

# **Variability of selected physical and chemical soil quality parameters under conservation agriculture production systems in the Philippines**

*by*

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# **OBJECTIVE**

**To determine and analyze the variability of selected physical and chemical soil quality parameters under conservation agriculture production systems (CAPS) in the Philippines.**

# The Research Site



Claveria,  
Misamis Oriental

# CAPS Treatments

	<b>Cropping pattern</b>
T1	Arachis Pintoï + Maize- Maize + Arachis pintoï
T2	Maize + Stylosanthes – Stylosanthes-fallow
T3	Maize+cowpea - Upland rice +cowpea
T4	Maize+Rice bean-Maize+Rice bean
T5	Cassava + Stylosanthes-Cassava+Stylosanthes
T6	Maize-maize (conventional plow-based) (control)

	<b>Fertility Level</b>
F0	120-60-60 for N, P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O
F1	60-30-30 for N, P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O

# The Research Site



December 2010



February 2011



April 2011



June 2011

# The Research Site



August 2012

# The Research Site



June 2013



September 2013

# The CAPS Treatments





# Soil Sampling



# Laboratory Analysis



**UPLB CEAT Hydraulic and Soils Lab and Soil Sci Lab**

# TDR Soil Moisture Retention Measurement

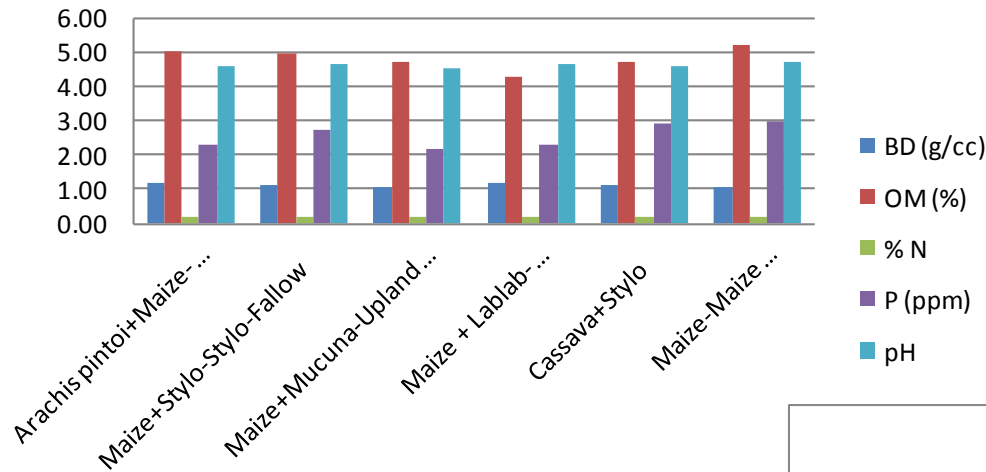


# Results

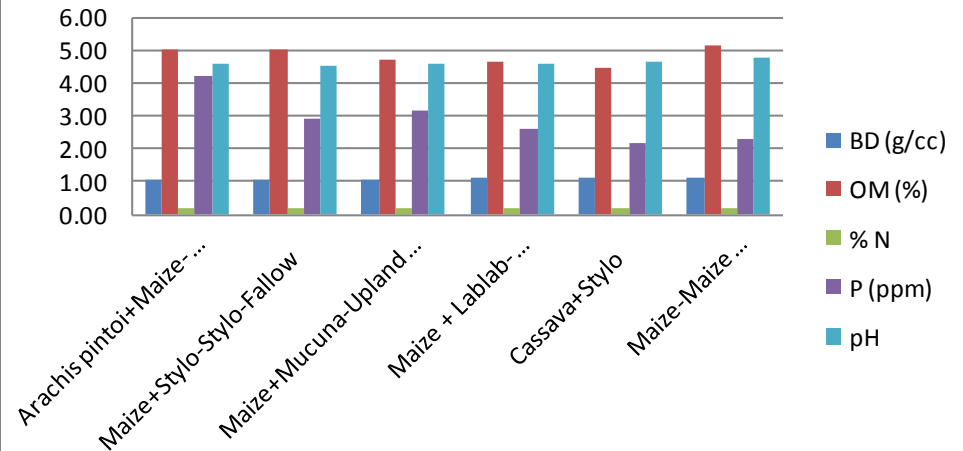
# **Selected Soil Quality Parameters (OM, BD, N, P and pH)**

