FLORIDA AGRICULTURAL EXPERIMENT STATION
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES

[1]Check-OFF Funds - Reports

UNIT: University of Florida DATE: 12/16/2011

North Florida Research and Education Center
155 Research Road
Quincy, FL RESEARCHERS D.L. Wright, J. J. Marois, and G. Anguelov

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**TITLE: Influence of cattle traffic/nutrient cycling on the following peanut crops (yields and grade)**

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.

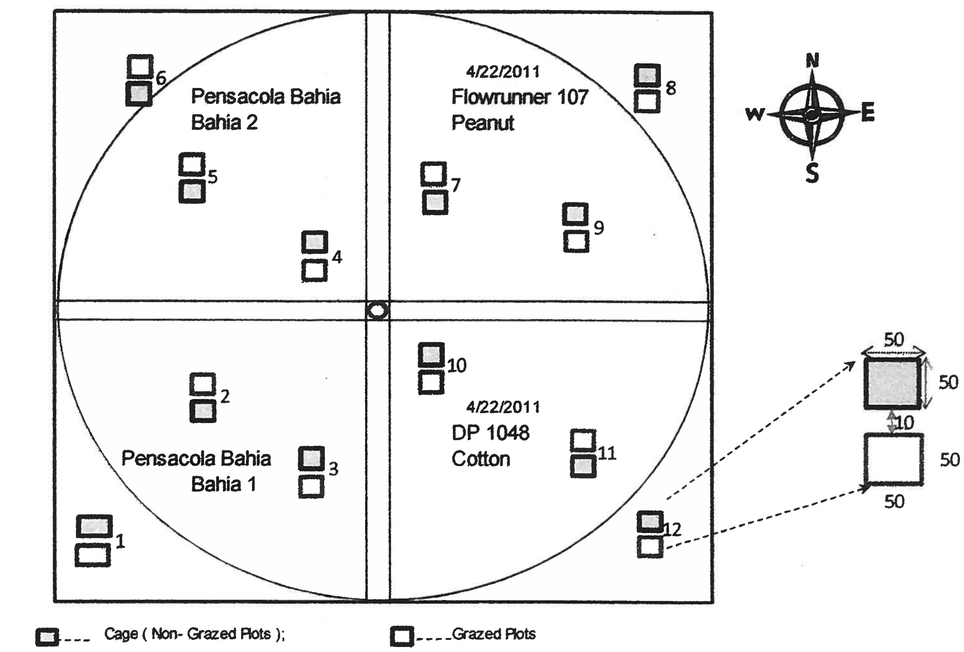
METHODS:

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.

Peanuts were planted after 2 years of bahiagrass in a 40 acre quadrant underneath a 160 acre variable rate center pivot irrigation system in May of 2011. This rotation was established in 2007 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.




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

Fig. 1 Field arrangement in 2011 and location of the small cages

RESULTS AND CONCLUSIONS:

The climatic characteristics and meteorological data for the experimental site have shown that there is a potential risk for leaching of nutrients. The annual precipitation for this area usually exceeds 60'; the monthly rainfalls are unevenly distributed with considerable rain events that may cause water and solutes leaching. However, following a rather dry 2010 year (43.6' annual precipitation), the rainfall deficit continue to grow gradually during next dormant and growing seasons to come almost to the same amount (42.6') at the end of the 2011 season. The monthly rainfalls distributions differ significantly from a 30-yr normal and short-term (10-yr) average (Fig. 2).

