

# The Effect of Tillage and Weed Management of Cassava on Nematodes Abundance and Diversity

by

I G. Swibawa, W. Ekawati & A. Indralaksmi  
Faculty of Agriculture, University of Lampung Indonesia

## Extended Abstract

Lampung province is one of cassava producer and the production were the highest among provinces in Indonesia. Most of cassava farmer in Lampung applied intensive tillage and weeding using herbicide to growing their crops. The application of intensive tillage and using herbicide for weed control in long term was lead to destructive of physical and biological of soil. Therefore, it is need to search the friendly land management. Utomo (2012) described that minimum tillage system can conserved the soil fertility and productivity because the system minimized of soil erosion and can conserved soil water content and other biophysical properties of soil.

Soil nematode was very sensitive to soil disturbance. Soil nematode community consisted of several feeding groups that have important role in soil ecological processes. Tillage practiced can influence the feeding groups. Ito *at al.* (2014) reported that, tillage system influenced abundance all of feeding groups of nematodes on soybean and Lopez-Fando & Belo (1995) described that virgin ecosystem had the greatest number and diversity of fungal feeders and predators, whereas the number of plant feeders increased in tillage soil of barley. It was still limited information about effect tillage and weed management practices of cassava on nematodes communities. The objectives of this reserach was to evaluate the soil nematodes community under application of tillage system and weed management for two growing seasons of cassava in Unila Experimental Plots.

This research that was a part of “Collaborative Research between Unila-YNU Japan” conducted in long term experimental plot of Faculty of Agriculture, University of Lampung beginning in December 2013. The randomized block experimental design with two factors was applied in this research. The first factor was tillage system consisted of minimum tillage and full tillage; the second factor was weed management consisted of weeding with glyphosate and 2.4 D herbicide application ( $1 \text{ l ha}^{-1}$ ) and weeding manually. The plots were planted with corn and cassava in rotations cropping system. Soil samples for nematodes were taken at two growing seasons of crops, i.e. in August 2014 when the

cassava was 3 month old and cassava in May 2016 when the age of 8 month after planting. Nematodes from 300 cc of soil were extracted using centrifugation with sugar solution technic, and then the specimens were identified up to genera taxonomic level and grouped into feeding groups (Yeates *et al.*, 1993). The variables of this research were feeding group abundance and taxonomic diversity and their diversity index of nematodes community. The maturity indices (Bongers, 1990) were counted to indicate the soil disturbance each plots. Analyzes of variance was applied to measure the effect of treatment on nematodes variables.

The results of this research showed that there were 30 genus of 9 family in five feeding group including plant feeders, bacterial feeders, fungal feeders, predator, and omnivore of nematodes community were found in cassava crops on experimental plots. Both of in August 2014 and in May 2016, had the community of nematodes dominated by plant feeders. Total individual of nematodes in 2014 were range of 99-250 and 358-891 individuals/300 cc of soil in 2016 respectively.

The effect of tillage and weed management on nematodes community variables were varie. The single factor of tillage system was significantly affect on abundance of total individual and omnivore of nematodes in cassava of 2016; the abundance of total individual and omnivores of nematodes were higher on full tillage than on minimum tillage system. The tillage system also significantly affect the number of genus and Shannon diversity index of nematodes in cassava of 2014; the genera number and Shannon diversity index were higher on minimum tillage than on full tillage respectively. The factor of weed management was significantly influence the abundance of predator feeding group in 2014; the abundance of these gruops was higher on minimum tillage than on full tillage. Combination of tillage system with weed management was significantly influence the abundance of bacterial feeders and predator feeding groups in cassava of 2014; the abundance of those two feeding groups were higher on minimum tillage combined with weeding manually plots than on full tillage combined with weeding manually plots and minimum tillage combined with herbicide application plots. The maturity indices were not significantly influenced by tillage and weed management.

### Acknowledgment

The research was facilitated by “Collaborative Research between Unila and YNU Japan Project”. The authors appreciate and thank to the facilititation support.

