Summary of UF Project # 00101244
2012 SPRI Final Report

North Florida Research and Education Center
155 Research Road
Quincy, FL

RESEARCHER(S): D.L. Wright, and J.J. Marois

TITLE: Impact of Cattle on Winter Grazing on Peanut Yield, Aflatoxin, Water Requirements and Nutrient Management.

Both grazed and adjacent non-grazed areas were set up for soil/plant sampling to measure the effects of grazing on the crop growth and yield under both non-irrigated and irrigated conditions. Soil samples were taken after 2-yr bahiagrass and winter grazing, i.e. before peanut planting and after winter grazing that followed the peanut harvest. Because sampling was made in early spring of 2010 and 2011 the results of soil analyses mirror the cumulative effects of grazing grasses for two consecutive years following by two winter cover crop grazing with the peanut crop in-between.

The biophysical controls that advance nutrients cycling in the root zone include soil bulk density (BD) and organic matter (OM), which in turn have affected soil moisture holding capacity and biogeochemical processes. Soil moisture in the top soil has been shown to be different under the grazed areas of both non-irrigated and irrigated fields and a tendency for higher moisture in lower layers of grazed areas was observed. However, soil moisture content in two consecutive years was considerably lower under grazing. This may be due to having more soil exposed to drying conditions.

Considerable differences for soil BD are detected in the upper layer after two-bahiagrass grazing seasons following by two winter grazing seasons with the peanut crop between. The BD in the upper 6 inches of both non-irrigated and irrigated fields tended to increase in grazed plots with 0.28 and 0.46 g/cm^3 respectively
However, a tendency for higher BD values at the lower depths is observed for non-grazed areas without irrigation in comparison with grazed areas under both irrigated and non-irrigated conditions. The differences detected at these soil layers could not be related with grazing or irrigation; it is probably aftereffect of both in addition to former management.

Apparently the grazing for two consecutive years had an effect on the penetration resistance and it is not surprise that the mechanical resistance in the top soil is higher after grazing of both irrigated and non-irrigated fields. A significant difference was seen between irrigated and non-irrigated fields in the lower soil layers of both grazed and non-grazed fields. This tendency continued after second winter-cover crop grazing with peanut crop in between.
We have shown in previous data that cattle keep 2 to 3 times as much nitrate-N in the top 20 cm of the soil profile after grazing the 2-year bahia and the following winter cover crop vs. non grazed. This is very significant to crops that have a high N requirement. A gradual decrease of nitrate-N content by depth was observed under grazed conditions, while non-grazed plots had

almost unchangeable N-content throughout the entire soil profile. Thus, if livestock are available to graze winter grazing less additional N would be needed for the following crop.
Potassium (K) content throughout the soil profile exhibited considerable land-use effect with lower values under non-grazed fields. Grazing 2-yr bahia and following cover crop definitely increase K content in the top soil with considerable differences between non-irrigated and irrigated plots. The majority of forage/feed/supplement-K is recovered in livestock excreta and the excreted K is kept in the top soil either recycled by pastures or adsorbed onto soil. After peanut growing and winter cover crop grazing a considerable decrease of K content in the subsoil of rain-fed and irrigated non-grazed plots was seen with totally different redistribution patterns thought soil profile.

Peanut yields were significantly higher with irrigation in 2012 even though yields were high statewide with almost 4000 lb/A yields. Aflatoxin was not detected in any of irrigated or non-irrigated plots. Even though we had detected no yield differences between grazed and non-grazed areas in past years, there was a tendency to have higher yields from the non-grazed areas. This is somewhat surprising since the field was turned prior to winter grazing and turn again prior to peanut planting. The big differences in the irrigated and non-irrigated may be due to the record breaking drought that occurred in 2011.

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OBJECTIVES:
1) Determine impacts of grazing winter cover crops on the following peanut crop yield, grade.
2) Determine impacts of rotations (conventional vs. sod based) and winter grazing on aflatoxin in peanut
3) Assess nutrient cycling and soil physical properties following winter grazing with and without cattle.