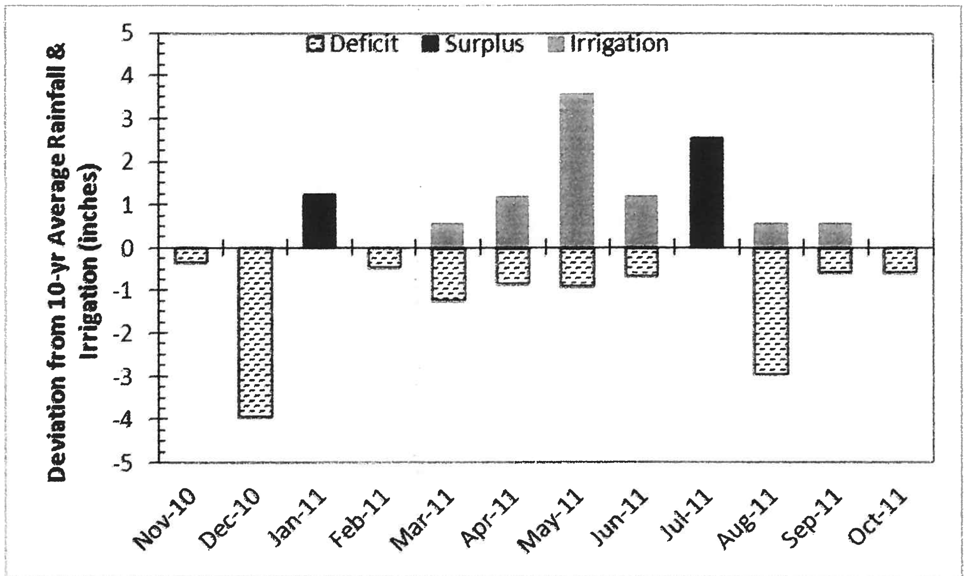



Fig. 2.Monthly rainfall deficit/surplus and irrigation distributions

Redistribution of soil-inherited and external-deposited elements often occurs in soils but the effect of livestock grazing short-term pasture (2-yr bahiagrass) and winter cover crops in a sod-based rotation on soil and following peanut crop is rarely discussed. In this report we address the impact of climate and grazing cattle on major soil properties and peanut. 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 was 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 areas (Fig. 3). Higher soil moisture content in the subsoil of non-grazed irrigated plot is detected; whether this is an aftereffect of deeper roots of bahiagrass needs further study.

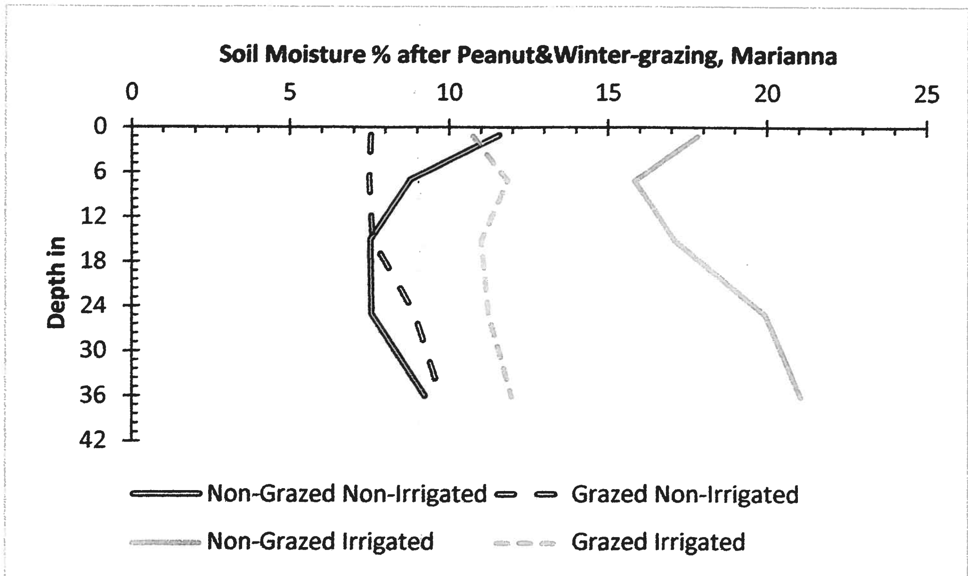



Fig. 3. Soil moisture with and without grazing and irrigation

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. 4).

