Forage Breeding and Genomics Lab

Agronomy Department

University of Florida

FCA Grant

Title: “Development of Improved Forage Cultivars and Management Systems for Florida Conditions”

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August 31st 2017

Summary

The Florida Cattle Enhancement Board awarded funds to the PI's listed above to perform research on three specific areas: 1) Reintroduction of white clover into South Florida pastures; 2) Development of a high quality alfalfa variety and management system adapted to central-north Florida conditions, and; 3) Development of high quality and high yield bermudagrass/stargrass cultivars.

Proposals were awarded in January 2017, and the award delivery for this specific proposal was delayed until June 2017 due to changes in PI's in the Forage Breeding Program at UF. Nevertheless, we were able to move forward with all the projects and the status for each specific aim will be updated in this report.

Due to the delay in award delivery for our proposal, we had some funding for year 1 that was not spent on personnel. Therefore, after obtaining approval from FCA representatives, we were able to use $25,000 from this specific grant for the purchase of a NIRS instrument to measure forage quality samples. The total cost for the Foss2500F spectrometer was $56,153.20. We leveraged matching funds from the Dean of Research in IFAS (Dr. Jackie Burns) to cover the remaining balance. The instrument was purchased and it is currently being calibrated (this process will take some days until we get trained on using the instrument properly). Nevertheless, all the forage quality measurements for the experiments described in this proposal will be run using this instrument. We have kept all samples harvested in 2017 dried and ground, and they are ready for quality analyses. We appreciate the willingness from FCA representatives who allowed this one-time budget adjustment to purchase this valuable instrument.

Specific Aims under the Winter Forage/Legumes

1. Reintroduction of white clover into South Florida pastures

2. Development of a high quality alfalfa variety and management system adapted to central-north Florida conditions.

3. Development of high quality and high yield bermudagrass/stargrass cultivars

Aim 1

Approach:

A series of three-year establishment and persistence field trials will be conducted in large areas in collaboration with Deseret Ranches to determine the right variety(ies) and management practices needed for establishing and maintaining white clover pastures in south and central Florida. Additionally, these trials will be used for breeding and development of new better-adapted varieties of white clover for the south.

Status:

Percent of the work completed in year 1: 50% (the establishment of the plots projected for October 2017 will represent the other 50%).

The award was release after the optimal time to establish white clover (October/November); therefore, during summer we traveled to Deseret Ranches and met with Mr. Erik Jacobsen and Mr. Clint Richardson. We identified an area of about 60 acres that will be used to establish 2 projects in October 2017 (see below). Soil tests indicated that pH is not a limiting factor and we did not have to apply lime in the selected area. Seed planting is scheduled for October 2017. The area is currently planted with bahiagrass, and the entire area will be grazed to allow planting in October.

1. Project 1: We will test 3 cultivars in a grazing study (Ocoee: nematode-resistant; Osceola: nematode-susceptible; and Durana: active summer-growing). The experiment will be planted as a RCBD with 3 replicates. Each experimental unit will have ~5 acres. Defoliation will be managed through grazing, and we will evaluate establishment, biomass production, nutritive value, persistence and nematode pressure. Seed has been purchased for the three cultivars and is ready for planting in October.
2. Project 2: breeding/variety trial. Five varieties will be tested in Citra, FL and in Deseret Ranches. The same three cultivars described above (standard commercial cultivars) and two breeding populations selected in our program (Late-Ocoee and a multi-leaf population). Seed from Late-Ocoee and Multi-leaf was increased during summer in a seed company farm located in Idaho (Picture 1). We expect to receive clean seed at the end of September, and the seed will be used for the experiments. The experimental design will be a RCBD with 4 replicates and it will be planted in both locations. We will harvest biomass (under cutting), and measure persistence, nutritive value and nematode resistance.

Figure 1. White clover seed increases in Idaho during the summer 2017. Exclusion cages are used to ensure purity and avoid pollen contamination. Seed production during summer in Idaho allows us to make selections in Florida during the spring, and produce seed of those selected plants for planting the following fall season, increasing the speed for cultivar development.

