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“6TH INTERNATIONAL WORKSHOP
ON CROP PRODUCTION AND PRODUCTIVITY
UNDER GLOBAL CLIMATE CHANGE”



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TABLE OF CONTENT

ROLES OF PLANT TISSUE CULTURE ON AGRICULTURAL PRODUCTIVITY

Dwi Hapsoro p.1

AIRFLOW RESISTANCE OF INSECT SCREEN AND EVAPORATIVE COOLING FOR NATURAL VENTILATED GREENHOUSE IN HUMID TEMPERATE / TROPICAL CLIMATE REGION

Teruaki SHIMAZU p.4

SUSTAINABLE AGRICULTURE, A STRATEGY TO MAINTAIN THE BUSINESS SUSTAINABILITY OF PT. GREAT GIANT PINEAPPLE UNDER GLOBAL CLIMATE CHANGE

Supriyono Loekito p.8

GIS ANALYSIS FOR VULNERABILITY ASSESSMENT OF SALT DAMAGE ON TARO PATCH IN PALAU

Natsuki YAMADA and Keigo NODA p.11

APPLICATIONS OF STRUCTURAL EQUATION MODELING IN CROP YIELD VARIABILITY OF THE FARMERS' FIELDS

Takashi S. T. Tanaka, Yusuke Kono, Tsutomu Matsui..... p.16

POTENTIAL OF YARD UTILIZATION FOR SUPPORTING THE FULFILLMENT OF FOOD SECURITY IN BANDAR LAMPUNG CITY, INDONESIA

Agustini and Tri Atmaningsih p.20

PREDICTING CASSAVA SUITABILITY AS IMPACTED BY CLIMATE CHANGE IN INDONESIA

Tumiar Katarina Manik p.23

TRACKING THE FATE OF ORGANIC MATTER RESIDUE USING SOIL DISPERSION RATIO UNDER INTENSIVE FARMING IN RED ACID SOIL OF LAMPUNG, INDONESIA

Afandi, Siti Chairani, Sherly Megawat, Hery Novpriansyah, Irwan Sukri Banuwa, Zuldadan and Henri Buchari p.26

MULTI-LAYERED MICROCAPSULES OF BIOPESTICIDES TO SUPPORT SUSTAINABLE AGRICULTURE

Warji p.29

EFFECTS OF WATERLOGGING ON PINEAPPLE GROWTH AND SOIL PROPERTIES ON RED ACID SOILS OF LAMPUNG, INDONESIA

Priyo Cahyono , Purwito and Afandi p.33

POTENTIAL YIELD OF REPLANTED TREES OF COCOA CLONES INTRODUCED IN LAMPUNG

Rusdi EVIZAL, SUGIATNO, Hidayat PUJISISWANTO, and Fembriarti Erry PRASMATIWI..... p.37

EFFECTS OF ALUMINUM STRESS ON SHOOT GROWTH, ROOT GROWTH AND NUTRIENT UPTAKE OF THREE PINEAPPLE SMOOTH CAYENNE CLONE [ANANAS COMOSUS (L.) MERR.]

Dudy Arfian, Paul B. Timotiwu, Abdul Kadir Salam, dan Afandi..... p.40

THE EFFECT OF LONG-TERM CASSAVA CULTIVATION ON ORGANIC CARBON CONTENT AND SOIL PHYSICAL PROPERTIES IN CENTRAL LAMPUNG

Didin Wiharso, Afandi, Irwan Sukri Banuwa and Dina Fanti..... p.44

CORN YIELD AND SOIL PROPERTIES UNDER LONGTERM CONSERVATION TILLAGE IN CLAYEY SOIL TROPICAL UPLAND OF LAMPUNG, INDONESIA

Siti Nur Rohmah, Muhajir Utomo, Afandi, Irwan Sukri Banuwa..... p.47

THE ROLE OF REFUGIA IN THE WETLAND PADDY ECOSYSTEM

Lestari Wibowo, Setyo Widagdo, Suskandini Ratih Dirmawati, and M. Nurdin p.50

SOIL ORGANIC CARBON IN SOIL FRACTION AND CORN YIELD OF LONG-TERM TILLAGE SYSTEM AND NITROGEN FERTILIZATION

Dwi Oktaria, Muhajir Utomo, Afandi, Abdul Kadir Salam..... p.53

VENTILATION FLOW RATE AND PHOTOSYNTHESIS PREDICTION BASED ON WATER VAPOR BALANCE UNDER VENTILATED GREENHOUSE

Ahmad TUSI, Teruaki SHIMAZU, Katsumi SUZUKI, and Masaki OCHIAI..... p.56

AGGREGATE STABILITY AND ROOT BIOMASS AFFECTED BY SOIL TILLAGE AND MULCHING IN GREEN NUT CULTIVATION (*VIGNA RADIATA* L.)

M. A. Fauzan, J. Lumbanraja, H. Novpriansyah, Afandi and N. Kaneko p.59

APPLICATION of INDUCED COMPOST of CELLULOLITIC (*Aspergillus fumigatus*) AND LIGNINOLITIC (*Geotrichum* sp.) INOCULUM on The VEGETATIVE GROWTH of RED CHILI (*Capsicum annuum* L.)