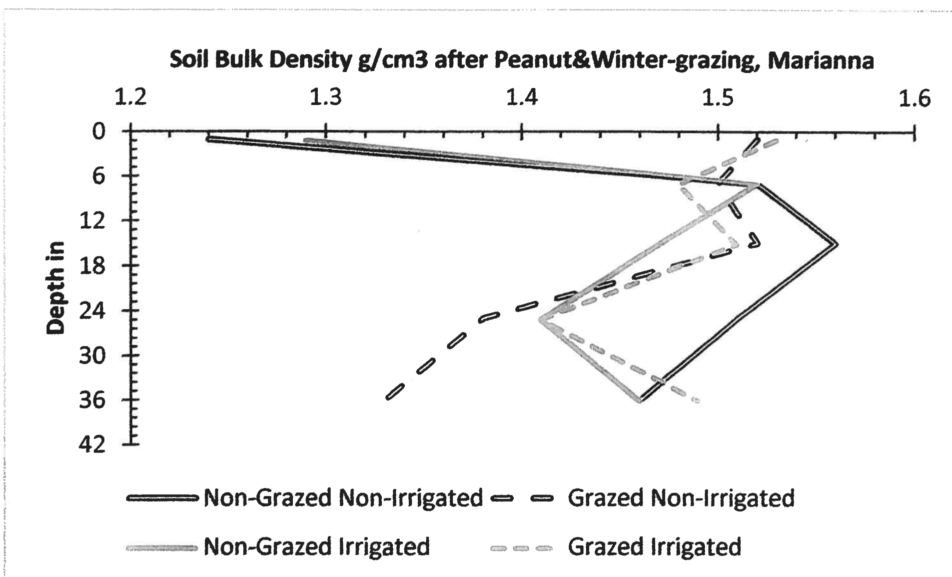



Fig.4. Soil bulk density with and without grazing and irrigation

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.

