

# Effect of Fresh and Composted Organic Amendment on Soil Compaction and Soil Biochemical Properties of Citrus Orchards in the Mekong Delta, Vietnam

Vo Thi Guong<sup>A</sup>, Ngo Xuan Hien<sup>A</sup>, Duong Minh<sup>B</sup>

<sup>A</sup>Soil Science Department, College of Agriculture&Applied Biology, Cantho University, Email [vtguong@ctu.edu.vn](mailto:vtguong@ctu.edu.vn)

<sup>B</sup>Plant protection Department, College of Agriculture&Applied Biology, Cantho University, Email [dminh@ctu.edu.vn](mailto:dminh@ctu.edu.vn)

## Abstract

The objectives of this study were to evaluate the degree of soil degradation and the effect of organic amendment on improving soil properties and fruit yield of citrus orchards on alluvial soil. Sixty raised beds of citrus orchards were selected in a range of age from less than 10 years, 12-18 years, 22-28 years and 30 years. Soil samples were collected and analyzed for selected soil properties. The effects of 10 t ha<sup>-1</sup> sugarcane filter cake compost plus *Trichoderma* spp. and 20 t ha<sup>-1</sup> of fresh *Tithonia diversifolia* were studied in orange orchards where the raised beds had been constructed for more than 26 years. Both these organic treatments were combined with recommended inorganic fertilizer (250gN-200g P<sub>2</sub>O<sub>5</sub> -120g K<sub>2</sub>O.plant<sup>-1</sup>), and compared with usual farmer practice (628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>). Soil analyses indicated that soil degradation occurred in 30 year old raised beds constructed. Soil aggregate stability was low and soil strength resistance was in the range of soil compaction. Soil organic matter, cation exchange capacity (CEC), and base saturation percentage were low compared to other raised beds (P<0.05). Amendment with sugarcane filter cake compost (plus *Trichoderma* spp.) and fresh *Tithonia diversifolia* led to an increase soil organic matter content, available nitrogen and phosphorus, CEC, percentage base saturation, soil respiration, soil aggregate stability and to reduced soil compaction (P<0.05). Fruit yield was also improved with both treatments compared with the farmers usual practice, which gave low fruit yield (P<0.05) and resulted in poor soil quality in terms of soil physical and chemical properties. While both treatments enhanced fruit yield, the application of 10t.ha<sup>-1</sup> of sugarcane filter cake was more effective than the application of 20 t ha<sup>-1</sup> of fresh *Tithonia diversifolia*.

## Key Words

Soil degradation, organic amendment, soil compaction, citrus fruit yield

## Introduction

Adding fresh and composted organic substrates usually has beneficial effects on soil aggregate stability, humification and microbial activity (Bipfubusa et al., 2008). This study was carried out to clarify whether there was soil degradation in old raised beds citrus and whether fresh and composted organic substrate could improve soil physical chemical properties and fruit yield in orange orchards.

## Methodology

Soil survey and soil sampling were carried out on sixty raised beds in citrus orchards that had been constructed for less than 10 years, 12- 18 years, 22-28 years and more than 30 years. Soil samples were analyzed for soil strength resistance, soil aggregate stability and some selected chemical properties. Four treatments were applied, with three replicates per treatment, arranged in a complete randomized block design: 1)10 Mg.ha<sup>-1</sup> sugarcane filter cake compost (plus *Trichoderma* spp. Fungi); 2) 20 Mg. ha<sup>-1</sup> of fresh *Tithonia diversifolia* plus reduced inorganic fertilizer; 3) Reduced inorganic fertilizer (250gN-200g P<sub>2</sub>O<sub>5</sub> - 120g K<sub>2</sub>O.plant<sup>-1</sup>); 4) A control treatment representing the usual farmers' practice (628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>). The changes of soil properties and fruit yield were recorded.