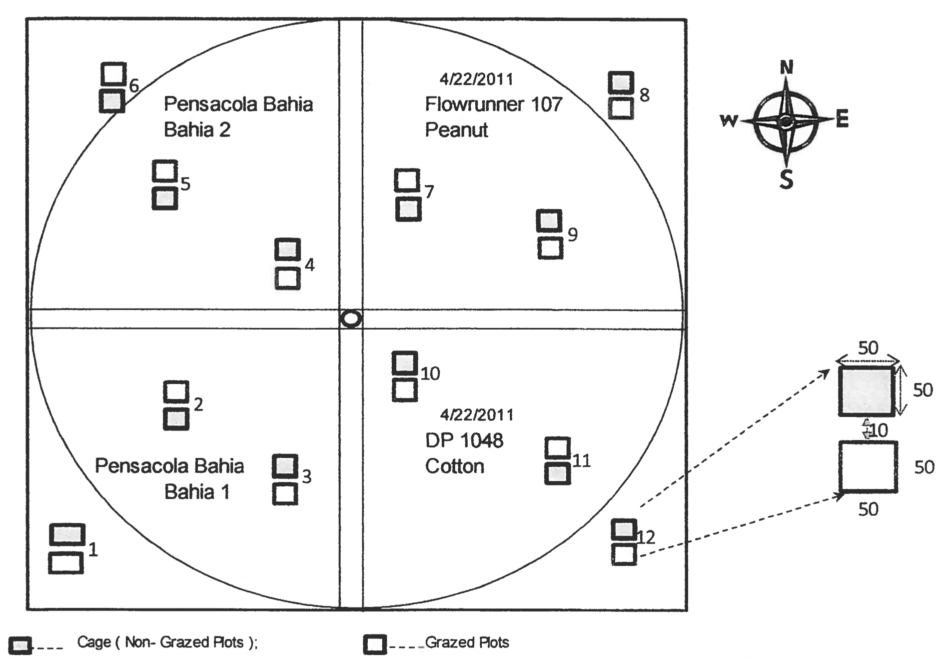
Rationale: More diversified conservation systems are needed to enhance peanut yield and quality. The "sod-based rotation system" at NFREC utilizes cover crops planted after bahiagrass, and cotton and peanut harvest. About 30% of the row-crop farmers in Florida have cattle and are more in favor of growing annual crops such as millet in the summer followed by oat and/or rye in the winter rather than using bahiagrass in rotation. Grazing perennials and cover crops by cattle can influence the time of planting for the following row crop and can have an impact on soil and water quality. Because peanut is sensitive to planting depth growers may find it difficult to get a stand due to soil compaction. Little is known about the impact of cattle grazing either perennials or winter-cover crops on the following peanut. This research will help to determine the effects of grasses on soil characteristics and yield and quality of peanut after being in either of the systems 2 years.

General approach: Basic climatic and soil information was gathering and soil samples from the established bahia-based system were collected. Following two-year bahia grazed by livestock, the cow/calf pairs were also placed for winter grazing in the field to be planted with peanut except for three 50-ft square areas in the quadrant that were fenced out. Cattle have not been allowed to graze in these areas when it was either in bahiagrass or following winter-cover crop. Therefore, the impacts of grazing cattle on the subsequent peanut crop can be determined.

METHODS:
The sod-based rotation and the arrangement of cages on farm-size field in Marianna (Fig. 1) are shown below. Samples were taken from sub-plots and the cages in both non-grazed and grazed areas of the crop quadrant.
The sod-based rotation was established in 2000 for investigating long-term sustainability and profitability of two cropping systems: Bahia-Bahia-Peanut-Cotton (B-B-P-C) vs. Peanut-Cotton-Cotton (P-C-C). The crop rotation of 2 years perennial grass followed by

peanut and then winter cover crop, followed by cotton and winter cover crop before being planted back to bahia is considered as environmentally friendly system. The perennial and winter cover crops allow cattle to be involved in a crop-livestock production system. Winter cover crops are planted as soon as row crops are harvested and second year bahia is killed. All crops are planted using conservation-till techniques (strip-till for summer crops). It is well known that bahiagrass in rotation prior to peanut can increase yield and decrease disease/nematode infestations. However, we have less knowledge of the impacts the grazing cattle could have on soil health and peanut crop.