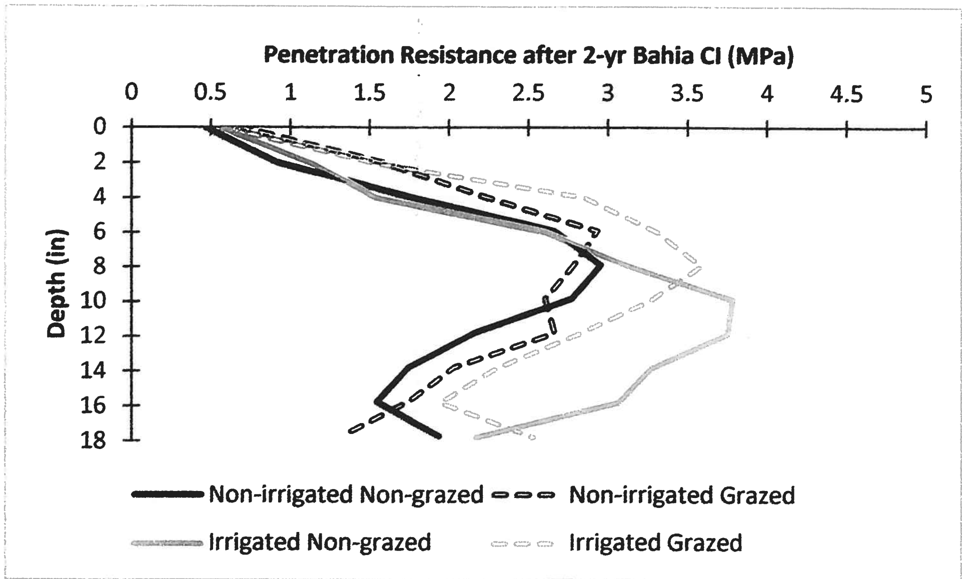



Fig. 5A. Penetrometer resistance with and without grazing and irrigation

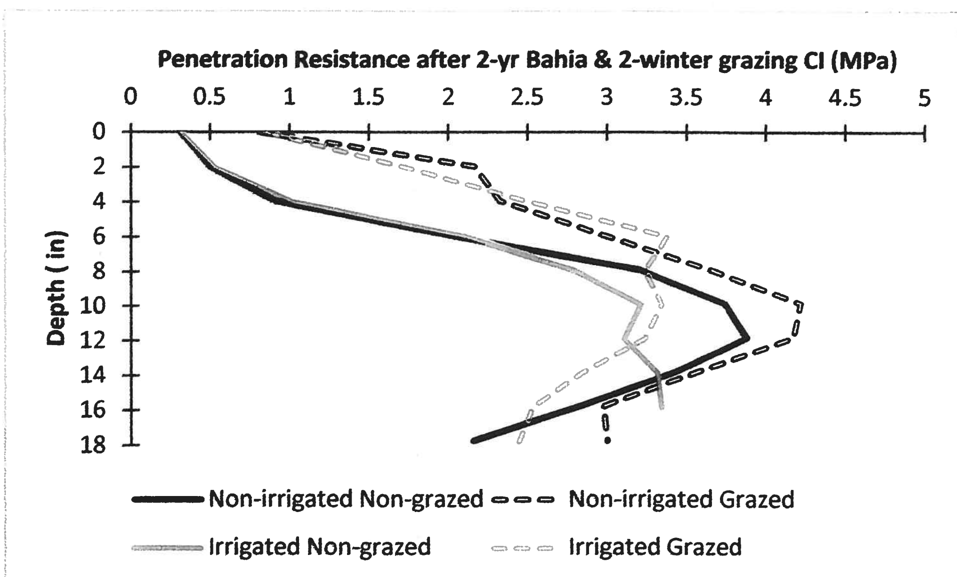



Fig. 5B. Penetrometer resistance with and without grazing and irrigation

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 (Fig. 5A). A more 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. 5B).

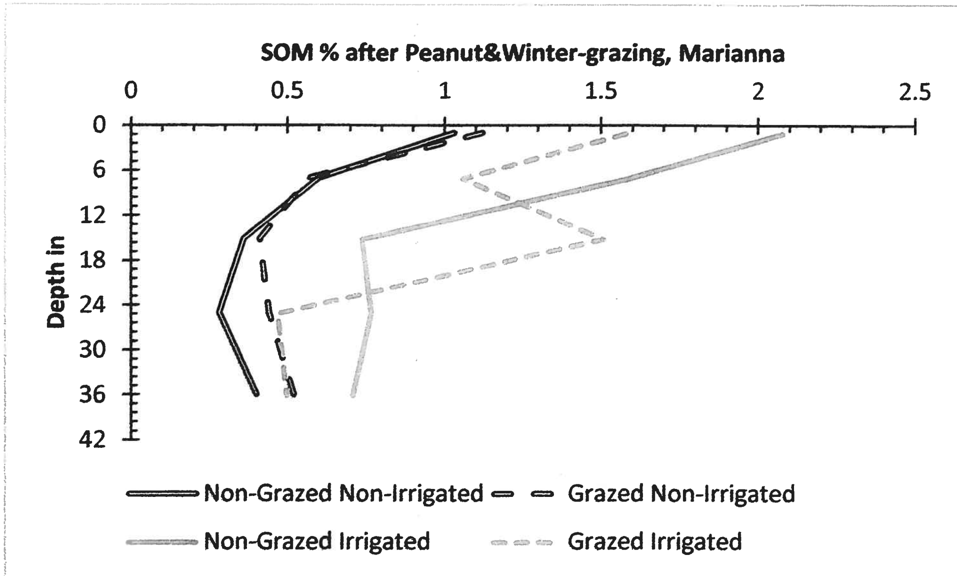



Fig. 6. SOM throughout the soil profile with and without grazing and irrigation.

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. This is probably due to not only the higher percentage of SOM but also the lower BD used to calculate the SOM content. 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. This might be the reason to see higher SOM in the lower layers. Likewise, irrigation tended to keep the amount of organic matter after grazing sod and following winter cover crops, while a decrease of SOM was found under non-irrigated fields (Fig. 6).

Of special importance to producers and consumers is the fate on nitrate-nitrogen in crop and animal products, as well as in the soil profile after harvesting or prior to planting another crop. Both nitrogen deficiency and excess can adversely affect crop yield and water quality. Figure 8 revealed that cattle kept 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. 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 (Fig. 7). Thus, if livestock are available to graze winter grazing less additional N would be needed for the following crop.