## Results

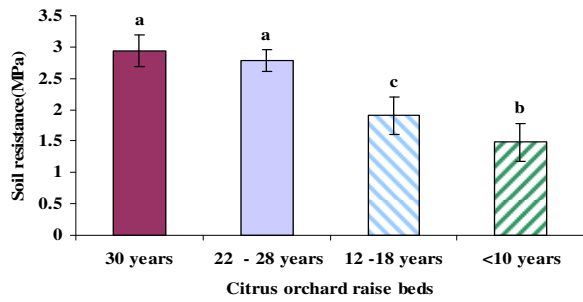


Figure 1. Soil compaction in raised beds of citrus orchards constructed for various lengths of time.

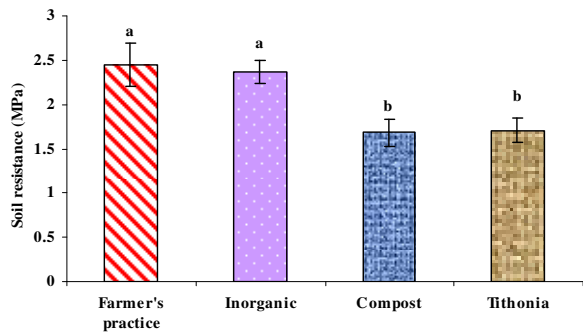


Figure 2. Effect of fresh *Tithonia* and sugarcane filter cake compost amendment on soil compaction in an orange orchard. Treatments: Compost -10 t ha<sup>-1</sup> sugarcane filter cake compost ; Tithonia - 20 t ha<sup>-1</sup> of fresh *Tithonia* ; Inorganic fertilizer - 250gN-200g P<sub>2</sub>O<sub>5</sub> -120g K<sub>2</sub>O.plant<sup>-1</sup>; Farmers' practice - 628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>.

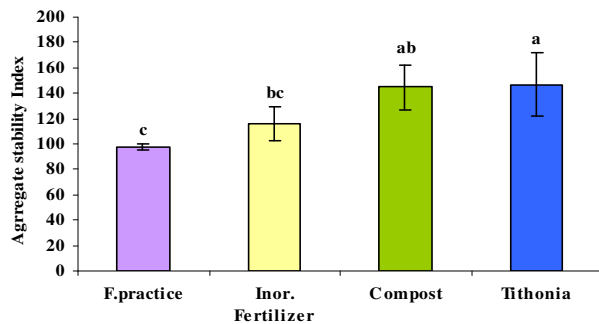


Figure 3. Effect of fresh *Tithonia* and sugarcane filter cake compost amendment on aggregate stability of soil. Treatments: Compost -10 t ha<sup>-1</sup> sugarcane filter cake compost ; Tithonia - 20 t ha<sup>-1</sup> of fresh *Tithonia* ; Inorganic fertilizer - 250gN-200g P<sub>2</sub>O<sub>5</sub> -120g K<sub>2</sub>O.plant<sup>-1</sup>; Farmers' practice - 628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>.

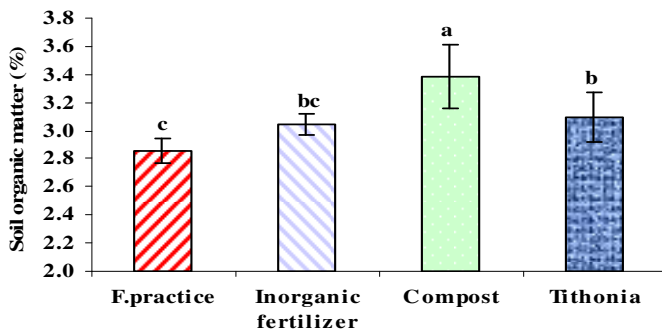


Figure 4. Effect of fresh *Tithonia* and sugarcane filter cake compost on soil organic matter. Treatments: Compost - 10 t ha<sup>-1</sup> sugarcane filter cake compost ; Tithonia - 20 t ha<sup>-1</sup> of fresh *Tithonia* ; Inorganic fertilizer - 250gN-200g P<sub>2</sub>O<sub>5</sub> -120g K<sub>2</sub>O.plant<sup>-1</sup>; Farmers' practice - 628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>.