### References

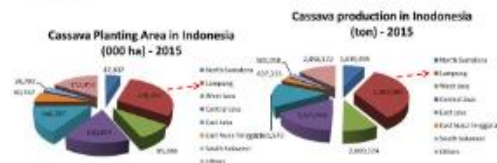
- Bongers, T. 1990. The maturity index: an ecological measure of environmental disturbance base on nematode species composition. *Oecologia* 83: 14-19.
- Ito, T., M. Araki, T. Higashi, M. Komatsuzaki, N. Kaneko & H. Ohta. 2014. Respons of soil nematode community structure to soil carbon changes due to different tillage and cover crop management practices over a nine-years periods in Kanto, Japan. *Applied Soil Ecology* 89: 50-58.
- Lopez-Fando, C. & A. Belo. 1995. Variability in soil nematode population due to tillage and crop rotarion in semi-arid mediterranean agrosystem. *Soil & Tillage Reserach* 36: 59-72.
- Utomo, M. 2012. Tanpa Olah Tanah: Teknologi Pengelolaan Pertanian Lahan Kering. Lempaga Penelitian Universitas Lampung. Bandar Lampung
- Yeates, G.W., T. Bonger, R.G.M De Goe, D.W. Freckman, & S.S. Georgieva. 1993. Feeding habits in soil nematode families and genera -an outline for soil ecologists. *Journal of Nematology* 25(3): 315-331.

# THE EFFECT OF TILLAGE AND WEED MANAGEMENT OF CASSAVA ON NEMATODES ABUNDANCE AND DIVERSITY

I G. Swibawa, W. Ekawati & A. Indralaksmi  
Faculty of Agriculture, University of Lampung  
Indonesia

## INTRODUCTION

- Lampung Province is one of cassava producers in Indonesia
- Lampung contributes to more than 30% of total national cassava production



- Generally intensive tillage and herbicide were applied for cassava growing in Lampung
- Nematode community were very sensitive to soil disturbance
- Ito *et al.* (2014) reported that, tillage system influenced abundance all of feeding groups of nematodes on soybean and Lopez-Fando & Belo, (1995) described that virgin ecosystem had the greatest number and diversity of fungal feeders and predators, whereas the number of plant feeders increased in tillage soil on barley.

- It limited information of nematodes communities under application of tillage system and weed management of cassava crop

## The objectives of this research

To evaluate the soil nematodes community under application of tillage system and weed management in two growing seasons of cassava in Unila Experimental Plots

## MATERIALS AND METHODES

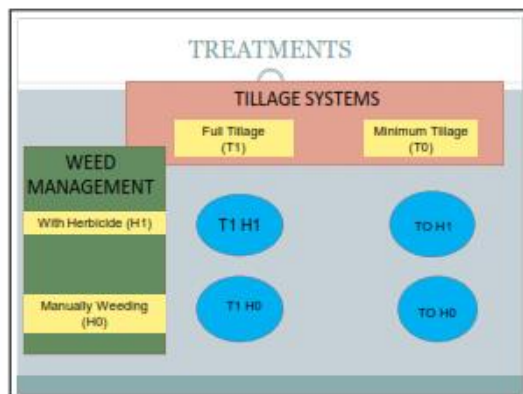
The experiment was a part of long-term research collaboration between Faculty of Agriculture, Unila and YNU Japan.

The plots site:

- Unila Campus → Field Experimental Station of Agricultural Faculty Lampung University, Indonesia

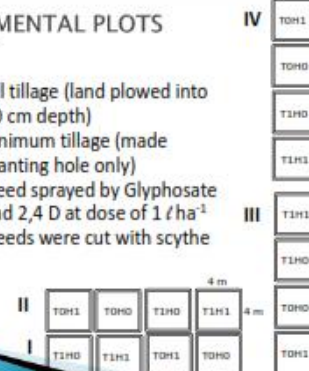
Experimental Design:

Experimental Units were arranged in Randomized Block Design (RBD) with two Factors (2 x 2) in four blocks

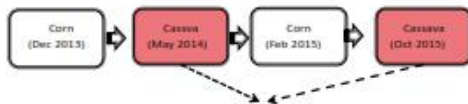


## EXPERIMENTAL PLOTS LAYOUT

- T1 = Full tillage (land plowed into 20 cm depth)
- T0 = Minimum tillage (made planting hole only)
- H1 = Weed sprayed by Glyphosate and 2,4 D at dose of 1 t/ha<sup>-1</sup>
- H0 = Weeds were cut with scythe



## Rotation Cropping System

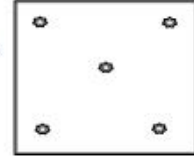


Cassava clone : UJ5  
 Row Spacing : 40 cm x 70 cm  
 Fertilizer : N (urea) : P (SP-36) : K (KCl)  
 (300 : 100 : 200) kg ha<sup>-1</sup>  
 Compost : 10 t ha<sup>-1</sup>

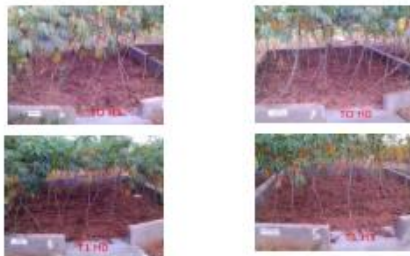
## Sampling of Nematodes and soil biophysics