# Physical & Chemical Soil Quality Parameters (2010, Baseline)

## All soil layers, F0

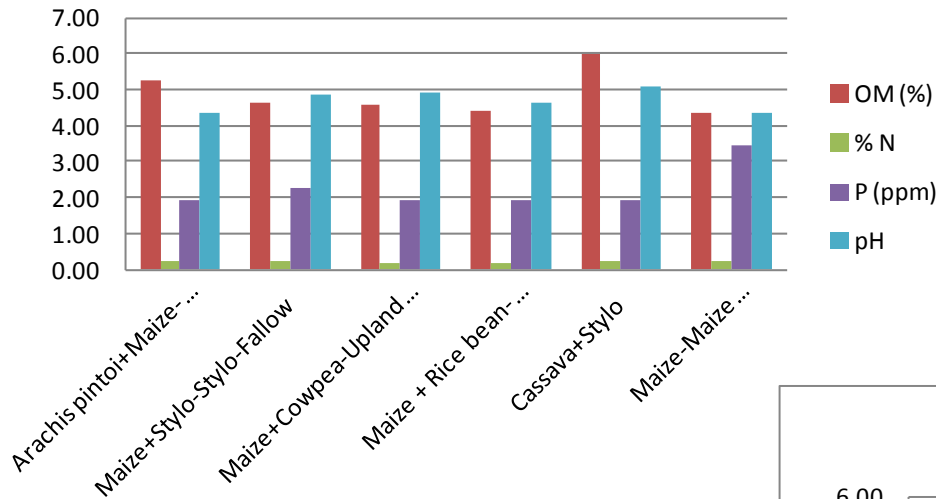


## All soil layers, F1

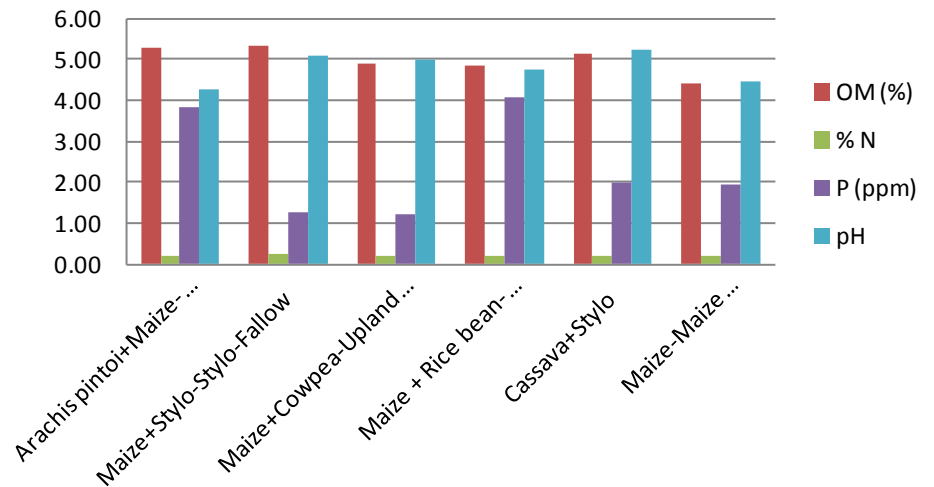


# Physical & Chemical Soil Quality Parameters (2011)

## All soil layers, F0

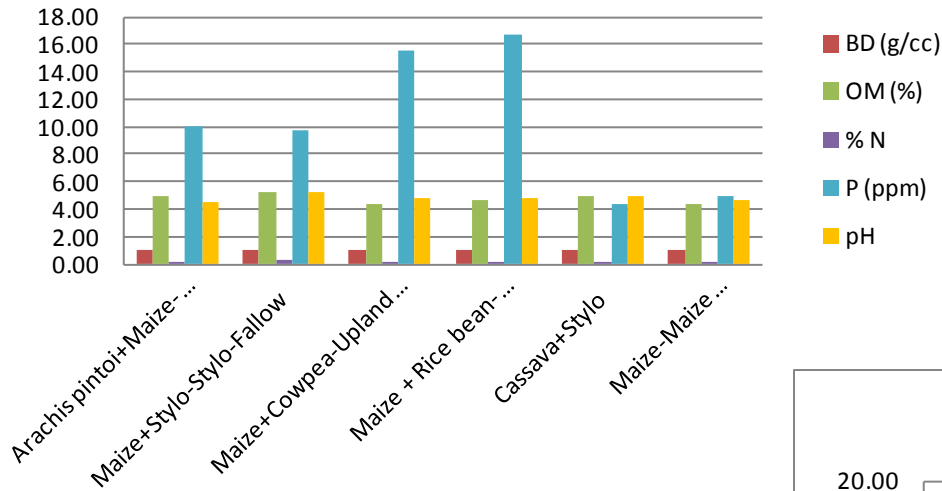


## All soil layers, F1

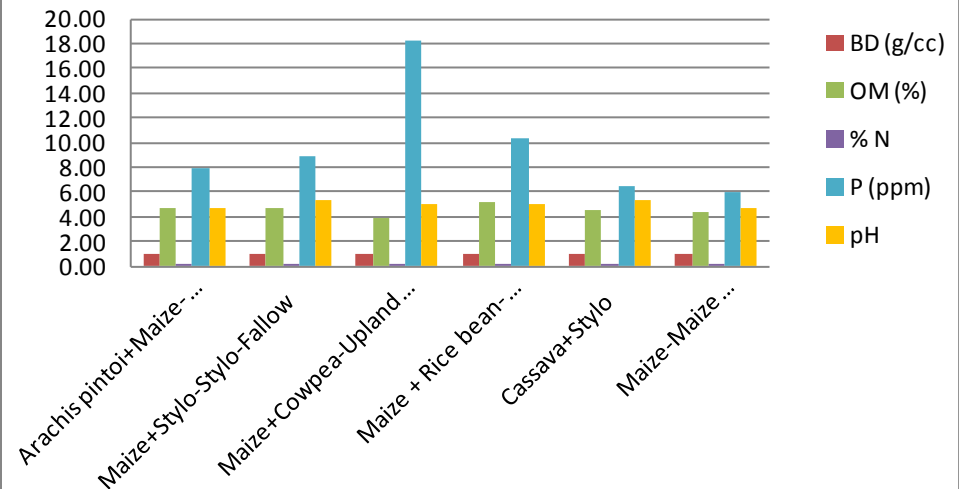


# Physical & Chemical Soil Quality Parameters (2012)

## All soil layers, F0



## All soil layers, F1

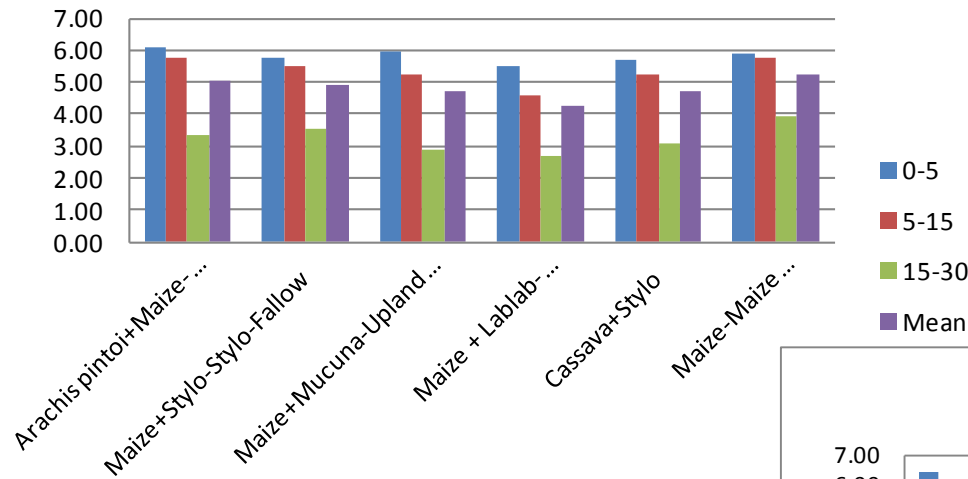