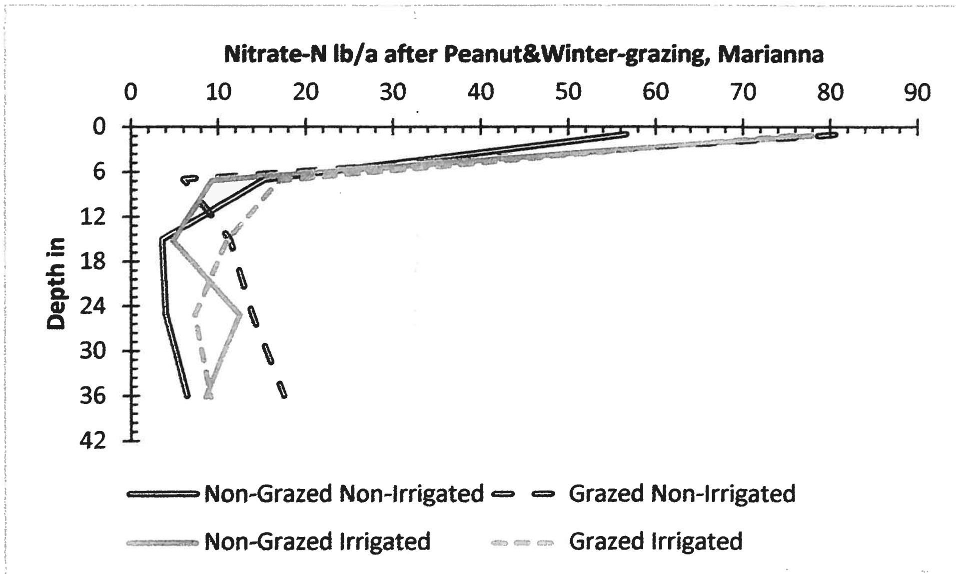



Fig. 7. Soil nitrate with and without grazing in the soil profile

After grazing for 2 years bahia, peanut growing and winter cover crop grazing, a higher P-content tended to occur in the upper soil layer of non-grazed and non-irrigated plots (Fig. 8).

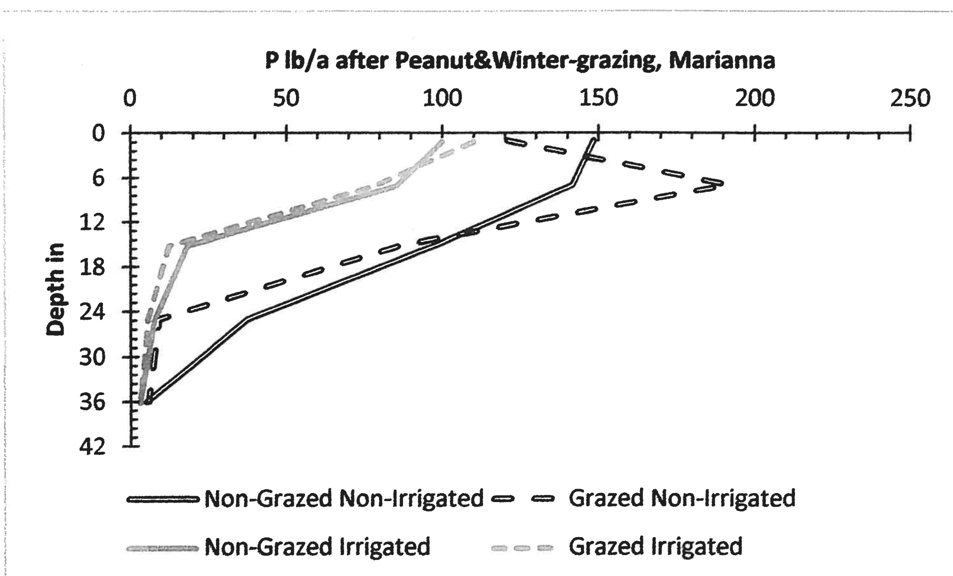



Fig. 8. P content of the soil profile with and without grazing

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 some severe rainfalls 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 (Fig. 9). 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. Whether this is a sing for initial leaching losses needs further research.