Anticipated Outputs:

1 – Determination of recommended practices **to establish and maintain** white clover cultivars in central/south Florida pastures.

2 – Development of new cultivars better adapted to central and south Florida. We will test the new breeding lines in two locations against current commercial varieties for two additional years before formal release, as University of Florida requires. We expect that cultivars might perform differently in both locations, and therefore we will make selections for central and for south Florida.

Aim 2

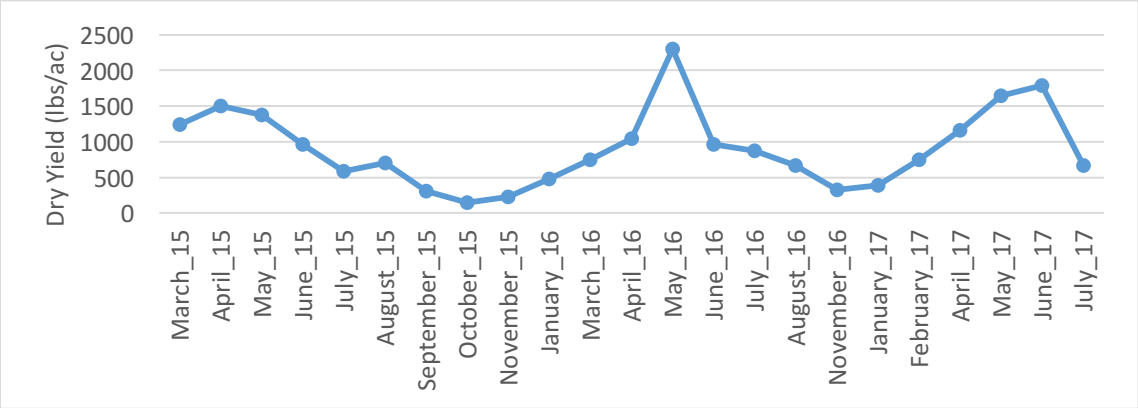
Approach:

We will conduct a series of trials over a three-year period to ascertain the right management practices to establish and maintain high yielding stand of high quality alfalfa in central-north Florida. We have developed improved material better adapted to Florida conditions and we need to test in multiple locations for at least 3 years under monoculture and mixture stands.

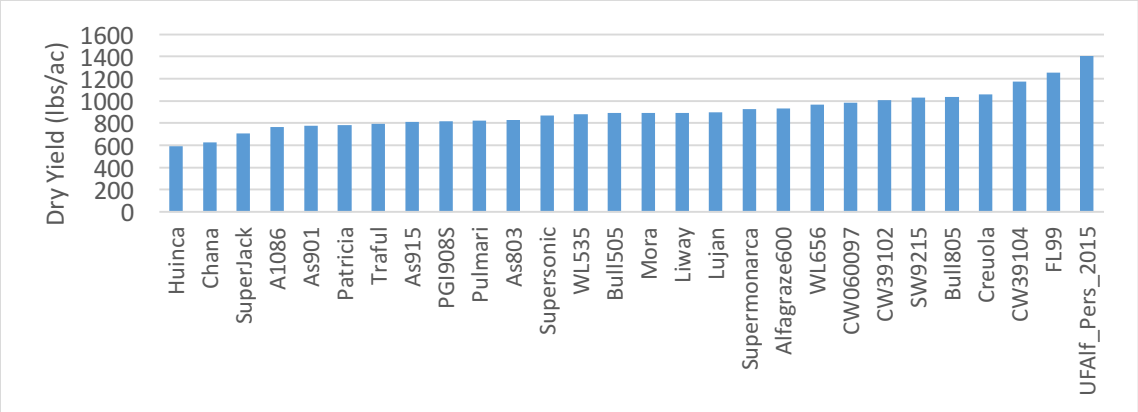
Status:

Percent of the work completed in year 1: 100%

We continue collecting data on monoculture alfalfa stands that were established in the Fall 2014. Our data demonstrates that adapted alfalfa cultivars can persist in Florida for up to three years in pure stands (Figure 2A and B). Our selected breeding line (UFAlf_Pers_2015) exhibited the highest yields (Figure 2B) and persistence. We need data on a multi-location trial prior a cultivar release (UF-IFAS policy); therefore, we established another variety trial in Citra, FL (January 2017) and Marianna, FL (December 2016).