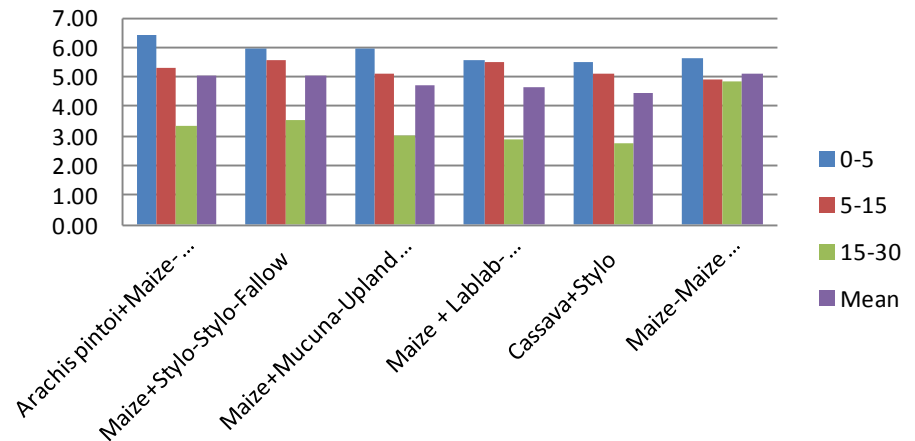
# **Soil Organic Matter**

# Soil Organic Matter at Various CAPS (2010, Baseline)

## Soil Organic Matter (%) @ F0

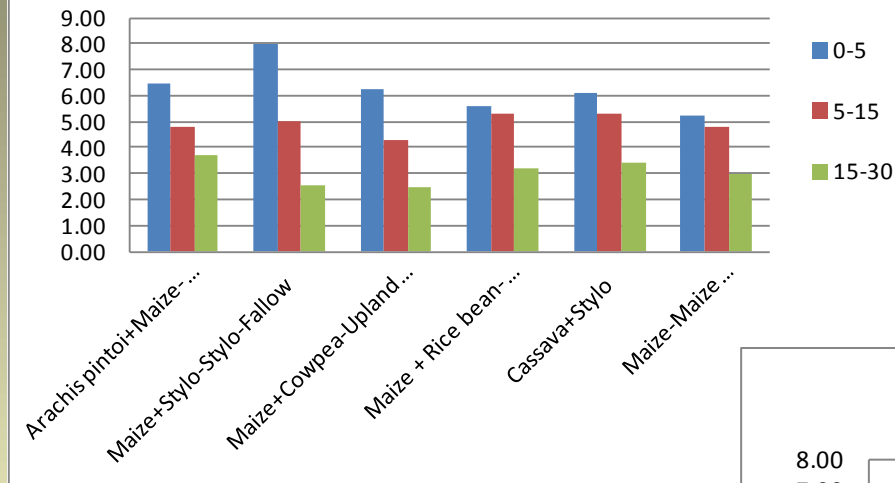


## Soil Organic Matter (%) @ F1

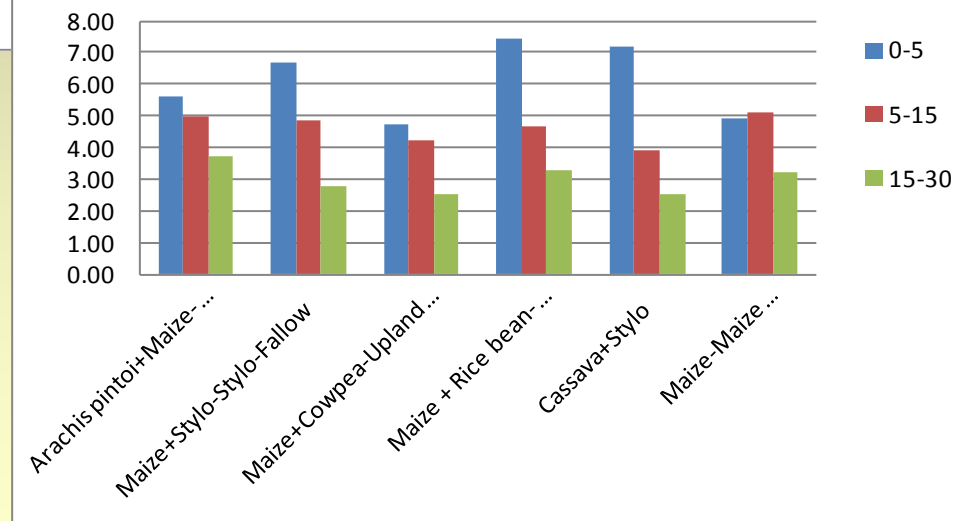


# Soil Organic Matter at Various CAPS (2012)

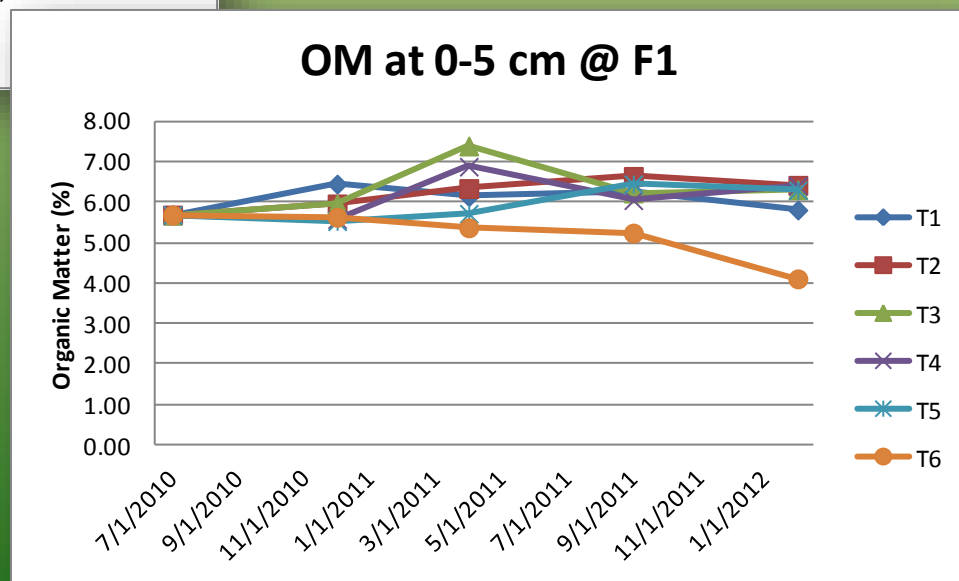
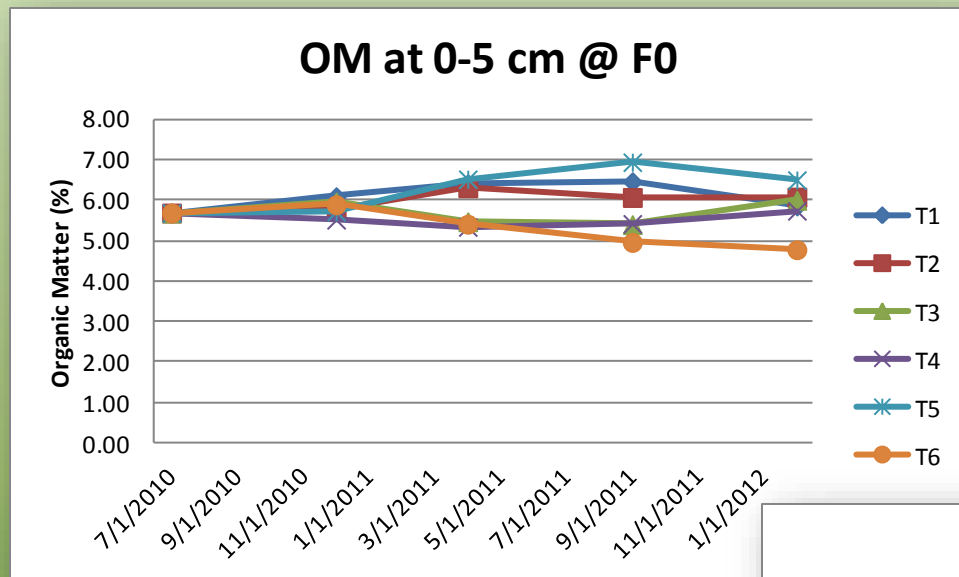
## Soil Organic Matter (%) @ F0



