# Soil Carbon Stock and Total Nitrogen in Hawaiian Sugarcane Commercial Plantations

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## Introduction

There has been a recent, renewed interest in Hawaiian sugarcane as a biofuel feedstock. However, there is little information on how much soil carbon (C) and nitrogen (N) is stored in Hawaiian sugarcane fields under normal two years monoculture operations. Soil C and N data are needed to assess the life cycle impacts of this biofuel system. Because of lack of quantitative and qualitative information on soil C and N , we collected soil samples from fields with different texture [i.e. sandy clay loam (scl), sandy clay(sc), clay (c), clay loam (cl)], management practices [i.e. burning before harvest (BH) vs. seed fields (SF)], sugarcane varieties (H65-7052 and H87-4319) and sugarcane growing stages. Collected soil samples were dried, ground and analyzed for dissolved organic carbon (DOC), organic (OC), inorganic (IC), total carbon (TC) and total nitrogen (TN).

## Objectives

- Determine textural effect on Soil Organic Storage (SOC) storage and sugarcane variety carbon efficiency over different sugarcane growing stage (tillering, grand growth and maturity).

## Materials and Methods

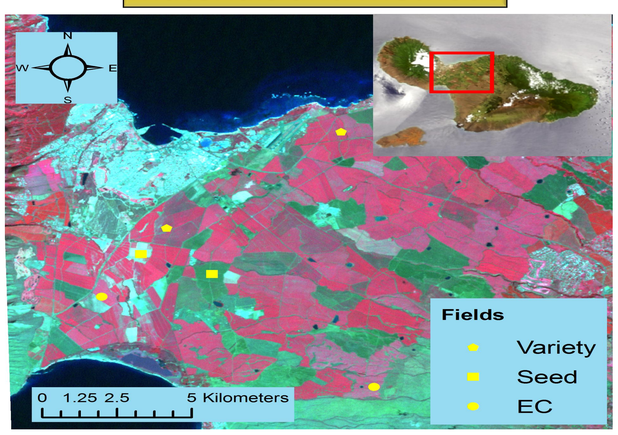


**Photo 1. Map of Maui–Hawaiian Commercial and Sugar Company plantations. Soil samples were collected from the six fields identified with different yellow symbols. The following fields were used for: Eddy Covariance (EC) trail (905 and 415), Sugarcane Variety trial (609 and 719) and Seed fields (911 and 902).**

- Soil samples from four soil depths (0-20, 20-40, 40-80 and 80-120 cm) were collected from six HC&SC fields (Photo1) to establish and compared SOC and sugarcane variety efficiency (Photo 2) over time [growth stage: tillering (15 d- 4 mo. DAP), grand growth (5-8 mo. DAP) and maturity (9-12 mo. DAP)].

**Photo 2.Collection of soil samples**

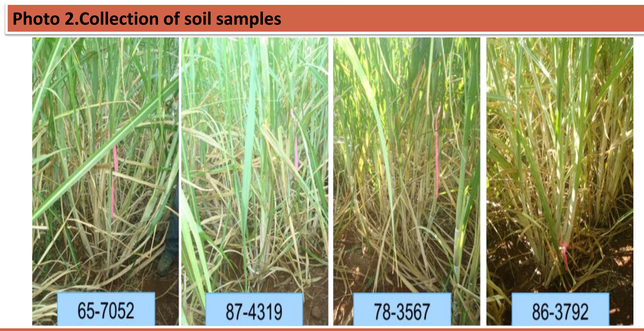


**Photo 3. Four Hawaiian sugarcane varieties used for the variety trials (F 719 and 609)**

- Total N and C (Organic and Inorganic) contents were determined by dry combustion with a Flash 2000 N & C Soil Analyzer from Thermo Scientific®.

- DOC was determined after saturating the soil with DI water (1:1 soil: water) for 24 hours, shaking for a one hour on a reciprocal shaker, and filtered through a Whatman, no. 42 filter. Carbon recovered in the water extract was determined by using Fusion Total Organic Carbon Analyzer from Teledyne Tekmar.

