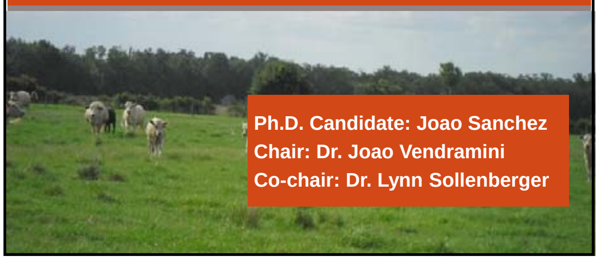
Evaluation of management practices to improve pintoi peanut productivity and nutritive value in South Florida



Ph.D. Candidate: Joao Sanchez
Chair: Dr. Joao Vendramini
Co-chair: Dr. Lynn Sollenberger

Outline

- Introduction
  - Pintoi peanut (*Arachis pintoi* Krapov. & W.C. Greg.)
  - Objectives
- Research Projects
  - Pintoi peanut grazing management
  - Soil organic C dynamics in pintoi peanut-bermudagrass mixtures
  - Pintoi peanut-bahiagrass establishment
- Conclusions

Introduction

Grasslands in Florida

- Nitrogen fertilization is usually limited in grasslands of South Florida
- The use of herbaceous warm-season legumes is an alternative to supply N to grasslands (Thomas, 1992)
- However, very few warm-season legumes persist in mixture with tropical grasses (Pitman et al., 1988)

Source: edis.ifas.ufl.edu

Grasslands in Florida

- Perennial peanuts (*Arachis* spp.) have shown persistence and forage potential in mixtures with perennial warm-season grasses (Valls and Simpson, 1994)
- Pintoi peanut has become popular among scientists and producers:

Pintoi Peanut

Pintoi peanut

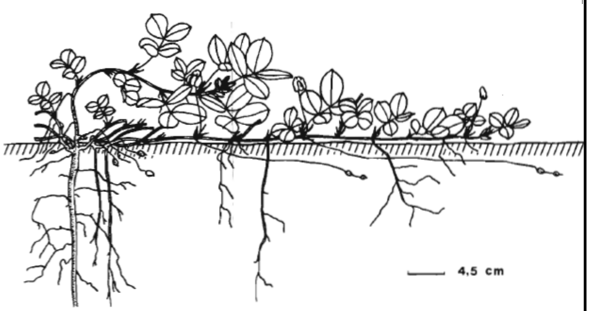
- *Arachis pintoi* (Krapov. & W.C. Greg.)
- Caulorhizae section of *Arachis*
- Perennial plant
- Native from South America
  - Jequitinhonha River
  - São Francisco River

Source: Biology and Agronomy of Forage Arachis, 1994

Pintoi peanut

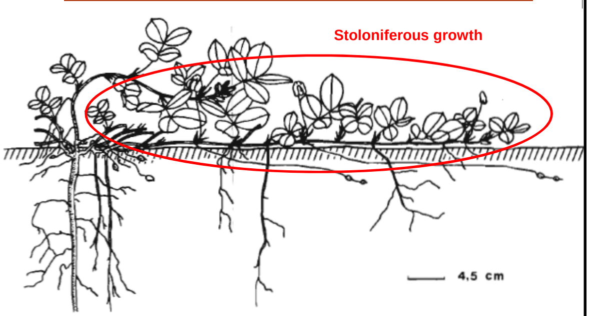
- Adapted to annual precipitations of 60 to 140 inch.
- Tolerates acidic, low fertility soils (Rao and Kerridge, 1994)
- Tolerates severe frosts (Carvalho and Quesenberry, 2012)