A



B

Figure 2. Alfalfa monoculture stand planted in Citra, FL in the Fall 2014. Dry matter yields across 28 varieties in 23 harvests (A), and average dry matter yield per harvest by variety (B). The last graph shows that varieties developed in Florida (FL99 and UFAlf_Pers_2015) produced higher yields than other commercial cultivars. We will continue collecting data in this experiment for another year, to determine if we can obtain high yields beyond 3 years.

The two new variety trials under pure stand conditions were established in Citra and Marianna, FL (Figure 3). The experiments were harvested in April 2017 for the first time in both locations and a total of 3 harvests were performed in Citra and 4 harvests in Marianna. Data for each location is presented below.

January 27th 2017 March 30th 2017 April 18th 2017

Figure 3. Alfalfa monoculture stand planted in Citra, FL on 01/27/2017 and harvested for the first time on April 18th 2017.

Location: Citra

Experiment Description

1. Site

   Location: CITRA -Plant Science research and Education Unit (Citra)

   Coord. Latitude 29° 24' 16" N, Longitude 82° 10' 17" W

2. Experimental design

   Design: Randomized Complete Block Design

   Plot size: length 4.6 m by width 1.8 m

   Number of Replicates: 6

   Treatments: 4 Varieties (Bulldog805, Amerstan901, FL99 and UF2015_ALFPers.

   Bulldog805 and AmerStan901 are established varieties, developed outside Florida that can be obtained commercially.

   FL99 is a discontinued Florida variety developed in the 90's that cannot be obtained commercially anymore.

   UF2015_ALFPers is a new experimental variety developed by the UF Forage breeding program that is being tested. This variety will be released for commercial production if results of testing are favorable.

3. Planting

   Date: 01/19/17

   Method: cone planter

   Seeding rate (lb/ac): 22 lb/ac (30% more when seed coated)

4. Harvest (5 cm stubble height)

   First harvest in the spring (April 25th 2017) conducted at the bud or early-bloom stage (approximately 10% of the plants with flowers)

5. Data analysis

   Software: R

   Model: yield = block + cultivar + error

6. Results

   All the alfalfa varieties had similar dry matter productivity dry matter production in the first and second harvest, while for the third harvest Ameristand901 produced significantly lower yields (Figure 4).

