Southeast Dairy Producer's Check-Off Program

Research Summary

Soil Organic Carbon Stocks in Florida Dairies

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Implications

Florida dairies stock, on average, 97 tons of soil organic carbon per ha from 0 to 36" deep. This is an important ecosystem service provided to the entire society. Furthermore, FL dairies recycle back nutrients to their field, improving nutrient cycling and reducing the use of industrial fertilizers, reducing the carbon footprint of their operations. Land use types within each dairy were not significantly different for most of the cases when, however, crop, grazing, and pine tree fields store more N than hay/baleage or low input areas. Florida has approximately 80,000 acres of corn crop and 280,000 acres of hay fields and a large portion of that is dedicated to forage production by the dairy industry. If we assume an average of 43.2 short tons (2,000 lbs.) per acre and we consider 360,000 acres, this represents a carbon stock of 15.5 million tons of carbon stored in the soil from 0 to 36". This is an important ecosystem services provided by FL dairies to the entire society.

Methods

We collected soil samples from 20 Florida Dairy sites across the State of Florida (Figure 1). Farm selection was based on geographical location and willingness of the dairy producer to participate in the project. We selected farms representing North, Central, and South Florida. Within each farm, we collected samples from the following land uses: cropping fields (e.g., corn, sorghum, millet), hay and/or baleage fields with perennial grasses (e.g., bermudagrass, limpograss, bahiagrass), grazing areas, and native vegetation and/or areas with less manage/ inputs. On each land use type, we collected a composite sample formed by 20 subsamples using a random transect in a representative area of the field. Soil samples were collected down to 3 ft. depth, at the following soil layers: 0- to 6-, 6- to 12-, 12- to 36-inch layers. Soil cores were used to determine soil bulk density to estimate soil organic carbon stock. In addition, soil texture of each site was determined within each layer. Soil organic C was determined after acid fumigation to remove

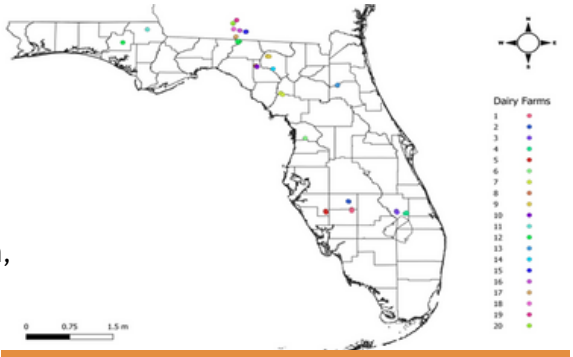

Figure 1. Dairy farms sampled over two years of the project.

carbonates prior to total organic carbon analyzes (Harris et al., 2001). Soil samples from each layer was ball milled in a Mixer Mill MM 400 (Retsch) for 9 min at 25 Hz and analyzed for total carbon using a CHNS analyzer (Vario Micro Cube) and the Dumas combustion method. Soil carbon stock of each land-use type within each farm was estimated by using soil bulk density and soil organic C concentration within each soil layer. Each farm was considered a block. Therefore, we had five land use types as treatments and 20 blocks (each farm was a block). Within each farm, we kept the sites as uniform as possible in terms of soil type using web soil survey from USDA. Statistical analyzes were performed using proc mixed from SAS where land use type was considered a fixed effect and farm site a random effect. Soil layers were considered repeated measures in space. We analyzed SOC and N stocks down to the entire soil profile.

Table 1 - Cumulative soil organic carbon and nitrogen stocks in Florida dairies by layer.

	Crop	Grazing	Hay/Baleage	Low-Input	Pine-tree	P-value
SOC stock (Mg ha-1)						
0-6 in	47.84	47.41	28.19	35.22	47.99	0.550
0-12 in	81.67	75.52	50.19	62.82	94.16	0.399
0-36 in	120.9	98.9	69.9	92.7	103.8	0.525
N stock (Mg ha-1)						
0-6 in	4.86	5.32	2.86	3.62	3.44	0.211
0-12 in	7.55 ab	8.38 a	4.45 c	5.66 bc	5.19 bc	0.074
0-36 in	11.35 a	11.18 a	7.42 b	8.69 b	9.19 a	0.093

Results

The cumulative (0-36 in) soil organic carbon (SOC) did not differ among land uses, averaging 97 Mg ha-1 (43.2 t/acre), with the deep soil layer (12-36 in) representing 25% and 35% of the total SOC and N storages, respectively. (Table 1). Differently, the cumulative N stock was greater in crop, grazing, and pine tree fields compared to hay/baleage or low-input areas ($P < 0.1$). The cumulative SOC of approximately 97 Mg C ha-1 is a very significant amount that indicates the importance of FL Dairies sequestering carbon and providing an important ecosystem service for society by mitigating greenhouse gas emissions. There were differences among land uses regarding soil fertility. Fields under effluent irrigation (hay/ baleage) typically had better soil fertility compared to other areas on the farm. This also demonstrates another important ecosystem service of the dairies by recycling nutrients back to production fields and adding them to the production system while saving on fertilizer costs and reducing carbon emissions related to fertilizer manufacturing. Soil layer also affected the fertility. Overall, the top layer had greater concentration of soil nutrients and soil organic matter. Potassium tended to be better distributed along the soil profile, likely because it is more soluble than P and other nutrients. This also reinforces the need to replenish soil K more frequently in FL sandy soils, especially in harvesting systems, where the K extraction is greater than in grazing conditions

References of Published Work

1. Dubeux, J.C.B., Jr., C. Zhao, L. Garcia, I. Brêtas, L. Queiroz, C. Erazo, J. Harley, A. Zare, Z. Tang. 2024. Soil organic carbon stocks in Florida grazing lands. The Florida Cattleman and Livestock Journal, July 2024, v. 88, n. 10, p.28-32.