ISBN : 978-4-909365-04-0

PROCEEDINGS of IC-GU 12 UGSAS-GU

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

Editors :

Dr. Afandi
Prof. Dr. Ken Hiramatsu

DECEMBER 3-4, 2018

at FACULTY OF AGRICULTURE, LAMPUNG UNIVERSITY
BANDAR LAMPUNG, INDONESIA

PROGRAM

Date : December 3rd,2018

Venue : Hall of Faculty of Agriculture, Lampung University (UNILA),

Plenary Session

Start		Speaker/Chair Person	Title
8:00	Registratio		
8:30	Session 1	Chair: Cicih Sugianti & Auliana Afandi	Welcoming and Introductory Session
8:30		Prof. Dr. RA Bustomi Rosadi,	Committee Report
		Prof. Dr. Irwan S.Banuwa, Dean of Faculty of Agriculture,	Welcome Address
		Prof. Dr. Hasriadi Mat Akin, Rector of UNILA	Welcome Address
		Prof. Masateru SENGE Dean of UGSAS, GU	Declaration of Opening
9:00	Photo Session & Welcome Ceremony		
9:15	Coffee Break		
9:30	Session 2	Chair: Prof. Chihara E., GU	
9:30		Dr. Dwi Hapsoro, Faculty of Agriculture, UNILA	Roles of Plant Tissue Culture on Agricultural Productivity
10:00		Assoc. Prof. Teruaki Shimazu , GU	Airflow resistance of insect screen and evaporative cooling for natural ventilated greenhouse in humid temperate/ tropical climate region
10:30		Supriyono Loekito PT.GGP	Sustainable agriculture, a strategy to maintain the business sustainability of PT. Great Giant Pineapple under Global Climate Change
11:00	Q & A		
11:45	Lunch break		
12:45	Session 3-Paralell at Post Graduate Building, Fac. of Agriculture, Lampung University		
15:15	Coffee Break		
15:35	Session 4	Chair: Dr. Tumiar K Manik	
15:35		Assis. Prof. Tanaka, T., GU	Applications of Structural Equation Modeling in Crop Yield Variability of the Farmers' Fields
15:55		Agustini (Agric.Service, Bandar Lampung City)	Potential of yard Utilization for Supporting the Fulfillment of Food Security in Bandar Lampung City, Indonesia
15:15		Assis. Prof. Noda, K., GU	GIS analysis for vulnerability assessment of salt damage on Taro Patch in Palau
16:45		Prof. K. Hiramatsu, Vice Dean of UGSAS, GU	Closing
18:30		MC: Dr. Afandi UNILA	Banquet , at Bandar Lampung' s mayor house

Study Excursion/field trip, at December 4, to PT.GGP, Central Lampung

Start : 06.30 from Faculty of Agriculture, Lampung University.

Parallel Session

Venue : Post Graduate Building, Faculty of Agriculture, Lampung University

Room 1

Start	Speaker/Chair Person	Title
12:45	Chair: Assis. Prof. Noda,	*Influence of Climate Change on Crop Production*
12:45	T.K.Manik	Predicting Cassava Suitability as Impacted by Climate Change in Indonesia
12:55	Afandi	Tracking the fate of organic matter residue using soil dispersion ratio under intensive farming in red acid soil of Lampung, Indonesia
13:10	WARJI	Multi-layered Microcapsules of Biopesticides to Support Sustainable Agriculture
13:20	Irwan S. Banuwa	Effect of Ridges and Organic Fertilizer on Erosion and Nutrients Loss
13:35	Q&A	
13:45	Coffee break	
13:55	Priyo Cahyono	Effects of Waterlogging on Pineapple Growth and Soil Properties on Red Acid Soils of Lampung, Indonesia
14:10	Rusdi EVIZAL	Potential Yield of Replanted Trees of Cocoa Clones Introduced in Lampung
14:25	Dudy Arfian (PT GGP)	Effects of aluminum stress on shoot growth, root growth and nutrient uptake of three pineapple smooth cayenne clone [*Ananas comosus* (L.) Merr.]
14:40	Didin Wiharso	The effect of long-term cassava cultivation on organic carbon content and soil physical properties in Central Lampung
14:55	Q & A	
15:15	Coffee break	

Room 2

Start time	Speaker/Chair Person	Title
12:45	Chair: Diding	*Cash Crop productivity and its constraint*
12:45	Siti Nur Rohmah	Corn Yield and Soil Properties under long term conservation tillage in clayey soil tropical upland of Lampung, Indonesia
13:55	Lestari Wibowo	The role of refugia in the wetland paddy ecosystem
13:10	Dwi Oktaria	Soil organic carbon in soil fraction and corn yield under long-term tillage system and nitrogen fertilization
13:20	Ahmad Tusi	Ventilation Flow Rate and Photosynthesis Prediction based on Water Vapor Balance under Ventilated Greenhouse
13: 35	Q & A	
13:50	Coffee break	

14:00	M. A. Fauzan	Aggregate Stability and Root Biomass Affected by Soil Tillage and Mulching in the Gedung Meneng Soil Planting Green Nut (*Vigna radiata* L.) of the Long Term Experiment
14:15	Ayu Wulan Septitasari	Application of induced compost of cellulolitic (*aspergillus fumigatus*) and ligninolitic (*geotrichum* sp.) inoculum on the vegetative growth of red chili (*Capsicum annuum* L.)
14:30	Yogi Irawan	Soil Compaction, Water Content, Bulk Density and Soil Root Biomass Affected by Tillage and Fertilizer on Gedung Meneng Soil under Green Bean Growth
14:45	Tubagus Hasanuddin	Perceptions of farmers, Effectiveness of Farmers Group, and Diffusion of Innovation of Organic Farming System in Lampung Province
15:00	Q & A	
15:15	Coffee break	

Room 3

Start time	Speaker/Chair Person	Title
12:45	Chair: Prof. K. Hiramatsu, GU	*Annual Crop productivity and technology for supporting*
12:45	Novita Desri Wanti	Production and harvested nutrient of cassava (*manihot esculenta l.*) affected by compost and its combination with NPK inorganic fertilizer for the 5th planting period
12:55	Debby N.A	Simulation of Cavendish Banana Transporation
13:10	Cicih Sugianti	The application of hot water treatment in mango cv arumanis
13:20	Maria Viva Rini	The Diversity of Arbuscular Mycorrhiza Fungi at Rhizosphere of Cassava of Thailand Clone Cultivated in Lampung Timur and Tulang Bawang Barat
13:35	QA	
13:50	Coffee break	
14:00	Adinda Kusuma Dewi	Harvested nutrient and production of cassava (*manihot esculenta*) affected by tillage and herbicide in the 4th planting period in Gedung Meneng soil Bandar lampung
14:10	Nurhidayat	Production and Harvested Nutrients of Sugarcane 1st Ratoon (*Saccharum officinarum* L.) Affected by Organic and Inorganic Fertilizer
14:25	Agus HARYANTO	Biogas Production From Oil Palm Empty Fruit Bunches through Dry Fermentation Process: Preliminary Results
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15:15	Coffee break	

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Roles of Plant Tissue Culture on Agricultural Productivity

Dwi Hapsoro
(Faculty of Agriculture, Lampung University, Indonesia)

Introduction

As human population grows, its need for food increases. It was estimated that by the year of 2050, human population would be 9.1 billion, which is about 34% higher than the world's population now (Salokhe, 2016). Therefore, increasing agricultural production has become never-ending effort to catch up the population growth to sufficiently meet its demand.

Rising agricultural production could be achieved by intensification and extensification. Intensification is carried out mainly by increasing the technological level, or by employing more modern one, while extensification is done mainly by increasing land area. For a large company, the two strategies are often executed simultaneously, in order to meet increasing product demand. Plant tissue culture technology has been very adventegous for supporting both intensification and extensification.

This paper aims to put forwad roles plant tissue culture for supporting agricultural productivity.

Plant Tissue Culture and Its Role on Agricultural Productivity

Plant tissue culture could be defined as aseptically culturing in vitro small parts of plants (protoplast, cell, tissue, organ) on a spesific medium containing a complete mineral nutrients and plant growth regulators under controlled environmental condition in order that the plant parts grow, proliferate and develop into complete plants or just grow and proliferate for special purpose. Based on the definition, the end goal is not always complete plants, but it could be other forms, for example proliferating calli, roots, or shoots. Based on the definition, plant tissue culture has five important characteristics i.e in vitro, aseptic, complete mineral nutrients, plant growth regulators, and controlled environmental conditions.

In relation to agricultural productivity, plant tissue culture has been applied for (1) rapid clonal propagation of plants with novel characters, (2) production of disease-free plants, (3) seed germination, especially for orchids, (4) embryo rescue, (5) induction of desirable, heritable trait through somaclonal variation, (6) production of homozigous, pure lines of plants for hybrid variety production, and (7) providing facility for mutation breeding and plant genetic engineering. Basically plant tissue culture could be applied for rapid clonal propagation and for facilitating plant breeding, both being supportive for plant productivity.

<u>Rapid clonal propagation by tissue culture for supporting productivity</u>. Planting materials are vital to productivity. They should be genetically, physiologically, and physically superior. The plants being mass propagated are always those considered to have novel, heritable characters. Environmental condition of plant tissue culture system, which is aseptic and supplied with optimal amount of nutrients, enables the production of planting materials which are physiologically and pysically superior and free of disease, especially caused by pathogenic bacteria and fungi. Virus-free planting materials could also be produced, i.e. by culturing a very small part of meristem tips.

Plant tissue culture has been used to clonally mass propagate various species of plants for commercial purpose and for community development. Plant tissue culture has been applied to propagate many herbaceous plants and floricultural plants. This technology has long been used to propagate banana of Cavendish type. It is almost impossible to use suckers as planting materials for growing banana in a large area (on the scale of thousand plants) because one mother plant could only produce more or less five suckers with variable sizes. This means they have variable ontogenetic ages, which could most likely result in variable harvesting time.

Recently, some oil palm plantation companies have been using plant tissue culture to clonally mass-propagate superior mother plants to produce a large number of planting materials. Traditionally, the planting materials are hybrid seeds from hybridization of progenitors *dura* type and *picifera* type. The hybrid planting materials, which are called *tenera* (D x P) type, are of high variability genetically, which in turn will result in variable productivity. If the superior *tenera* (D x P) type is selected, and clonally mass-propagated, superior uniform planting meterials will be produced and productivity will increase. It was reported that productivity of oil palm using clonal tenera plants was 30% higher than that using (D x P) seeds (Ng et al., 2003). Similar results were also reported by Alwee et al.(2010), when comparing productivity of oil palm plants derived from clonal propagation and those derived from (D x P) seeds.

<u>Tissue culture-facilitated plant breeding for supporting productivity</u>. The use of plant tissue culture for facilitating plant breeding includes embryo rescue, production of homozigous, pure lines of plants for hybrid variety production; induction of desirable, heritable trait through somaclonal variation; mutation breeding and plant genetic engineering.

Embryo rescue could be conducted by tissue culture by culturing the embryos, unless otherwise they will undergo abortion. The embryos being rescued are usually resulted from hybridization of distantly related plants. For example, rice varieties called NERICAs (New Rices for Africa) are derived from hybridization between *Oryza glaberrima*, an African species, and *Oryza sativa*, an Asian species. *Oryza glaberrima* are local variety which is well adapted to local agroclimate conditon (Africa) but has low productivity (yield of about 1 ton per hectar), while *Oryza sativa* is not adapted to African agroclimate condition but shows relatively high productivity (yield of about 5 tons per hectar). The resulting NERICAs show characteristics of the African and Asian rice varieties. The characteristics of Africal rice varieties include tolerant to drought stress, poor nutrient condition and mineral toxicity, and local pest and disease; grow well on upland condition, and perform early vigorous growth. The characteristics of Asian rice varieties include producing more erect leaves and full panicles of grain and showing earlier harvesting time i.e 90-100 days after planting, which is 30-50 days earlier than local varieties. The NERICAs has higher yield (around 4 tons per hectar) compared to the African varieties (approximately 1 ton per hectar).

Plant tissue culture can be applied for producing homozigous, pure lines of plants for hybrid variety production. This is done by culturing haploid cells such as those from anthers and pollen grains of plants derived from the hybridization of two or more progenitors with desired characters, allowing them to proliferate as calli, which expectedly consist of haploid cells. Chromosome doubling could occur spontaneously or by applying a chromosome-doubling agence such as colchicines, causing the cells in the calli to become diploid. Each individual diploid cells are by theory completely homozygous, meaning that the genes at each locus are homozygous. The calli are then regenerated into population of plants which were then selected for novel characters. The selected plants could be propagated to become varieties or become parental lines for producing hybrid varieties. One example of producing homozygous plant of rice using plant tissue culture were reported by Dewi and Purwoko (2016).

Plant tissue culture could be used to induce somaclonal variations. Somaclonal variations could be defined as genetic variations in somatic cells resulted from in vitro culture of plants (tissue culture of plants). Inducing somaclonal variations could be used as a means to produce new varieties with desired characters. Somaclonal variations usually result from induction and proliferation of callus in a tissue culture system. The rapid induction and proliferation of callus may lead to changes in genes which in turn cause changes in heritable characters. In a breeding program for certain novel characters, the proliferating calli are subjected to a selection pressure which is related to the desired characters. In this case, the proliferating calli are cultured on the media containing selection pressure materials, and the survived cells are then selected and regenerated into plants. Some researchers used polyethylene glycol (PEG) as a selection pressure to obtain plants with drought tolerance. Some also used sodium chloride as a selection pressure material to obtain plants with both tolerance to drought and high salinity stress. The selection pressure materials could also be those to mimic biotic stresses. For example, some researchers used toxins as a selection pressure material to produce plant varieties with tolerance to patogens that release the toxins.

Plant tissue culture could facilitate mutation breeding and plant genetic engineering. In this case, certain concentration (LD_{50}) of mutagenic chemical agence such as EMS (ethyl methanesulfonate) could be put into culture of proliferating callus or shoots. The lethal dosage (LD_{50}) of EMS should be determined an experiment. The survived callus or shoots are then regenerated into plants and the plants are selected for desired characters. The mutagenic agence could be physical, such as gamma ray. As with the chemical mutagenic agence, LD_{50} of physical mutagenic agence should be determined before being applied (Hapsoro et al., 2018)

Basically, plant tissue culture is not theoretical requirement for plant genetic engineering. However, almost all genetic engineering practices has used plant tissue culture system. Plant genetic engineering is a biotechnology to modify character (s) of a plant by directly inserting a gene (s) of interest into its genome. What it means by “directly” is that the sexual hybridization does not occur. The process of gene insertion uses plant tissue culture system, usually in the form of callus culture and shoot culture.

Conclusion and future prospects

Roles of plant tissue culture for supporting agricultural productivity are on the area of rapid clonal propagation and facilitating plant breeding. Rapid clonal propagation is intended mainly to provide high quality planting materials, in term of genetics, physiology, and physical appearance. Facilitating plant breeding is done by induction of genetic variability due to somaclonal variations, mutation breeding, and genetic engineering. In practice, the application of plant tissue culture technology find limitations especially in many developing contries such as Indonesia. The technology is still considered expensive. Therefore, low-cost plant tissue culture operation should be formulated. Since each plant species need special “recepie”, it is necessary in the future to find more general recepie by deciphering mechanism of plant regeneration in vitro. Research in molecular biology and plant physiology on regeneration aspects of plant tissue culture will expectedly solve the problem.

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Airflow resistance of insect screen and evaporative cooling for natural ventilated greenhouse in humid temperate / tropical climate region

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Teruaki SHIMAZU

(Faculty of Applied Biological Science, Gifu University)

SUMMARY

In subtropical climate area and the summer season of temperate humid climate area, important issues in greenhouse management are the avoidance of temperature rise and pest insect's infestation. Although fine-mesh screens incorporated into greenhouse openings can prevent the penetration of insect pests, increasing air temperature and stagnation of air movement in the greenhouse due to ventilation limitation is unsuitable for plants cultivation during summer. The air temperature in the greenhouse covering the fine-mesh screen deteriorates greatly at low wind speed. We developed the duct-type pad & fan (DPF) cooling system for disseminating evaporative cooling systems into small-scale and simple greenhouses where the climate is high radiation, hot and humid in summer.

Key words: duct-type pad and fan system, evaporative cooling, greenhouse ventilation, insect screen,

Introduction

In subtropical climate area and the summer season of temperate humid climate area, greenhouses are often used as a shelter to isolate cultivated plants from rainfall and insect pests. Fine-mesh screens restrict the smallest insects from entering the greenhouse, but large airflow resistance greatly reduces the greenhouse ventilation rate (Sase and Christianson, 1990; Muñoz et al., 1999; Kittas et al., 2002; Teitel, 2007). As a result, covering the greenhouse opening with fine-mesh screen may deteriorate the greenhouse microclimate, especially during summer season (Teitel, 2001; Shimazu et al., 2005; Soni et al., 2005).

Even in the tropical climate region like Indonesia, it is possible to cool greenhouse air to wet bulb temperature by evaporative cooling at a daytime (example: if dry bulb temperature is 35 °C and relative humidity is 50% then wet bulb temperature is 26.2 °C). However, main evaporative cooling systems, namely pad & fan system and a fogging system have disadvantages to adopt in simple structured plastic greenhouses as fellows. 1) The pad & fan system is too expensive for installation in mentioned greenhouse and entails large mechanical ventilation for exhausting hot and humidified air. 2) The fogging system has difficult to avoid excess wetness of plant foliage by a cheap controller and low ventilation rate. Especially limitation of natural ventilation is subject to the failure of fog evaporation in a greenhouse equipped with fine-mesh screens.

We developed the duct-type pad & fan system in a greenhouse (DPF system). Since this system supplies humidified cooling air of positive pressure to the cultivation area via a poly-film tube. This makes it possible to install in a natural ventilated greenhouse, and cool cultivation zone locally.

This paper introduces the influence of covering vents with fine-mesh screen on the greenhouse microclimate, and the performance of the DPF system combing with natural ventilation in a greenhouse.

Material and Method

1. Effects of vent opening with and without fine-mesh screens on greenhouse microclimate

The experiments were carried out in two tunnel-type greenhouses covered with a transparent polyolefin film; this type is commonly widespread among farmers involved in the small-scale production of vegetables in Japan. The greenhouses were adjacent buildings located at National Agricultural Research Center for Western Region, near Ayabe, Japan (32°18'N, 135°15'E). Each was built using iron pipes and a single-span design, with the ridge oriented south-north. The two greenhouses were 7 m apart in an east-west direction. Each was 20 m long by 5.5 m wide, with the eaves and ridge 1.6 and 3.2 m, respectively, above the ground. The eastern and western eave walls were always rolled up to a height of 1.6 m from 0.4 m above the ground. The side-openings and roof windows were covered with 0.6-mm mesh screen (porosity of 0.50; N-3000, Nippon Widecloth Ltd., Kashiwabara, Japan). This screening was capable of excluding insect pests such as the imago of *Plutella xylostella* L., *Phyllotreta striolata*, and *Chromatomyia horticola*. Komatsuna (*Brassica campestris* L.), a leafy vegetable, was cultivated in soils in the greenhouses during measuring periods.

The dry and wet-bulb temperatures were measured with the copper-constantan thermocouples in aspirated tubes at heights of 1.5 m (head height of a worker) at the center and outside edges of the greenhouses. Solar radiation was measured with a pyranometer at a height of 2 m outside the greenhouses. Wind velocity was measured with the three-dimensional sonic anemometers (SAT-540, Kaijo Co., Tokyo, Japan) at heights of 1.5 m at the center of the greenhouse and outside the greenhouse, respectively. The measurements of outside environment were taken 3 m from the southern end of the eastern greenhouse.

2. The DPF system combing with natural ventilation in a greenhouse

The experiments were conducted by using two adjacent pipe-greenhouses (floor area 50 m^2: width 5, length 10 m, ridge height 3 m, volume 120 m^3) covering with polyolefin film without shading oriented in a N-S direction on Gifu University (Gifu, Japan, 136.74˚E, longitude and 35.46˚N latitude). These were 2 m apart in an east-west direction. Both greenhouse floors were left uncultivated, and covered by a transparent plastic film for limiting evaporation from the soil surface. Side ventilators were roll-up film type (height 1.2 m, length 8 m), and two continuous hinged ventilators were built at the ridge (length 6.0 m, hinged height 0.65 m). All ventilators were covered with fine-mesh screens (0.4 mm-mesh size, porosity of 0.52).

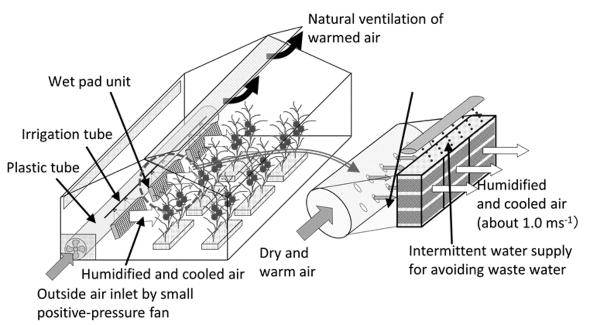

Fig.1 Overview of the aspect of DPF system combing with natural ventilation.