FloRun 107 was planted in twin rows on April 20, 2012 immediately after cattle were removed from winter grazing. This rotation was established in 2002 so that 2 years of bahiagrass would be followed by peanut and then cotton with winter grazing being planted after peanut/cotton harvested and bahia killed. Cattle were allowed to graze on the first and second year bahiagrass throughout the year as well as on winter cover crops when available; the cow/calf pairs are excluded from 3 areas of the 40 acre quadrants for both bahiagrass and winter grazing. Exclusion cages are 50'X50' in size so that measurements and treatments can be made on the row crops, cover crops and bahiagrass within, as well as outside the exclusion cages. Two of the cages in each quadrant are under the pivot and one cage is outside the pivot in a dry corner (Fig. 1). A tractor mounted soil-core sampler was used for sampling down to 1 m depth. Also, soil penetration resistance was determined by a tractor-positioned penetrometer. Data concerning climate, soil physical and biogeochemical characteristics, as well as plant/crop biomass partitioning, yields and grades cycling were collected. Peanuts were inverted on September 12, 2012 and harvested five days later.



Plot (Exclusive Cage) Size is 50 x 50 , ;
The distance between 2 adjacent plots (grazed and non- grazed) is 10 feet;
These plots will be used for soil and plant data collection

Fig. 1 Field arrangement in 2012 and location of the small cages

RESULTS AND CONCLUSIONS:

Both grazed and adjacent non-grazed areas were set up for soil/plant sampling to measure the effects of grazing on the crop growth and yield under both non-irrigated and irrigated conditions. Soil samples were taken after 2-yr bahiagrass and winter grazing, i.e. before peanut planting and after winter grazing that followed the peanut harvest. Because sampling was made in early spring of 2010 and 2011 the results of soil analyses mirror the cumulative effects of grazing grasses for two consecutive years following by two winter cover crop grazing with the peanut crop in-between.

The biophysical controls that advance nutrients cycling in the root zone include soil bulk density (BD) and organic matter (OM), which in turn have affected soil moisture holding capacity and biogeochemical processes. Soil moisture in the top soil has been shown to be different under the grazed areas of both non-irrigated and irrigated fields and a tendency for higher moisture in lower layers of grazed areas was observed. However, soil moisture content in two consecutive years was considerably lower under grazing. This may be due to having more soil exposed to drying conditions.

Considerable differences for soil BD are detected in the upper layer after two-bahiagrass grazing seasons following by two winter grazing seasons with the peanut crop between. The BD in the upper 6 inches of both non-irrigated and irrigated fields tended to increase in grazed plots with 0.28 and 0.46 g/cm^3 respectively (Fig. 2).