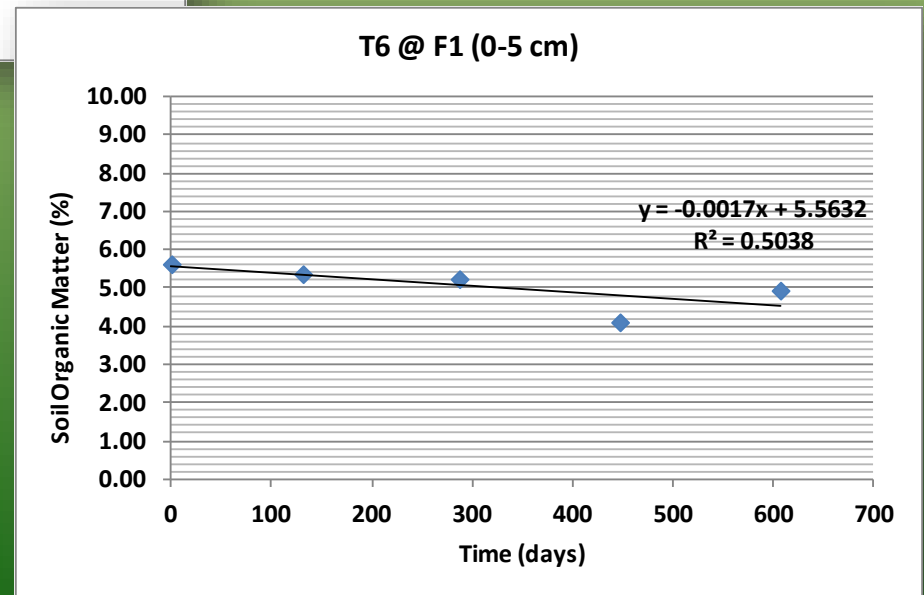
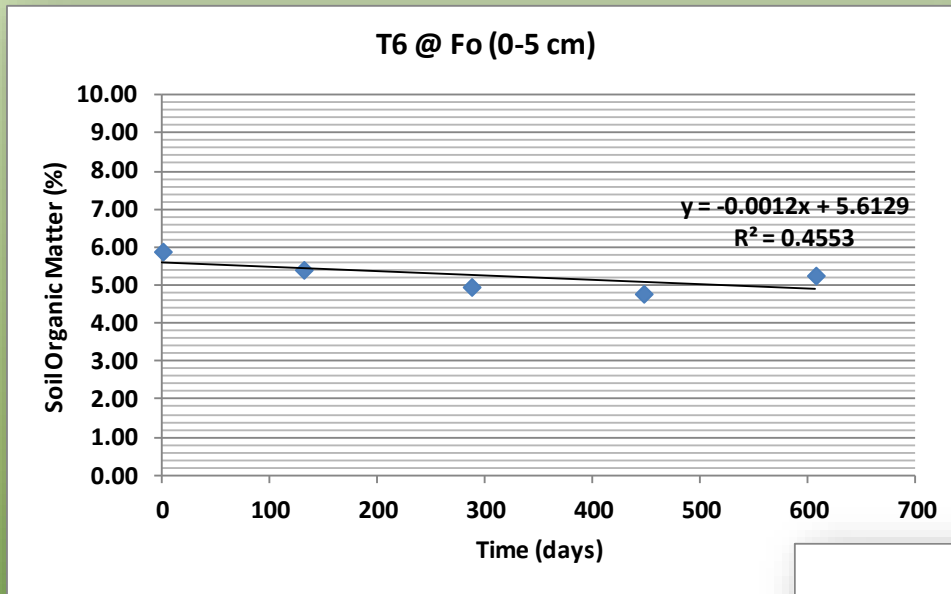
## Soil Organic Matter (%) @ F1



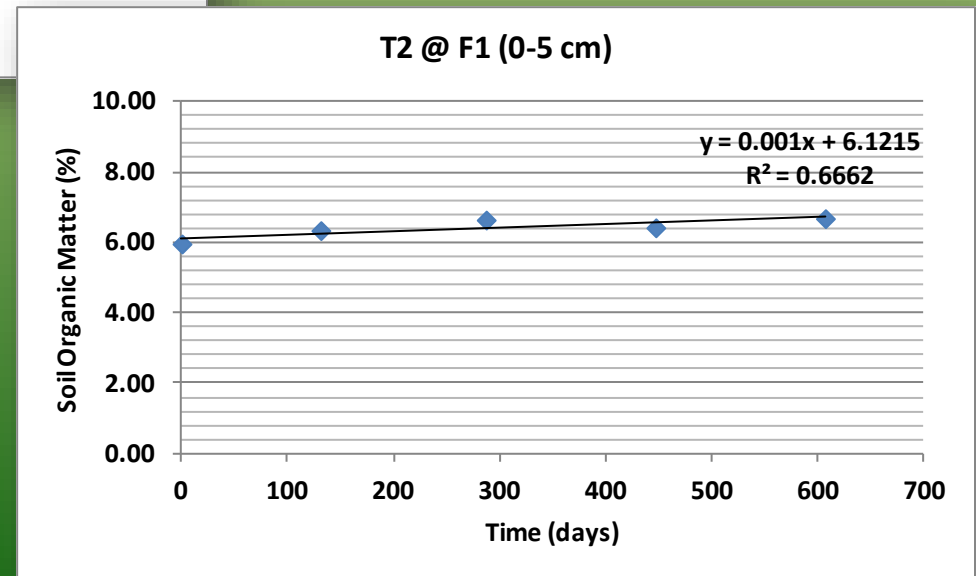
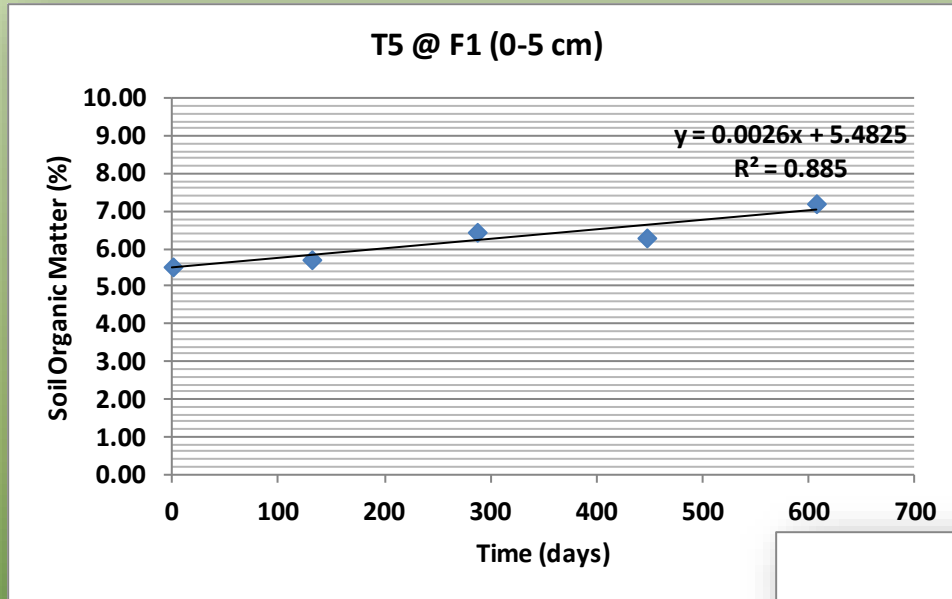
# Temporal Variation of Soil Organic Matter