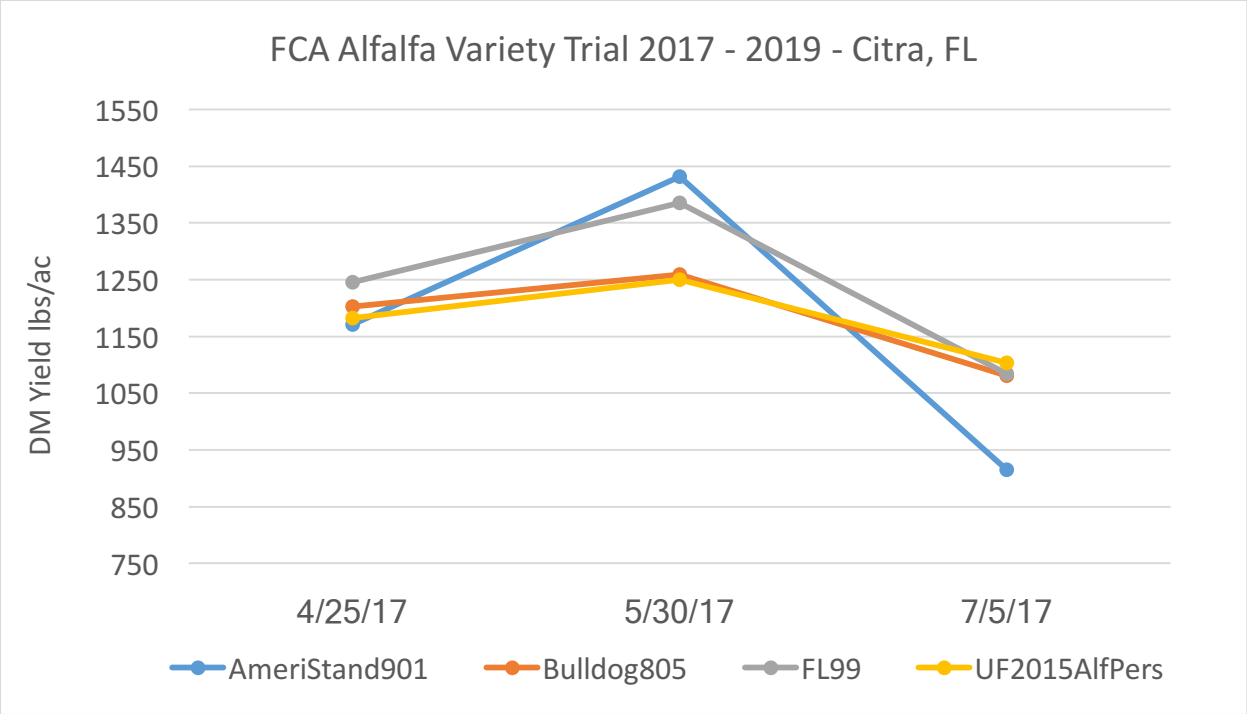


Figure 4. Alfalfa dry matter yield for the variety trial located in Citra, FL.

Location: Marianna

Experiment Description

1. Site

   Location: Marianna, FL – North Florida Research and Education Center (NFREC). Dr. Jose Dubeux.

2. Experimental design

   Design: RCBD

   Treatments: 3 Varieties (Bulldog805, FL99 and UF2015_ALFPers).

   Plot size: length 3 m by width 1.8 m.

   Number of Reps: 4

3. Planting

   Date: 12/01/16

   Seeding rate (lb/ac): 28 lb/ac (30% more when seed coated)

4. Harvest (5 cm stubble height)

First harvest in the spring (April 18th 2017) conducted at the bud or early bloom stage (approximately 10% of the plants with flowers).

5. Data analysis

   Software: R

   Model: yield = block + cultivar + error

6. Results

   The alfalfa germplasm had similar dry matter productivity (Table 1), with average DM yield of 1,172 kg DM ha^{-1} $harvest^{-1}$.

   Table 1. Dry matter production of alfalfa germplasm in Marianna, FL

Variety	Dry matter production (kg ha^{-1} $harvest^{-1}$)
Bulldog 805	1100 a[§]
FL 99	1300 a
UF 2015 Experimental Line	1117 a
Standard Error	234

[§]Average across four harvests and four blocks

There was an effect of the harvest date on alfalfa production. The harvest in July 2017 resulted in greater alfalfa production than the other harvests (Table 2).

Table 2.

Harvest date	Dry matter production (kg ha^{-1} $harvest^{-1}$)
4/18/2017	993 b[§]
5/23/2017	916 b
7/12/2017	1993 a
8/23/2017	787 b
Standard Error	209

[§]Average across three varieties and four blocks

Conclusion for alfalfa monoculture:

In both locations, the monoculture alfalfa variety trial was successfully established and the firsts harvests showed no significant differences among cultivars, which was expected for the first year. Even though cultivars were not statistically different for yield, we would expect to find differences in yield and persistence in the long term, as the experimental line UF2015_ALFPers was specifically selected from FL99 for improved persistence and yield under Florida conditions (Figure 2).