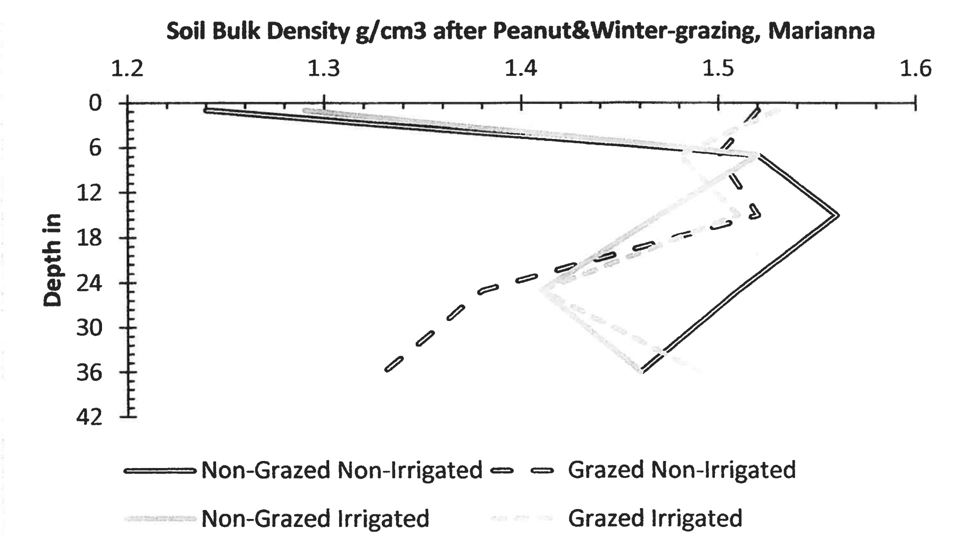


Fig.2. Soil bulk density with and without grazing and irrigation

However, a tendency for higher BD values at the lower depths is observed for non-grazed areas without irrigation in comparison with grazed areas under both irrigated and non-irrigated conditions. The differences detected at these soil layers could not be related with grazing or irrigation; it is probably aftereffect of both in addition to former management.

Apparently the grazing for two consecutive years had an effect on the penetration resistance and it is not surprise that the mechanical resistance in the top soil is higher after grazing of both irrigated and non-irrigated fields. A significant difference was seen between irrigated and non-irrigated fields in the lower soil layers of both grazed and non-grazed fields. This tendency continued after second winter-cover crop grazing with peanut crop in between.

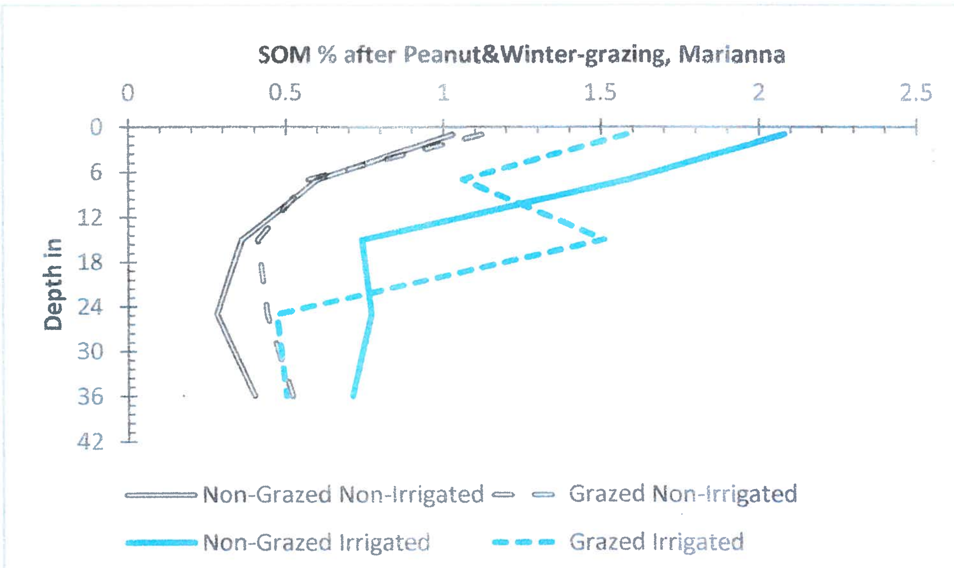


Fig. 3. SOM throughout the soil profile with and without grazing and irrigation.

The soil organic matter (SOM) is considered as a major biochemical control to advancing nutrients recycling in the root zone. The differences for BD detected in the top soil layers, however affected also the SOM content after two-grazing seasons following by 2 winter grazing of cover crops with the peanut crop between. A considerable difference was seen between non-irrigated and irrigated plots throughout the soil profile of grazed field, while the difference between non-grazed areas of non-irrigated field was insignificant (Fig. 6). Grazing non-irrigated plots lead to a lower SOM content in the lower soil layers. Also, a similar tendency was noted under irrigation but the decreasing of SOM content with the depth of observations was less rapid. When cattle grazed perennials and following winter cover crops a tendency for more SOM was observed under irrigated than non-irrigated plots. Grazing livestock plays a dominant role in the soil-crop-animal system by returning back to the soil most of the ingested forage and feed supplements. Also, grazed soil has higher concentration of dissolved organic carbon.