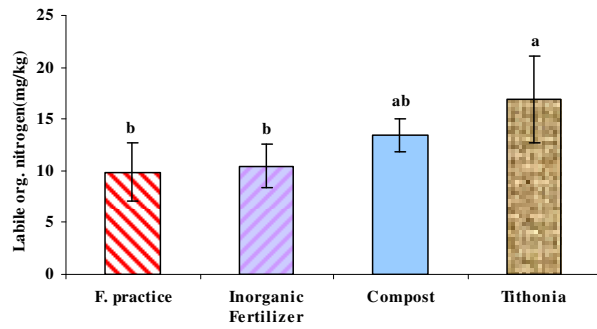


Figure 5. Effect of fresh *Tithonia* and sugarcane filter cake compost on labile organic nitrogen in soil.

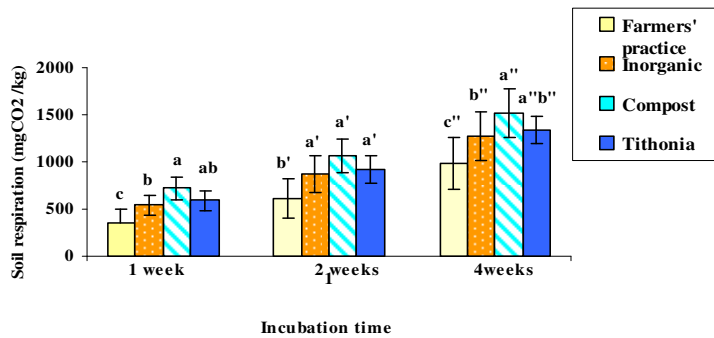


Figure 6. Effect of fresh *Tithonia* and sugarcane filter cake compost on soil respiration.

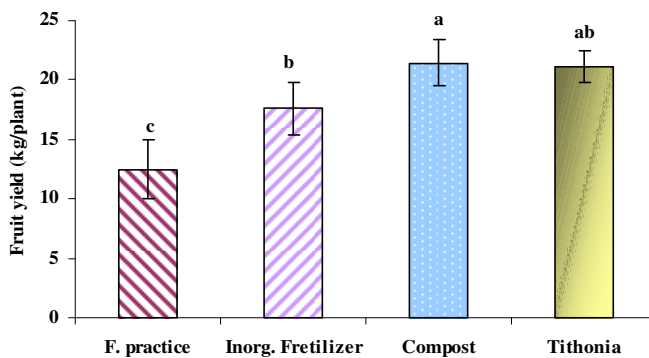


Figure 7. Effect of fresh *Tithonia* and sugarcane filter cake compost on orange fruit weight per plant. Treatments: Compost - 10 t ha<sup>-1</sup> sugarcane filter cake compost ; *Tithonia* - 20 t ha<sup>-1</sup> of fresh *Tithonia* ; Inorganic fertilizer - 250gN-200g P<sub>2</sub>O<sub>5</sub> -120g K<sub>2</sub>O.plant<sup>-1</sup>; Farmers' practice - 628g N-327g P<sub>2</sub>O<sub>5</sub> - 64g K<sub>2</sub>O.plant<sup>-1</sup>.

## Conclusion

Old raised beds of orange orchards and high dosage of inorganic fertilizer used in the past lead to soil physical and chemical degradation. Soil amendment with fresh *Tithonia* and compost, which returned carbon to the soil, resulted in reduced soil compaction, increased aggregate stability, enhanced soil respiration, increased soil organic matter and labile organic nitrogen, and therefore increased fruit yield significantly.

## Reference

Bipfubusa M, Angers DA, N'Dayegamiye A, Antoun H(2008) Soil aggregation and biochemical properties following the application of fresh and composted organic amendments. *Soil Science Society of America Journal* 72, 160-166.