For the second part of this aim (testing alfalfa in mixture with bermudagrass), the bermudagrass stands (Tifton85) were established in summer 2017 in Citra, FL (Figure 5) and the overseeded of alfalfa will be planted in October 2017 with the same 4 varieties (recommended planting dates for alfalfa in FL). The lower alfalfa yields observed in our monoculture studies (Figure 2A), and the well-known forage yield distribution of bermudagrass and bahiagrass suggests that a mixture of grass/legume has potential to provide forages 365 days in Florida.

Figure 5. Tifton85 springs being planted at the Plant Science Research and Education Unit, Citra, FL in August 2017.

Expected Outputs

1 – Determination of recommended practices to establish and maintain alfalfa both as a pure stand and as in mixture with bermudagrass.

2 – Development of a new variety better adapted to the Central-North Florida. After the data is collected in both locations, we will formally release the new variety (UFAlf_Pers_2015).

Aim 3

Approach

We will conduct a series of experiments in the period of three years to determine the best bermudagrass cultivar for south, central and north Florida conditions. We will test 6 selected breeding lines plus 4 current commercial cultivars. Experimental lines exhibiting improved traits in each of the three areas will be increased by the second year with collaboration of local producers.

Status:

Percent of the work completed in year 1: 100%

Land preparation on each site was conducted in the Spring 2017 in Ona, FL (Dr. Joao Vendramini), Marianna, FL (Dr. Jose Dubeux) and Hague, FL (Dr. Esteban Rios). Bermudagrass plugs were propagated for each genotype (Figure 6 A) and they were used for establishing the experiments on each location. The experiment located at the Agronomy Forage Research Unit in Hague, FL was planted on April 27th 2017 (Figure 5 B), under a RCBD with 10 genotypes and 4 blocks (1.8 x 4.6 m plot size). The same experimental design was used in Ona and Marianna where the experiments will be planted in May 2017. Biomass yield, nutritive value and Bermudagrass Stem Maggot ratings will be taken once the plots are well established in 2018 and 2019.



A B C

Figure 2. Bermudagrass plug (A), experiment established at Hague, FL on April 27th 2017 with 4 plugs per block (B), and staging of the plots in August 2017.

Expected Outputs:

1 – Development of better-adapted cultivars with increase yield and better forage distribution across the season.

2 – Development of cultivars with good tolerance to Bermudagrass Stem Maggot.

BUDGET FOR FLORIDA CATTLE ENHANCEMENT FUND- BUDGET JUSTIFICATION					
PROJECT TITLE: Development of Improved Forage Cultivars and Management Systems for Florida Conditions					
DETAILED LINE ITEM DESCRIPTION	QTY	% Complete	TOTAL	EXPLANATION/JUSTIFICATION OF DELIVERABLE	COMPLETION DATE
Clover seed (Aim 1)	5	100%	$ 5,000.00	lab consumables (reagents, filter paper, plastic containers, instrument parts), syringes, soil moisture sensors, tubes, vacuum pump	9/1/2017
Alfalfa seed (Aim 2)	1	100%	$ 919.02	field supplies. Items include (but not limited to): paper bags, soil core liners, batteries	9/1/2017
Plant propagation, plot establishment, maintenance, harvest and postharvest sample processing	1	100%	$ 15,000.00	purchase of commercial fertilizer and biochar for the field study	9/1/2017
Land charge and equipment charges from PSREU, Citra (Aims 2 and 3)	1	100%	$ 2,400.00	soil, plant tissue, biosolids, and biochar characterization, shipment of samples for analysis	9/1/2017
Land and equipment charges Ona, FL (Aim 3)	1	100%	$ 2,000.00	soil water release curve characterization	9/1/2017
Land and equipment charges Marianna (Aims 2 and 3)	1	100%	$ 2,000.00	project report detailing research, which may include, findings, future needs, results, conclusions, issues, risks, assessments and all other pertinent information.	9/1/2017
Foss2500F NIRS	1	100%	$ 25,000.00		
Indirect Cost	N/A		$ 5,972.24		N/A
GRAND TOTAL: (equal to percentage of completion)			**$ 58,291.26**		