Fig. 1 illustrates an overview of the aspect of DPF system combing with natural ventilation. Two pressure-type fans with attached perforated polyethylene tube were placed on both side floors along length of a greenhouse (airflow rate per a fan: 46 $m^3 min^{-1}$). The cool pad units (width 120 cm, height 39 cm, thickness 10 cm, IBIKO co., Japan) were composed of sheets of corrugated cellulose. 4-pads were closely-spaced to polyethylene tube in a greenhouse. The outside air is supplied into 4-pads through the polyethylene tube, and then evaporated cooled air passed through cool pads was blown into the lower layer in the greenhouse with air velocity of 0.9-1.1 m s^{-1} during every day from 8:00 to 17:00. Cool pads were irrigated by water drip at 1 minute with an interval time of 3 minutes during every day from 8:00 to 16:00. Water supply rate was 500 mL min^{-1} per one pad. Another greenhouse was control treatment (naturally ventilated greenhouse) or intermittently cooled by spraying water-fog at 1 minute with an interval time of 3 minutes with natural ventilation (Fogging greenhouse). A constant fogging rate of 26 mL m^{-2} min^{-1} was supplied to the greenhouse using 7-spray nozzles (2-nozzles in a body, MS-1-W, DIK AGRI WORKERS co., Japan) on 2.2 m height during from 9:00 to 16:00.

The dry- and wet-bulb temperatures were measured with copper-constantan thermocouples in aspirated tubes at next to inner surface of the cool pads, outside edges of the greenhouse (1.0 m height), and the heights of 0.3 m, 1.0 m and 2.5 m above the ground of 3 locations in the greenhouse center line (north, center and south). The climatic variables were measured by a meteorological station (wind speed and direction at a height of 5 m, solar radiation at a height of 4 m) located about 5m from the south wall of the greenhouse, and The greenhouse ventilation rate was calculated from the heat balance method by greenhouse environmental data.

Result and Discussions

1. Effects of vent opening with and without fine-mesh screens on greenhouse microclimate

Figure 2 shows the variation in wind speed outside and inside the greenhouses with and without insect-proof screening. Wind speed in the screened greenhouse fell to half that in the greenhouse without screening, and seldom exceeded 0.5 m $s^{–1}$ even when the outside wind became strong. This suggests that it would be difficult for workers to benefit from a comfortable wind inside the screened greenhouse.

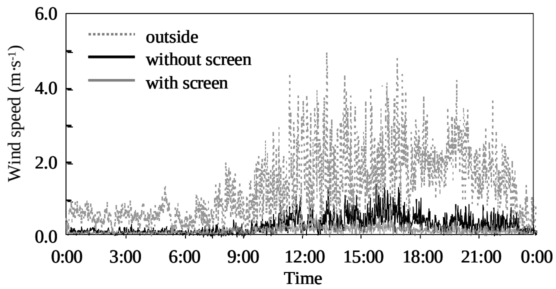

Fig. 2 Variation of wind speed outside and inside greenhouses with and without an insect-proof screen at a height of 1.5 m on 9 June 2003.

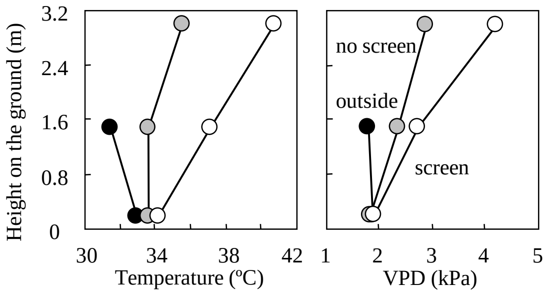

Fig. 3 Typical vertical distribution of air temperature and VPD inside and outside greenhouses at a time with high levels of solar radiation and low wind speed (11:20, 22 August 2003; outside solar radiation of 899 W m^{-2} and wind speed of 0.79 m s^{-1}).

Figure 3 shows the typical vertical distribution of air temperature and vapor pressure deficit (VPD) inside and outside the greenhouses at a time with high solar radiation and low wind speed. There was only a small difference in temperature and VPD between treatments at plant height (0.2 m); consequently, growth of Komatsuna in the screened greenhouse would be equivalent to that in the unscreened greenhouse (data not shown). However, the strongest gradients in air temperature and VPD occurred in the screened greenhouse, with particularly warm air stagnating in the space immediately below the roof.

In addition, the relationship between outside wind speed and the air temperature difference between the inside and outside of the greenhouse at that with high levels of solar radiation (above 600 W m^{-2}) is shown in Figure 4. The air temperature in the unscreened greenhouse was within 2 °C of the temperature outside the greenhouse at all measured outside wind speeds. In contrast, the air temperature in the screened greenhouse increased by up to 6 °C at outside wind speeds lower than 2 m s^{-1}. These results show that the ventilation effect due to wind was drastically reduced at low wind speeds in the single-span greenhouse when its eave openings were covered with insect-proof screening, owing to the increased resistance to airflow caused by the screening.

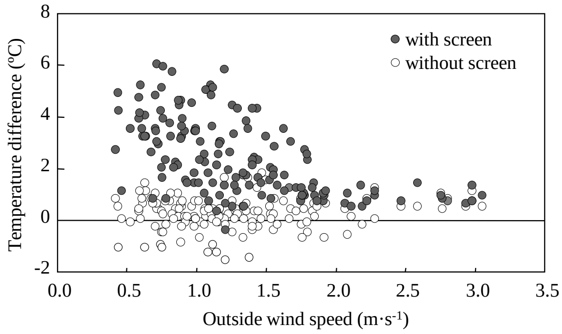

Fig. 4 Relationship between outside wind speed and the difference in air temperature between the inside and outside of the greenhouse at a height of 1.5 m and with high levels of solar radiation (above 600 W m^{-2}).

2. The DPF system combing with natural ventilation in a greenhouse

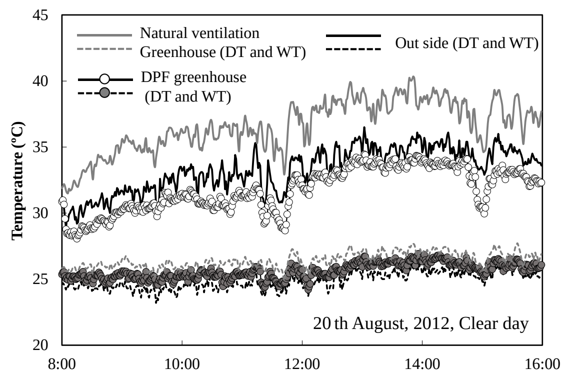

Fig.5 Temperature change of natural ventilated greenhouses with DPF cooling and without cooling (1 m height point in the greenhouse center). The greenhouse openings were covered with the fine-mesh screen (0.4 mm-mesh size, porosity of 0.52). DT: dry temperature, WT: wet temperature.

Figure 5 shows temperature change of natural ventilated greenhouses with DPF cooling and without cooling. The dry temperature in the DPF greenhouse was not only

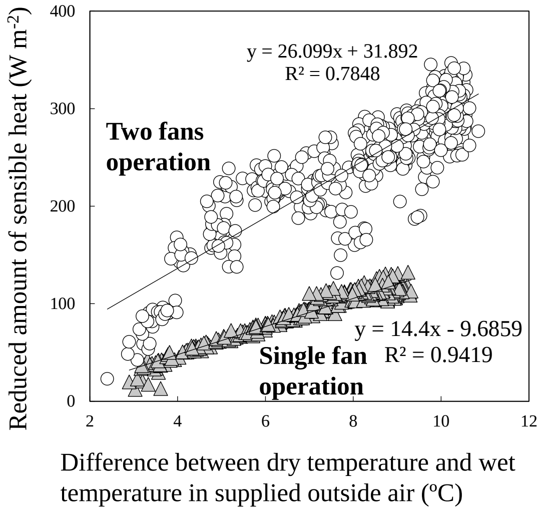

Fig.6 Relationship between the difference between dry temperature and wet temperature and the reduced amount of sensible heat of air that passed the cooling pad (per greenhouse floor area) during DPF cooling operation (a fan's flow rate: 46 m^3 min^{-1}, greenhouse's floor area: 50 m^2). Cooling efficiency (η) of DPF's cool pads were stabilized at 80-90%.

4~6 °C cooler than that in the no cooling greenhouse, but also lower than the outside dry temperature.

Figure 6 shows that the sensible heat reduction amount of the air depends on the between dry temperature and wet temperature difference of the air passing through the cooling pad and fan's airflow rate. Although this sensible heat reduction amount is smaller than the absorbed solar radiation in the greenhouse, the dry temperature in the cultivation space was lower than the outside air. The area ratio of the opening of the greenhouse to the floor was as large as 0.54, and the ventilation rate by natural ventilation was also a sufficiently large value (4 $m^3m^{-2}min^{-1}$). This means that the DPF system can cool the cultivation area locally below outside air temperature with a small amount of fans while exhausting the heat of the solar radiation by natural ventilation.

Figure 7 shows air temperature comparison between fog cooling, DPF cooling and natural ventilation only in the greenhouse covered opening with insect screen. DPF greenhouse always maintained lower temperature than fogging greenhouse. The DPF system can humidify and cool the outside air, but the fogging system humidifies and cools the greenhouse air. Also, when the fogging is stopped, the air temperature rises in the fog cooling greenhouse. Therefore, the air temperature in the DPF cooling greenhouse has always been lower than that of the fog cooling greenhouse.

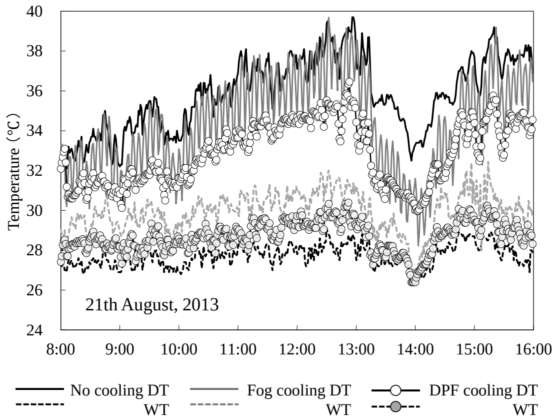

Fig.7 Temperature comparison between fog cooling, DPF cooling and natural ventilation only in the greenhouse covered opening with insect screen. Cucumbers are cultivated in the greenhouse (LAI: 1.05).

Conclusion

Although greenhouses with insect-proof screens can reduce or eliminate the need to use insecticides, the reduced ventilation caused by these screens can lead to unacceptable changes in the greenhouse microclimate. The increase in airflow resistance by the fine-mesh insect screen lowered the ventilation rate under low wind speed condition, and markedly increased the air temperature in the greenhouse. Therefore, the duct-type pad & fan cooling system capable of combining with natural ventilation is effective for a small-scale and simple greenhouse in humid temperate / tropical climate region.

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Sustainable agriculture, a strategy to maintain the business sustainability of PT. Great Giant Pineapple under Global Climate Change

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Introduction

As of August 2018, the total population of the Earth is exceeds 7.63 billion people, about 266.79 million is Indonesian people and this number is continuing to grow each day (worldpopulationreview.com). Such population explosion will create the demand increase in food, feed and fiber production. However, land is a limited resource and agricultural use of land will be in competition with land use for habitation, infrastructure and industry. In general the challenge is how to increase the crop production without a significant increase in the use of arable land (Godfray and Garnett, 2014). Also there is a pressing need to develop suitable strategies for increasing global food production without any additional social, economic or ecological pressures (Dubey et al, 2016). The difficulty become increasingly under changing climatic conditions and the resulting effects on crop growth, yield and disease susceptibility. The changing climate may also influence the nutritional quality of crops (Myers et al, 2014). Climate change is an impact of global warming that could also lead to long droughts and droughts, and the irregular rains. Global warming is a phenomenon of increasing temperatures on the surface of the earth as a result of the concentration of greenhouse gases in the atmosphere.

PT. Great Giant Pineapple (PT. GGP) is the world's largest fully integrated single location pineapple facility from plantation to processing and shipping. Start commercially planting in 1979, PT. GGP now is the third world largest pineapple producer with more than 600,000 MT fruit annually harvested from 82,000 acres (32,000 Ha) of plantation in Lampung, Indonesia. The big goal of the company is "Business Sustainability". To achieve the goals required a holistic business sustainability capability (business, operation, environment, and social). Sustainable agriculture must be done by changing agricultural practices using principles of ecology; reduce chemical fertilizer, pesticide and water usage; using biofertilizer and organic fertilizer, organic pesticide, reduce fuel consumption.

Integrated operation in PT. GGP

Great Giant Agri-Group is an integrated operation in 32,000 Ha plantation planted with pineapple, banana, cassava, guava and other fruits. **Pineapple Plantation**, divided into 3 plantation group. **Pineapple Factory**, integrated factory consists of Canning Plant, Concentrate Plant, Mill Juice Plant, Can Making & Drum Plant, Labelling & Packaging Plant, and Sugar Refinery Plant. **Tapioca Factory**, produce native tapioca starch from cassava**.** **Cattle Fattening and Dairy**, utilize pineapple waste pulp as a cattle feed. **Bromelain Enzyme Factory**, produce bromelain enzyme from pineapple stem. **LOB (Liquid Organic Bio-fertilizer)**, produce LOB for pineapple plantation as part of company soil sustainability program. **Composting Plant**, Utilize the cow dung secretion from cattle to produce organic fertilizer (compost) for plantation. **Biogas Plant**, produce biogas from pineapple and tapioca liquid waste water. **Co-gen Plant**, produce steam and power. Zero waste is the fundamental concept to manage the operational of the whole business.

Sustainable business strategy

There are several aspects such as economic, environment, social, and welfare that must be considered to maintain the business sustainability of the company. Sustainability division was established in PT. GGP since 2011 to strengthen the implementation of sustainable business strategy to achieve claim as a green company. A green company claims to act in a way which minimizes damage to the environment. To realize green company, some things have been and are being done such as declaration of **Great Giant Going Green 30-40-50** (kick off September, 2009), it is a policy program launched by management in an effort to achieve the target to be a sustainable green company. Reduce fossil fuel use by 30%, since fossil fuel is a source of

CO_2 emission which is a cause of global warming. Reduce chemical use by 40%. Increase yield by 50%.

Sustainable agriculture

Sustainable agriculture was defined as an integrated system of plant and animal production practices having a site-specific application that will last over the long term, for example to satisfy human food and fiber needs, to enhance environmental quality and the natural resource base upon which the agricultural economy depends, to make the most efficient use of nonrenewable and on-farm resources and integrate natural biological cycles and controls, to sustain the economic viability of farm operation, and to enhance the quality of life for farmers and society as a whole (Mary, 2018). Sustainable agriculture is one of the sustainable business strategies that must be done by changing agriculture practice using principles of ecology, such as reduce chemical fertilizer, pesticide and other hazard substances contaminant, reserve water and biodiversity losses. Increase biological, physic and soil chemistry quality by using liquid organic bio-fertilizer (LOB) and organic fertilizer (compost). Biological control and integrated pest management. LOB plant and Compost plant were build to support the success of the program.

Regulation compliance

Implementation and certification of management system such as : **ISO 14001** (certified July, 2006) **,** environment management system, identification of aspects and environmental impacts of production activity to determine the significance both through operational control and program determination, objectives and targets which are based on applicable laws and regulations and refer to the PDCA cycle. **Rainforest Alliance** (certified)**,** plantation must meet criteria of the Rainforest Alliance Sustainable Agriculture Standard. The standard encompasses all three pillars of sustainability-social, economic, and environmental. The standard is built on these important principles of sustainable farming: Biodiversity conservation, improved livelihoods and human well-being, natural resource conservation, effective planning and farm management system. **Social Accountability 8000** (certified)**,** this certification was originally developed as a social standard in order to ensure companies comply with their commitments to social responsibility. Elements of SA8000 standard are child labor, forced or compulsory labor, health and safety, freedom of association and right to collective bargaining, discrimination, disciplinary practices, working hours, remuneration, and management system. **ISO 9001** (certified), quality management system, food safety, halal, etc.

Environment & natural resources management

Integrated waste and natural resources management (water, soil, energy), carbon footprint. The waste water produced by pineapple factory and tapioca factory if not treated well could pollute the environment due to high of COD-Chemical Oxygen Demand (8,000 ppm COD from pineapple factory waste water and 25,000 ppm COD from tapioca factory waste water). It can be an-aerobically de-composted by methanogenic bacteria to be converted into biogas as renewable energy. The biogas then used to replace 100% of Heavy Fuel Oil used in tapioca starch drying, and substitute partly coal consumption up to 8 – 9%. Replacement of 100% of HFO, is a significant contribution to company objective to reduce 30% non renewable fuel and reduce drying cost.

The waste to energy project

Source of waste water treated in the Biogas Plant is coming from the pineapple factory and tapioca factory and if it is untreated will contribute to environmental pollution. The company has decided to launching program **"The waste to energy project"** and registered as CDM (Clean Development Mechanism) project under UNFCC (United Nations for Climate Change). The waste water is treated in an anaerobic UASB (Up-flow Anaerobic Sludge Blanket) system and converting the liquid waste into renewable energy called biogas. The biogas is used to substitute partly coal consumption in coal power plant that generate steam and power for factories and also replacing Heavy Fuel Oil (HFO) for tapioca starch drying. Biogas as renewable energy is more environment friendly compared to coal and HFO. The GGP's Biogas Plant is considered to be the first one in the world to combine waste water from pineapple and tapioca factory. It is also the first one in pineapple industry to use anaerobic UASB (Up-flow Anaerobic Sludge Blanket) system and resulted in producing higher biogas yield (COD removal > 90%) and methane gas content (60 – 65%). The waste water mixture has been observed and developed together with third parties. Biogas plant was design with the capacity of 9.5 mio Nm^3 biogas produced per year with UASB efficiency to remove COD 90 – 95%. Biogas plant now produce 8.5 mio Nm^3 biogas per year, about 4.9 mio Nm^3 is transferred to cogen plant, equivqlen to 7,000 ton coal consumption (118 mio GJ) or about 8-9% of energy consumption in Cogen. Another 3.1 mio Nm^3 is transferred to Tapioca factory to replace 100% (2 mio Liter) of HFO consumption (75 GJ).

The utilization of biogas from liquid waste water in steam and electric production is also considered as the first one in Indonesia. GGP Biogas CDM has been registered in the UNFCC and got the CDM Certification in 2015. Participation in the CDM project means that together with the citizens of the world play an active role in reducing greenhouse gas emissions. The Indonesian government also has a target of reducing greenhouse gas emission by 26% by 2020.

Conclusions

PT. GGP is a green company that claims to act in a way which minimizes damage to the environment. Sustainable agriculture is one of the strategies used and implemented to maintain the business sustainability of the company under climate change. Climate change is an impact of global warming as a result of increasing concentration of greenhouse gases in the atmosphere. GGP Biogas has been registered as a Clean Development Mechanism (CDM) project in the UNFCC and got the CDM Certification in 2015. CDM is a mechanism to reduce greenhouse emission as a responsibility of the developed countries as attached in attachment no. 1 of the Kyoto Protocol.

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GIS analysis for vulnerability assessment of salt damage on Taro Patch in Palau

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SUMMARY

Due to the global climate change, sea level rise and storm surges are worried to accelerate salt damage to coastal agricultural fields. The Republic of Palau, a small island nation in the Pacific Ocean is suffering from increasing taro patch abandonment. The purpose of this paper is to clarify the characteristics of taro patches which are damaged by seawater based on the GIS analysis and clustering, such as elevation, distance from the sea, slope, catchment area, and area of taro patch. The target area was the Babeldaob Island, which is the largest island in Palau. The results showed that the taro patches were mostly distributed in less than 10 m in elevation, within 1 km in distance from seawater, and on slopes below 3%. We divided taro patches into two clusters by k-means clustering; cluster 1 which the elevation was high and catchment area, and area of taro patch were small and cluster 2 which the elevation was low, and catchment area and area of taro patch were large. These results imply that the large catchment area might lead to suppression of salt damage.

Introduction

Current and future climate-related drivers of risk for small islands include sea level rise, tropical and extratropical cyclones, increasing air and sea surface temperatures, and changing rainfall patterns. Soil salination from inundation is one of the impacts from those drivers on ecosystems and natural resources and threatens the sustainability of agriculture [1].

Taro, which is an inclusive term of araceous plants with edible corms, is indispensable for Palauan people as a staple food. **Figure 1** is a schematic of a Palauan traditional village for the reference to a picture in the possession of Bureau of Art and Culture. The taro paddy field is drawn in the center of this picture and called 'Taro Patch'. Each taro patch is flat and partitioned into small grids, and connected to a stream via small channels in the purpose of irrigation and drainage. The irrigation system allows water to enter on top and the side of the soil as well as bottom of the soil. The field is protected by embankments. An outflow is created at the downstream end of the taro patch to allow excess water to flow back into the main stream. This structure ensures a steady flow of water that neither dries up or floods the taro patches [2].

