acre + limpograss	Winter pea 60 lb/acre + stockpiled limpograss
Aeschynomene 16 lb/acre + limpograss	Vetch 30 lb/acre + stockpiled limpograss
Aeschynomene 24 lb/acre + limpograss	
	Crimson clover 25 lb/acre + stockpiled limpograss
Sunn hemp 8 lb/acre + limpograss	
	White clover 4 lb/acre + stockpiled limpograss
Sunn hemp 16 lb/acre + limpograss	
	Limpograss only
Sunn hemp24 lb/acre + limpograss	
	Limpograss + 50 lb N/acre
Limpograss only Limpograss + 50 lb N/acre	

**Main plot. Stockpiling periods (Oct., Nov., Dec., and Jan.) will be the split-plot.*

Experimental management and response variables

For study 1, experimental units (plots) was 6 x 11 ft. with 6 ft. aisles between plots; for study 2, main plot was measure 6 x 24 ft. and the split-plot was 6 x 6 ft. For both studies, the limpograss was already previously established. Soil samples were collected and sent for soil fertility and soil texture. Before no-till drilling the legumes, 'Gibtuck' limpograss was mowed at 5-in. stubble height and the plant material removed from the plot area. Legume seeds was inoculated with *Rhizobium and Bradyrhizobium sp.* For study 1, all treatments were clipped at 5 in. every 6 weeks. For study 2, the first harvest were 8 weeks after plots are staged for the beginning of the stockpiling period followed by three more harvests with 28-d intervals. Harvests for study 2 happened in Oct., Nov., Dec., and January. All plots were fertilized with P and K according to the soil test results. Nitrogen was applied only in the control N-fertilized limpograss for both studies. For both studies, response variables include herbage mass, herbage accumulation, legume stand, botanical composition, biological nitrogen fixation, and nutritive value (CP and IVOMD) for both forage legume and limpograss.

At each harvesting date, two 0.25-m^2 sample was clipped per plot at 5-in. stubble height. The remaining material was mowed at the same stubble height and removed from the plot. The sample was used for all response variables. In study 1, Aeschynomene, sunn hemp, and limpograss are morphologically different and was hand-separated after each harvest. Likewise, legumes in study 2 was hand-separated for botanical composition. All forage samples were dried at 55̊ C for 72 h. Forage accumulation of each component was calculated as the product of the forage accumulation and the proportion of the component (limpograss, legumes) in the mixture, within each plot. Canopy height was evaluated with a ruler at five random locations per plot.

Samples was grounded to pass a 2-mm screen and then analyzed for in vitro digestible organic matter (IVOMD) using the 2-stage technique described by Tiller and Terry (1963) and modified by Moore and Mott (1974). The ball milled samples were analyzed for total N by dry combustion using an elemental analyzer (Vario Micro cube, Elementar). Protein concentration was calculated multiplying total N concentration by 6.25.

To access biological nitrogen fixation, we used the hand-separated sample. The sample was ground to pass a 2-mm screen. Two grams of ground forage was ball milled in a Mixer Mill (MM 400, Retsch) at 25 Hz for 9 min. Sample was analyzed for $\delta^{15}N$ using an isotopic ratio mass spectrometer (Isoprime 100, Isoprime) interfaced in continuous flow with an elemental analyzer (MICRO cube, Elementar). Biological N fixation contribution was calculated from the ^{15}N abundance, and a companion non-N_2-fixing reference plant (control limpograss without fertilizer) as indicated by the equation bellow.

$$Ndfa = \frac{(\delta 15\text{N of reference plant} - \ \delta 15\text{N2} - \text{fixing plant})}{\delta 15\text{N of reference plant} - \text{B}} \ x\ 1000$$

Project goals was to extend the grazing season, reduce feeding costs, and diminish dependence on off-farm industrial N fertilizer. This was the first time that limpograss-legume mixtures are assessed in North Florida. Stockpiled limpograss is a way to reduce carbon footprint of beef cattle systems because of the reduced off-farm input. The inclusion of legume in the system has potential to increase the crude protein in the diet leading, improve cattle performance, and reduce costs with N fertilizer.

Data analyses

Both studies will follow a randomized complete block design. Harvest dates will be analyzed as repeated measurement using proc mixed from SAS. Fixed effects will include treatment and harvest date. Block and its interactions will be random effect. For study 2, treatments will be allocated in a split block in randomized complete block design. Main plot will be forage/management combination and stockpiling period will be the split plot. Treatments will be analyzed using proc mixed from SAS.