## Results

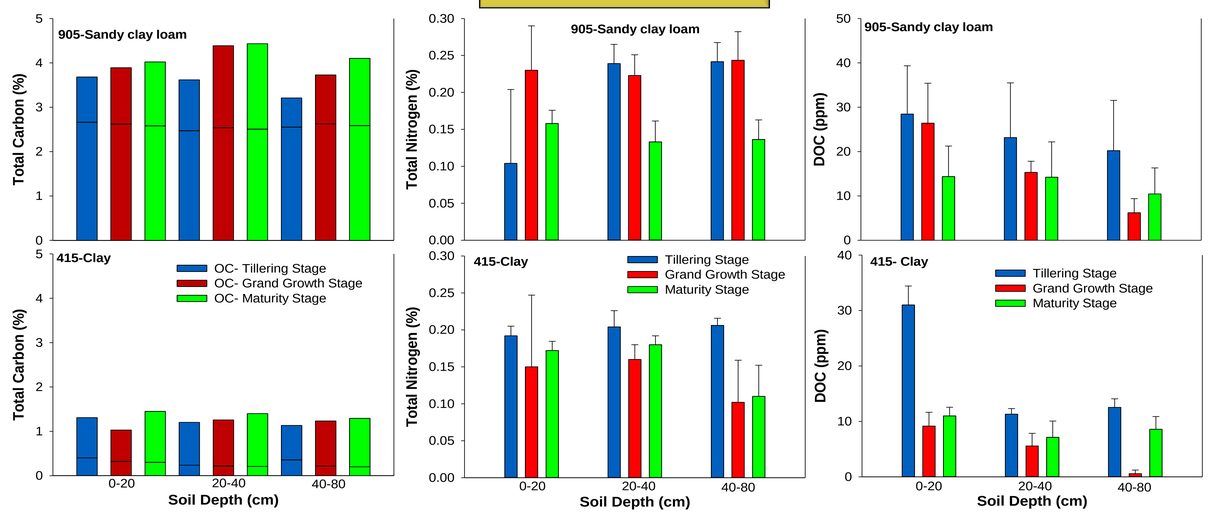


**Figure 1. Vertical distribution of Total Carbon (Organic and Inorganic Carbon) and Total Nitrogen and Dissolved Organic Carbon (DOC) of soils collected from Eddy Covariance (EC) trail fields . For these two fields H 65-7052 sugarcane variety was planted. Error bars are standard errors of the mean value (n=6).**