We have shown in previous data that cattle keep 2 to 3 times as much nitrate-N in the top 20 cm of the soil profile after grazing the 2-year bahia and the following winter cover crop vs. non grazed. This is very significant to crops that have a high N requirement. A gradual decrease of nitrate-N content by depth was observed under grazed conditions, while non-grazed plots had almost unchangeable N-content throughout the entire soil profile. Thus, if livestock are available to graze winter grazing less additional N would be needed for the following crop.

Also, a clear increase of P-content is detected under non-irrigated grazed areas; it seems that organic form of P excreted by grazing livestock can influence P-content in the sub-soil. Whether rainfall during the wet periods are facilitating downward P movement needs further investigation.

Potassium (K) content throughout the soil profile exhibited considerable land-use effect with lower values under non-grazed fields. Grazing 2-yr bahia and following cover crop definitely increase K content in the top soil with considerable differences between non-irrigated and irrigated plots. The majority of forage/feed/supplement-K is recovered in livestock excreta and the excreted K is kept in the top soil either recycled by pastures or adsorbed onto soil. After peanut growing and winter cover crop grazing a considerable decrease of K content in the subsoil of rain-fed and irrigated non-grazed plots was seen with totally different redistribution patterns thought soil profile.

Yields:

Peanut yields were significantly higher with irrigation in 2012 (Fig. 4) even though yields were high statewide with almost 4000 lb/A yields. Aflatoxin was not detected in any of irrigated or non-irrigated plots. Even though we had detected no yield differences between grazed and non-grazed areas in past years, there was a tendency to have higher yields from the non grazed areas. This is somewhat surprising since the field was turned prior to winter grazing and turn again prior to peanut planting. The big differences in the irrigated and non-irrigated may be due to the record breaking drought that occurred in 2011.

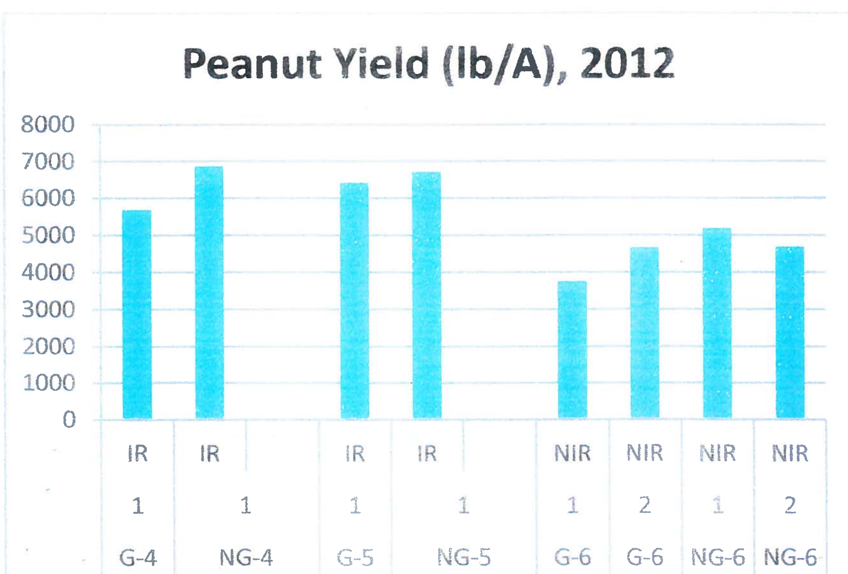


Fig. 4. Peanut yields following winter grazing or none and irrigation vs. non irrigated, IR=irrigated, NIR=non irrigated G=grazed, NG=non grazed

Likewise, there was a tendency for higher grades with irrigation than non irrigated areas and grazing made no difference in peanut grades (Table 1).

Trt.	Total SMK %	Other Kernel %	Total Kernel %
IG	69.3	4.9	74.2
ING	68.5	4.6	73.1
NIG	64.5	5.2	69.9
NING	66	4.6	70.9

Table 1. Peanut grades. IG=irrigated grazed, ING=irrigated non grazed NIG=non irrigated grazed, and NING=non irrigated non grazed