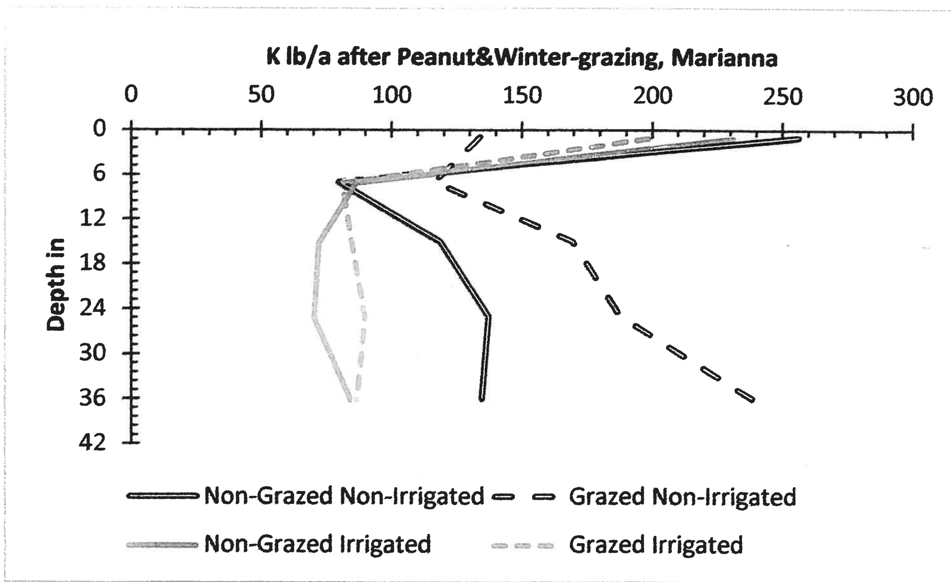



Fig. 9. K in the soil profile with and without winter grazing and irrigated vs. non irrigated.

Yields:

Following are the figures with the peanut yields from 2011. Unexpectedly the peanut yields from both conventional and sod-based rotations in Quincy are higher under no irrigation. Aflatoxin was not detected in any of irrigated or non-irrigated plots. Also, no after effects were observed on the plots with N-fertilizers applied for the previous sod and winter cover crops.

In Marianna however, a significantly higher yield was obtained from irrigated fields, while no differences are detected between grazed and non-grazed areas (Fig. 10). The big differences in the irrigated and non-irrigated are due to the record breaking drought in the county for 2011. One reason might be that the soil nutrients status is balanced and does not appear to be a limiting factor when winter grazing follows an already grazed for two consecutive years bahiagrass. Aflatoxin was also not detected in any of irrigated or non-irrigated plots from both grazed and non-grazed fields.

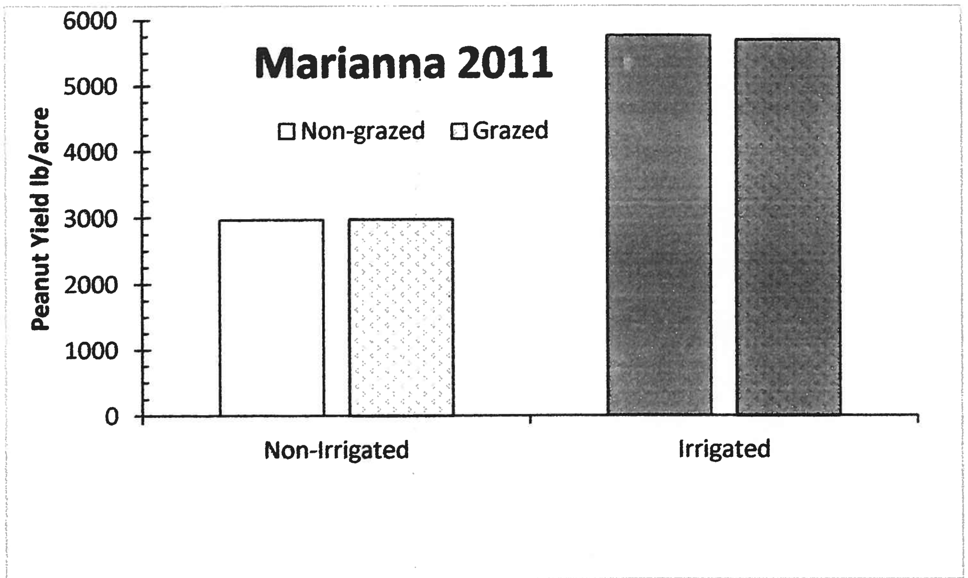



Fig. 10. Peanut yields following grazing or none and irrigation vs. non irrigated