Pintoi peanut



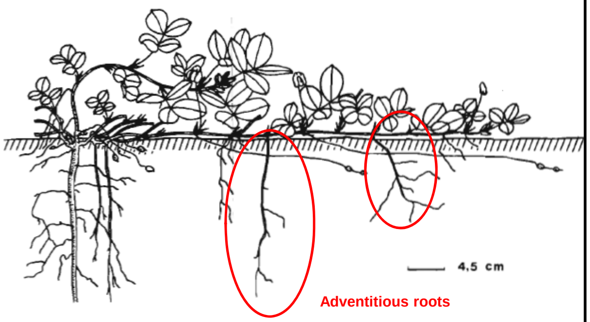
Source: Krapovikas and Gregory, 1994

Pintoi peanut



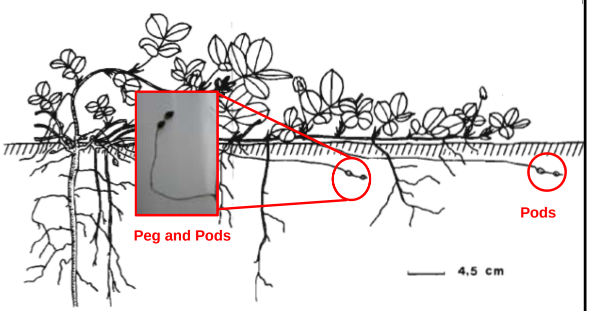
Source: Krapovikas and Gregory, 1994

Pintoi peanut



Source: Krapovikas and Gregory, 1994

Pintoi peanut



Source: Krapovikas and Gregory, 1994

Pintoi peanut

- Herbage accumulation in different locations:
  - Africa (Stür and Ndikumana, 1994)
    - Herbage accumulation ranged from 0.3 to 2.3 ton/ac
  - South America (Pizarro and Rincón, 1994)
    - Annual herbage accumulation ranging from 3.0 to 5.8 ton/ac
- Nutritive value:
  - Crude protein ranging from 13.0 to 18.0 % (Rincón et al., 1992)
  - Average IVDOM of 67.0 % (Carvalho and Quesenberry, 2012)

Pintoi peanut

- Most pintoi peanut research has been conducted in Central and South America and Australia
- Information about the use of pintoi peanut in North America is limited

Pintoi peanut

- Establishment:
  - Propagated by seeds and vegetative material (Carvalho and Quesenberry, 212)
  - Seeds are usually expensive with limited availability (Cook et al., 1994)
  - Slow establishment (Cook et al., 1994; Carvalho and Quesenberry, 2012)

Pintoi peanut

- Use of N on the establishment:
  - N fertilization up to ~50 lb/ac may increase pintoi peanut above ground biomass (Thomas, 1994)
  - However, research evaluating such effect in grass-legume mixtures is scarce

Pintoi peanut

- Establishment of pintoi-grass mixtures:
  - Greater number of studies on pintoi peanut-palisadegrass mixtures (Valentin et al., 2002)
  - Literature about simultaneously seeding pintoi peanut and grasses has not been found

Pintoi peanut

- Harvest/grazing management:
  - Tolerates short stubble heights (2-4 inch.) (Sinclair et al., 2007)
  - In grass-legume mixtures, pintoi peanut proportion increases with greater grazing intensities (Ibrahim and 't Mannetje, 1998)

Pintoi peanut

- Impact on soil carbon:
  - Recently, more importance has been given to carbon mitigation strategies in agriculture
  - Legumes have the potential to increase soil organic carbon content (Dubeux et al., 2007)
  - Mosquera et al. (2012) found that pintoi peanut-grass mixtures had greater SOC concentration than grass monoculture (1.9 vs 1.7%)

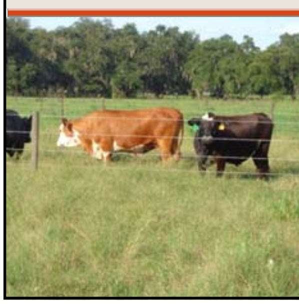
Pintoi peanut

- There is a demand for a persistent, perennial, warm-season legume which can be established by seeds
- Few studies were conducted with pintoi peanut in Florida (Carvalho and Quesenberry, 2009; 2012)
- Studies are necessary to evaluate effective establishment and management practices to assure pintoi peanut persistence and productivity

Objective

- To evaluate management practices to improve the establishment, productivity and nutritive value of pintoi peanut in South Florida