# Temporal Variation of Soil Organic Matter at Plow-Based System (T6)



# Temporal Variation of Soil Organic Matter at Best CAPS



# Regression Analysis of the Temporal Variation of Soil Organic Matter

F0

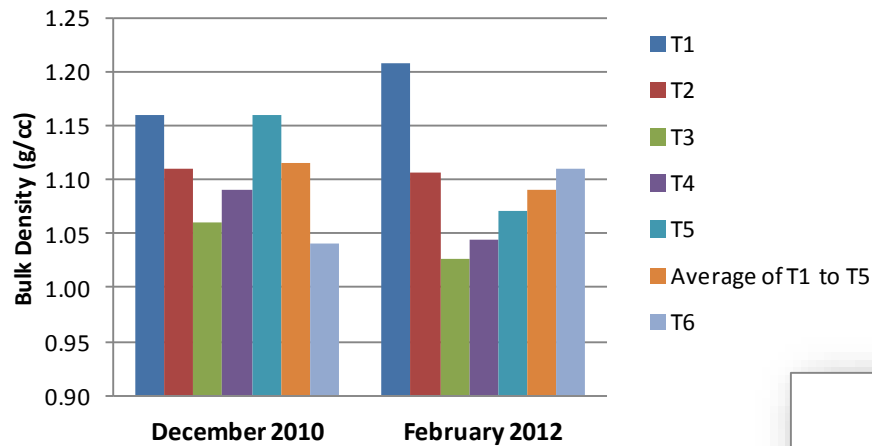
Treatment	Regression Equation	R <sup>2</sup>
T1	$y = 8E-05x + 6.2278$	0.006
T2	$y = 0.0028x + 5.6285$	0.573
T3	$y = 0.0008x + 5.583$	0.275
T4	$y = 0.0004x + 5.4106$	0.365
T5	$y = 0.0004x + 6.2309$	0.051
T6	$y = -0.0012x + 5.6129$	0.455

F1

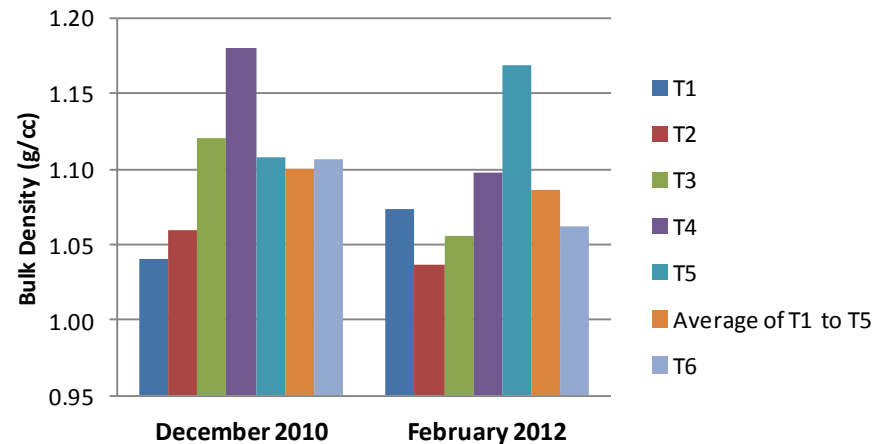
Treatment	Regression Equation	R <sup>2</sup>
T1	$y = -0.0013x + 6.441$	0.875
T2	$y = 0.001x + 6.1215$	0.666
T3	$y = -0.0024x + 6.8338$	0.377
T4	$y = 0.0021x + 5.8558$	0.495
T5	$y = 0.0026x + 5.4825$	0.885
T6	$y = -0.0017x + 5.5632$	0.504