3. Preliminary results

Limpograss herbage mass significantly differed among evaluations for study 1, ranging from 2832 to 931 lb/acre (Figure 1A). For treatment, limpograss herbage mass did not differ among treatments and averaged 1945 lb/acre (Figure 1B). For study 2, limpograss herbage mass significantly differed among evaluations, ranging from 1294 to 2055 lb/acre (Figure 2A). For treatment, limpograss herbage mass did not differ among treatments and averaged 1646 lb/acre (Figure 2B). Legume herbage mass did not contribute to total herbage mass in both studies.

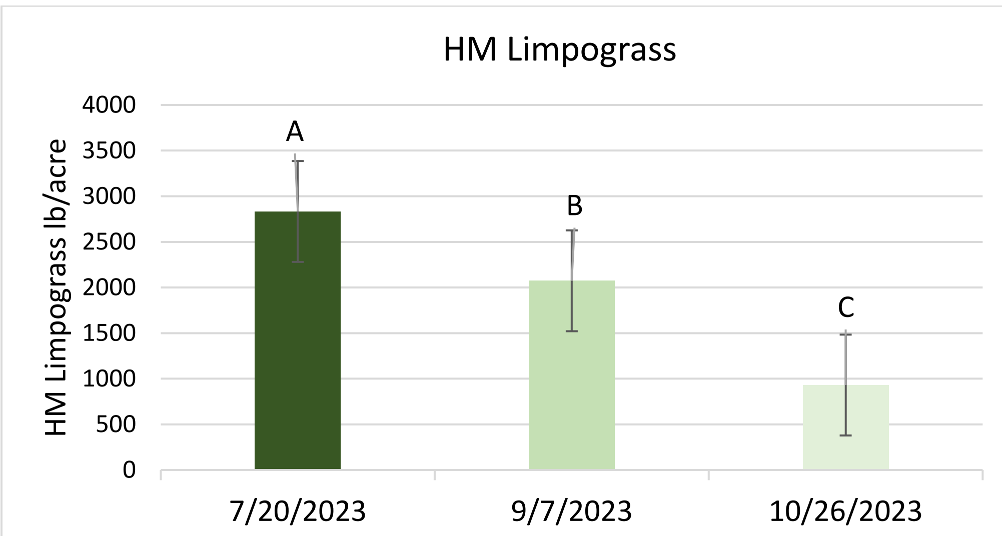