Research Projects



FORAGE CHARACTERISTICS OF BERMUDAGRASS PASTURES OVERSEEDED WITH PINTOI PEANUT AND GRAZED AT DIFFERENT STUBBLE HEIGHTS

Objectives

- To evaluate the persistence, productivity and nutritive value of bermudagrass and pintoi peanut mixtures as affected by stubble height

Hypothesis

- Pintoi peanut will persist in mixture with bermudagrass
- Shorter stubble height will increase pintoi peanut in the mixture
- Mixed swards will have greater productivity and nutritive value

Material and Methods

- UF/IFAS Range Cattle Research and Education Center, Ona-FL
- Jiggs pastures were overseeded with 12 lb/ac of pintoi peanut seeds in June of 2013
- Pastures were fertilized with 12 lb P and 45 lb K/ac on May 2014
- Experimental period: June to October of 2014 and 2015

Material and Methods

- Treatments were the split-plot design of:
  - Sward type (main plots): bermudagrass pastures as monocultures or overseeded with pintoi peanut
  - Stubble height (subplots): stubble heights of 6- or 10-in.
- Randomized complete block design with 4 replicates
- Experimental units were mob stocked with 28-d resting periods

Material and Methods

- Botanical composition
  - Proportion of pintoi peanut in the herbage mass
  - Initial and final
- Herbage accumulation rate (HAR)
- Nutritive value
  - Samples clipped at target stubble heights
  - CP
  - IVDOM

Results

- There was no effect of stubble height on proportion of pintoi in HM (4.7%; $P > 0.62$):
  - Reduced pintoi productivity
  - Canopy architecture of companion grass

Results

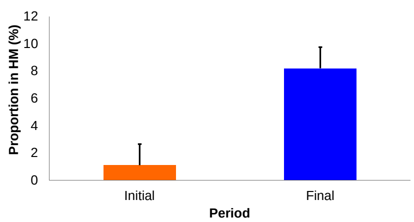


Figure 1. Proportion of pintoi peanut in the herbage mass.

Results

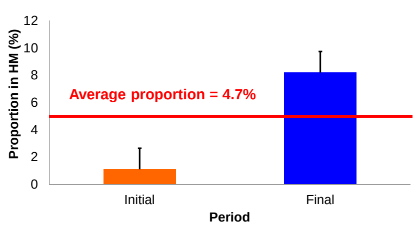


Figure 1. Proportion of pintoi peanut in the herbage mass.

Results

Table 1. Effect of overseeding pintoi peanut on herbage accumulation rate and nutritive value.

Sward type	HAR	Nutritive value	
		CP	IVDOM
	lb/ac/d	— % —	
Bermudagrass	25	10.3	43.7
Bermudagrass /pintoi	17	9.8	42.4
SE	19.0	2.8	3.8
***P*-value ‡**	0.20	0.17	0.35

‡ *P*-value refers to the effect of sward type in each variable.

Results

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There was no overseeding effect

SOIL CARBON AND NITROGEN POOLS OF BERMUDAGRASS PASTURES AS AFFECTED BY OVERSEEDING WITH PINTOI PEANUT AND GRAZING STUBBLE HEIGHTS

Objectives

- To evaluate the effect of overseeding pintoi peanut and stubble height on soil organic C and N pools of bermudagrass pastures

Hypothesis

- Overseeding pintoi peanut will increase soil organic C and N pools
- Increasing stubble height will increase soil organic C and N pools

Material and Methods

- UF/IFAS Range Cattle Research and Education Center, Ona-FL
- Same experimental area of previous experiment
- Experimental period: June 2014 to October 2015

Material and Methods

- Treatments were the split-plot design of:
  - Sward type (main plots): bermudagrass pastures as monocultures or overseeded with pintoi peanut
  - Stubble height (subplots): stubble heights of 6- or 10-in.
- Randomized complete block design with 4 replicates
- Experimental units were mob stocked with 28-d resting periods

Material and Methods

- Soil samples were collected in October 2015 (2 yr)
- Separated by depth:
  - 0-2 in.
  - 2-4 in.
  - 4-8 in.
- Soil OM fractionation was performed

Material and Methods

- Particulate organic matter (POM) fractionation (Cambardella and Elliot, 1992):
  - POM = organic material retained in a 53 µm sieve
  - C-min = organic material passing through a 53 µm sieve