The taro patches are important in terms of cultural succession as well as food supply and their sustainable management is expected. However, the area of abandoned fields is currently increasing. There should be

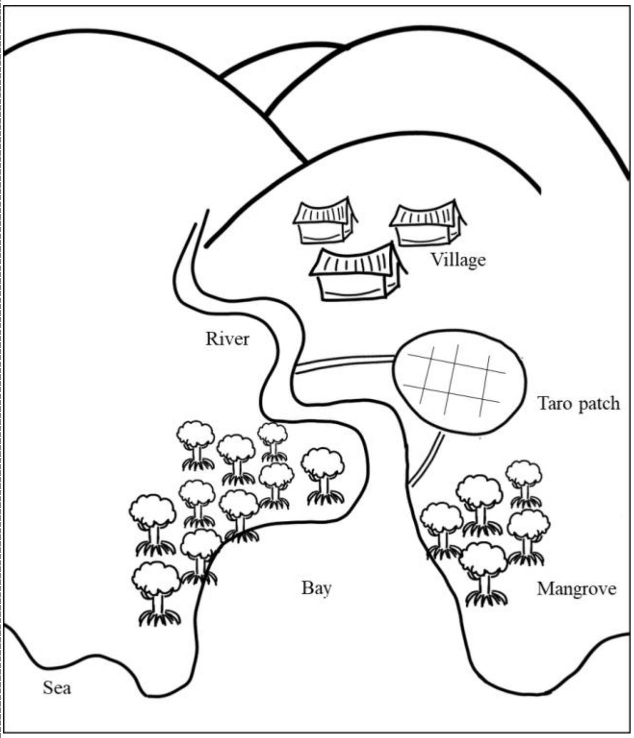

Figure 1. Schematic of traditional village in Palau.

some reasons for this abandonment and the soil salination is regarded as one of the major reasons, especially after a big typhoon attacked in 2013 [3]. Kimura et al. continuously measured the groundwater level and water salt concentration at two taro patches in Babeldaob Island and revealed that the water salt concentration was mainly affected by the daily variance of groundwater level engaged with the tidal level and that the supplied water on the surface in a rainfall event also influenced the salt concentration [3]. These results imply the importance of water availability from the catchment as well as the seawater impact from the sea to assess the vulnerability of taro patch to soil salinity. Here, we set the purpose of this paper to investigate the characteristics of taro patches which are vulnerable to salt damage using the GIS analysis based on the geographical parameters such as elevation, distance from the sea, catchment area, and area of taro patch.

Material and Method

The Republic of Palau is located in Oceania, group of islands in the North Pacific Ocean, southeast of the Philippines (**Figure 2**). The climate is tropical, hot and humid; wet season is from May to November. The total area is 459 km^2 and the Babeldaob is the largest island, with 409 km^2 [4]. Main land cover is farmland and forest land and they cover 10.8%, 87.6% of the total area, respectively. The population is 21,431 people, with the GDP per capita is $16,700 whereas agriculture accounts for 1.2%, industry for 12.4%, services for 86.4% of the GDP [5].

The target of this study was 84 taro patches in total in Babeldaob Island, the Republic of Palau. We analyzed all 84 taro patches in Babeldaob Island.

In this study, the digital elevation model (DEM) in the spatial resolution of 10 m [6] and land-use map in 2011 [7] were analyzed using ArcGIS 10.5. From the land-use data, taro patches were extracted and numbered from 1 to 84. The land-use map and the DEM were overlaid and the average of the elevation, the distance from the sea of each taro patch were calculated. The distance used the length between the edge of taro patches and the line of elevation at zero meter. The slope was calculated with elevation/distance (**Figure 3**). In addition, using Special Analysis Tool of ArcGIS 10.5, flow accumulation was calculated from DEM and the maximum value in each taro patch was taken as the catchment area of the taro

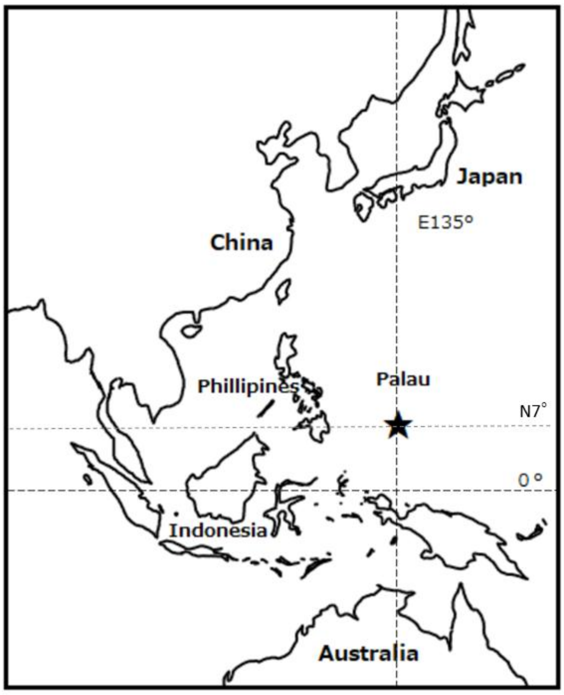

Figure 2. Location of Palau in the Pacific Ocean**.**

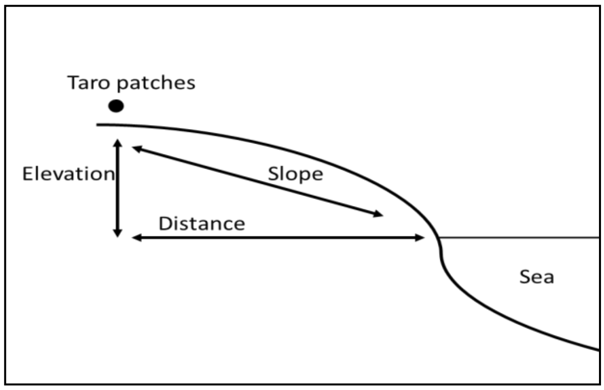

Figure 3. Definitions of elevation, distance and slope

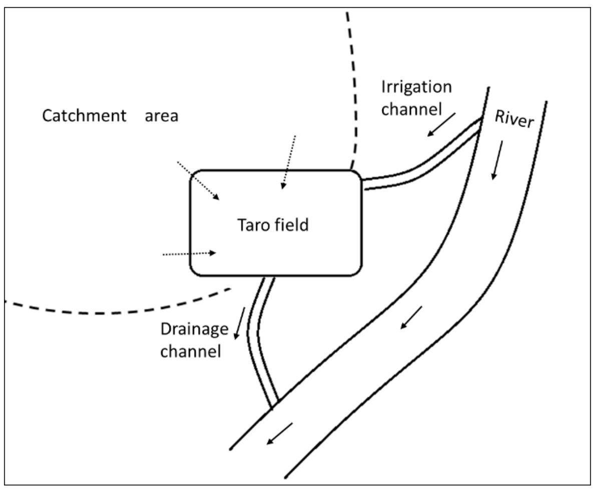

Figure 4. Schematic of catchment area and river around taro patches.

patch where grids supposed to be a river was excluded (**Figure 4**). Furthermore, the area of each taro patch was obtained from the land-use map.

We adopted K-means method in order to divide the taro patches into two clusters: cluster1 and cluster2. A data set of elevation, distance, catchment area, area of taro patch was used as input for the analysis and average values of each element in two clusters were tested for significant difference by the Wilcoxon Rank Sum. These analyses were conducted by R 3.5.0 statistical.

In addition, the Euclidean distance was adopted as in indicator to assess the contribution of each parameter.

We calculated the distance between the two clusters with three parameters except one (i.e. elevation, distance and catchment area) for the four cases and compared the value with the distance calculated with all the four parameters. From the gap between those distances, we can compare the contribution of variables.

Result and Discussions

Histograms for all 84 taro patches of elevation, distance from the sea, slope, catchment area were shown in **Figure 5**. The median of elevation was 5.7 m asl, and the range of 2-10 m asl occupied more than 90%. The median of distance from the sea was 0.41 km, and the range within 1 km occupied more than 90%. The median of slope was 1.7%, and the range within 3% accounted for more than 90%. The median of catchment area was 1.78 ha, and the range of 0 to 1 ha was the largest. On the other hand, 9.5% of taro patches which had a larger catchment area than 15ha.

Taro patches had low elevation and distributed more on flat land in the coastal area near the sea (**Figure 5**). Flat lands can store water like rice paddy and are suitable for growing taro, because taro prefers peaty soil with poor drainage [5]. There are, however, many steep terrains and flat land spreads only in the coastal area; this is a typical topography in small islands.

We divided the 84 taro patches into two clusters by k-means method; cluster 1 and 2 consisted of 69 and 15 fields, respectively. The taro patches in the cluster 1 and 2 distributed not biased in specific areas and no regional tendency was found in the result of clustering.

Box plots of elevation, distance, catchment area, area of taro patch in cluster 1 and 2 are shown in **Figure 6**. The elevations of the taro patches in the cluster 2 were significantly lower ($p<0.05$), and the catchment area and area of taro patch in the cluster 2 were highly significant bigger than those in the cluster1 ($p<0.001$). There was no significant difference in the distances from the sea between cluster1 and 2. The differences in the catchment area and area of taro patch between the two clusters were remarkable. The cluster 1 was a group with a high elevation, and small catchment area and area of taro patch, and the cluster 2 was a group with a low elevation, and large catchment area and area of taro patch.

The results of the Euclidean distance analysis between the cluster 1 and 2 are shown in **Table 1.** The Euclidean distance of all data (elevation, distance, catchment area, area of taro patch) was 2.81. The value of three data without catchment area (elevation, distance, area of taro patch) decreased to 1.93. The Euclidean distance without the catchment area was smaller than that of the other three elements. The Euclidean distance between the clusters containing the catchment area was large.

Two taro patches which were investigated in the previous study [3] can be adopted as reference points: Plot A which was located in Airai state, the south part of island where the water salt concentration was high and Plot B in Ngaraard state, the northeast part, without salt damages. Plot A and Plot B were included in the cluster 1 and 2, respectively. Generally, low elevation land is considered to be susceptible to the impact from sea water, such as high tide or inundation. The results shown in **Figure 6** means the taro patches in the cluster 2 had been received the higher impact of salination than those in the cluster 1. However, since Plot B with lower salt content in its soil was included in the cluster 2, it suggests that taro patches in the cluster 2 suppresses the influence of salt water from the sea due to large both catchment area and area of taro patch. The larger catchment area supplies more water flow in a rainfall event. Therefore, the taro patches in the cluster 2 assumed that they have a larger amount of inflow water in a rainfall event than those in the cluster 1, and that the salt damage could be alleviated. The result of the Euclidean distance (**Table 1**) also support this assumption; catchment area was a factor that contributed more in clustering than the other factors.

Conclusion

Taro patches of 84 fields in Babeldaob Island were divided into two clusters: cluster 1 and 2. In the cluster 1 the elevation was high, and the catchment area the area of taro patch were small. In cluster 2, the elevation was low and the catchment area and the area of taro were large. Taro patch which has features such as cluster 1 with high elevation and small catchment area and area of taro patch is considered to be vulnerable to salt damage. The fact that it was divided by the area of catchment means that the amount of water coming from the area of catchment affects the vulnerability of taro patch to salt damage. It has been known that climate change will derive sea level rise and changes in the frequency and intensity of cyclones causing salt damage on agricultural land. It was, at the same time, suggested that the ability to flush the stored salt damage away was also important. To support this conclusion, it is expected to measure the salt concentration in soil water actual in various taro patches and to validate the relationship between the topographic parameters and the vulnerability to the salt damage.

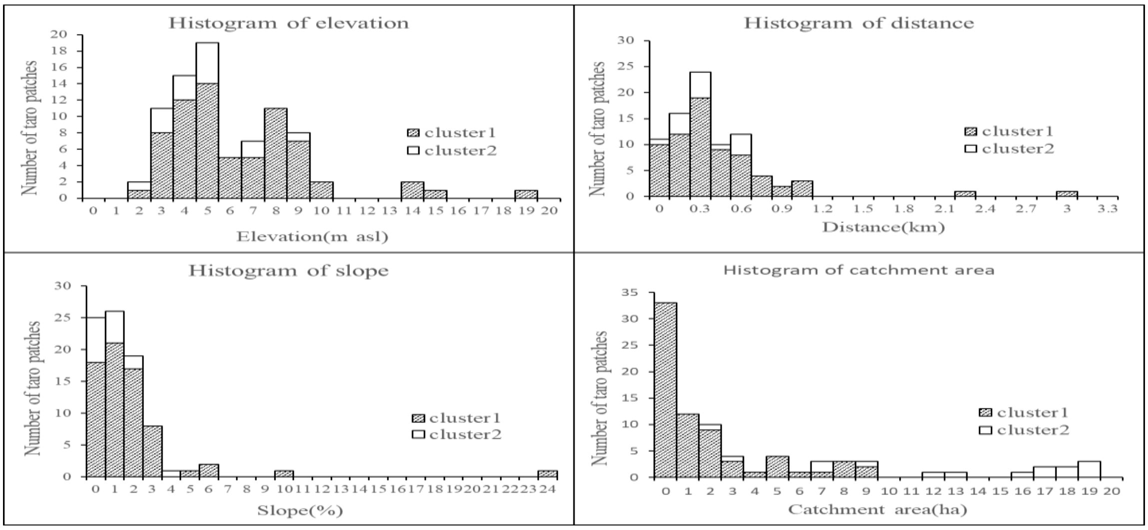

Figure 5. Histograms of geographical parameters of the taro patches.

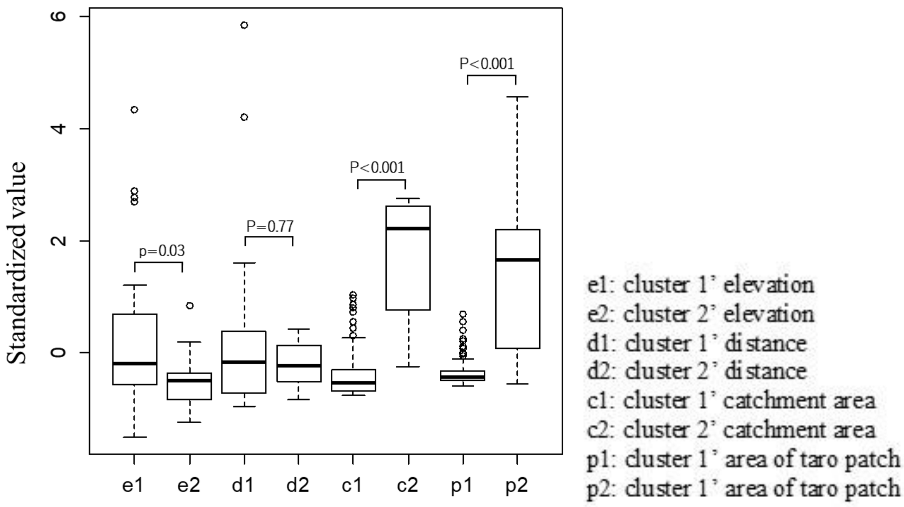

Figure 6. Boxplot for geographical parameters of the taro patches in cluster 1 and 2

Table 1. Euclidean distance between the cluster 1 and 2

All data	Without elevation	Without distance	Without catchment area	Without area of taro patch
2.81	2.76	2.80	1.93	2.15

Acknowledgement

This paper is a short version of a conference paper for International Conference on Climate Change 2018, held in Solo, Indonesia, on 27 and 28 November, 2018. This research was supported by Grants-in-Aid for Scientific Research in Japan(18H03417) from the Japan Society for the Promotion of the Science (JSPS), the Environment Research and Technology Development Fund (4RF-1401) from the Ministry of Environment, Japan and the scholarship for overseas training from the endowment of Gifu University.

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Applications of Structural Equation Modeling in Crop Yield Variability of the Farmers' Fields

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SUMMARY

Crop yields are affected by a variety of yield limiting factors including climate, soil properties, and farmers' management practices. Thus, it is essential to understand the casual relationships between external factors and crop yields from the perspective of the yield formation process. This study presents an effectiveness of structural equation modeling (SEM) when analyzing crop yield variability at the field-scale experiments. We introduced two case studies including (1) wheat yield variability with in a large-scale paddy field; (2) forage yield variability in upland fields converted from paddy fields in Japan. The results of SEM application for the first study demonstrated that spatial variability of the sand content significantly affect the number of established seedlings, which in turn affect the number of panicles. Although the effect of the number of established seedlings on the number of panicles was not relatively high (r^2=0.20), development in variable seeding technology in the basis of spatial variability in sand content may be a solutions for improving wheat yield. The result of the second case study indicated the relative importance of unstable seedling establishment for both crops (corn and sorghum) were higher than that of the amount of applied N, and the negative effect of corn yield on sorghum yield can be offset by the effect of the amount of applied N. The classical linear regression analyses were not be able to detect the direct effects of environmental factors or yield components on crop yields for both case studies. Thus, we demonstrated that SEM application is an effective approach to analyze multivariate data obtained from the field-scale experiments.

Introduction

It is essential to quantitatively evaluate the effect of environmental factors on variability of crop yield and quality by analyzing multivariate data obtained from field-scale experiments. However, the multivariate data are generally affected by multicollinearity. There are several multivariate analyses to avoid multicollinearity. Structural equation modeling (SEM) is a powerful statistical approach for the analysis of complex intercorrelated data with a wide range of potential applications in the plant sciences (Lamb et al. 2011). Although SEM had been used frequently in the social sciences because of its advantages in facilitating systems understanding, it has been increasingly applied in agronomic studies (Liere et al., 2015; Hill et al., 2017).

Here we present two examples of SEM application on multivariate data obtained from field-scale experiments in Japan. The first case study is focusing on the variability of wheat grain yield in a large-scale paddy field. The second case study is focusing on the variability of forage yield under corn–sorghum mixture in the upland fields converted from paddy fields. We evaluated the effect of soil properties or yield components on crop yield variability with SEM in both case studies. We also applied classical statistical analyses (linear regression) to evaluate direct relationships between parameters.

Material and Method

In this study we analyzed multivariate data obtained from two case studies on crop yield variability in the field-scale experiments.

Data Collection for the first case study

The lack of knowledge of spatially variable crop yield and quality is limiting development and adoption of site-specific management technology in Asian countries. It is recommended to cultivate wheat or soybean in paddy fields in Japan because of the low price of rice and high demand for domestic production of wheat and soybean. However, the relatively high moisture content of paddy soil after rice cropping hinders establishment, tillering, and yield of winter wheat in the rice–wheat–soybean cropping system of Japan.

Furthermore, the recently consolidated large-scale paddy fields may have high spatial heterogeneity of soil properties. Thus, we evaluated the spatial variability of soil properties and their impacts on wheat yield in a large-scale paddy field in Kaizu city, Gifu, Japan from 2017 to 2018. We collected surface soil (0–15 cm) samples by the line transect method from two large-scale paddy fields immediately before wheat seeding. The sampling points were at 5 m intervals along the long side of each field and at 2.5 m intervals along the narrow side. We analyzed soil pH, EC, moisture content, total carbon and nitrogen contents, particle-size distribution (sand, silt, and clay), and available nitrogen (N) with a hot KCl extraction method (Gianello and Bremner, 1986). At the soil sampling points, the number of established seedlings per square meter was counted at seedling stage, and plant samples were collected at maturity stage. We totally collected data on soil properties, wheat grain yield and its components from 95 plots.

Data Collection for the second case study

To meet the demands for forage production and to solve an recent issue of the increasing number of abandoned paddy fields, paddy fields have been converted to upland fields to produce whole crop silage including corn in Japan. However, corn is susceptible to high moisture content of paddy soil specifically at the seedling establishment stage. Thus, sorghum is often recommended to sown with corn to stabilize the seedling establishment ratio because sorghum is much more tolerant to wet soil conditions than corn. Thus, the corn–sorghum mixture cropping system has been increasingly introduced in upland fields converted from paddy fields. However, the large spatiotemporal variability in forage yield still remain largely unknown at the farmers' fields. To investigate forage yield variability in Gero city, Gifu, Japan, we collected 3 plant samples by the diagonal line transect method from each 12 farmers' fields with different years of continuous cropping at the dough stage of corn in August 2018. We measured the number of shoot and dry matter weight after the plant samples were divided into two crop species (corn and sorghum). All of the fields received the same amount of chemical fertilizer (10 g N m^{-2}, 10 g P_2O_5 m^{-2}, and 10 g K_2O m^{-2}) (only basal application). Seeding rate was 80,000 seeds ha^{-1} and 20 kg ha^{-1} for sorghum, respectively.