Figure 1A. Herbage Mass Limpograss (lb/acre) – Study 1

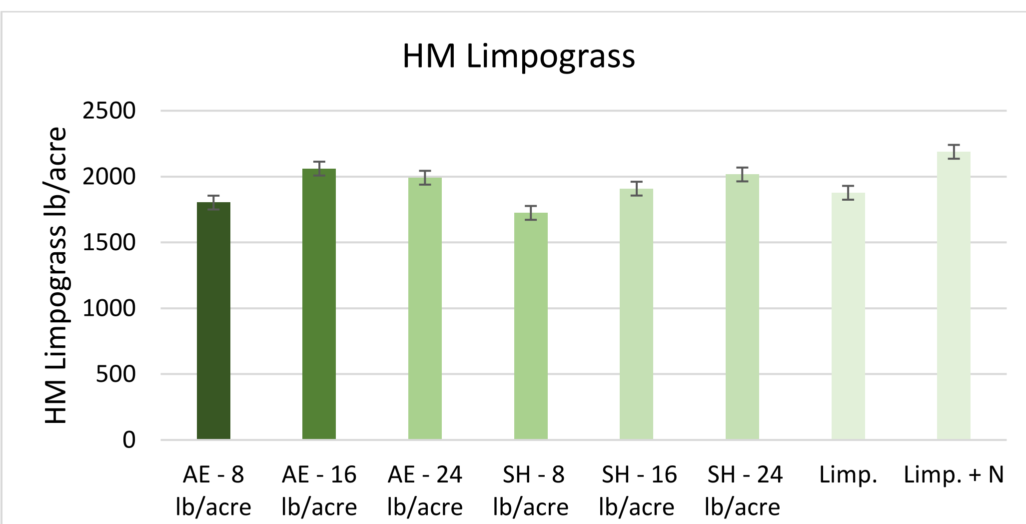

Figure 1B. Herbage Mass Limpograss (lb/acre) – Study 1

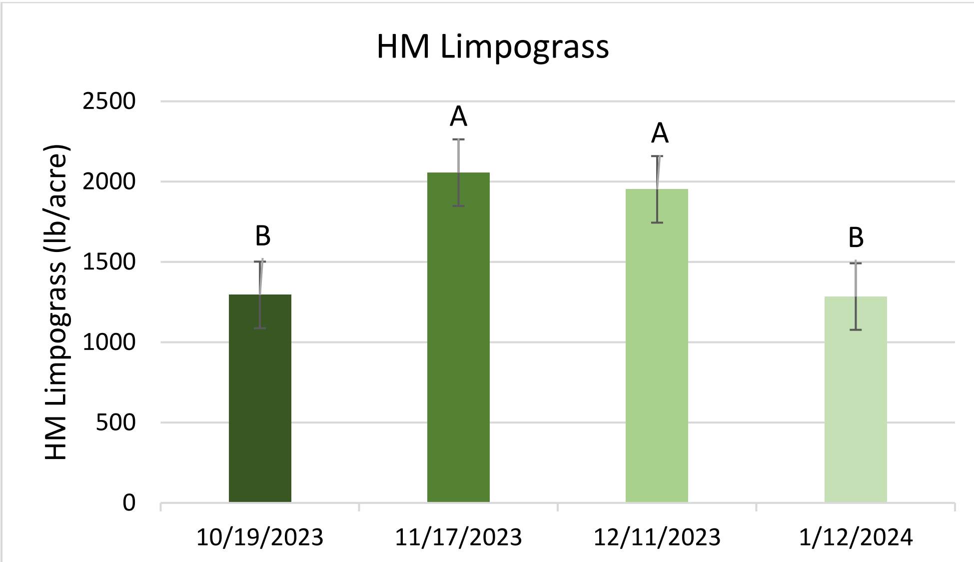

Figure 2A. Herbage Mass Limpograss (lb/acre) – Study 2

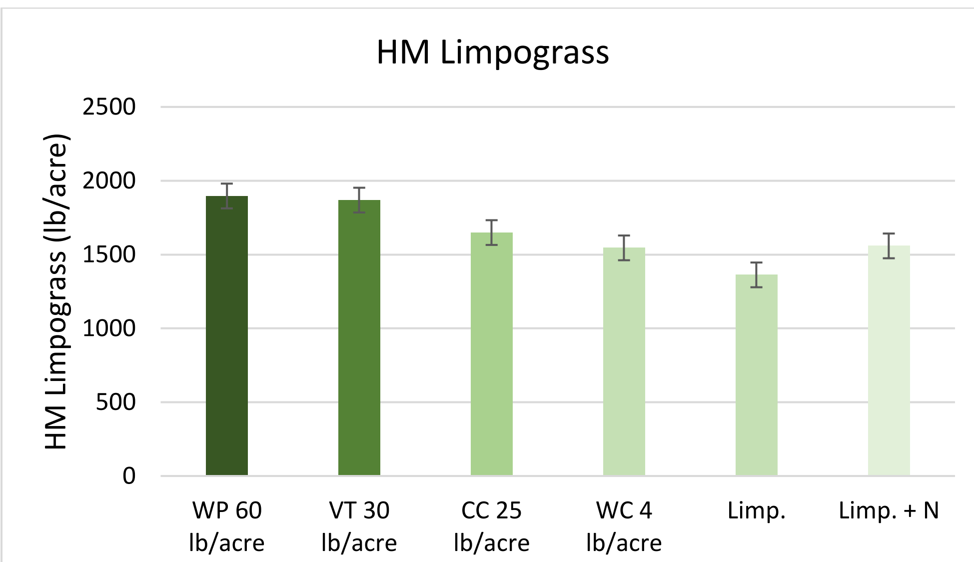

Figure 2B. Herbage Mass Limpograss (lb/acre) – Study 2

Limpograss nutritive value significantly differed for crude protein among evaluations in Study 1, ranging from 6.7 to 8.9% (Figure 3A). No difference was observed for limpograss crude protein among treatments in study 1 (Figure 3B). Data still need to be analyzed for study 2.