Material and Methods

- POM samples were fractionated by density, similar to described by Six et al. (1998):
  - Solution of sodium iodide (1.8 g cm^{-3})
  - Light fraction (< 1.8 g cm^{-3}): recently deposed, partially decomposed plant material
  - Heavy fraction (> 1.8 g cm^{-3}): more advanced decomposition stage

Material and Methods

- Soil organic C and N were analyzed by dry combustion as described by Silveira et al. (2014)
- Only light fraction results will be presented

Results

Table 2. Light faction C concentration, content, and C/N ratio as affected by sward type.

Response variable	Sward type		*P*-value	SE
	Bermuda.	Berm./pintoi		
0-5 cm layer				
LFC† concentration (%)	27.7	30.7	0.05	0.67
LFC content (ton ac^{-1})	3.5	4.3	0.15	0.28
LFC C/N ratio	13.7	14.4	0.11	0.29
5-10 cm layer				
LFC concentration (%)	21.0	22.3	0.51	1.24
LFC content (ton ac^{-1})	2.1	2.4	0.28	0.19
LFC C/N ratio	13.5	14.0	0.43	0.44
10-20 cm layer				
LFC concentration (%)	19.4	22.7	0.08	1.54
LFC content (ton ac^{-1})	3.6	4.5	0.15	0.56
LFC C/N ratio	13.8	13.9	0.88	0.25

† LFC: light fraction carbon

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Results

Table 3. Light faction C concentration, content, and C/N ratio as affected by stubble height.

Response variable	Stubble height		*P*-value	SE
	SH6	SH10		
0-5 cm layer				
LFC† concentration (%)	30.9	27.5	0.01	0.67
LFC content (ton ac^{-1})	3.8	4.0	0.60	0.29
LFC C/N ratio	14.2	13.9	0.23	0.27
5-10 cm layer				
LFC concentration (%)	21.3	22.1	0.52	1.05
LFC content (ton ac^{-1})	2.4	2.1	0.15	0.19
LFC C/N ratio	13.6	13.9	0.37	0.34
10-20 cm layer				
LFC concentration (%)	22.7	19.3	0.04	1.54
LFC content (ton ac^{-1})	4.3	3.8	0.32	0.56
LFC C/N ratio	13.9	13.7	0.57	0.25

† LFC: light fraction carbon.

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EVALUATION OF SEEDING STRATEGIES OF BAHIAGRASS AND PINTOI PEANUT ON PASTURE ESTABLISHMENT

Objectives

- To evaluate the establishment parameters of pintoi peanut and bahiagrass seeded as monocultures or mixture

Hypothesis

- Establishment parameters of pintoi peanut and bahiagrass in mixed planting will be similar to parameters of respective plants in monocultures
- Increasing N fertilization increases establishment parameters of both plants

Material and Methods

- UF/IFAS Range Cattle Research and Education Center, Ona-FL
- Experimental period was from June to October of 2014 and 2015 (112 d/yr)
- Different areas for 2014 and 2015
- Preparation of the area:
  - Glyphosate 30 d before planting
  - Rototiller at 20 and 1 d before planting

Material and Methods

- Treatments were the split-plot design of:
  - Seeding strategy (main plots): pintoi peanut monoculture, bahiagrass monoculture, or pintoi peanut-bahiagrass mixture
  - N fertilization (subplots): 30 and 80 lb N/ac
- Randomized complete block design with 4 replicates

Material and Methods

- Plant density (plants/ft^2):
  - Every 4 wk after planting
- Frequency (%):
  - Every 4 wk after planting
- Ground cover (%):
  - October of 2014 and 2015

Results

Table 4. Establishment parameters of bahiagrass and pintoi peanut as affected by seeding strategy.

Response Variables	Seeding strategy		SE	*P*-value
	Monoculture	Mixture		
Bahiagrass				
Frequency (%)	38.7	33.7	5.67	0.14
Ground cover (%)	17.5	14.3	5.42	0.39
Pintoi peanut				
Density (plants/ft^2)	0.62	0.50	0.73	0.20
Frequency (%)	11.7	10.2	5.57	0.11

Results

Table 4. Establishment parameters of bahiagrass and pintoi peanut as affected by seeding strategy.