AyuWulan Septitasari, Bambang Irawan, Zulkifli and Salman Farisi..... p.61

SOIL COMPACTION, WATER CONTENT, BULK DENSITY AND SOIL ROOT BIOMASS AFFECTED BY TILLAGE AND FERTILIZER ON GEDUNG MENENG SOIL UNDER GREEN BEAN GROWTH

Yogi Irawan, J. Lumbanraja, Nur Afni Afrianti, Afandi..... p.62

PERCEPTIONS OF FARMERS, EFFECTIVENESS OF FARMERS GROUP, AND DIFFUSION OF INNOVATION OF ORGANIC FARMING SYSTEM IN LAMPUNG PROVINCE

Tubagus Hasanuddin..... p.65

PRODUCTION AND HARVESTED NUTRIENT OF CASSAVA (*MANIHOT ESCULENTA* L.) AFFECTED BY COMPOST AND ITS COMBINATION WITH NPK INORGANIC FERTILIZER FOR THE 5TH PLANTING PERIOD

Novita Desri Wanti, Jamalam Lumbanraja, Supriatin, Sarno, Dermiyati Sugeng Triyono, and N. Kaneko..... p.69

SIMULATION OF CAVENDISH BANANA TRANSPORTATION

Debby Nuzulia Arlin, Cicih Sugianti, Siti Suharyatun, and Tamrin..... p.72

THE APPLICATION OF HOT WATER TREATMENT IN MANGO CV ARUMANIS

Cicih Sugianti and Dondy A Setyabudi..... p.76

HARVESTED NUTRIENT AND PRODUCTION OF CASSAVA (*Manihot esculenta*) AFFECTED BY TILLAGE AND HERBICIDE IN THE 4th PLANTING PERIOD IN GEDUNG MENENG SOIL BANDAR LAMPUNG

Adinda Kusuma Dewi Rachmat, Jamalam Lumbanraja, Nur Afni Afrianti, Muhajir Utomo, and N. Kaneko..... p.80

**PRODUCTION AND HARVESTED NUTRIENTS OF SUGARCANE 1ST
RATOON (*SACCHARUM OFFICINARUM* L.) AFFECTED BY ORGANIC AND
INORGANIC FERTILIZER**

*Nurhidayat, Jamalam Lumbanraja, Supriatin , Sarno, Dermiyati
and Sugeng Triyono.....*

p.83

**BIOGAS PRODUCTION FROM OIL PALM EMPTY FRUIT BUNCHES
THROUGH DRY FERMENTATION PROCESS: PRELIMINARY RESULTS**

*Agus HARYANTO, Cicih SUGIANTI, Sugeng TRIYONO,
and Nanda Efan APRIA.....*

p.87

**THE CURRENT STATUS OF AUTHENTICATION OF INDONESIAN
SPECIALTY COFFEES USING UV-VISIBLE SPECTROSCOPY AND
CHEMOMETRICS**

Diding SUHANDY and Meinilwita YULIA.....

p.90

**THE DIVERSITY OF ARBUSCULAR MYCORRHIZA FUNGI AT
RHIZOSPHERE OF CASSAVA OF THAILAND CLONE CULTIVATED IN
LAMPUNG TIMUR AND TULANG BAWANG BARAT**

*Maria Viva RINI, Kuswanta Futas HIDAYAT, Diah PURBANINGRUM,
Annisa HASKA*

p.93

The effect of long-term cassava cultivation on organic carbon content and soil physical properties in Central Lampung

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SUMMARY

The effect of long-term cassava cultivation on organic carbon content and soil physical properties in Central Lampung has been investigated. A plot of land that had been cultivated for Cassava plants and another plot for mixed garden for more than 30 years were studied in order to know how the effect of long-term cassava cultivation on organic carbon content and soil physical properties. The results show that long-term cultivation of cassava had reduced the thickness of the surface layer and organic carbon content, changed soil color become lighter and changed the shape of soil structure in the soil surface layer from crumbs become angular blocky. There was a tendency that the bulk density and the soil strength in cassava cultivation were lower in the surface layer and higher in the bottom layer.

Introduction

Cassava (*Manihot esculenta* Crantz) (*Manihot esculenta* Crantz) is an important agricultural commodity for Lampung Province. In 2015, Lampung Province had contributed 34% of national cassava production (BPS, 2015). Cassava could performs best in soils of friable nature to permit expansion of tubers (Nnaji, 2009), however, it is very tolerant of various soil conditions even in marginal soils which for other food crops are difficult to grow properly

Cassava is usually grown by farmers in the tropics with a minimum of inputs, and continuous production under these conditions can lead to soil nutrient depletion. On sloping land, cassava cultivation can also cause severe erosion if the crop is not properly managed (Howeler, 1991). Cassava is increasingly attractive as an energy crop due to its high rate of CO₂ fixation, high water-use efficiency, high carbohydrate content, and superior starch conversion ratio for ethanol compared to other crops (Kristensen *et al.*, 2014).