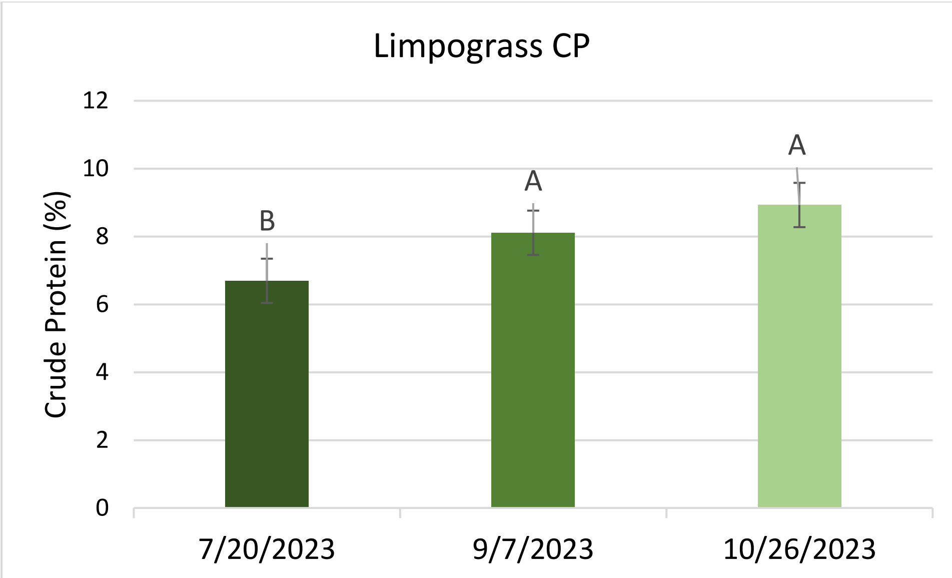

Figure 3A. Limpograss crude protein (%) – study 1

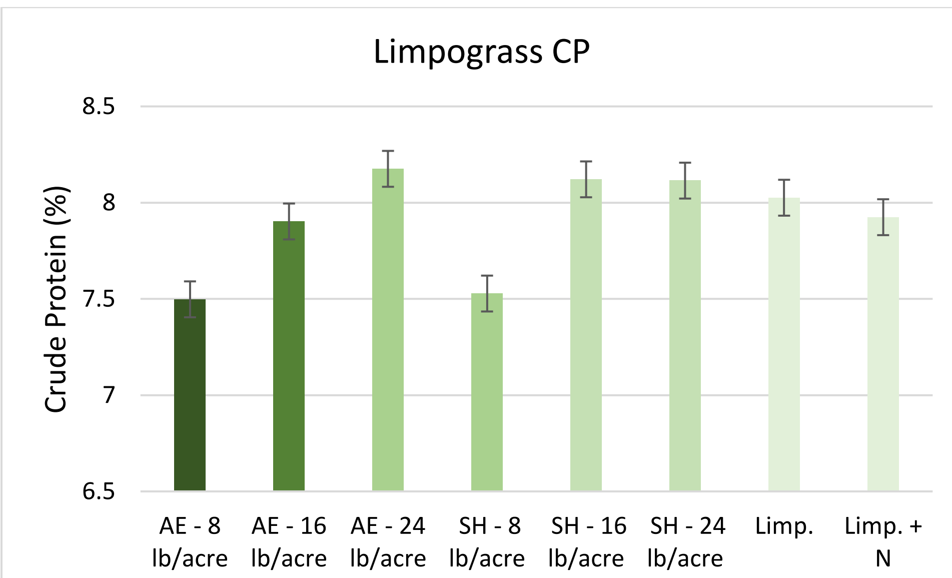

Figure 3B. Limpograss crude protein (%) – Study 1

In vitro, digestibility organic matter (IVDOM) had a significant difference among evaluations in study 1, ranging from 53% to 55% (Figure 4A). IVDOM showed no difference among the treatments in Study 1 (Figure 4B). For study 2, limpograss IVDOM presented a significant difference among evaluations, ranging from 45% to 56% (Figure 5A). Among treatments, limpograss IVDOM had a significant difference, where limpograss control with no fertilization had the lower digestibility, 50% (Figure 5B).