# Soil Bulk Density (2010 vs. 2012)

## Soil Bulk Density at 0-5 cm @ F0



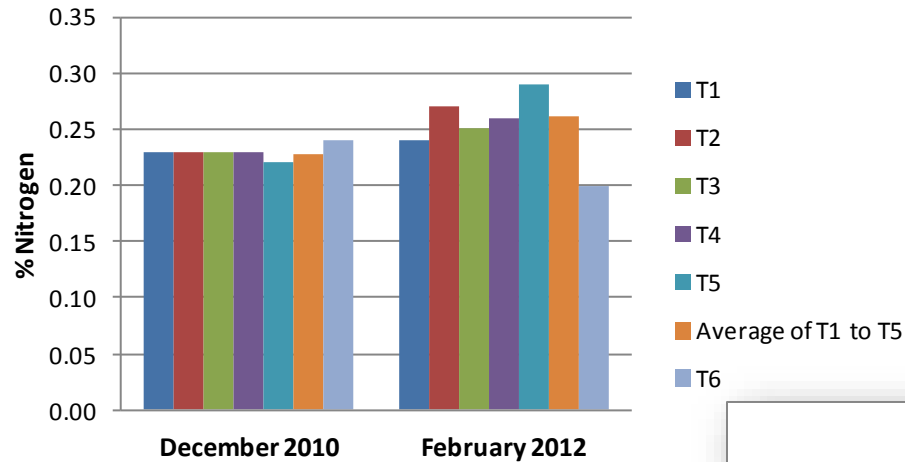
## Soil Bulk Density at 0-5 cm @ F1



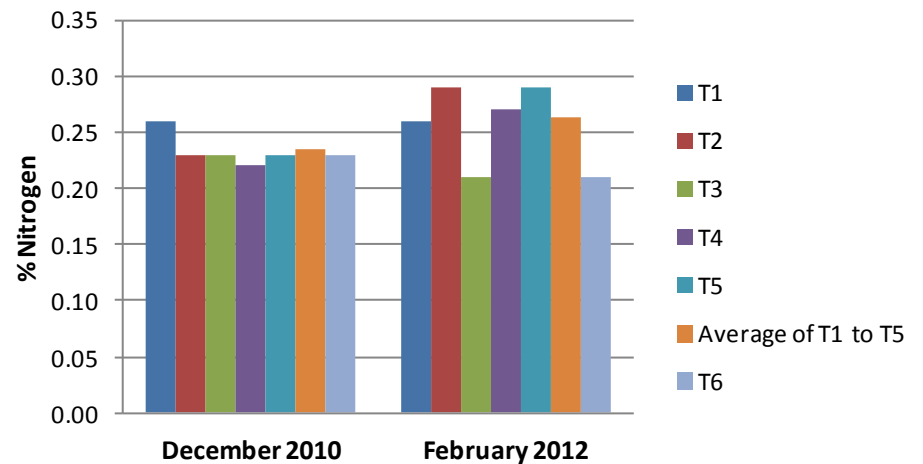


# Soil Nitrogen (2010 vs. 2012)

## Soil Nitrogen at 0-5 cm @ F0

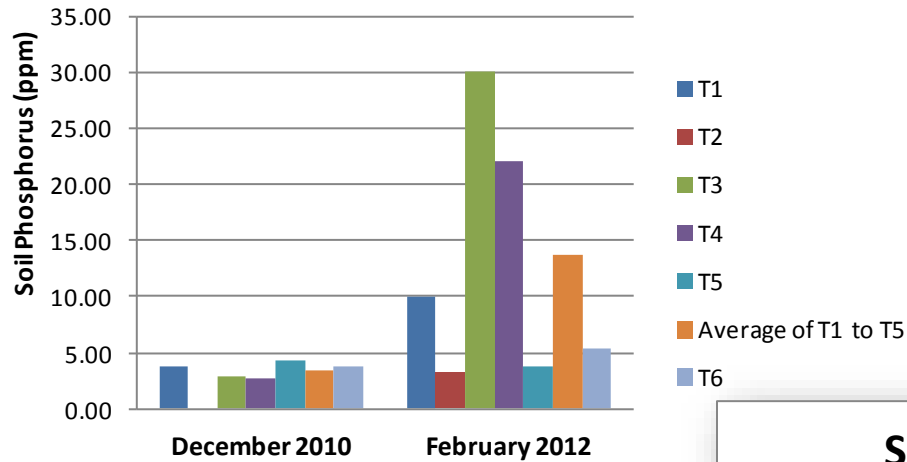


## Soil Nitrogen at 0-5 cm @ F1

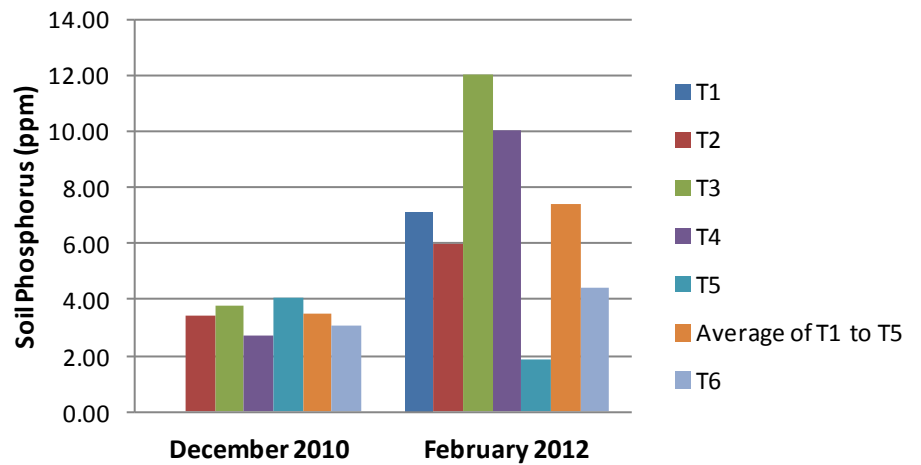


# Soil Phosphorus (2010 vs. 2012)

## Soil Phosphorus at 0-5 cm @ F0

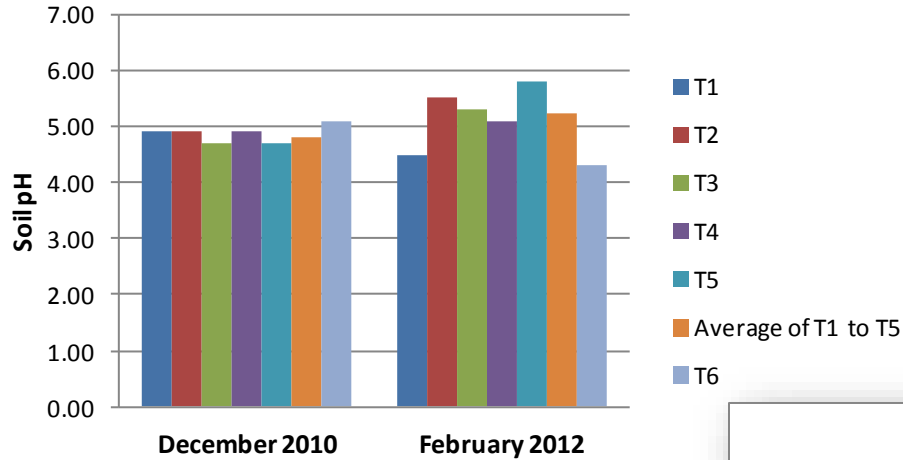