Many people are convinced that cassava production leads to soil degradation, and some governments do not encourage cassava cultivation in the belief that it causes serious erosion and nutrient depletion (FAO, 2014). Cassava is grown throughout the tropics on a great variety of soils, but is mainly found on Ultisols, Oxisols and Entisols, which are generally characterized by low

soil fertility. In many parts of the tropics it is grown on the poorest soils, such as on eroded slopes or extremely sandy soils, where it produces something whereas other crops would not. This ability has led many to think that cassava does not require high soil fertility nor responds to fertilization (Howeler, 1991).

This study aims to determine the effect of long-term (> 20 years) cassava cultivation on organic carbon content and soil physical properties compared to mixed garden in Central Lampung.

Materials and Method

This research was conducted on land that had been cultivated with cassava plants for 30 years in the Central Lampung, Sumatra. For comparison, a land that was planted with various trees on coffee base was chosen, and this land system was called mixed garden (MG). Both types of land use have the same land characteristics such as slope (3-4% gentle slope), acid tuffs parent materials (Mangga *et al.*, 1994), altitude (53 m asl) climate (2205.48 mm rainfall per year), and adjacent locations of around 60 meters.

Each plot of land has an area of about 1 hectare, with a rectangular shape stretching north to south. On each plot of land, three mini profiles are determined and made at the top of the slope, the middle of the slope and at the bottom of the slope. The soil profiles were described according to the Manual Survey Soil (1993) and then the soil samples were taken in the middle of soil layers, both

undisturbed soil samples using sample rings and disturbed soil samples. Soil Strength of each soil layer was determined in the fields by using Pocket Penetrometer. Soil samples analyzed include organic carbon (Walkley and Black), soil texture (Bouyoucos), bulk density. Then data of three profiles were averaged.

Result and Discussion

3. 1 Soil Morphology and Texture

After more than 30 years of cassava cultivation (C), it was seen that there were differences in surface layer thickness, soil color, and soil structure shape and soil organic matter content (Table 1). Accumulation of litter from dead leaves and then decomposition has led to higher organic carbon content in mixed garden (MG) . Meanwhile on cassava cultivation land which is rarely applied by organic matter and crop residues not returned to the land has caused lower organic carbon content. In addition, the more open land from the beginning of post-harvest, tillage, the beginning of planting until the next 3 months makes conditions conducive to the ongoing process of oxidation of soil organic matter and erosion. As a result, the thickness of the surface layer on cassava cultivation land is reduced.

The amount of soil organic matter is very influential on the color of the soil, making the color of the soil darker, this is indicated by the color of the soil on darker natural veg land (lower value and chroma) compared to cassava cultivation. Reduced soil organic matter on cassava cultivation has caused changes in the shape of the soil structure from crumbs to angular blocky. Another possibility that can change the shape of the structure in the surface layer is the loss of the surface layer so that the existing surface layer is actually the lower horizon that appears on the surface.

The consistency of soil is strongly influenced by the shape and size of the particles (Baver, 1956) and the type of clay minerals. Because the soil texture on both types of land is not much different (Table 2) and is predicted to have the same type of clay minerals, the consistency of the soil of the two types of land is the same, which is friable in the surface layer and firm in the lower layers (Table 1).

Bulk density in both types of land is not much different (Table 2). On cultivated land for cassava plants, soils is

always ploughed before planting so that the soil surface layer is more nested (lower bulk density). Therefore, even though the content of organic matter in cassava cultivation land is lower than natural vegetated land, it has a slightly lower bulk density value. This is supported by the value of the soil strength which is also slightly lower. On the second layer, the opposite happened that bulk density on cassava cultivation land was slightly higher than mixed garden land, this was supported by the soil strength value and also its higher clay content. The higher content of clay in the lower layers of cassava fields is related to the higher leaching processes of clays due to the opening of the canopy.

Table 1. Soil Morphology

Land Use	Layer	Layer Thickness	Color	Stru	Cons	C-org
C	I	9	10 YR 3/3-3/4	ab	fr	1.54
	II	17	10 YR 5/6-5/8	ab	fi	0.85
MG	I	17	10 YR 2/2	cr	fr	3.09
	II	16	10 YR 4/4-4/6	ab	fi	1.21

*)Stru: Structure: ab (angular blocky),cr:crumb

**)Cons: Consistency: fr:friable; fi:firm

Table 2. Soil Physical Properties

Land use	Hor	%			Bulk Density	Soil Strength
		sand	silt	clay	g/cm ³	kgf/cm ²
C	A	29.3	11.7	59.0	1.16	0.91
	B	18.9	9.5	71.6	1.22	3.09
MG	A	33.2	17.6	49.2	1.22	0.93
	B	21.6	12.2	66.2	1.16	2.89

Conclusion

Long-term cultivation of cassava results in reduced thickness of the surface layer and organic carbon content, the lighter color of the soil, and changes in the shape of

the soil structure in the soil surface layer from crumbs to angular blocky.

Although it is not much different, but there is a tendency that the bulk density and the soil strength in cassava cultivation land are lower in the surface layer and higher in the bottom layer.

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