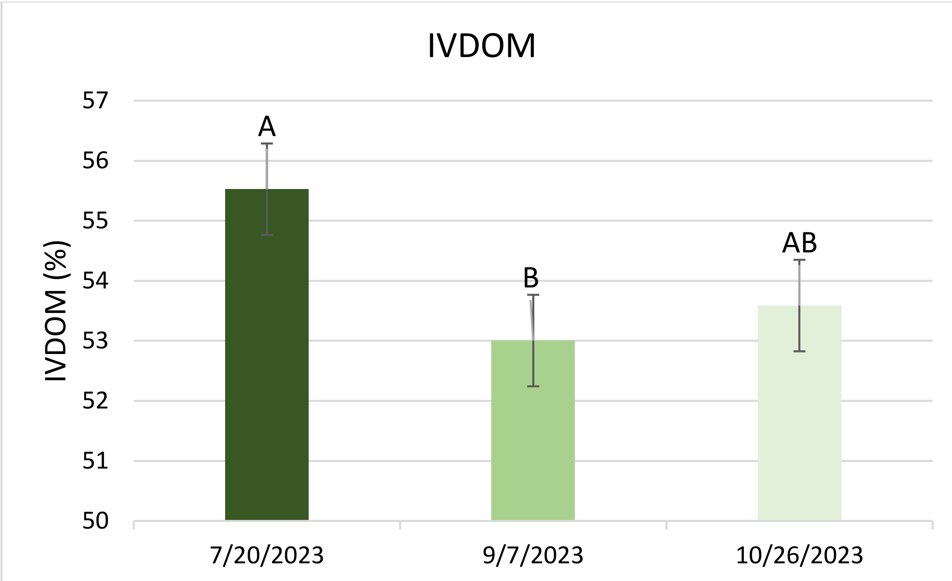

Figure 4A. Limpograss IVDOM (%) – study 1

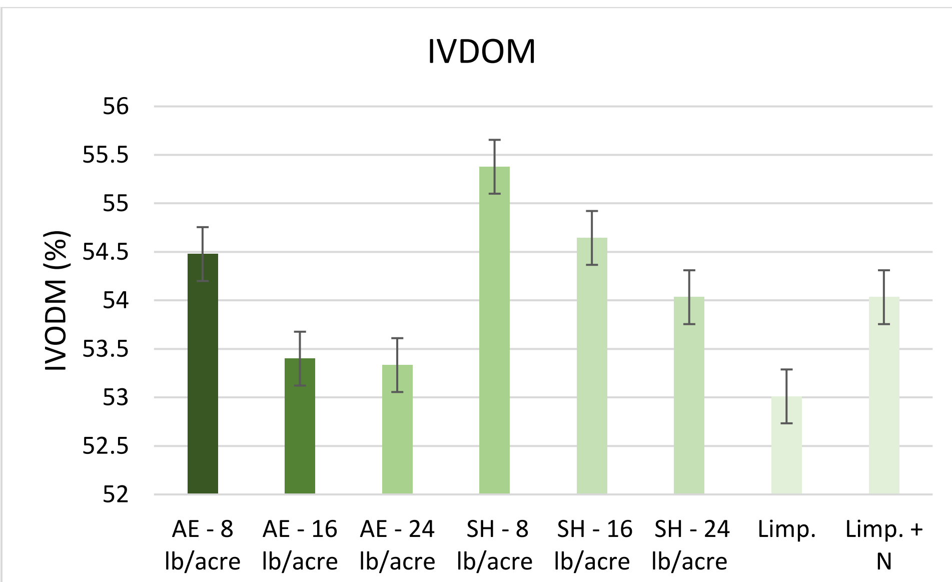

Figure 4B. Limpograss IVDOM (%) – study 1

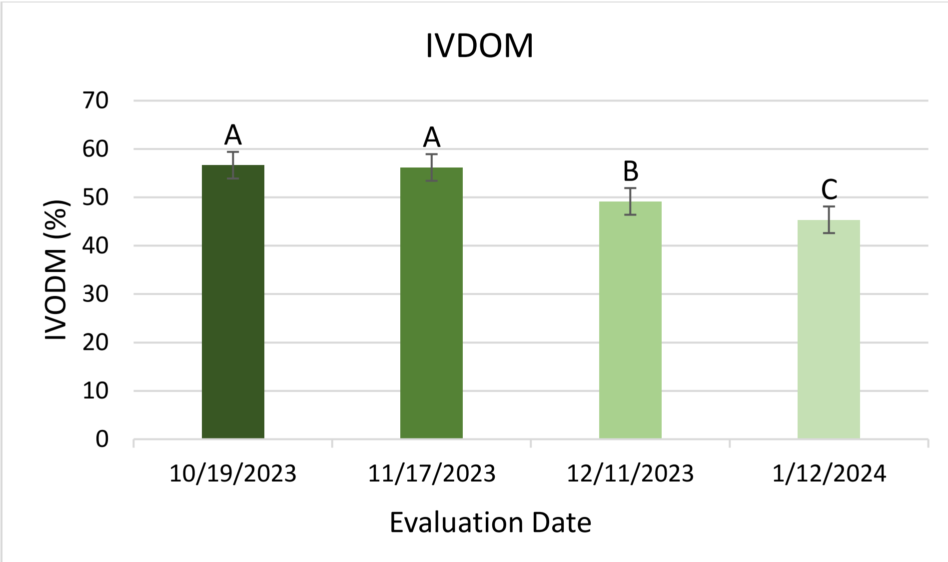

Figure 5A. Limpograss IVDOM (%) – study 2

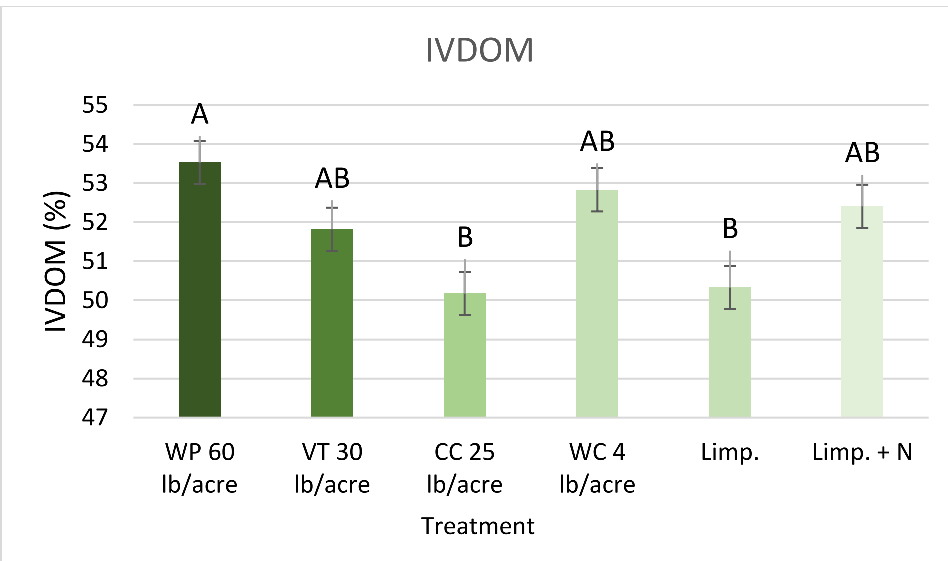

Figure 5B. Limpograss IVDOM (%) – study 2

4. <u>Anticipated outcomes and their potential benefits</u>
   The data obtained in this project will provide a quantitative basis for assessing the advantages and disadvantages of inclusion of legumes 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 and The Florida Cattleman and Livestock Journal.

<u>References</u>

Moore, J. E., & Mott, G. O. (1974). Recovery of residual organic matter from in vitro digestion of forages. Journal of Dairy Science, 57(10), 1258–1259.

Newman, Y., Vendramini, J., Sollenberger, L. E., & Quesenberry, K. (2014). Limpograss (Hemarthria altissima): Overview and Management. UF/IFAS Extension (SS-AGR-320), Revised August, Gainesville, FL.

Tilley, J. M. A., & Terry, dan R. A. (1963). A two-stage technique for the in vitro digestion of forage crops. Grass and Forage Science, 18(2), 104–111

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Invoice Date:	08/14/2024
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:	13
Award Title:	Strategies to overseed forage legumes on limpograss in the summer and stockpiling period
Award Amount:	$34,070.00

Invoice #	I000130469
UF Award #	AWD15775
Primary Project #	P0324505
Primary Department:	60770000
Current Invoice Amount:	$20,115.42

Description	Current	Cumulative
Personnel - Salary	$8,974.16	$13,768.89
Personnel - Fringe Benefits	$2,003.04	$3,635.89
Materials and Supplies	$5,402.47	$5,434.97
Contractual Services	$704.50	$5,906.50
Domestic Travel	$876.01	$1,593.93
Direct Cost	$17,960.18	$30,340.18
Facilities and Administrative Costs	$2,155.24	$3,640.85
Total	$20,115.42	$33,981.03

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).

Nathan Peterson

Certifying Official

Payment History	
Cumulative Invoices:	$33,981.03
Payments Received:	$13,865.61
Outstanding Balance:	$20,115.42
Note: Outstanding balance includes current invoice amount	

FOR UF USE ONLY Additional Projects: N

Project ID	Deptid	Department Name	Current	Cumulative
P0324505	60770000	AG-NFREC-QUINCY	$20,115.42	$33,981.03