In addition to the field survey, we also conducted fertilizer experiment at a farmer's field to determine the effect of different N application rate to forage yield. Four N application with 6 replicates were carried out in a randomized block design. Each replicate plot area was 40 m^2 (5m × 4 m). Four N application plots received 0, 5, 10, and 20 g N m^{-2} as a basal application of slow releasing fertilizer LP100 (N-P-K: 41-0-0) (JCAM AGRI, Japan). Forage yields were surveyed as described above. The 'SH4681' corn cultivar (Snowseed, Hokkaido, Japan) and 'High Sugar Score Sorghum DH' (Snowseed, Hokkaido, Japan) sorghum cultivar were used in this study. The management was not different from those of the other surrounding corn–sorghum mixture fields, excluding the N application rate.

Data Analysis

All the statistical analyses were performed in R version 3.5.0 (R Development Core Team, 2018). The direct relationships between parameters were analyzed using linear regression. Statistically significant level was considered at $P < 0.05$.

To elucidate the causal relationships affecting crop yield, structural equation modeling was performed with the 'lavaan' package version 0.6-3 (Yves, 2012) implemented in R 3.5.0. The construction of initial model is an essential step in SEM. The model is constructed in the basis of theoretical knowledges. The initial path models were developed for the wheat and forage yield data (Fig. 1). Wheat establishment ratio is

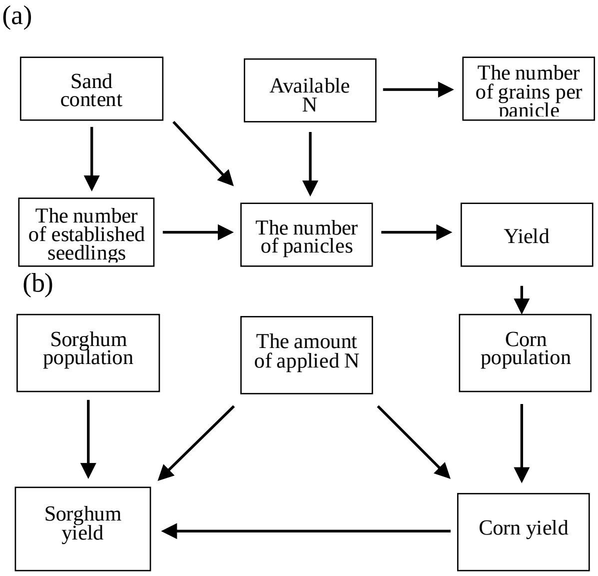

Fig.1 The initial path model for wheat yield (a) and corn–sorghum yield (b). Rectangles indicate observed variables. Single-headed arrows indicate a causal relationship.

known to be affected by particle-size distribution (sand content) and soil moisture relevant to the determination of clod size during the sowing season, as suggested by Inamura et al. (2010). We hypothesized that the particle-size distribution (sand) may also affect soil moisture, which in turn affect the active tillering (the final number of panicles) because high soil moisture content of paddy soil often negatively affects the wheat growth. Furthermore, we hypothesized that soil available N may affect on the final number of panicle or the number of grain per panicle. Thus, we developed the initial model for wheat yield (Fig. 1 a). We developed the initial model for corn–sorghum yields on the assumption that an unstable establishment of corn and sorghum seedlings and the amount of the applied N would affect forage yields. We further hypothesized that vigorous and early corn growth would negatively affect on sorghum growth. Thus, the path from corn to sorghum yield was included in the initial model. The model fit was measured by χ^2 test with a null hypothesis of adequate fit. The model fit was further evaluated by goodness of fit index (GFI). The value of GFI more than 0.9 indicates satisfactory model (Hair et al., 2010).

Result and Discussions

First Case Study

A satisfactory model should have an insignificant χ_2 test. The result of χ_2 test indicated that the initial model was not an adequate fit (χ_2=24.70, p=0.002). Insignificant effects of available N on both the number of panicles and that of grains per panicle were observed according to the regression analyses (p<0.05). Furthermore, the effect of sand content on the number of panicles was also insignificant. These results indicated no important paths have not been omitted from the model. Therefore, the insignificant paths were removed from the initial model. The modified model had an adequate fit according to the χ_2 test (χ_2=8.44, p=0.21) (Fig. 2). The value of GFI also indicated a satisfactory fit (GFI=0.96).The result of SEM application demonstrated a strong effect of the number of panicles to wheat yield (standardized coefficient=0.90). The classical linear regression analysis was not able to detect the strong direct relationships between the sand content and wheat yield (r^2=0.04, p=0.04). On the other hand, the results of SEM application demonstrated that

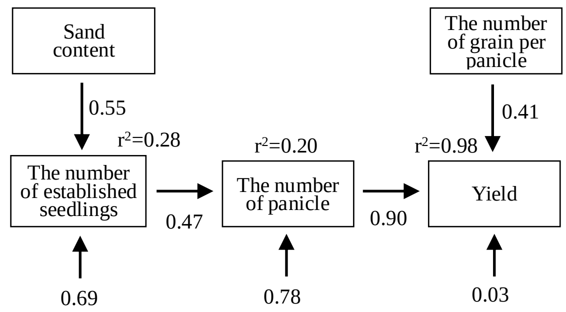

Fig.2 Fitted observed model modified from the initial model in Fig. 1 (a). All standardized path coefficients are significant (P<0.05). R^2 value is presented for two endogenous variables (the number of established seedlings, the number of panicles, and wheat yield).

the sand content affected on the number of established seedlings, which in turn affected the number of panicles. Although the amount of variance in both the number of established seedlings (r^2=0.28) and panicles (r^2=0.20) explained by the modified model was not high, the results indicated that spatial distribution of soil properties (sand content) relevant to clod size partially affected on the final yield. Thus, development in variable rate seeding technology may be one of the solution for improving wheat yield in large-scale paddy fields where have a high spatial variability in soil particle-size distribution. Furthermore, relatively low determination coefficient of the number of panicles indicated that further research should be oriented toward exploring the other environmental factors affecting the number of panicles.

Second Case Study

The result of χ_2 test indicated that the initial model was an adequate fit (χ_2=10.08, p=0.07). However, there was an insignificant effect of the amount of applied N on corn yield (P=0.78). Thus, the path from the amount of applied N to corn yield was removed from the initial model. The modified model was also accepted by the χ_2 test (χ_2=10.152, p=0.118) (Fig. 3). The value of GFI also indicated a satisfactory fit (GFI=0.94). The result of SEM application demonstrated that there was a significant effect of applied N on the sorghum yield but not on corn yield, although the classical linear regression

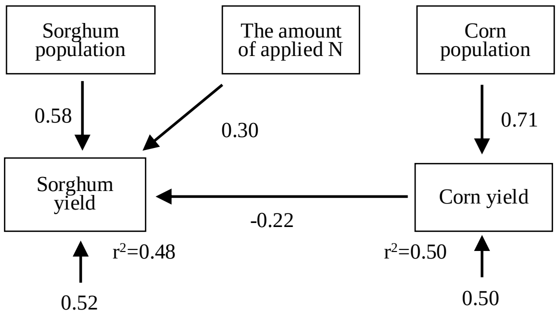

Fig. 3 Fitted observed model modified from the initial model in Fig. 1 (b). All standardized path coefficients are significant (P<0.05). R^2 value is presented for two endogenous variables (corn and sorghum yield).

analysis was not able to detect the direct relationships between the mount of the applied N and forage yields (p=0.60). Furthermore, populations of sorghum and corn population strongly affect the forage yield. The result of SEM application further indicated the negative effect of corn yield on sorghum yield whose standardized coefficient (-0.22) was close to that of the amount of applied N (0.30). These results indicated the relative importance of unstable establishment for both crops were higher than that of the amount of applied N, and the negative effect of corn yield on sorghum yield can be offset by the effect of the applied N. Thus, the cost of the N application should be considered because primary crop yield limiting factor was the unstable seedling establishment in the fields. Previous studies indicated that seeding depth, soil temperature, and soil moisture would affect the corn emergence strongly (Alessi and Power, 1971; Gupta et al., 1988). However, in this study, it still remains unclear as to what factors affected on the variability of corn and sorghum populations. Therefore, further study is needed to determine the factors affecting the corn and sorghum populations in the fields. If the environmental factors affecting seedling establishments or information on available nutrients were also incorporated in the SEM, we would be able to use the further modified model to give comprehensive prescriptions according to the conditions of each farmers' field.

Conclusion

The classical linear regression analysis was not able to detect the direct effects of environmental factors or yield components on crop yields for both case studies. However, the SEM application comprehensively visualized the relative importance of each yield limiting factors on the final yields to facilitate the understandings of hierarchic processes. The two case studies are ongoing project whose data is based on single year, and all of the data have not been measured yet. Even with these restrictive data obtained from field-scale experiments, we demonstrated that SEM application would be useful to provide comprehensive understandings of crop yield limiting factors in farmers' fields.

Acknowledgement

This work was supported by JSPS KAKENHI Early-Career Scientists Grant Numbers 18K14452, and the Yanmar Environmental Sustainability Support Association Research Grant.

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Potential of yard Utilization for Supporting the Fulfillment of Food Security in Bandar Lampung City, Indonesia

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SUMMARY

Food security remains a fundamental problem challenging the cities in Indonesia, including Bandar Lampung City. This is in line with the increase in population which causes a reduction in agricultural land due to the increasing need for housing, increased purchasing power, and climate change. One of the efforts made by the government of Bandar Lampung City in building food security is by strengthening family food security by optimizing the use of household yards. Focusing on PKK (Pembinaan Kesejahteraan Keluarga, Family Welfare Empowerment) because it is a woman organization that focus in empowering women especially household's women and the families. This paper aims to review the potential, policies and programs as well as constraints in the use of yards through the activities of "Beauty, Integrated, Lovely, and Comfort Yard" or in Indonesian "*Halaman Asri Terpadu Indah dan Nyaman*" abbreviated with HATINYA PKK to support food security, especially at the household level. This is because backyard has great potential in providing family food, reducing household expenditure for food purchases and potentially increasing family income. A number of obstacles were still found in the program are unfamiliar in backyard intensive cultivation part time activities and not market oriented, as well as the inadequate mentoring process. Therefore, cross-sectoral support is needed in the implementation of activities so that it is more optimal in supporting food.

Introduction

Population growth has led to the conversion of agricultural land to non-agriculture which threatens food availability, which is exacerbated by the phenomenon of global climate change. The government needs to think of the right solution so that food availability is maintained, especially in urban areas. One of the solutions for encounter this problems is utilizing household land for agricultural cultivation.

Bandar Lampung City has implemented the use of household yards since 2012, by involving the role of the community, especially women who are members of the women's farmer group and PKK. The purpose of this activity is for households to be able to provide for their family's food needs, reduce household expenses for food and increase family income. However, in its implementation there are still problems that make this activity not run well such as the low culture of planting in the community, cultivation is not market oriented, and inadequate mentoring process from the officers.

Yard farming (or cultivation of plants in the yard) is not new. This activity has long been carried out by the community, especially in rural areas, but the management has not been carried out optimally. The facts in the field show that until now the yard is still not managed optimally and sustainably, and even tends to be left out. This is due to, among other things, the lack of information and technology in managing the land, as well as a lack of awareness from the owner of the yard.

This paper review the potential and policies and constraints in the use of the yard in Bandar Lampung city through the activities of PKK and women's farmer group.

Land use in Bandar Lampung

The city of Bandar Lampung has also implemented land use for vegetable cultivation since 2012. This is realized because there has been a downward trend in agricultural land in the city of Lampung city although it is not large enough (Table 1).

Table 1. Land use area for agriculture purposes in Bandar Lampung (ha)

Year	Rice *	Dry field		
		yard	Garden	Unused land
2012	979	7.755	1.770	510
2013	987	1.306	1.607	443
2014	947	1.044	1.180	510
2015	944	791	1.229	302
2016	936	784	1.238	276

*) irrigated and dry land rice

Yard utilization in Bandar Lampung

The city of Bandar Lampung with an area of 19,722 km2 consists of 20 districts and 126 sub-districts. Bandar Lampung City is a city of trade and services as well as the capital of Lampung Province, so the need for vegetables and agricultural products is quite large.

The yard in the city of Lampung city is generally a narrow yard with an area of less than 120 m^2, so that the utilization that can be done is the cultivation of vegetables, planting "herbal plant and fruit in pots / polybags / verticulture.

Generally the yard management is carried out by mothers and is of a secondary nature. So that the use is only used for family consumption. But there are some households that sell their produce such as vegetables to neighbors around their homes.

Yard utilization activities in Bandar Lampung is an activity carried out by the Agriculture Service as an effort to optimize the use of land with cultivation of vegetables, fruit and herbal plants to increase family income and nutrition. This activity is designed to be developed in home yards in urban areas which generally have limited employment.

This activity is fully supported by the city government with the issuance of the Mayor of Bandar Lampung Instruction Number: 1115 / 14.34 / HK / 2014 concerning optimizing the utilization of the grounds, especially the home yards.

The program related to utilization of the land that has been carried out by the Agriculture Service includes cooperation with the PKK through the activities of " Beauty, Integrated, lovely, and comfort yard " or in Indonesian "*Halaman Asri Terpadu Indah dan Nyaman,"* and abbreviated with HATINYA PKK.

The activities of this program is utilization of home garden with vegetables, medicinal plants and fruit in pots, polybags and hydroponic vegetable cultivation. Collaboration carried out by the Agriculture Service in the PKK has been carried out since 2012. The activities carried out in the form of assistance of seeds, vegetable seeds, medicinal plant seeds, fertilizers and other cultivation facilities.

The yard utilization activities are also carried out with vegetable cultivation in hydroponics. Implementation is carried out by providing assistance for hydroponic cultivation such as seeds, and fertilizer. In addition, guidance and counseling are carried out regarding hydroponic cultivation.

The City Agriculture Service also promotes Green Hallway activities, namely efforts to green narrow alleys or alleys in densely populated residential areas and urban slums in each urban village in Bandar Lampung . This activity was carried out in 2018 and involved communities who are members of the Women's Farmers Group and Community Self-Sufficiency Institutions (LKM) with assistance from agricultural extension officers,

Obstacles in yard utilization

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The use of yards in the city of Bandar Lampung can be implemented properly. However, there are still various problems, namely: (i) Land utilization is generally not optimal and is sideline / not yet economically oriented; (ii) Quality of output is relatively low (iii) The results of household level processing have not been carried out to obtain added value.

Broadly speaking, various problems that occur because of these constraints can be grouped into 2, namely technical and non-technical constraints. Technical constraints relate to pest attacks, weather changes, and the lack of knowledge of residents regarding good cultivation techniques. This technical constraint has implications for the difficulties in the field and the quantity and quality of crops that are not as expected. While the non-technical constraints are closely related to the lack of enthusiasm and public response which has implications for the maintenance and sustainability of future activities. The weakness of institutions (capital and marketing) and the system of technology transfer are also obstacles to the development of yard utilization in the city of Bandar Lampung.

Conclusion

Yard utilization in Bandar Lampung City has gone well despite many obstacles in its implementation. Yard utilization activities is secondary activity so that more intense mentoring and coaching is needed so that yard farming is more economical. In addition, movements need to be carried out that involve the wider community so that the use of the yard can be sustainable continuously. Marketing of high-end products also needs to be developed so that people can market their business results.

Fig.1. Utilization of yard through hydroponic

Fig.4.Woman's empowerment through farmer's woman group

Fig.2.Mixed crop, vegetables and fruits

Fig.5.Plant nursery managed by farmer's woman group

Fig.3. Utilization the alley of small street

Fig. 6. Selling activities in farmer's woman group

Predicting Cassava Suitability as Impacted by Climate Change in Indonesia

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SUMMARY

Cassava is renowned for its drought tolerance and hardiness in stressful environments. Of the few studies which have quantified the impacts or responses of cassava to climate change, and all have found cassava to be the least affected crop when compared with other major staples such as maize, sorghum and millets. Harvesting area of cassava in Indonesia in 2015 was 0.95 million hectares with the productivity 21.80 tons/ha; in 2016 the harvesting area was 1.11 million hectares with the productivity was 20.23 tons/ha. For carbohydrate compliance cassava was the the third food crops in Indonesia after rice and maize. Not many studies about the impact of climate change on crops production in Indonesia, while that is important since agriculture is the main. Therefore, using climate world portal data and crop ecology models this study aimed to identify the climatic changes projected for cassava growing regions in Lampung, Indonesia for 2030 and beyond and to quantify the impacts of these changes on cassava climate suitability in that area. The results showed that with the available generated global data ; there are possibilities impact of climate change to crop productions can be predicted.

Introduction

Times or Century 10pt Cassava as a crop originated from South America and it is extensively propagated as an annual crop in the tropical and sub-tropical regions for its edible starchy tuber as root. Nigeria is the world's largest producer of cassava with other top producers being Indonesia, Thailand, the Democratic republic of Congo and Angola (Ajayi, 2015). In Indonesia Cassava is one food source and considered as an alternative to rice. Therefore, cassava is important for food security.

Harvesting area of cassava in Indonesia in 2015 was 0.95 million hectares with the productivity 21.80 tons/ha; in 2016 the harvesting area was 1.11 million hectares with the productivity was 20.23 tons/ha. For carbohydrate compliance cassava was the the third food crops in Indonesia after rice and maize. Cassava is cultivated in lowland dry area and the most preference crops for farmers in those areas.

Cassava is renowned for its drought tolerance and hardiness in stressful environments. Of the few studies which have quantified the impacts or responses of cassava to climate change, and all have found cassava to be the least affected crop when compared with other major staples such as maize, sorghum and millets (Jarvis, et al., 2012). (Lobell et al., 2008) found cassava to moderately benefit from climate change by 2030 with an average increase of 1.1% in production from 2000 through the use of statistical models.

Other study found a decrease in production of 8% for cassava by mid-century, compared with much more severe impacts for maize (-22%), sorghum (-17%) and millets (-17%) (Schlenker and Lobell, 2010). All studies report uncertainties in these estimates due to the underlining climate projections, or the model that captures crop-climate response. Furthermore, these studies do not take into account CO_2 fertilization where there is no consensus on the response of cassava to increased CO_2 concentrations.

Not many studies about the impact of climate change on crops production in Indonesia, while that is important since agriculture is the main. Therefore, this study aimed to identify the climatic changes projected for cassava growing regions in Lampung, Indonesia for 2030 and beyond and to quantify the impacts of these changes on cassava climate suitability in that area.

Material and Method

1. Climate portal data

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) distributes data in ARC GRID, and ARC ASCII format, in decimal degrees and datum WGS84. Available on http://www.ccafs-climate.org/.

WorldClim dataset is publicly and freely available at http://www.worldclim.org.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) with criteria; Delta Method : IPCC AR5, Area : B5, Prediction : 2030s, Scenario baseline: RCP 2.6,Model: bcc_csm1.1(m)

2. The model

EcoCrop:

A database developed in 1992 by the Land and Water Development Division of FAO (AGLL) as a tool to identify plant species for given environments and uses, and as an information system contributing to a Land Use Planning concept. Latest version of DIVA-GIS [7.1.7] (freely available at http://www.diva-gis.org)

EcoCrop is a simple mechanistic model designed to operate at a monthly time scale and capable of analyzing the geography of crop suitability with regards to climate conditions.

The model uses environmental ranges to determine the main niche of a particular crop and numerically assesses the environmental conditions to determine a potential climatic suitability rating (Hijmans et al., 2001; Ramirez-Villegas et al., 2011).

Bioclimatic variables

Bioclimatic variables are derived from the monthly temperature and rainfall values in order to generate more biologically meaningful variables. These are often used in species distribution modeling and related ecological modeling techniques.

The bioclimatic variables represent annual trends (e.g., mean annual temperature, annual precipitation) seasonality (e.g., annual range in temperature and precipitation) and extreme or limiting environmental factors (e.g., temperature of the coldest and warmest month, and precipitation of the wet and dry quarters). A quarter is a period of three months (1/4 of the year).

Result and Discussions

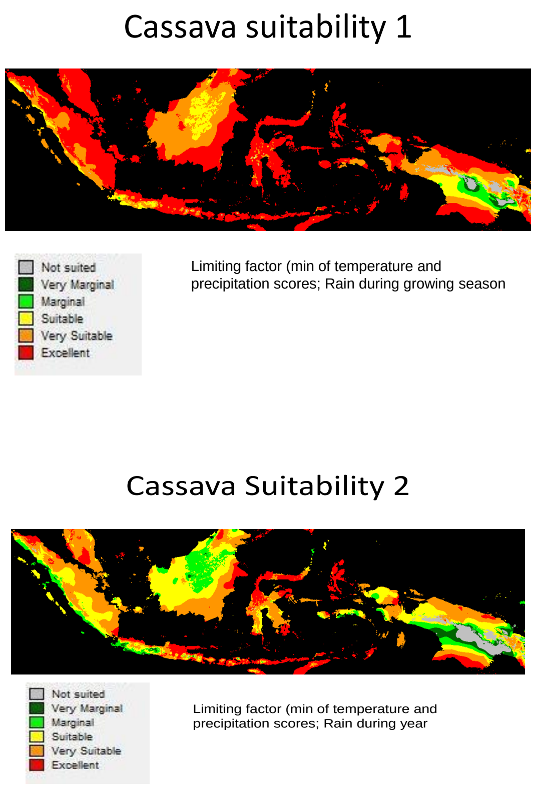

Fig.1 Cassava suitability as the model projected for 2030s

With combination of temperature and rainfall yje projection was presented in Figure1. Rainfall would be the dominant factor for cassava growth and production compared to temperature. If it is guaranteed that rain would be pored during the growing season the excellent suitable area for cassava in Indonesia could be securedly spreaded. On the other hand if rain fall during the whole year, cassava would be still suitably grown in Indonesia. This result indicating that cassava is the least sensitive crop to a changed 2030 climate. cassava may be an important substitute crop for other carbohydrat source crops.