Response Variables	Seeding strategy		SE	*P*-value
	Monoculture	Mixture		
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Frequency (%)	38.7	33.7	5.67	0.14
Ground cover (%)	17.5	14.3	5.42	0.39
Pintoi peanut				
Density (plants/ft^2)	0.62	0.50	0.73	0.20
Frequency (%)	11.7	10.2	5.57	0.11

Results

Bahiagrass plant density

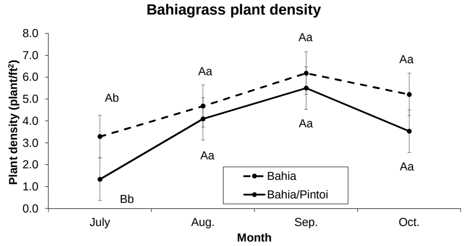

Figure 2. Bahiagrass plant density as affected by seeding strategy × month interaction. Means followed by similar uppercase letters within a month or a lowercase letters within a seeding strategy are not different ($P < 0.10$).

Results

Table 5. Pintoi peanut ground cover as affected by seeding strategy × N fertilization.

N fertilization	Seeding strategy		SE
	Monoculture	Mixture	
	%		
30N[†]	1.5 a[§]	2.2 a	0.94
80N	3.6 a	2.0 b	
P-value[‡]	< 0.01	0.93	

[†] 30N: 30 lb N/ac 2 wk after seeding; 80N: 30 lb N/ac 2 wk after seeding plus 50 lb N/ac 8 wk after seeding.
[§] Means followed by similar lowercase letters within rows are not different ($P < 0.10$).

Results

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	Monoculture	Mixture	
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30N[†]	1.5 a[§]	2.2 a	0.94
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[§] Means followed by similar lowercase letters within rows are not different ($P < 0.10$).

Results

Table 6. Establishment parameters of bahiagrass and pintoi peanut as affected by N fertilization.

Response Variables	N fertilization		SE	*P*-value
	30N[†]	80N		
Bahiagrass				
Density (plants/ft²)	4.6	3.9	0.75	0.18
Frequency (%)	35.6	36.8	5.65	0.65
Ground cover (%)	15.7	16.1	5.42	0.83
Pintoi peanut				
Density (plants/ft²)	0.5	0.6	0.07	0.11
Frequency (%)	9.9	12.0	5.55	0.02

[†] 30N: 30 lb N/ac 2 wk after seeding; 80N: 30 lb N/ac 2 wk after seeding plus 50 lb N/ac 8 wk after seeding.

Results

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Response Variables	N fertilization		SE	*P*-value
	30N†	80N		
Bahiagrass				
Density (plants/ft^2)	4.6	3.9	0.75	0.18
Frequency (%)	35.6	36.8	5.65	0.65
Ground cover (%)	15.7	16.1	5.42	0.83
Pintoi peanut				
Density (plants/ft^2)	0.5	0.6	0.07	0.11
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† 30N: 30 lb N/ac 2 wk after seeding; 80N: 30 lb N/ac 2 wk after seeding plus 50 lb N/ac 8 wk after seeding.

Conclusions

Conclusions

- Pintoi peanut is persistent when overseeded in bermudagrass pastures, but it did not respond to stubble height
- Due to reduced proportion, it did not have positive effects on forage productivity and nutritive value on early sward
- Better management practices should be developed and tested to increased proportion of pintoi in early mixed sward life

Conclusions

- Overseeding pintoi peanut increased only light fraction C and N concentration; however, it is an indicative of the potential for long-term increases in soil organic C and N content
- Grazing bermudagrass at 10-in. stubble height can potentially decrease soil organic C and N if applied in long periods

Conclusions

- Pintoi peanut may be simultaneously seeded with bahiagrass during the establishment of a mixed sward
- Using greater N fertilization levels after seedling emergence may be a strategy to increase pintoi peanut spread

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Joao M. D. Sanchez
joaomdsanchez@ufl.edu