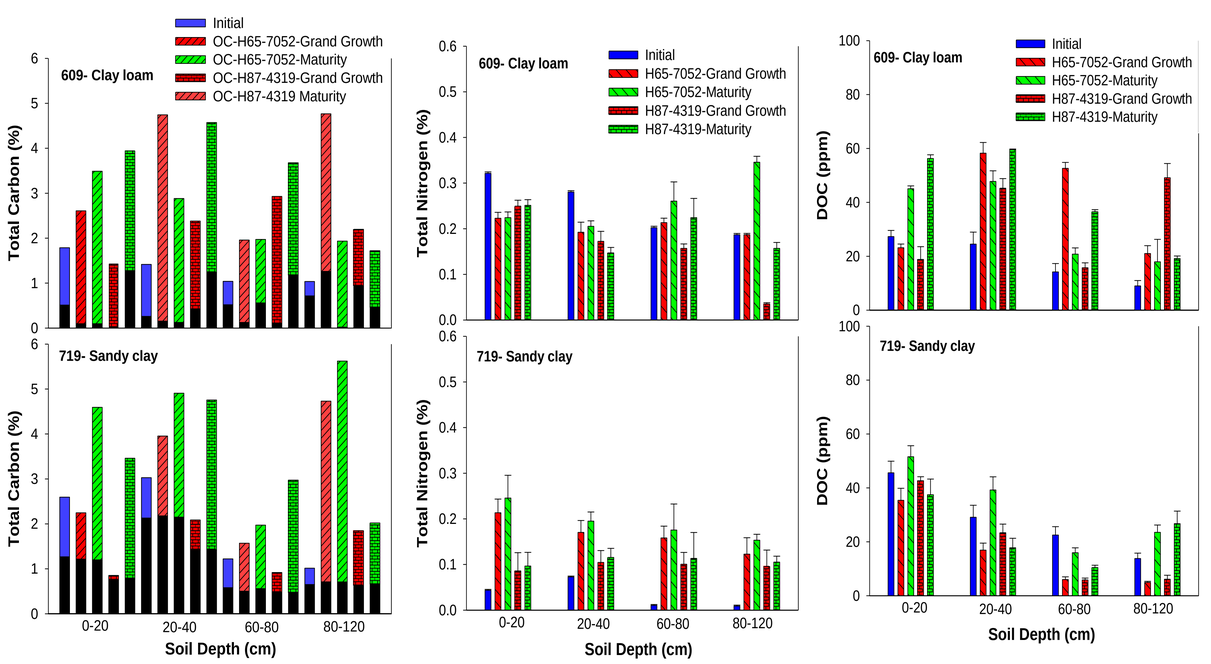


**Figure 2. Vertical distribution of Total Carbon (Organic and Inorganic Carbon) and Total Nitrogen, and Dissolved Organic Carbon (DOC) of soils collected from Sugarcane Variety trial fields. Error bars are standard errors of the mean value (n=3).**

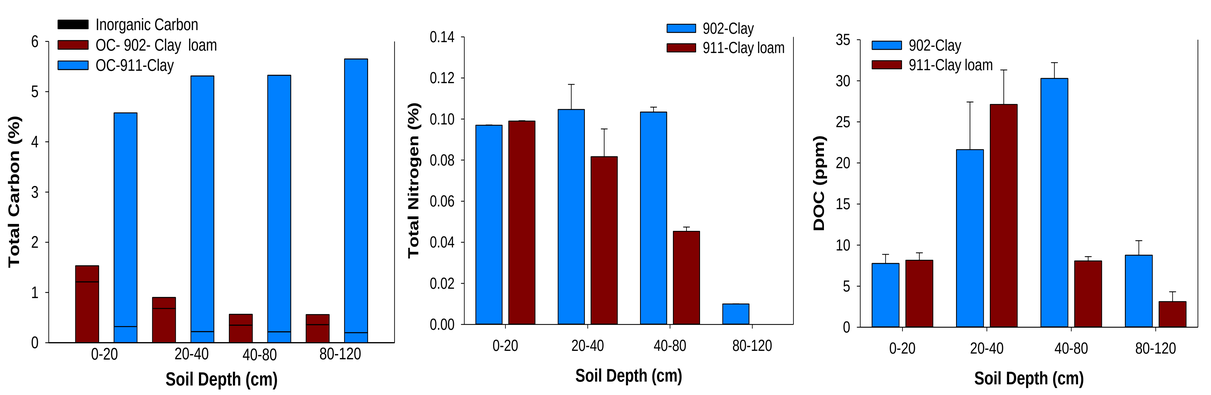


**Figure 3. Vertical distribution of Total Carbon (Organic and Inorganic Carbon) and Total Nitrogen, and Dissolved Organic Carbon (DOC) of soils collected from Seed fields. The Hawaiian sugarcane varieties planted on : Field 902 (clay)- H87-4319 and Field 911 (Clay loam)-H65-7052. Error bars are standard errors of the mean value (n=6).**

## Discussion

### Eddy Covariance Fields

For these fields (905 and 415) we were only able to collect soil samples up to 80 cm due to a restrictive layer (Figure 1).

- **TC Results**- Field 905-(scl) has higher TC (IC form) compared with 415-(c) under (BH) practices. In addition, both fields were found to have a slight increase in OC with respect to growth stage due to root presence.

- **TN Results-** Field 905-(scl) showed has lower TN during the maturity stage compared with other two stages. However, there was no consistent response on Field 415-(c).

- **DOC Results-** Lower DOC was observed on Field 415 compared with Field 905.

### Sugarcane Variety Fields

Two varieties were chosen for data interpretation (Figure 2).

- **TC Results** - Field 719-(scl) has higher IC compared with Field 609-(cl).

- **TN and DOC Results -** No consistent response is observed in both sugarcane variety fields for the different sugarcane varieties.

### Seed Fields

Soil samples were collected from these fields at the maturity growth stage (Figure 3)

- **TC Results-** Field 902-(c) had higher TC (OC form) compared with Field 911-(cl).

- **Total Nitrogen Results -** Field 911-(cl) had a reduction in TN with respect to soil depth. However, there was no consistent response in Field 902-(c).

- **DOC Results -** Higher DOC was found on Field 902-(c) compared with Field 911-(cl) on all soil depths.

## Conclusion

The research is ongoing and additional results will help further elucidate soil C and N status for the two year growing environment.

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