However, other studies did show that the principal weakness of cassava is in terms of pest and disease sensitivity (Herrera Campo et al. 2011). Therefore, to ensure that cassava adapts to climate change lie in increasing resistance to these key pests and diseases, as well as further developing management practices to address greater pest or disease pressure (Herrera Campo et al. 2011)

Conclusion

With the available generated global data ; there are possibilities to predict the impact of climate change to crop productions.

Using EcoCrop model, bioclimatic variables, RCP 2.6 scenario on BCC_CSM1.1(m)nmodel Cassava is predicted still suitable in Indonesia up to 2030s

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Tracking the fate of organic matter residue using soil dispersion ratio under intensive farming in red acid soil of Lampung, Indonesia

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SUMMARY

Organic matter or compost which applied to the soil can improve soil physical properties, such as forming microaggregates and increasing soil water holding capacity. However, the effect and the sustainability in the soil depended on the type of organic matter origin and its composition as well as its environment. This study aims to determine the fate of organic material , which is mainly its composition from cowdung using simple tools, soil dispersion ratio (DR). A soil survey was done to the area with different land use and organic matter (compost) application . The area with no compost application (0 t ha^{-1}) including in cassava, oil palm, and pineapple (3 locations), while area with banana and guava applied with compost around 50 t ha^{-1} - 100 t ha^{-1} and pineapple with 180 t ha^{-1} . The experiment showed that the soils were generally categorized as moderately to extremely dispersive, except cassava was little dispersive. Clay particles were mostly binded by organic material by the mechanism of cation brigde, and contributied >50% of clay aggregate form, and the highest one was in cassava .

Introduction

In humid tropical area of Lampung, Indonesia, Red acid soil are dominat, which generally have low nutrient content and soil organic carbon due to intensive leaching and rapid decomposition processes. Organic matter or compost application is mostly recommendation to improve soil fertility in the humid tropics climate.

Tisdall and Nelson (1982) pointed out that the organic binding agent could be (a) transient, mainly polysaccharides, (b), temporary, roots and fungal hyphae, and (c) persistent, resistant aromatic components associated with polyvalent metal cations, and strongly sorbed polymers.

Watanabe (2017) showed that continuous application of cattle manure could stabilize soil organic matter such as in the form of structural alterations, occlusion in soil aggregates, and adsorption to clay minerals, preserved soil organic matter derived from cattle manure.

Due to the fact that clay particle will bind carbon organic component though electrostatic binding or cation bridge ("forming pseudo sand"), a comparison between clay particles and "pseudo sand" particles could be used to evaluate the effect of organic carbon to the soil. This concept which known as dispersion ratio was introduced by Middleton (1930). By comparing comparing dispersed soil partiles with undispersed soil particles, estimation of clay particles which was binded by organic carbon ("pseudo sand or micro aggregate") could be estimated.

This research aimed to evaluate residue of organic matter which mainly consisted of cow manure in pineapple plantation under various amount of application as well as crop rotation.

Material and Method

This research was carried out in at Terbanggi Besar, Central Lampung, Indonesia. Soil survey was done to the area with different land use and organic matter (compost) application in which the compost was 90% consisted of cow dung. The area which no compost application (0 t ha^{-1}) including cassava, oil palm, and pineapple with different age 3,6,9 months,6,9,and 15 months(harvest area), while area with banana and guava applied with compost 50 t ha^{-1} - 100 t ha^{-1} and one pineapple area with 180 t ha^{-1} (code :pineapple 11). Each location was taken 4-5 soil sample with distance 25-50 m, analysed separately as replications. The compost were applied 6-8 months previous to soil sam pling.

The soil dispersion ratio (DR) was defined :

$$\frac{\text{Percent silt+clay Undispersed}}{\text{Percent silt+clay dispersed}} \text{ x } 100\ \% \qquad (1)$$

The percentage of silt and clay in dispersed form were analysis using texture analysis with the addition of Calgon + H_2O_2 + distilled water, while only distilled water was used to get undispersed fraction. Soil texture analysis was carried out using the hydrometer method.

The classification of dispersion ratio was according to Elges (1985) which was as followed : dispersion ratios > 50% (extremely dispersive), 30%- 50% (moderately dispersive), 15% -30%(a little dispersive) and < 15% (non-dispersive).

The calculation of clay fraction that binded by organic carbon could be dvided into two forms (1) binded using “glue mechanism” (2) binded by “cation brigde” mechanism”, which were calculated as follows :

Clay-glue mechanism (Cg)

$$Cg = \text{Silt}_{\text{undispersed}} - \text{silt}_{\text{dispersed}} \qquad (2)$$

Clay cation bidge mechanism (Cc)

$$Cc = \text{Sand}_{\text{undispersed}} - \text{Sand}_{\text{dispersed}} \qquad (3)$$

So total partices clay that becomes “aggeregate” (Cag)

$$C\ ag = Cg + Cc \qquad (4)$$

Result and Discussions

The basic soil properties which were listed in Table 1 showed that experiments sites were dominated by clay and sand fraction which the soil texture from sandy clay to clay, with clay is dominant.

Table 1.Basic soil properties in the experiment site

Land use	Texture class*	Clay	Silt	Sand	C-organic
			%		
Banana-1	SC	45.4	7.7	46.9	1.31
Banana-2	SCL	35.3	7.5	57.2	1.06
Cassava	C	53.6	7.6	38.8	1.25
Guava-1	SCL	34.0	8.5	57.5	1.34
Guava-2	SC	38.5	8.0	53.4	0.31
Oil Palm	C	49.2	10.1	40.7	0.88
Pineapple (3)	C	52.2	5.9	41.8	0.57
Pineapple (6)	C	46.1	7.5	46.4	0.57
Pineapple (9)	C	46.9	12.7	40.4	0.77
Pineapple(11)	C	50.1	6.5	43.4	1.57
Pineapple(15)	C	46.4	15.5	38.1	1.08

*C: clay; S:sandy; L : loam

The soil carbon organic were low, less than 2%, some even less than 1%, except in pineapple with 180 t/ha compost was 1.57%. With low soil carbon as well as low of kation base in Ultisol soil, the soil aggregation would be very weak

The experiment showed that the soils were generally categorized as moderately to extremely dispersive, except cassava was little dispersive (Fig.1). Although guava and banana had high compost application, the dipersion ratio falled to extremely dispersive, while pineapple with no compost only have moderately dispersive.

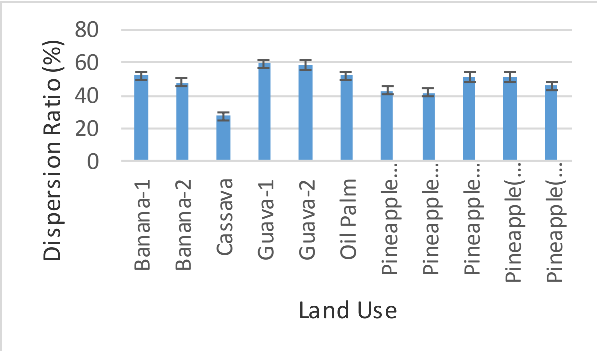

Fig 1. Dispersion ratio from various land use

The lowest of DR was found in cassava land use., which was usually manage with minimum tillage and management. Rasheed (2016) got that the DR value from bare soil with lowest organic matter (1.1%) was only13%. Lipiec et al. (2018) showed that the amount of readily dispersible clay was also effectec by the deformation level of the soil, which was increase in strongly compacted soil and positive correlations with bulk density.

High dispersion showed that there is binding between soil particles with the binding agency, and the binding are not strong. To see the mechanism of “glue” or “cation bridge” mechanism, the equation (2) and (3) were used to calculate from each contribution. The resultas were shown in Table 2.

Table 2 showed that clay particles were mostly binded by organic material by the mechanism of cation brigde, and contribution were above >50%, and the highest one was in cassava land use with 88% value

Table 2. Percentage of clay in silt and sand fraction

Land use	Cc	Cg	Cag	Cc/Cag	Cg/Cag
			%		
Banana(1)	22	20	41	52	48
Banana(2)	22	10	32	70	30
Cassava	44	6	50	88	12
Guava(1)	19	16	36	54	46
Guava(2)	20	12	32	63	37
Oilpalm	28	17	46	62	38
Pineapple(3)	33	16	49	67	33
Pineapple(6)	31	11	43	73	27
Pineapple(9)	29	14	43	69	31
Pineapple(11)	28	21	48	57	43
Pineapple(15)	33	12	45	74	26

However, the dispersion ratio (Fig.1) showed that the most of soils were categorized as moderately to extremely dispersive that "the bridging cation" were not enough or low to make strong aggregation between soil organic carbon and clay particles. The low cation bases in Ultisol probably the main cause that the micro aggregate built was not strong enough. Baohua and Doner (1993) stated that in the absence of polyvalent cations, negatively charged such as humic acid, may not contribute to stable soil aggregation**.** The effect of exchangeable cation to clay dispersion, such as Na, Fe, OC, Mg, and and Al, as well as Mg, were also shown by .Igwe et al. (2006).

The "glue mechanism" which form "silt undiepersed fraction" contribute significantly in high compost application, such as in banana, pineapple (11) and guava

Conclusion

The soil were dominately by clay fraction, however , the DR was moderately to extremely dispersive . The binding mechanism were mainly in sand fraction, using cation bridge mechanism, however, it is not strong enogh due the low of soil organic carbon as well as polyvalent cation in red acid soil. The application of high compost with dominated by cowdung material only gave "glue binding mechanism" which aggregated in silt pool.

Acknowledgement

The authors thanked to PT. Great Giant Pineapple. Central Lampung. Lampung. Indonesia, for facilitating this research.

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Multi-layered Microcapsules of Biopesticides to Support Sustainable Agriculture

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SUMMARY

The use of biopesticides is one way to overcome plant pests that are environmentally friendly and in line with the concept of sustainable agriculture. The disadvantages of vegetable pesticides are that vegetable materials decompose quickly and their working power is relatively slow so the application must be more frequent, less practical and not hold up for a long time. Furthermore smart method is needed to extend the shelf life and release process of plant materials slowly and in a controlled manner. One of the methods that can be applied is multi-layer microcapsules asembly by layer-by-layer adsorption method. The microcapsules made by this method can produce multilayer microcapsules which can be adjusted in size, thickness, permeability, stability, responsibility and encapsulated material. This method forms self-assembly based on physical-chemical phenomena that occur naturally, namely the arrangement of alternately positive and negative charged shell of microcapsule.

Introduction

Agriculture has had to face the destructive activities of numer ous pests like fungi, weeds and insects which have serious effect on feed production as global crop yield is reduced by 20 to 40% annually due to plant pest and diseases [1]. With the advent of chemical pesticides, this crisis was resolved to a great extent. But the over dependence on chemical pesticides and eventual uninhibited use of them has necessitated for alternatives mainly for environmental concerns. Though biopesticides cover about 1% of the total plant protection products globally, their number and the growth rate have been showing an increasing trend in the past two decades [2]; about 175 biopesticides active ingredients and 700 products have been registered worldwide.

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria and certain minerals. In commercial terms, biopesticides include microorganisms that control pests (microbial pesticides), naturally-occurring substances that control pests (biochemical pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants). Biopesticides are employed in agricultural use for the purposes of insect control, disease control, weed control, nematode control and plant physiology and productivity. The EPA separates biopesticides into three major classes based on the type of active ingredient used, namely, biochemical, plant-incorporated protectants and microbial pesticides. Within each of these, there are various types of products, each with its own mode of action [3]. Pest management products from plants are also an important segment of the biopesticide market, including such products as pyrethrum and neem for insect control and many essential oil formulations for a range of pest management options [4].

Biopesticides have a range of attractive properties that make them good components of integrated pest management. Most are selective, produce little or no toxic residue, and development costs are significantly lower than those of conventional synthetic chemical pesticides [5]. The demand for biopesticides is rising steadily in all parts of the world. When used in Integrated Pest Management systems, biopesticides' efficacy can be equal to or better than conventional products, especially for crops like fruits, vegetables, nuts and flowers. By combining performance and safety, biopesticides perform efficaciously while providing the flexibility of minimum application restrictions, superior residue and resistance management potential, and human and environmental safety benefits. It is very likely that in future their role will be more significant in agriculture and forestry. Biopesticides clearly have a potential role to play in development of future integrated pest management strategies Hopefully, more rational approach will be gradually adopted towards biopesticides in the near future and short-term profits from chemical pesticides will not determine the fate of biopesticides [6].

The potential benefits to agriculture and public health programmes through the use of biopesticides are considerable. The interest in biopesticides is based on the advantages associated with such products which are inherently less harmful and less environmental load; designed to affect only one specific pest or, in somecases, a few target organisms; often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems and when used as a component of Integrated Pest Management (IPM) programs, biopesticides can contribute greatly [6]. The disadvantages of biopesticides are that plant materials decompose quickly and their working relatively slow; power is therefore the application of biopesticides must be more frequent, less practical and not hold up for a long time. Furthermore smart method is needed to extend the shelf life and release process of plant materials slowly and in a controlled manner. One of the methods that can be applied is multi-layer microcapsules asembly by layer-by-layer adsorption method.

Method of Multi-layered Microencapsulation

Microencapsulation is a process in which tiny particles or droplets are coated by certain material to give small capsules with many unique properties. Sobel et al. [7] define microencapsulation as the process of enclosing small particles, liquid, or gas within a layer of coating, or within a matrix for protection and/or slow/controlled release. There are various compounds that can be enclosed in the microcapsules, e.g., pigments, monomers, catalysts, drugs, antioxidants, polyphenols, amino acids, carotene, phytosterols, nanoparticles and oil soluble components [8] or other materials on a micro or nano metric scale. Any materials enclosed inside the microcapsule is referred to as the core, internal phase, or fill, whereas the wall is sometimes called a shell, coating, or membrane (Figure 1). Ghosh [9] indicated that compatibility of the enclosed materials with the shell are one of the determining factors for improving the microcapsule's performance; pre-treatment of the enclose materials might needed to achieve certain compatibility. There are two types of microcapsules, mono-layered and multi-layered microcapsules. The advantages of designing multi-layered microcapsules are control over the thickness of shell and therefore the release can be controlled. The microcapsules can carry different active

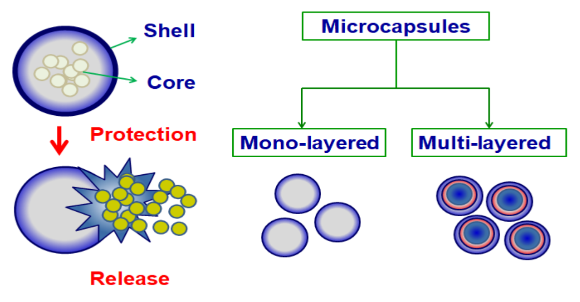

Fig.1 Two types of microcapsules

materials either in between the layers or in the core.

The essence in manufacturing microcapsules as controlled release devices is that the capsules must be able to protect and then release their contents in respone to spesific triggers at a controlled rate. The spesific property is influenced by mechanical, physical, and chemical exposures as well as their release properties are essential factors for microcapsules.

In addition, size monodispersity and core design are important to determine the microcapsules' behaviour at spesific release rate and sensory perception of capsules by consumers [10]. One of method to produce microcapsules with the mentioned properties is layer by layer (LbL) adsorption technique. This methods makes use of self-assembly at interface in which –physical-chemical phenomena by nature is utilized (Rossier-Miranda 2010). Oil droplets act as templates for the microcapsules and as reservoirs for the active material that will be carried out [10]. The schematic route to produce microcapsules by LbL adsorbtion technique is depicted in Figure 2.

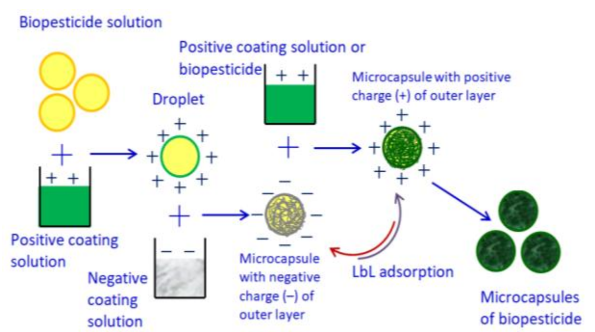

Fig. 2 Schematic route of LbL adsorpsion method (Adapted from Rossier-Miranda [10], Purwanti [11] and Warji et al. [12])

Microcapsules of Pesticides

Layer-by-layer adsorption method is one of the methods used to prepare multi-layered microcapsules. This method allows fine tuning the desired size of microcapsules by designing appropriate number of layers. In addition, different functional compounds can be stored among and within the layers which makes slow release possible, such as a biopesticide released in first day, second day, and thirth day. Therefore, the development of multi-layered microcapsules pesticides have a prospective, especially in sustainable agriculture. There are two way make slow release biopesticide microcapsule; the various layer of microcapsules (Figure 3A) and multi-layered microcapsule (Figure 3B).

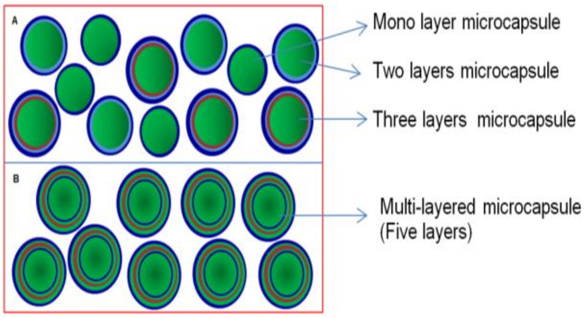

Fig. 3 Two types of slow release biopestiside. (A) The various layer of microcapsules and (B) Multi-layered microcapsules

Figure 3A shows that biopesticide microcapsules are designed to have various layers; for example biopesticide microcapsules one layer (mono layer), two layers and three layers are mixed together. The three different layers are applied to the same agricultural crop; It is expected that one layer of biopesticide is released on the first day, two layers break on the second day and three layers break on the third day so that so that the applied biopesticide lasts for 3 days. The release of the third different layer microcapsules is shown in Figure 4A. Furthermore Figure 3B shows a 5-layer multi-layered microcapsules of biopesticide. These biopesticides are designed to be in the core of the microcapsules, and placed between the shells of the microcapsules (in the second and fourth layers). Figure 4B illustrates the release of multi-layer microcapsules of biopesticide; the first day of biopesticide in the second layer of release after the first layer microcapsule shell broke, the second day of pesticide in the fourth layer of release after the third layer microcapsule shell broke, and on the third day biopesticide in the microcapsule nucleus release after the fifth layer microcapsule shell broke.

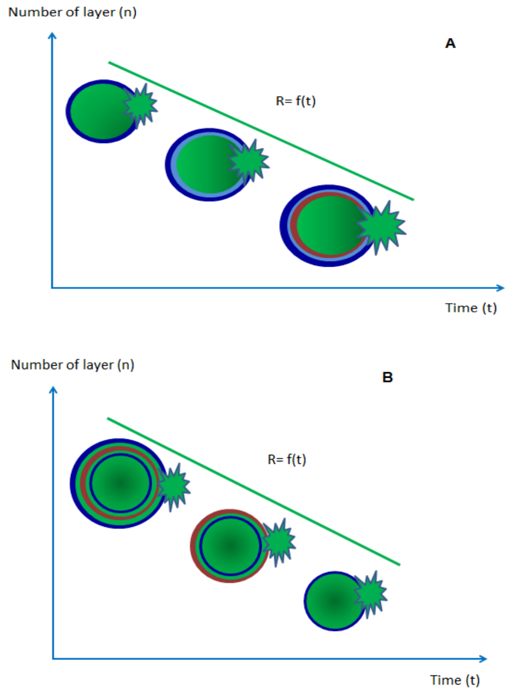

Fig. 4 Release of biopesticide microcapsules

The time-based release process of biopesticides greatly helps the process of applying biopesticides to plants. Once a biopesticide application can be regulated release for several days. Triger against biopesticide releases can be combined with other trigers, such as pressure, sun exposure and the presence of certain chemicals. Furthermore, the breakdown of biopesticide microcapsules can also be setup based on the presence of insect or fungal activity in cultivated plants. Based on the application of multilayer biopesticide microcapsules, it is expected that the use of biopesticides can be more developed. The use of biopesticides is expected to reduce chemical pesticides and create an environment that is environmentally friendly and sustainable agriculture.