## Soil Phosphorus at 0-5 cm @ F1

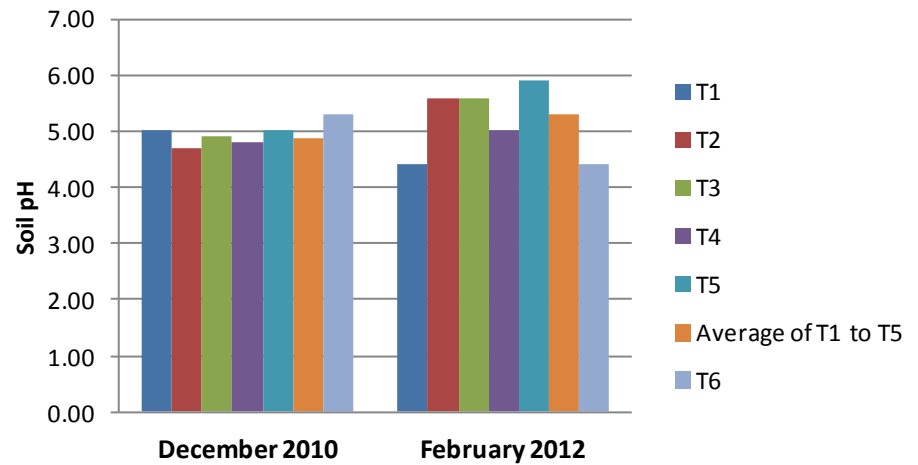


# Soil pH (2010 vs. 2012)

## Soil pH at 0-5 cm @ F0

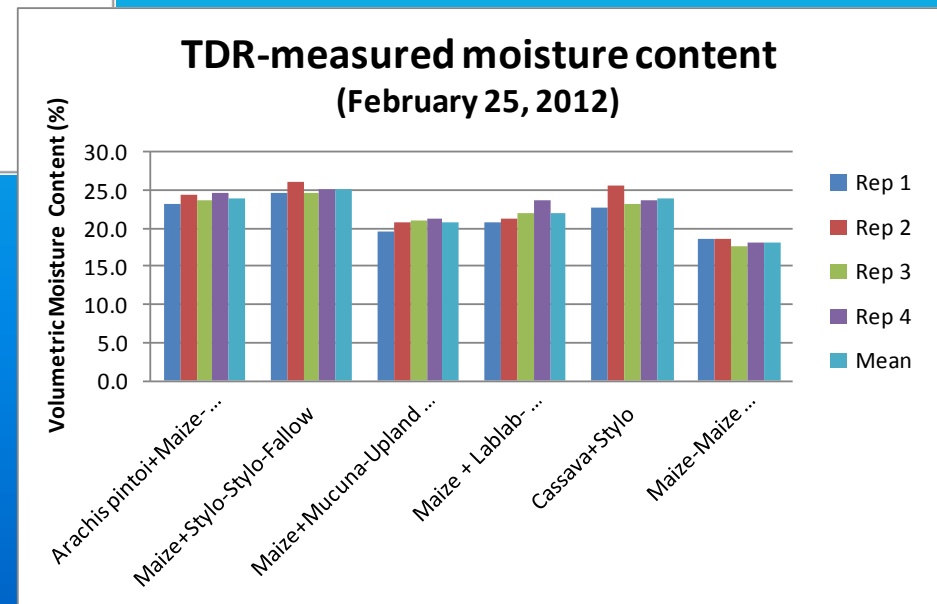
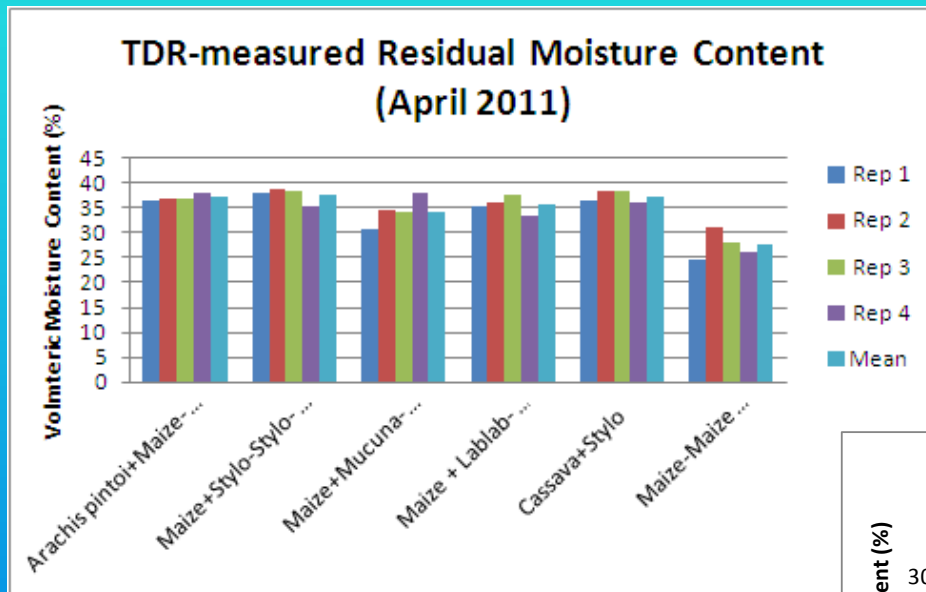


## Soil pH at 0-5 cm @ F1

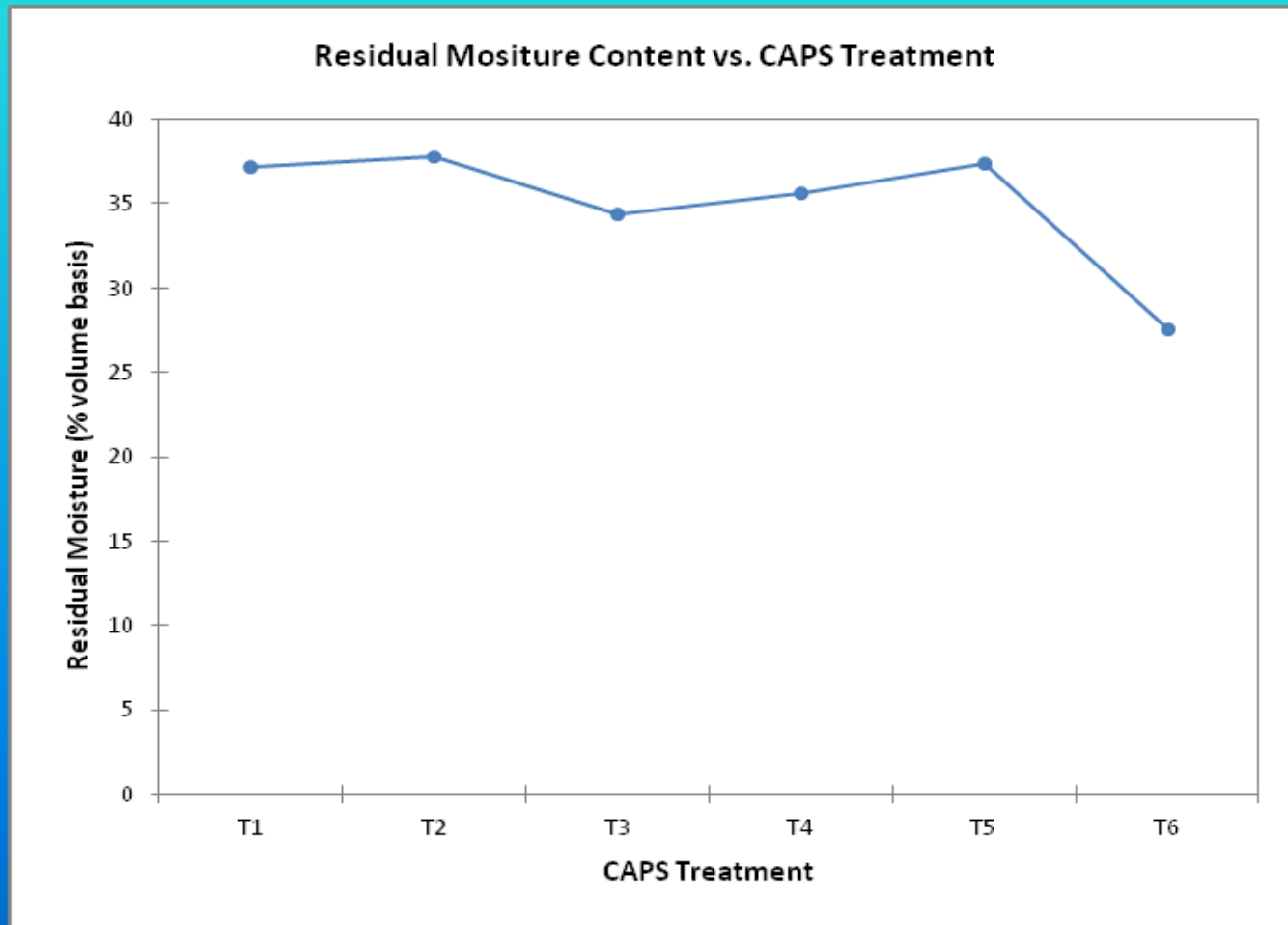


# **Residual Soil Moisture from TDR Measurements**

# TDR-measured Residual Moisture Content



# TDR-measured Residual Moisture Content



# TDR-measured Residual Moisture Content

Tukey (HSD) / Analysis of the differences between the categories with a confidence interval of 95%

Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
T2 vs T6	10.200	7.219	3.178	< 0.0001	Yes
T2 vs T3	3.425	2.424	3.178	0.200	No
T2 vs T4	2.100	1.486	3.178	0.677	No
T2 vs T1	0.625	0.442	3.178	0.997	No
T2 vs T5	0.375	0.265	3.178	1.000	No
T5 vs T6	9.825	6.953	3.178	< 0.0001	Yes
T5 vs T3	3.050	2.159	3.178	0.303	No
T5 vs T4	1.725	1.221	3.178	0.821	No
T5 vs T1	0.250	0.177	3.178	1.000	No
T1 vs T6	9.575	6.777	3.178	< 0.0001	Yes
T1 vs T3	2.800	1.982	3.178	0.389	No
T1 vs T4	1.475	1.044	3.178	0.897	No
T4 vs T6	8.100	5.733	3.178	0.000	Yes
T4 vs T3	1.325	0.938	3.178	0.931	No
T3 vs T6	6.775	4.795	3.178	0.002	Yes

Tukey's d critical value: 4.495

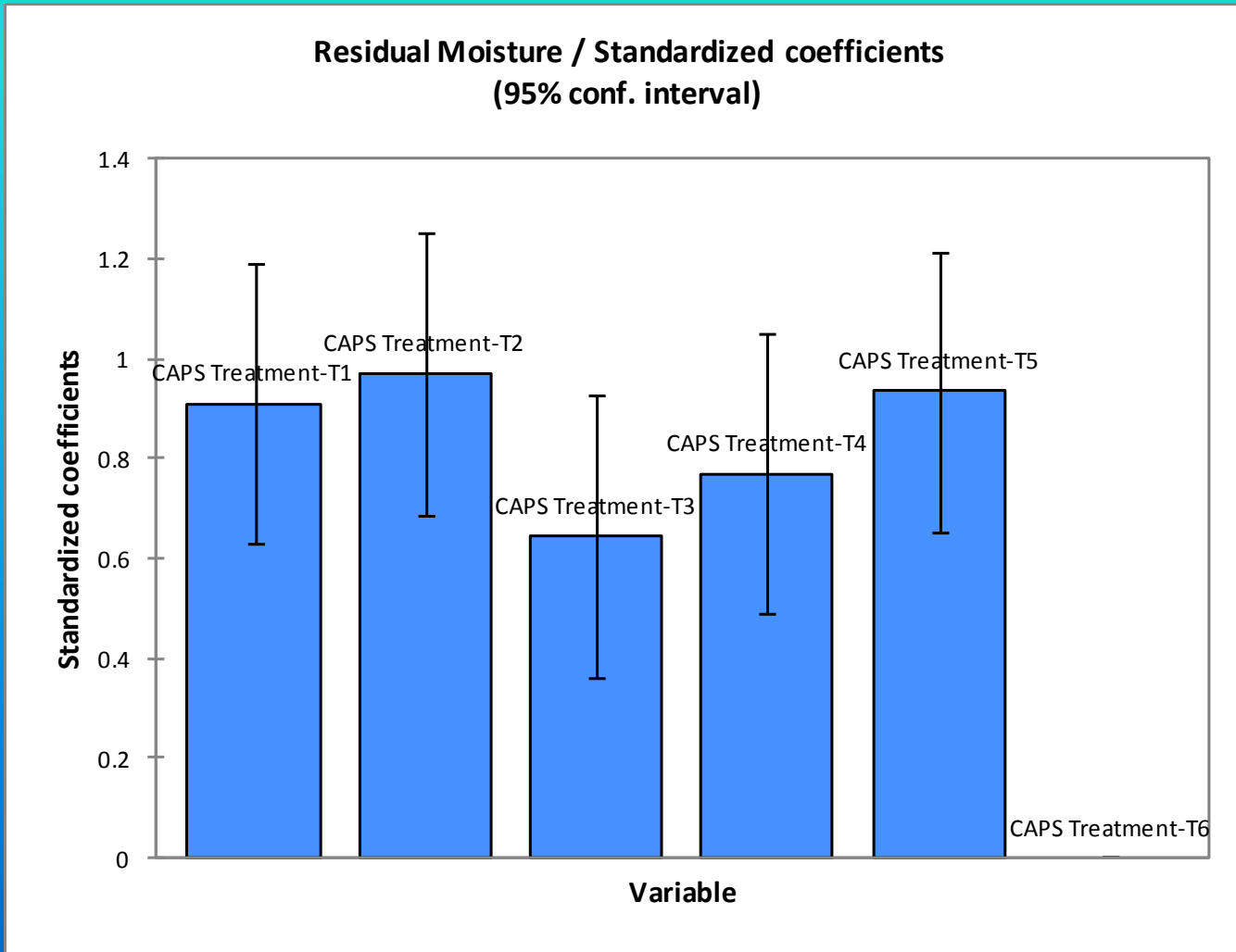
# TDR-measured Residual Moisture Content

Dunnett (two sided) / Analysis of the differences between categories

Category	Difference	Standardized difference	Critical value	Critical difference	Pr > Diff	Significant
T6 vs T2	-10.200	-7.219	2.761	3.902	0.000	Yes
T6 vs T5	-9.825	-6.953	2.761	3.902	0.000	Yes
T6 vs T1	-9.575	-6.777	2.761	3.902	0.000	Yes
T6 vs T4	-8.100	-5.733	2.761	3.902	0.000	Yes
T6 vs T3	-6.775	-4.795	2.761	3.902	0.001	Yes



# TDR-measured Residual Moisture Content



# CONCLUSION

- **Variability in soil quality was observed over time at different depths under the various CAPS treatments, although the observed differences over time did not appear to be substantial after three years of cropping.**
- **The soil organic matter content at the uppermost layer (0-5 cm) steadily declined under under plow-based system after 3 years of cropping**

# CONCLUSION

- The soil organic matter at the uppermost layer (0-5 cm) generally increased slightly under conservation agriculture production systems after three years of cropping.
- Under a high fertility level, CAPS treatment T2 (*maize+stylosanthes guianensis*) exhibited the highest rate of increase in soil organic matter over time at the uppermost soil layer.

# CONCLUSION

- Under a moderate fertility level, CAPS treatment T5 (*cassava+stylosanthes guianensis*) exhibited the highest rate of increase in soil organic matter over time at the uppermost soil layer.
- The soil bulk density remained practically the same as the baseline conditions for all soil layers after 3 years.
- Both soil nitrogen and phosphorus concentrations did not exhibit a well-defined pattern of variation although they generally increased under CAPS treatments over the last three years.

# CONCLUSION

- The residual moisture content is significantly higher under conservation agriculture than under conventional plow-based system with treatment T2 (*maize+stylo-stylo-fallow*) exhibiting the highest residual moisture.
- Continuous soil quality monitoring is necessary to generate additional empirical evidence on the impact of conservation agriculture on soil quality.

# Acknowledgement

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***Thank You!***

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