- ❑ On August 2014 → cassava was 3 MAP
- ❑ On May 2016 → cassava was 8 MAP
- ❑ Soil samples of nematodes were taken on five sub-samples each plot at 20 cm depth

- ❖ Centrifugation with sugar solution were applied to extract nematodes from 300 cc of soil
- ❖ Nematodes then identify up to genera taxonomic level and grouped into feeding habit
- ❖ SWC, BD, Weed and litter biomass were measure for cassava 2016



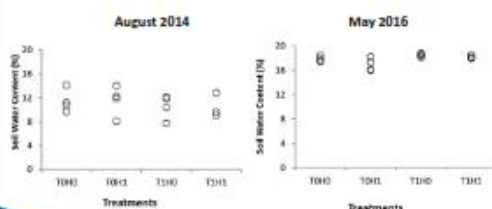
## Cassava 3 MAP (August 2014)



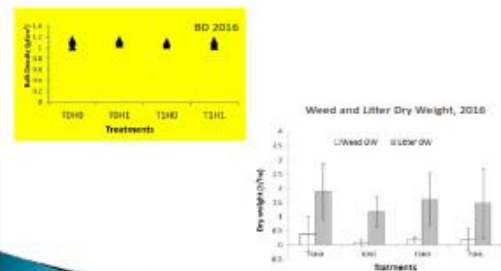
## Cassava 8 MAP (May 2016)



## Soil Water Content (SWC)

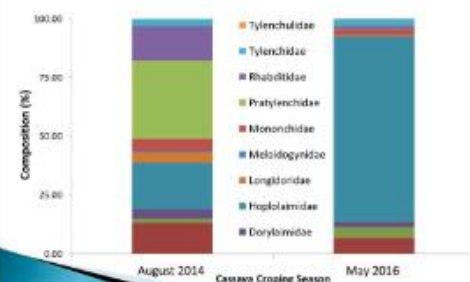


## BD, Weed and Litter dry weight

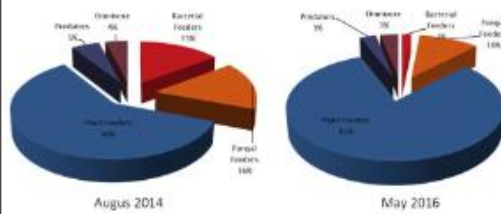


## RESULTS and DISCUSSION

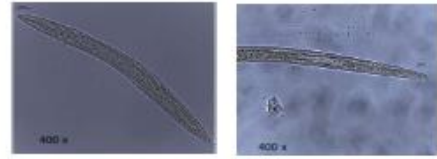
## Nematodes inhabited of cassava crops on experimental plots



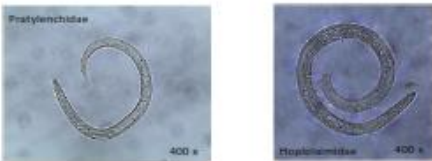
## FEEDING GROUPS COMPOSITION



## Several Nematodes Found



Rhabditidae (Bacterial Feeders)



Plant Feeders



Mononchidae - Predator



Aphelenchidae - Fungal feeders



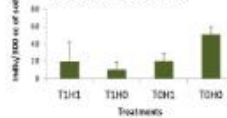
Dorylaimidae - Omnivore

Significance (P) value of ANOVA, the effect of tillage and weed management on nematodes

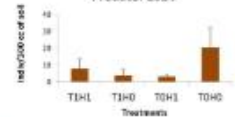
No	Variables	Tillage		Weed Manag		Tillage x Weed Manag	
		2014	2016	2014	2016	2014	2016
<b>A Abundance</b>							
	Total Individual	0.904	0.022	0.088	0.424	0.1069	0.567
	Bacterial Feeders	0.003	0.485	0.062	0.142	0.0038	0.126
	Fungal Feeders	0.441	0.446	0.498	0.309	0.1393	0.559
	Plant Feeders	0.405	0.076	0.212	0.206	0.5982	0.798
	Predator	0.007	0.414	0.046	0.841	0.0056	0.919
	Omnivore	0.418	0.008	0.320	0.027	0.134	0.987
<b>B Diversity</b>							
	Genera number	0.052	0.924	0.898	0.639	0.527	0.238
	Family number	0.547	0.259	1.000	0.443	0.242	0.076
	Simpsons Index	0.070	0.485	0.385	0.908	0.717	0.984
	Shannon Index	0.040	0.610	0.771	0.834	0.916	0.610
<b>C Maturity Index</b>							
	MI	0.995	0.734	0.500	0.152	0.192	0.992
	MI 2-5	0.638	0.746	0.516	0.164	0.167	0.984
	PPI	0.348	0.920	0.367	0.111	0.362	0.809
	SMI 2-5	0.070	0.650	0.385	0.068	0.717	0.568