Conclusion

Multilayer microcapsules made by layer-by-layer have the potential to be applied to biopesticides. Multilayer biopesticide microcapsules are expected to increase the life of biopesticide applications. Increasing the age of biopesticide applications is expected to increase the use of biopesticides in agriculture so that they can support sustainable agriculture.

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Effects of Waterlogging on Pineapple Growth and Soil Properties on Red Acid Soils of Lampung, Indonesia

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SUMMARY

Red acid soils in humid tropic generally have high rainfall in this area. Including acid soils in Indonesia, the average annual rainfall more than 2000 mm which occurred in the rainy season for six months. Mismanagement of excess water will adversely affect the growth of plant. Waterlogging occurs when the amount of rainfall exceeded the infiltration of water in the soil. This is the main problem especially for pineapple plant because this plant cannot survive long in conditions of waterlogging for a long period. This research want to know the effect of waterlogging on soil chemical properties and the second, to know the pineapple resistance to waterlogging, and its effect on the growth of pineapple root. This experiment was conducted at the location of Research and Development (R&D) PT Great Giant Pineapple (PT GGP), Lampung, Indonesia along 2 months, from August to October 2016. The experiment design was arranged in completely randomized design with three replication. Waterlogging treatment is treatment by adding water into the polybag until saturated and let the water flooded up to 2 cms from soil surface. There are 6 treatments: W0: no waterlogging (maintain soil humidity in field capacity) (control), W24: waterlogging 1x24 hours, W48: waterlogging 2x24 hours, W72: waterlogging 3x24 hours, W96: waterlogging 4x24 hours, W120: waterlogging 5x24 hours. The research showed that waterlogging 1x24 hours can increased soil pH and decreased exchangable aluminium in the soil significantly different, the second, waterlogging can increased iron in the soil and significantly different on 5x24 hours and the third, waterlogging star 2x24 hours can inhibit root growth of pineapple

Introduction

Red yellow podzolic is an acid soil that spread very wide in Indonesia which was almost occupied 30% of Indonesian's soil. Red yellow podzolic is found in all parent materials such as vulcanic tuff, granite, sandstone and andesite (Buurman, 1980). The high rainfall on this soil can cause waterlogging. Waterlogging has both direct and indirect effects on plant growth and production. The effects on plants will be more serious if salinity occurs in the soil, if both occur simultaneously it can cause the production will decrease drastically (Singh, 2015).

Waterlogging can inhibit plant growth of pineapple. Iron toxicity can occurs only in waterlogging soil that has in a long period of time, by lowering the redox potential of the soil causes the Fe^{3+} on mineral soil is reduced to Fe^{2+} is more soluble in water, caused iron concentration reached 1000 mg l-1 (Kirk, 2004). The amount of ferrous (Fe^{2+}) in the soil solution can caused nutrient imbalances which affect plant growth (Audebert, 2006). Plants with a high iron content is characterized by stunted growth, leaf spot rusted, stained leaf edge, and a poor root system. In some cases, it can lead to the death of plants and lower yields of up to 100% (Sahrawat, 2004), depend on cultivar tolerance, resistance to stress, and field management (Audebert and Fofana, 2009).

The aim of this research to investigate the effect of waterlogging on the growth of pineapple root.

Materials and Methods

This experiment was conducted at the Research and Development (R&D) site of PT GGP, Lampung, Indonesia. The texture of the soil is sandy clay with particle sizes of 52.4% sand, 2.6% silt and 45.0% clay. The soil properties prior to planting are shown in Table 1. Seed materials were used from crown of pineapple.

The experiment design was arranged in completely randomized design with three replication. The weight of the soil used was 10 kg in polybag. Waterlogging treatment is treatment by adding water into the polybag until saturated and let the water flooded up to 2 cms from soil surface. There are six treatments, W0: no waterlogging (maintain soil humidity in field capacity/control), W24: waterlogging 1x24 hours, W48: waterlogging 2x24 hours, W72: waterlogging 3x24 hours, W96: waterlogging 4x24 hours, W120: waterlogging 5x24 hours**.**

Table 1 Selected characteristic of soil

Property	value
pH	4.26
Total C (%)	1.32
Total N (%)	0.15
C/N ratio	8.80
P (g Kg^{-1})	0.02
K (g Kg^{-1})	0.08
Ca (g Kg^{-1})	0.08
Mg (g Kg^{-1})	0.03
Exc. Al (me 100 g^{-1})	0.61

The treatment were started one month after planting to make sure that the crop were already grown well. Soil chemical analysis was done before and after treatment

Soil properties observation consist of: (1) The pH was determined by using pH Meter, (2) Analysis of K, Ca and Mg was determined by using extraction with ammonium acetic pH 7 and reading with Atomic Absorption Spectrofotometry (AAS). Analysis of iron (Fe) by Mehlich method and aluminium by volumetry method.

Several parameter growth of pineapple growth were measured were (1) root weight, (2) plant of weight, (3) length of leaf

Result and Discussion

Waterlogging can increase soil pH and soil Fe

Figure 1 showed that effect of waterlogging on soil pH significant. On treatment of 1x24 hours waterlogging, the soil pH increase and significant different than control. The highest soil pH on treatment waterlogging 5x24 hours (W120) , and the lowest soil pH on treatment control (W0).

Figure 2 showed that the highest of iron in the soil is on treatment W120. Increased of period of waterlogging tend increase iron in the soil. Audebert (2009) states that poor water conditions can resulting in soil degradation that will increase the accumulation of iron in the soil solution. Silveira (2007) also showed in his research that under waterlogging conditions, the availability of iron would be able to increase and in certain concentrations would cause toxicity in plants. Iron is one of the easier elements to changing in waterlogging condition that from Fe^{3+} to Fe^{2+} (Syafruddin, 2011)

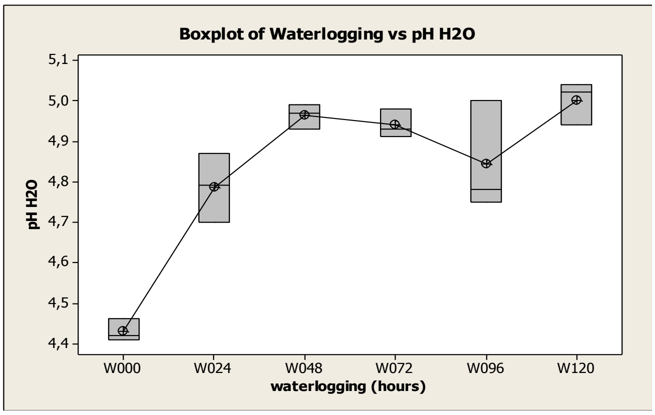

Figure 1. The effect of waterlogging on soil pH

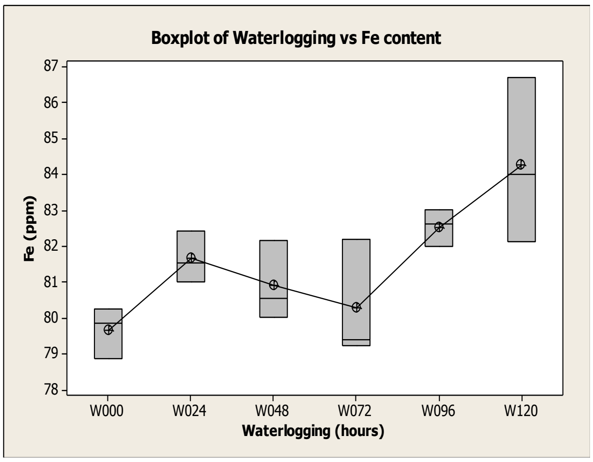

Figure 2. The effect of waterlogging on iron in the soil

Treatment Effect on Al Content in The Soil

Waterlogging can decrease exchangeable aluminum in the soil. Figure 3 showed that the lowest of aluminum in the soil is on treatment W120. Increased of period of waterlogging tend decrease aluminum in the soil. This occurs because increasing in soil pH due to waterlogging. higher pH will cause the availability of aluminum in the soil decreased.

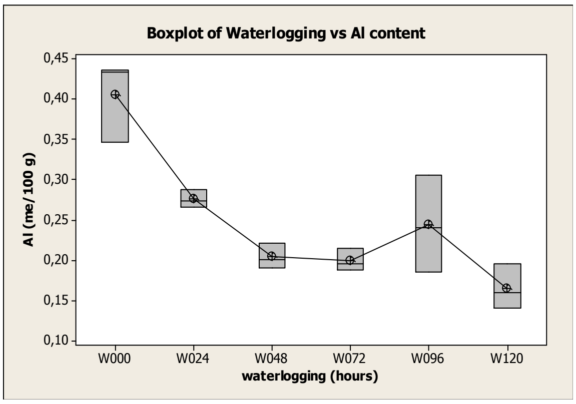

Figure 3. The effect of waterlogging on aluminum in the soil

Treatment Effect on Root and Plant Growth of Pineapple plant

Figure 4 shows that 2x24 hour waterlogging treatment is very severe with roots. This is very different when compared to the control treatment (soil conditions under field capacity). The roots of pineapple plants in field capacity conditions have many roots.

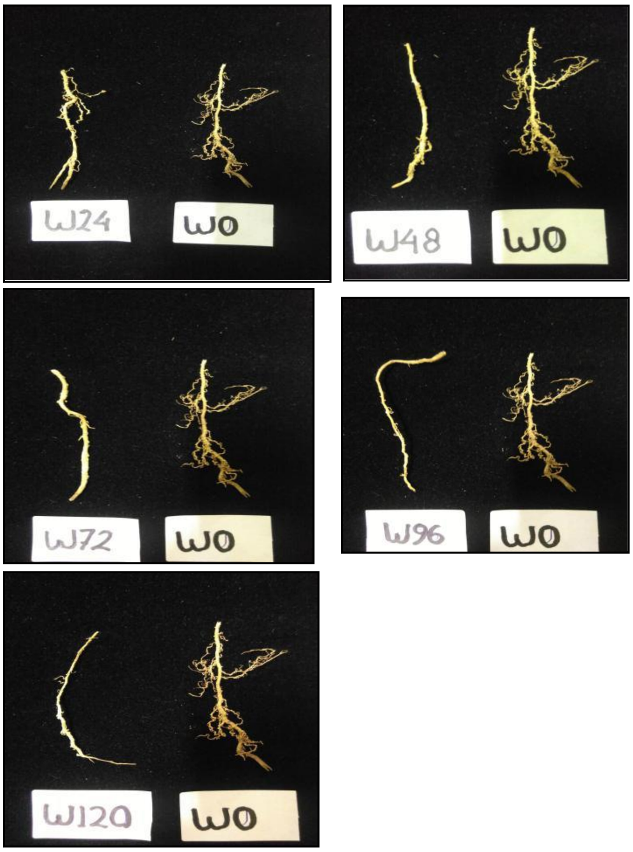

Figure 4. The effect of waterlogging on root growth of pineapple

The root weight of the control treatment was highest compared with the waterlogging treatment (Figure 5). This shows that standing water can inhibit the growth of pineapple plant roots. This is in line with Singh (2015) opinion that waterlogging was harmful and may affect plant growth because soil in the waterlogged condition can reduce soil aeration around the root zone so that root growth will be stunted.

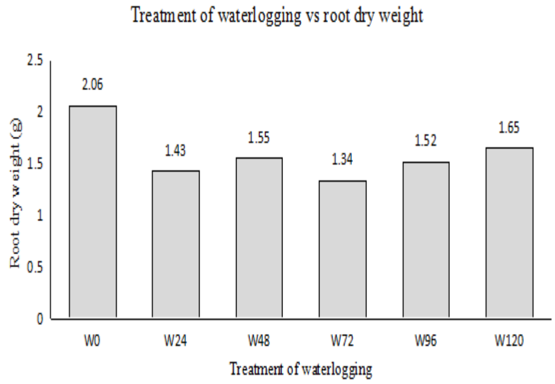

Figure 5. The effect of waterlogging on root dry weight of pineapple plant

Pineapple tolerant in waterlogging condition maximum until 2x24 hours. Figure 6 showed that the gain growth of plant weight after waterlogging 1x24 hour, occur decrease the gain growth of plant. The highest is on treatment W24 and after this is on treatment W48 lowest. Treatment of W72 and W96 are also give the low but on treatment W120 higher than W0.

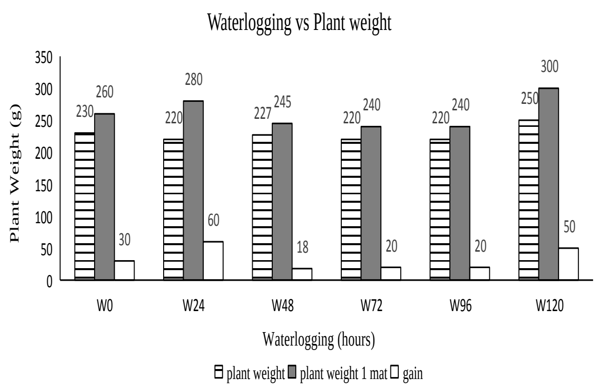

Figure 6. The effect of waterlogging on plant weight of pineapple plant

Conclusion

Waterlogging 1x24 hours can increased soil pH and decreased exchangable aluminium in the soil significantly different, the second, waterlogging can increased iron in the soil and significantly different on 5x24 hours, the third, waterlogging start 2x24 hours can inhibit root growth of pineapple

Acknowledgment

The authors express their gratitude to Management of PT Great Giant Pineapple, Lampung, Indonesia, for the all supporting from location and materials of experiment.

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Potential Yield of Replanted Trees of Cocoa Clones Introduced in Lampung

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SUMMARY

In Lampung Province, Indonesia, cocoa plantation started in 1984 succeeded in increasing farmers' incomes that encourage others farmer to expand cocoa planting area using local varieties that performed low yield. Nowadays about 23% of the cocoa trees were old and needed to be replanted. The research aimed to study adaptation of 9 elite cocoa clones used as top grafted seedling in rehabilitation cocoa field in Lampung including clone Sul 1, Sul 2, Sul 3, ICCRI 3, ICCRI 7, RCC 70, RCC 71, TSH 858, and MCC 1. The results showed that those 9 national clones introduced in Lampung still did not perform a superior yield. However Clone MCC 1, ICCRI 7, and Sul 3 produced better pod number per tree and pod number per phase of fruit development. Pod structure varied among cocoa clones and showed a dynamic among months.

Introduction

Cocoa production in Lampung Province mainly located in District of Tanggamus, South Lampung, and Pesawaran. In year 2015 the yield was only 0.66 ton/ha indicating improper management practices including the use of unselected planting material and 23% of cocoa trees were more than 20 years old that need to be replanted or rejuvenated using high yield clones (Evizal et al., 2018). Farmers started planting cacao in 1984 using hybrid varieties provided by the government. This program succeeded in increasing farmers' incomes that encourage others farmer to expand cocoa planting area using local varieties that performed low yield. Recently, many stakeholders introduced national clones that superior in yield and resistant to pests and diseases such as Sul 1, ICCRI 7, MCC 1, MCC 2 (McMahon et al., 2015; Susilo et al., 2015), Sul 2, Sul 3, RCC 70, RCC 71, ICCRI 3, and TSH 858 (Evizal et al., 2016).

Material and Method

The research was conducted at Way Ratai Subdistrict, Pesawaran District of Lampung Province. Observations were made in 2017 on the population of cocoa plants in plots measuring 200 m^2 for each clone consisting of 9 clones namely Sul 1, Sul 2, Sul 3, ICCRI 3, ICCRI 7, RCC 70, RCC 71, TSH 858, and MCC 1. A cocoa field was land cleared, replanted in 2014 with grafted seedling of those national clones, spaced at 3x 3 m, and shaded with trees of Leucaena lecocephala. Farm maintenance included pruning 3 times a year, fertilizing twice a year (NPK 250 g per tree), and no spraying pesticide. For each clone, 6 trees were sampled randomly for observation. Fruit development was observed with stages of cherelle (BBHC 70-74), small pods (BBHC 75-76), big pods (BBHC 77-80), and ripe pods (BBHC 81-89) according to Niemenak *et al.* (2010). We categorised 1-10 cm long for small pod, 11-15 cm for medium and >15 cm for big pod (Prawoto, 2014). Pod production in semester II was estimated by counting all pod (small, medium, and big) in August.

Result and Discussions

The result showed that pod number during September estimation varied among clones indicating that there was different adaptation of those clone to local agro-climate. There were 5 clones produced poor pod and only MCC1 produced high number of pod and the lowest CV value indicating good adaptation, high potential yield, and low risk to grow under Lampung agro-climate.

In Lampung, number of fruit would be multiplied in the main fruiting season commonly occurred during February – August. Clones that had high pod number during low fruiting season could be expected to have more regular harvest times along the year. However pod structure of small, medium, and big pod was important to predict pod distribution as supposed by Prawoto (2014).

Table 1. Pod number in August estimation

Clone	Fruit number Semester II	CV	Yield category
Sul 2	6 ± 4,83	0,80	poor
ICCRI 3	22,5 ± 15,93	0,71	medium
ICCRI 7	10,7 ± 3,40	0,32	medium
TSH 858	1,7 ± 0,95	0,55	poor
Sul 3	20,7 ± 9,60	0,46	medium
Sul 1	13,7 ± 12,84	0,93	medium
MCC 1	32,5 ± 8,50	0,26	high
RCC 71	2,2 ± 3,20	1,42	poor
RCC 70	3,5 ± 3,78	1,08	poor

Note: < 10 poor, 10-29 medium, > 29 high

Pod structure varied among cocoa clones and months of observation. Clone TSH 858, MCC 1, and RCC 70 exhibited single pod stage while clone ICCRI 3, ICCRI 7, Sul 2 and RCC 71 had 3 pod stage in one observation. This characteristic indicated a continue fruiting that could lead to high pod production. Prawoto (2014) reported that pod structure was dynamic amog clones included Sul 1, Sul 2 and TSH 858 with major production of mature pod in Juni – November. The major season of pod production occurred during May – November. Sul 1 and Sul 2 produced more pods. Anita-Sari and Susilo (2013) reported that cocoa pod production in West Java varied among clones and months which occurred during March and June.

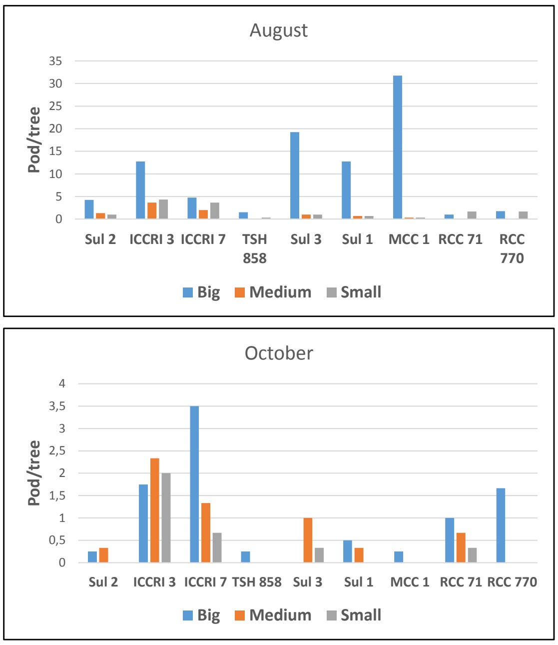

Figure 1. Pod structure in September and October

Adjaloo et al (2012) reported that floral and fruit phenology related to dry and rainy season. Cherelles and new pods was increasing during rainy season but could be distributed along the year controlled by both genetic and environmental factors. We observed that good flowering might not be followed by good new pods formation. The effectiveness of pollination might depend on pollinator activities. Falque et al (1995) reported that there was relationship between pollination intensity and fruit survival. However Frimpong-Anin et al (2014) reported that in wet season pollinated flowers were more stable (95% stability ratio) than those in dry season (65% stability ratio). N'Zi et al (2017) reported incompatibility among clones. Figure 1 showed dynamic of pod structure. Some clones continued to flower during dry season and produced new pod resulted in a complete pod phase of small, medium and big pod.

Pod number per phase of fruit development varied among clones. A complete pod phase and balance pod number per phase performed by clone ICCRI 3 especially in October observation. Clone ICCRI 3 had about 6 pods for each pod phase and lower CV value contrasted with clone MCC 1 which had 7 pods for each phase but higher CV value (Table 2). It indicated that clone ICCRI 3 produced pods more continuously while MCC 1 might have peak in August as shown by Figure 1. Pod number per phase was lower for the rest clones.

Table 2. Pod number per phase of fruit development

Clone	Pod number per phase (big, medium, small)	CV
Sul 2	2.00 ± 2.88	1.44
ICCRI 3	5.83 ± 3.45	0.59
ICCRI 7	3.50 ± 1.80	0.51
TSH 858	0.42 ± 0.53	1.26
Sul 3	5.20 ± 5,00	0.96
Sul 1	3.58 ± 2.52	0.70
MCC 1	7.33 ± 11.10	1.51
RCC 71	0.75 ± 1.66	2.21
RCC 70	1.08 ± 1.76	1.63

The yield of those 9 elite clones was under performance of superior clones due to weather extreme. Long dry season in 2015 with 5 dry months (June-October) followed by heavy wind in dry season of 2016 caused most all of mature leaves fallen, new leaves (flush) dried due to hard contact among each other, and many tip branches died. The research started when cocoa trees were just recovered in 2017. Only about 90% of the trees were survive. Therefore clones that sensitive to drought performed poor yield production and stunting growth including Sul 2, TSH 858, RCC 70 and RCC 71. Towaha and Wardiana (2015) reported that long drought had negative impact on cocoa trees growth and yield. Drought for 6 months decreased production component 5-42%.

Conclusion

Based on yield estimation in August, those 9 national clones introduced in Lampung still did not perform a superior yield. However Clone MCC 1, ICCRI 7, and Sul 3 produced better pod number per tree and pod number per phase of fruit development. Pod structure varied among cocoa clones and showed a dynamic among months.

Acknowledgement

We thank LPPM of Lampung University for funding this research through scheme of “Superior Research Grant” year 2017.

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Effects of aluminum stress on shoot growth, root growth and nutrient uptake of three pineapple smooth cayenne clone [*Ananas comosus* (L.) Merr.]

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SUMMARY

Aluminum (Al) is a biotoxic metal to most of plants which inhibits root growth, led to a series of influence metabolic abnornal and becomes the main limiting factor productivity in acid soils. In this experiment, effect of Al strees on plant growth, root growth, macronutrient uptake (N, P, K, Ca, Mg) and Al uptake in root and plant were studied. Three pineapple crown of smooth cayenne clones (GP1, GP3 and F180) was cultured from 0 to16 weeks in aquadest culture medium that contain 6 level of Al concentration treatment 0, 100, 200, 300, 400 and 500 μM $AlCl_3$. Experiments using a factorial randomized block design with 5 replications in a greenhouse growing environment. Results of this experiment showed that the three clones have a different response of tolerance to Al stress. GP3 clone showed the highest growth in the number of leaves, number of seminal roots, production of roots sugar, P leaf uptake and the lowest roots uptake of Al compared to other clones. GP1 clone produce the highest root length, percent of weight vertical root, and K leaf uptake. While F180 clone produces the highest water volume uptake of roots, weight of fresh roots, weight of plant, leaf uptake of N, Ca and Mg, and the lowest Al toxicity morphology than other clones. For the optimal balance proportion of plant and root growth, we can be said that F180 and GP3 clones have high levels to Al toxicity tolerance for that can growth well for acidic soils that have low pH.

INTRODUCTION

Pineapple [*Ananas comosus* (L.) Merr.] is one of the main plantation crop commodity in the world after bananas and oranges (Bartholomew et al., 2003). Generally, the pineapple is cultivated in the area 30 ° North latitude to 30º South latitude, with a temperature of 20-30 ºC, and variations in photo-periodism 10-12 hours. Pineapple is reported have adaptability at low pH soils containing high Al and Mn (Bartholomew, 2005).

The primary effect of Al toxicity is the inhibition of root growth; however, the mechanisms involved in this toxicity are far from clear (Matsumoto 2000).

Nutrient absorption and cell function will be impaired after exposure to high concentrations of Al. Root tip is the area where Al and interact root, root cell walls have a mechanisms to protect the entry of Al into the roots. Root cell walls are formed of a material that is negatively charged pectin that serves to attract cations. When the root tip saturated by Al, uptake of nutrients such as K^+, Ca^{2+}, Mg^{2+} and NO_3 will decline to enter the root cell walls. If the bond is excessive Al appeared between Al and the cell walls of root, root growth is inhibited (Lin and Chen, 2011).

Although aluminum toxicity can be ameliorated by surface application of lime, this is often not economically or physically feasible. Hence, combining the use of Al tolerant cultivars with liming is often the most effective strategy for improving crop production on acid soils. Several screening methods have been employed for this purpose, from genotype screening in the laboratory to soil bioassays and field evaluations (Hede et al, 2001). This study was conducted to examine the effects of six different Al concentration on plant growth, root growth and nutrient uptake of root and leave of three pineapple smooth cayenne clones [*Ananas comosus* (L.) Merrill] in strongly acid environment.

MATERIALS AND METHODS

Seed material used pineapple of three clones from smooth cayenne cultivar, namely GP1, GP3 and F180, which is derived from pineapple plantation location in PT Great Giant Pineapple, Terbanggi Besar, Central of Lampung, Lampung, Indonesia. Seedlings were selected from crown seed which have fresh weight 200-350 gr (medium size seed for cultivation). After cleaning with deionized water, these seeds were cultivated in tin-coated plastic container (15 cm inner diameter and 10 cm height) which contain 500 ml of distilled water were treated with $AlCl_3.6H_2O$ appropriate level of Al toxicity (0, 100, 200, 300, 400 and 500 μM $AlCl_3$). Plants planted in a greenhouse environ-ment. $AlCl_3$ solution was added every 1 week to replace the water that is absorbed by the roots reaching back to 500 ml. Climate condition during the experiment was daylight temperature 31.4 – 33.9 °C, night temperature 21.6 – 23.2 °C, and relative humidity 85.0 – 91.3%.

Experimental design used randomized block design factorial (3x6) with 5 replications. Factor 1, pineapple smooth cayenne clones, consists of three clones : GP1, GP3 and F180. Factor 2, $AlCl_3$ concentration in the water culture solution, consists of 6 levels $AlCl_3$ concentration : 0, 100, 200, 300, 400 and 500 μM.

Shoot growth observation

Pineapple shoot growth parameters which measured were (1) plant height (2) length of D-leaf, (3) plant weight at 16 weeks after planting.

Root growth observation

Root growth parameters which measured were (1) the length of the (2) the amount of seminal roots, (3 the volume of water absorption by roots (4) fresh and dry plant weight (5) percentage of vertical root, (6) total sugar roots production

Observation of leaf and root nutrient uptake

The content of N, P, K, Ca, Mg and Al leaves were measured at 16 weeks after planting for composite samples of roots and leaves.

RESULTS AND DISCUSSION

Effect of $AlCl_3$ concentration on shoot growth

Figure 1 shows the effect of $AlCl_3$ concentration on the growth of plant height, length of D-leaf, number of leaves, and plant weight. Shoot growth tend decrease with increasing $AlCl_3$ concentration in the solution. F180 clone showed the highest of plant height (Figure 1), length of D- leaf (Figure 2), and plant weight (Figure 3) compared to the other clones. GP3 clone showed the best of number of leaves growth In addition, GP3 clone also did not show a decrease in plant weight at the higher $AlCl_3$ concentration in the solution.

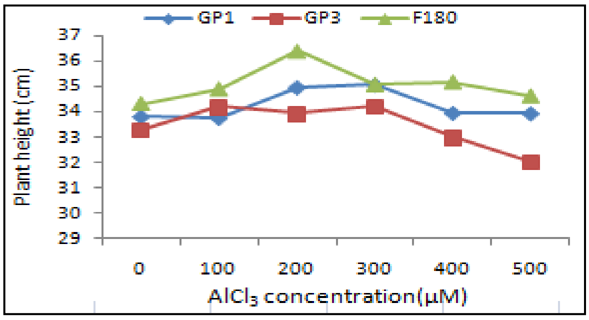

Fig.1. Effect of $AlCl_3$ on plant height

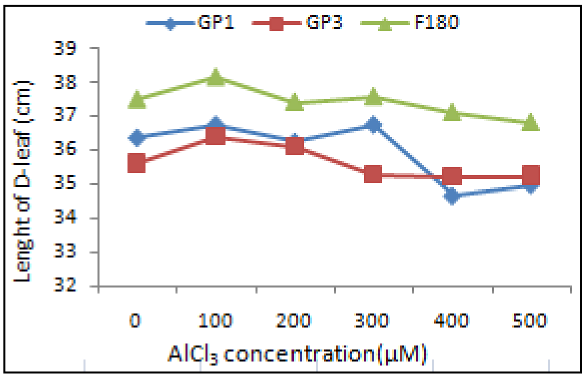

Fig.2. Effect of $AlCl_3$ on D-leaf length

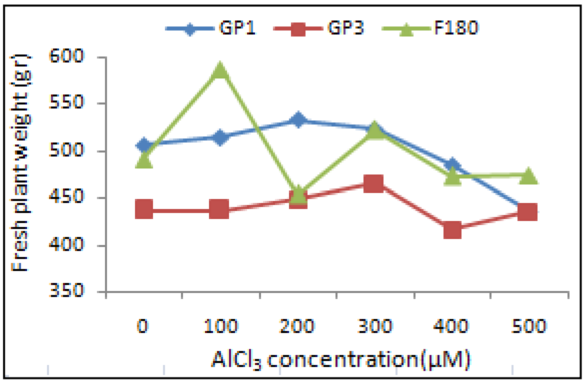

Fig.3. Effect of $AlCl_3$ on plant weight

Effect of $AlCl_3$ concentration on root growth

Root growth tend to decrease with increasing $AlCl_3$ concentration in the solution as seen in the root length (Figure 4), the number of seminal roots (Figure 5), fresh weight roots (Figure 6), percentage of vertical root weight (Figure 7).. Each clone showed a different root growth response to Al stress. GP1 clone shows the best growth of root length and percentage of vertical root weight especially in high Al stress (> 300 μM $AlCl_3$). While the best number of seminal root on Al stress at 500 μM $AlCl_3$

seen in GP3 clone (Figure 5) and F180 clone showed the highest fresh root weight in the Al highest stress

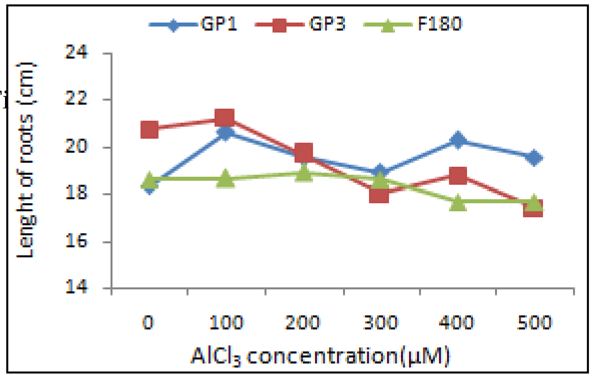

Fig. 5.Effect of AlCl3 on root length the root length

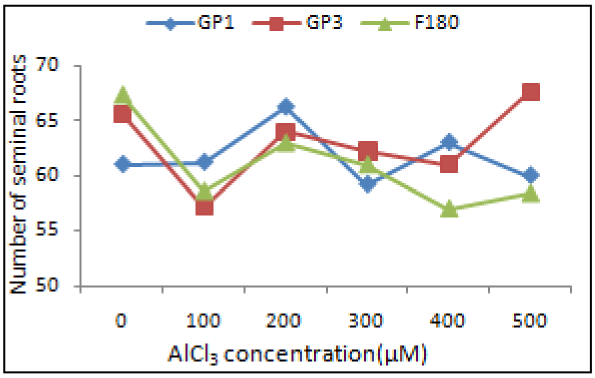

Fig. 6.Effect of AlCl3 on the number of seminal roots

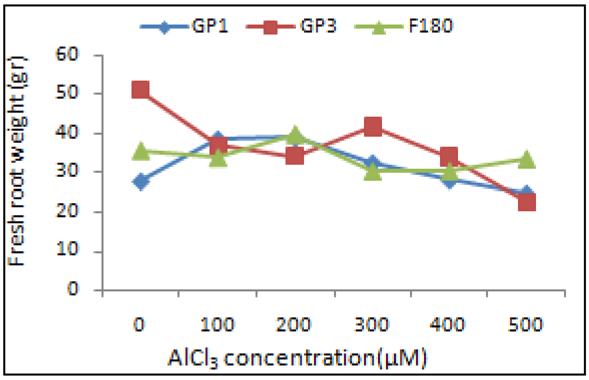

Fig. 7 .Effect of AlCl3 on fresh weight roots

Nutrient uptake by leaf

Ca and Mg leaf nutrient uptake nutrient uptake with the higher $AlCl_3$ concentration in the solution. concentration. This is similar to study Lin and Chen (2011) which states that the decreased uptake of Ca and Mg with increasing concentrations of $AlCl_3$. Increasing Ca and Mg uptake become an important indicator of the ability of the plant to reduce the toxicity of Al. Ca and Mg root uptake remain high in GP3 and F180 clones at high Al stress indicates that both these clones have a degree of tolerance to Al toxicity better than clone GP1.

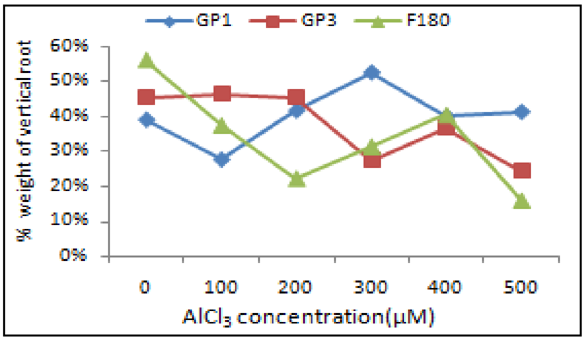

Fig. 8 .Effect of AlCl3 percentage of vertical root

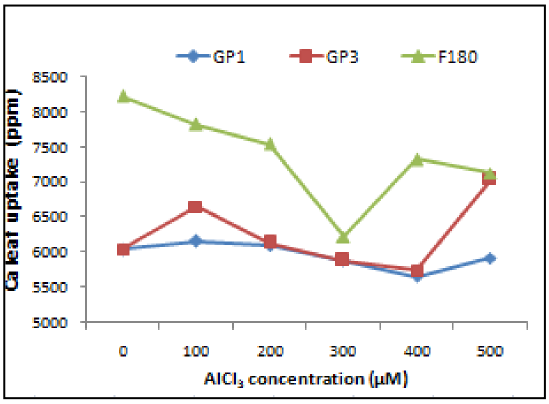

Fig. 9.Effect of AlCl3 on Ca upatke.

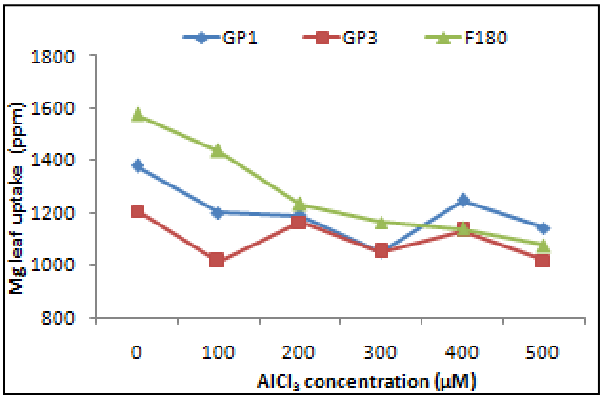

Fig. 10.Effect of AlCl3 on Mg uptake

CONCLUSION

In the Al high stress (500 µM $AlCl_3$), GP3 clone still show the best growth in the number of leaves, number of seminal roots, Tolerance of GP1 clone is shown in the best root length, percentage of weight vertical root. While F180 clone shown the best in root volume water uptake, fresh weight root, fresh weight plant, leaf uptake of N, Ca and Mg. In other word, we can said that F180 and GP3 clones are clones that have good adaptability to grow well under conditions of stress Al.

ACKNOWLEDGEMENTS

The authors want to acknowledge the financial support for this research from PT Great Giant Pineapple, Terbanggi Besar, Central of Lampung, Lampung, Indonesia, especially for Research and Development Departement of PT Great Giant Pineapple for all their support during the experiment.

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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 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 escu/enta* Crantz) *(Manihot escu/enta* 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 CO_2 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*
		cm				%
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/cm3	kgf/cm²
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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Corn Yield and Soil Properties under longterm conservation tillage in clayey soil tropical upland of Lampung, Indonesia

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SUMMARY

The conservation tillage system which includes minimum and non-tillage tillage becomes an alternative land preparation that can maintain high productivity. One thing that determines the success of conservation tillage is to restore plant residues after harvest as a source of organic material in the form of mulch to maintain the physical properties of the soil. This study aims to determine the effect of tillage and nitrogen fertilization systems on the soil prorerties and corn yeild. The study was conducted using a Randomized Block Design (RBD) which was arranged factorially with 4 replications. The first factor is a long-term tillage system (T1 = Intensive tillage, T2 = Minimum tillage, T3 = No tillage) and the second factor was long-term nitrogen fertilization (N0 = 0 kg N ha^{-1} and N1 = 200 kg N ha^{-1}). The data obtained will be tested for homogeneity by the Bartlet test and the additivity of the data was tested by the Tukey Test. The results showed that long-term tillage and fertilization systems did not affect the physical properties of the soil, namely bulk density, soil porosity, soil texture, and soil structure. The highest soil organic carbon was obtained when the treatment of the minimum soil combined with of 200 kg N ha^{-1} treatment was 1.56%. The highest corn yield was obtained from the treatment of the minimum tillage and no tillage combined with nitrogen fertilization of 200 kg N ha^{-1}.

Introduction

Lampung Province, Indonesia, is one of the largest corn producing provinces in Indonesia. In 2017, Lampung was ranked as the third corn producer in Indonesia after East Java and Central Java, in which Lampung contributes 8.59% of corn production. In 2016 corn production was 1.7 million tons, while in 2017 Lampung corn production increased to 2.4 million tons.

Dry land is one of the natural resources that has the potential to increase agricultural production in Indonesia. However, this potential area has not been used optimally. Constraints that are often encountered on dry land include low soil fertility, high erosion and drought in the dry season (Utomo, et al., 1993). To empower maximum dry land, it is necessary to have suitable cultivation techniques in solving dry land use problems for annual crops. Conservation land is one of the approaches to crop production systems that pay attention to land conservation (Utomo, et al., 1989).

Arsyad (2010) stated that land conservation is relatively more profitable for long-term agriculture, including maintaining or improving soil structure and soil organic matter content, increasing water availability, improving infiltration and reducing environmental damage, and increasing crop yields.

This study aims to find out 1). the effect of conservation tillage on maize (*Zea mays* L.) cropping areas on soil physic property compared to intensive tillage systems, 2). the effect of Nitrogen 200 kg ha^{-1} fertilization on soil physic property in maize (*Zea mays* L.) cropping areas compared to without nitrogen fertilization and 3). interaction between soil tillage systems and nitrogen fertilization on soil physical property in maize (*Zea mays* L.) crop fields.

Material and Methods

This research has been carried out from October 2016 to March 2017 in the 29th year of planting. The study was conducted in the Lampung State Polytechnic experimental garden. The application of long-term tillage conservation and fertilization treatment that has been going on since 1987 (Utomo, 2012).

The study was conducted using a randomized block design (RBD) which was arranged factorially with 4 replications. The first factor is a long-term tillage system, IT = Intensive tillage, MT = Minimum tillage, NT = No tillage, and the second factor is long-term nitrogen fertilization, N0 = 0 kg N ha^{-1} and N1 = 200 kg N ha^{-1}.

Furthermore, the data obtained will be tested for homogeneity with the Bartlet test and data additivity tested by the Tukey Test. If the assumptions are met the data is analyzed by variance, the difference in the middle value of the treatment was tested by the Smallest Significant Difference Test (LSD) at the level of 5%.
The variables observed were bulk density, porosity, soil organic carbon, and corn yeild. Bulk density and porosity analyzed by the gravimetric method.

Results and discussion

Bulk density and Soil Porosity

The results of the analysis of the weight of soil volume and soil porosity (Table 1). Treatment of soil tillage systems and nitrogen fertilization had no significant effect on the weight of soil volume and soil porosity. This is presumably because the mulch that comes from weeds and the residue of plant litter given is too little, which is only 6-8 tonnes ha-1 (Utomo, 2012). To reduce the weight of the soil contents, increase permeability, porosity, and total pore space, the remaining plant mulch is more than 11 tons ha-1 (Brown and Dicky, 1970 in Khair, 2017). Mulyani (2003) states that the application of organic matter from ground cover plants that are immersed in new soil can increase the total porosity of the soil and maintain soil organic matter content and improve the efficiency of inorganic fertilization.