## The abundance of Bacterial Feeders and Predator Feeding Groups in 2014

### Bacterial Feeders 2014

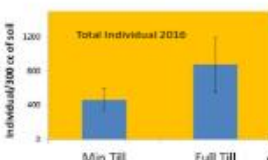


### Predator 2014

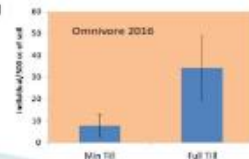


Notes: Bar = mean + confidence  
T1 = Full tillage, T0 = Minimum tillage  
H1 = Weed applied with herbicide, H0 = Weed manually cutting

Abundance of Total individual : Full Till > Min Till



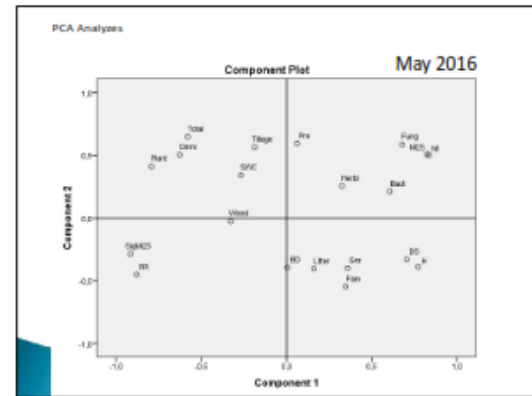
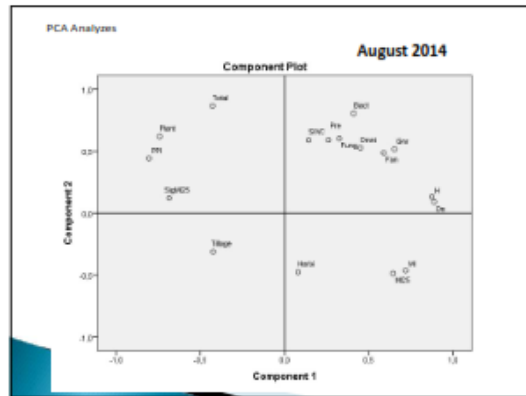
Abundance of Omnivore Groups: Full Till > Min Till



## Diversity and Maturity

Diversity & Maturity	T1H1		T1H0		T0H1		T0H0	
	2014	2016	2014	2016	2014	2016	2014	2016
<b>Diversity</b>								
Genera number	10.0	10.8	9.5	9.8	11.5	9.3	12.3	11.5
Family number	8.3	6.8	7.8	6.0	8.0	6.3	8.5	8.0
Shannon Index (H')	1.84	0.88	1.82	0.90	2.10	0.98	2.06	0.99
Simpsons Index (Ds)	0.78	0.34	0.79	0.39	0.83	0.41	0.84	0.39
<b>Maturity Index</b>								
MI	1.21	0.78	0.79	0.37	0.94	0.09	1.07	0.29
MI 2-5	1.09	0.74	0.69	0.37	0.72	0.67	0.88	0.28
PPI	1.52	2.00	1.99	2.65	1.60	2.09	1.60	2.63
SMI 2-5	2.61	2.75	2.68	3.01	2.32	2.76	2.47	2.91





## Conclusions

- ❖ There were 30 genera in 9 families of soil nematodes, consisted of plant feeders, bacterial feeders, fungal feeders, predator, and omnivore found on cassava crop
- ❖ The nematodes community dominated by plant feeders. The total individual 99–250 indiv/300 cc of soil (in 2014) and 358–891 indiv/300 cc of soil (in 2016).
- ▶ The number of genera and Shannon diversity index on minimum tillage higher than on full tillage

## Conclusions–cont

- ▶ The abundance of total individual and omnivore on full tillage higher than on minimum tillage in 2016
- ▶ The abundance of bacterial feeder and predator on minimum tillage with no herbicide higher than on full tillage with no herbicide or on minimum tillage with herbicide
- ▶ The manurty indices were not influenced by tillage and weed management

## Acknowledgment

The research was facilitated by Collaborative Research between Unila and YNU Japan Project.

The authors appreciate and thank to the facilitation support.

Thank You