Table 1. Bulk density and porosity at a depth of 5 cm

Treatment		Bulk density ($g\ cm^{-3}$)	Porosity (%)
Soil tillage methode	Nitrogen Fertilization		
IT	0	1.13	57.37
	200	1.13	57.51
MT	0	1.16	56.29
	200	1.22	54.03
NT	0	1.19	55.22
	200	1.18	55.57

Soil Texture and Soil Structure

Soil texture and soil structure in the study area was obtained from previous research. The soil texture in 0-20 cm and 20-40 cm depth for each treatment is clay. In the clay texture, the soil pores will be dominated by micro pores so that water passing through the soil is slower.
The intensive tillage has granular soil structure, while the minimum tillage and no tillage have the same soil structure that are subangular blocky. The stability of the structure and resilience of conservation soil chunks is on average two times higher than intensive tillage. In this case the aggregate is clearly formed and can still be broken down.

Soil Organic Carbon

Soil tillage has a significant effect on soil organic carbon content, while nitrogen fertilizer treatment does not have a significant effect on soil organic carbon (Table 2).

Table 2. Tillage effects and N fertilization on soil organic carbon in

Treatment		Soil Organic
Soil Tillage	IT	1.45b
	MT	1.56a
	NT	1.48b
BNT 5%		0.06
N Fertilizer	N 0 kg ha^{-1}	1.50a
	N 200 kg ha^{-1}	1.50a
BNT 5%		0.05

Using LSD test at 5% level

The minimum tillage has the highest soil organic carbon content which is equal to 1.56% and is significantly different from other tillage systems. This is because in the minimum tillage, weeds and plant residues were previously left on the land, so they can be a source of soil organic matter. This soil surface treatment will facilitate organic matter from mulch weeds and previous plant residues that have been decomposed to enter the soil so that it can increase the soil organic matter content.

Corn Yield

The highest yield of corn was obtained in the treatment of N2T2 and N2T3 while the lowest corn yield was obtained in the treatment of NO3 (Table 3).

Table 3. Effect of soil tillage systems and N fertilization on corn yield

Treatment	IT	MT	NT
N0	4.65cb	5.25cb	2.90dc
N2	5.35cb	7.15aa	6.80aba
P-value N	1.0131		
p-value T	1.2408		

The treatment of minimum tillage and non-tillage with 200 kg fertilizer Nitrogen ha-1 has the highest corn production compared to others because it has the highest soil organic carbon content and soil permeability compared to other treatments. . The content of soil organic carbon can increase soil fertility so that crop production also increases. Soil organic carbon can also increase the ability of soil to hold water. With the ability of land to hold water, the needs of plants for water are fulfilled to support plant growth and development so that crop production increases.

Conclusion

From the results of this study it can be concluded that Long-term tillage and fertilization systems did not affect the physical properties of the soil, namely bulk density, soil porosity, soil texture, and soil structure. The highest soil organic carbon was obtained when the treatment of the minimum soil combined with fertilizing nitrogen of 200 kg ha^{-1} was 1.56%. The highest corn yield is obtained from the treatment of the minimum tillage and without tillage combined with nitrogen fertilization 200 kg ha^{-1}.

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The role of refugia in the wetland paddy ecosystem

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SUMMARY

To support rice productivity over a long time, paddy cultivation is done with a sustainable farming system that based on conservation. Conservation-based agriculture increase the diversity of agroecosystems with refugia planting. Refugia plants are flowering plants that grow around cultivated plants that have the potential to provide suitable microhabitat that contribute to the conservation of natural enemies.The study was conducted in August to October 2018 in the wetland paddy at Sidosari Village, Natar District, Lampung. Identification of arthropod families in the Plant Pest Laboratory of the Department of Plant Protection, Faculty of Agriculture, Lampung University. Result study are planting refugia and applying IPM to the ecosystem of wetland paddy increase arthropods diversity, the population of pest insects is lower in wetland paddy ecosystem with planting refugia and application of IPM, population density of biological agents higher than conventional wetland paddy fields, and the disease incidence tungro is dependent on *Nephotettix virescens* in wetland that refugia planting and the application of IPM or the conventional paddy fields.

Introduction

To support rice productivity over a long time, paddy cultivation is done with a sustainable farming system that based on conservation. Conservation-based agriculture increase the diversity of agroecosystems with refugia planting. Refugia plants are flowering plants that grow around cultivated plants that have the potential to provide suitable microhabitat that contribute to the conservation of natural enemies. Refugia plants are a place of refuge, are a source of food, or other resources for natural enemies such as parasitoids, predators, and other beneficial insects. Landis *et al*. (2005) state that many plants and wild plants are a direct source of food for natural enemy organisms, for example by providing nectar and pollen and indirectly providing prey and host, in addition to managing microclimates that are in accordance with the life needs of the enemy natural.

Flowering plants can attract the arrival of insects. The mechanism of flowering plants attracts the arrival of insects using the morphological and physiological characters of the flower, the size of the flower, the shape of the flower, the color of the flower, the smell and the fragrance of the flower, flowering period, as well as nectar and pollen content (Kurniawati & Martono, 2015).

Refugia plants are chosen by criteria such as having striking flowers and colors, fast and sustainable plant regeneration, seeds or seedlings are easily obtained, easy to plant, and can be intercropped with other plants. Plants that have the potential as refugia include sunflowers (*Helianthus annuus*), zinnia paper flowers (*Zinnia* spp.), Kenikir (*Cosmos caudatus*), weeds from the asteraceae family such as babadotan (*Ageratum conyzoides),* ajeran (*Bidens pilosa* L.), and kotok(*Tagetes erecta*). This study aims the role of refugia planting on arthropod diversity, population density of biological agents, pest population density and disease incidence tungro that transmitted by green leafhoppers (*Nephotettix virescens*) in wetland agroecosystems

Material and Method

The study was conducted in August to October 2018 in the wetland paddy fields at Sidosari Village, Natar District, Lampung. Identification of arthropod families in the Plant Pest Sciences Laboratory of the Department of Plant Protection, Faculty of Agriculture, University of Lampung.

The treatment is done in a plot namely

K = Control, conventional wetland paddy cultivation (applied by farmers local).

P1 = Cultivation of wetland paddy fields by applying IPM

P2 = Conservation-based wetland paddy cultivation (by applying IPM and planting refugia).

The treatment of IPM are use straw compost 10 tons / ha added with biological fertilizer in the form of MOL (local microorganism). In conventional cultivation, inorganic fertilizers are used Urea 200 kg / ha, SP-36 150 kg / ha, and KCl 150 kg / ha (Urea 50% at planting and 50% at 4 wap, SP-36 and KCl 75% at 4 wap and 25% at 6 wap). Control of pests and plant diseases is carried out in a technical culture *(jajar legowo planting*) and application of vegetable pesticides (3 times).

The Shannon index is calculated by the following formula (Krebs, 1985):

H '= -∑ pi x ln pi

with:

H '= Shannon index

pi = proportion of arthropods to i

The magnitude of the species diversity index is defined as follows:

a. H '> 3: shows that diversity is high

b. 1≤H'≤3: indicates that diversity is moderate

c. H '<1: shows that the level of diversity is low

Equity is calculated by the evenness (Price, 1997) formula as follows: E = H ’/ ln S

With

E = evenness index

S = number of arthropod types

With the following criteria:

E <0.3 shows low evenness

E0,3–0,6 shows moderate type evenness

E> 0.6 shows high evenness

Result and Discussions

The arthropods obtained are quite abundant and varied. In paddy fields with conventional treatment, 25 species of Arthropods were found with 294 individuals. The types of arthropods include herbivorous arthropods, predators, parasitoid, and decomposers. Pests in conventional treatment are brown planthopper (*Nilaparvata lugens*), greenleafhopper (*Nephotettix virescens* is necessary as Tungro vector) , white planthopper (*Sogatella furcifera*), *Cnaphalocrocis medinalis, Scotinophara* sp. and *Leptocorisa* sp. Predator found in conventional paddy fields are ladybugs (*Cyrtorhinus* sp., *Andrallus spinidens*), predatory flies (*Tomosvariella* sp.), Predatory spiders (*Oxyopes* sp., *Tetragnatha* sp., *Lycosa* sp.) , predatory dragonflies (*Odonata*), plankton-eating flies (Chironomiidae), decomposer arthopods (Collembola), and various parasitoids from the Hymenoptera order.

In the paddy fields with the treatment of the application of IPM, 28 species of arthropods were found with 243 individuals. In this treatment the number of species found was higher than in the conventional treatment. Insects of natural enemies namely predatory ladybugs (*Microvelia* sp.) and predatory grasshoppers (*Metioche* sp.) were found in IPM treatment and were not found in conventional treatments. The natural enemies controlled the pest populations.

In paddy fields with refugia planting treatment and application of IPM, 30 species of arthropods were found with 238 individuals. In this treatment the number of species found is mostly from natural enemies. The pest insects found in low populations. In this treatment natural enemies are able to suppress pest populations in the field (Table 1 and 2).

Table 1. Types and quantities of insect pest in cosystem paddy fields with conventional patterns, IPM, and conservation patterns (planting refugia and IPM)

No	Ordo	Spesies/ famili	Pest in ecosystem		
			Conventional	IPM	IPM+ Rf
1	Hemiptera	*Nilaparvata lugens*	86	38	19
2	Hemiptera	*Nephotettix virescens*	23	6	5
3	Hemiptera	*Sogatella furcifera*	8	4	3
4	Lepidoptera	*Cnaphalocrocis medinalis*	12	6	5
5	Hemiptera	*Scotinophara* sp.	40	26	11
6	Hemiptera	*Leptocorisa* sp.	35	9	10
7	Thysanoptera	*Thrips* sp.	12	10	8
			216	99	61

The types of arthropoda found in the three ecosystems of rice fields are not different, that is brown planthopper, green planthopper, white back planthopper. Although the types of pest insects in the three ecosystems of rice fields are not different, there are differences in population levels. The pest population is very low in paddy fields with conservation treatment (planting refugia and applying IPM). The highest pest population was found in conventional paddy field. It could be occured because in the field plots with conservation treatment had many types of natural enemies. The natural enemy was able to control pests so that the pest population was low and below the economic threshold.

Table 2. Types and quantities of arthropods in cosystem paddy fields with conventional patterns, IPM, and conservation patterns (planting refugia and IPM)

No	Ordo	Spesies/ famili	Arthropoda in ecosystem conventional	IPM	IPM+Rf
1	Hemiptera	*Nilaparvata lugens*	86	38	19
2	Hemiptera	*Nephotettix virescens*	23	6	5
3	Hemiptera	*Sogatella furcifera*	8	4	3
4	Lepidoptera	*Cnaphalocrocis medinalis*	12	6	5
5	Hemiptera	*Scotinophara* sp.	40	26	11
6	Hemiptera	*Microvelia* sp.	0	12	14
7	Hemiptera	*Leptocorisa* sp.	35	9	10
8	Orthoptera	*Metioche* sp.	0	2	2
9	Hemiptera	*Cyrtorhinus* sp.	4	8	9
10	Hemiptera	*Andrallus spinidens*	2	6	5
11	Coleoptera	*Ophionea nigrofasciata*	4	6	7
12	Coleoptera	*Coccinela* sp.	6	12	12
13	Coleoptera	*Paederus perigrinus*	7	7	8
14	Araneae	*Oxyopes* sp.	2	6	6
15	Araneae	*Tetragnatha sp.*	6	8	8
16	Araneae	*Lycosa* sp	4	6	6
17	Hymenoptera	*Telenomus* sp.	5	5	5
18	Hymenoptera	*Trichogramma* sp.	4	4	8
19	Hymenoptera	*Cotesiaflavipes*	2	8	15
20	Hymenoptera	*Stenobracon* sp.	0	1	3
21	Hymenoptera	*Gonatocerus* sp.	0	0	4
22	Hymenoptera	*Anagrus* sp	2	2	6
23	Diptera	*Tomosvariella* sp.	1	3	4
24	Diptera	Camillidae	0	0	2
25	Diptera	Chironomiidae	1	8	8
26	Thysanoptera	*Thrips* sp.	12	10	8
27	Collembola	Paranolidae	11	14	14
28	Collembola	Entomobrydae	10	13	16
29	Odonata	*Agriocnemis* sp.	3	8	9
30	Odonata	Libelullidae	4	5	6
	Total individu		294	243	238
	H'		**2.51149**	**3.06416**	**3.26203**
	E		**0.7802374**	**0.919558**	**0.959084**

The disease incidence of tungro and another disorder on leaf or grains of paddy can be seen in Table 3.

Table 3. Disease incidence

No	Form of Disorder	Disease Incidence (%) conventional	IPM	IPM+ Rf
1	Leaf disorder	17,3	8,6	6,4
2	Grains disorder	31,7	16,5	14,8
3	Tungro	12,6	0,0	0,0

The relation between the disease incidence tungro with quantities of *Nephotettix virescens* that is the low quantities of *Nephotettix virescens* (6 and 5 individuals) could not caused the disease incidence of Tungro in the application of IPM and conservation by refugia and the application of IPM. The disease incidence of tungro 12,6% related with 29 Nephottettix virescens in conventional wetland paddy ecosystem which sprayed chemical pesticide.

Conclusion

1. Refugia and applying IPM to the wetland paddy ecosystem increased arthropods diversity that ecosystems become stable and balanced.
2. The population of pest insects is lower in paddy fields with planting treatment refugia and application of IPM, and population density of biological agents higher than conventional fields.
3. The intensity of pest and tungro disease attacks on treated rice fields refugia planting and the application of IPM is lower than the plot conventional rice fields.

Acknowledgement

Thanked to the Dean of the Agricultural Faculty, Lampung University for funding this research.

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

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SUMMARY

Soil Organic Carbon (SOC) in tropical soil is important property for soil sustainability and corn production. Therefore, effort for increasing SOC and corn production in long-term tillage and nitrogen fertilization are important. The aim of this research was to measure SOC content in particle size fraction of long-term tillage systems and N fertilization. Additional aim was to establish the key management to sustain of soil health and corn production. The experiment was a factorial randomized complete block design, with 3 replications. Tillage treatments were No-Tillage (NT), Minimum Tillage (MT), and Intensive Tillage (IT), while N fertilization rate were 0 kg N ha^{-1} (N0) and 200 kg N ha^{-1} (N2). It revealed that, before plowing the long-term conservation tillage, SOC of MT was higher than IT but not different than NT. In our study showed that, both of tillage and N fertilization did not increase SOC in particle size fraction. It was found that, SOC in silt fraction was the highest than other fractions. SOC content in silt, sand, and clay fractions were 1.26%, 0.11%, and 0.10%, respectively. After plowing the long-term conservation tillage, corn yield of N2 was higher than N0. Corn yield in N0 and N2 were 4287 kg ha^{-1} and 6891 kg ha^{-1}, respectively.

INTRODUCTION

To increase corn production we must establish a good management to make soil keep health. Soil management like tillage and fertilization can increase soil production. Utomo (2012) reported that NT and MT could increase the SOC in top soil if followed by high nitrogen fertilization. Quantifying tillage and nitrogen capability to increase SOC will help to evaluate total carbon in particle size fraction. SOC in coarse fraction (sand : 105 -200 μm) was lower than in fine-fraction (silt and clay <20 μm).

The tillage system followed by proper fertilization is expected to increase the storage of SOC in soil particles. Application of a conservation tillage system with mulch and N fertilization are expected to contribute C through the decomposition process and can increase plant biomass. The aim of this research was to determine SOC content in particle size fraction from long-term tillage and N fertilization treatments. Additional aim was to establish the key management to sustain soil health and corn production.

MATERIAL AND METHOD

This research has been conducted in November 2017 until June 2018 (Second year after the plowing of long-term conservation tillage in March 2018). Soil samples were analysed in Soil Science Laboratory, Agrotechnology, Agriculture Faculty, Lampung University. This study was arranged in a factorial randomized complate block design with 3 replications. The first factors were tillage system (No-till; minimum till, intensive till) and the second factors were N fertilization (0 kg ha^{-1}; 200 kg ha^{-1}). Analysis of varience and mean test with HSD 5% were analysed using statistical analysis package.

Soil texture was analysed with Hidrometer's method (Afandi, 2005). The soil fractions were separated with Pipet's method. The clay (<2μm), was isolated by taking soil suspension in the sedimentation tube (±10-20 cm upper the suspention) with a strow (d=0,5 cm). After that, the suspension was put in erlenmeyer and left for 1 week to get the pure clay. While, for isolating of the silt and sand were done with sieved. The size of sieve was 48μm. The soil left under the tube, was sieved and the soil left in the sieve there was sand (2000-48μm), while the soil passed the sieve was silt (48μm- 2μm). The separated fractions was put in *aluminium foil* for air-dried. The air-dried soil sieved again. After that, SOC was analysed with Walkey and Black method.

RESULT AND DISCUSSIONS

Soil

Soil texture were categorized as clay class, with the clay fraction 48-55%, silt 27-33%, and sand 15-22%. The soil of this experiment is Typic Fragiudults (Utomo, 2012).

Soil Organic Carbon (SOC) Before Plowing

Based on analysis of varience (Table 1), SOC was only affacted by tillage system. SOC under MT was higher than IT, but similar to that of NT. It is because in conservation tillage, mulching and slightly tillage increased mulch mineralization, which resulted in higher SOC. While, in IT, tillage increased the SOC decomposition, resulted in less SOC.

This study did not agree with Bojolla *et.al* (2015) finding that there were no different between SOC in conservation and in intensive tillage. It was becauce SOC has reached the balance. Bojolla *et.al* (2015) reported that SOC decreased after 3 years study. SOC would be increased after change from intensive tillage to conservation tillage, but after certain periode the increase was very small becauce SOC has reached the balance.

Table 1. Table 1.Effect of soil tillage and long-term N fertilization on soil organic carbon before plowing

Tillage System	N (kg ha^{-1})	Soil Organic Carbon (%)
No-Till	0	1.49
Minimum	0	1.59
Intensive	0	1.47
No-Till	200	1.53
Minimum	200	1.57
Intensive	200	1.44
Source of Varience		**F-calc.**
N		0.02^{nt}
T		8.23**
N x T		0.64^{nt}

nt : Not Significantly Different at 5% ; ** : Significantly Different at 1%

Distribution of SOC in soil fraction

This study shown that both of tillage system and N fertilization did not affected the distribution SOC in particle size fraction. But regardless the combination treatments, SOC tended more distributed in silt fraction (Table 2)

Table 2. Effect of soil tillage and long-term nitrogen fertilization on soil organic carbon

Treatment		Soil Organic Carbon (%)		
Tillage System	N (kg ha^{-1})	Sand (2000-48 μm)	Silt (48-2 μm)	Clay (<2μm)
No-Till	0	0.12	1.36	0.11
Minimum	0	0.11	1.27	0.09
Intensive	0	0.10	1.32	0.12
No-Till	200	0.10	1.41	0.11
Minimum	200	0.10	1.42	0.11
Intensive	200	0.15	0.77	0.09
Source of variation		F-calc.		
N		0.05^{nt}		
T		0.16^{nt}		
N x T		0.17^{nt}		

nt : Not Significantly Different at 5%; N : Nitrogen Fertilization; T : Tillage System

In this study, texture tended to affected the SOC. SOC in silt fraction was higher than those of sand and clay fraction (Fig2). Liang *et.al* (2009) reported that size fraction SOC in <20 μm was believed as a stable fraction which resulted higher SOC. He also reported that clay has lost the 55% SOC in intensive tillage. It was because C in the soil has reached the balanced when and SOC was consumed by soil flora and fauna and because of harvest.

Different with our studies, however, Udom *et.al* (2015) also reported that clay had a higher SOC than the other. In our study shown that silt had a highest SOC. It was because the different between climate and clay mineralogy (Liang *et.al*, 2009).

Clay of 1:1 and 2:1 have different impact on SOC. Liang *et.al.* (2009) reported that soil in their study contained a lot of clay 2:1 so this clay did not really impact the SOC. The high temperature, lower rain-fall and lower organic matter were the reason why clay contained lower SOC.

In our study, silt cointaned higher SOC was because the character of silt as "*medium-term sink"* (Gerzabek *et.al.*, 2001, Barbera *et.al.*, 2010). But, silt has a meso-pore higher than clay so that silt can not retain C strongly. It was indicated that with long-term intensive tillage, the loss of SOC in silt fraction will be higher. Andita (2018) reported that intensive tillage could increased organic matter decomposition and resulted in decreased of soil organic carbon and humic acid.

While in treatments combination of tillage and N fertilization, silt of all combination of tillage and N fertilization contained SOC of 86-88%, except combination of IT and 200 kg N ha^{-1} that only contained 76 % SOC . It was because intensive till had a higher O_2 that could cause decomposition SOC more faster. On the other hand, N fertilization caused the fastest decomposition of SOC.

Corn Yield

Based on Anova (Table 3), corn yield was only affacted by N fertilization treatment. N fertilization of 200 kg ha^{-1} had higher corn yield than without fertilization. It was because the function of N is to establish amino acid and to arrange the nucleat acid (Muzammil *et.al*, 2012). This response was an indication that the soil was lack of available N.

Table 3. The effect of soil tillage and long-term nitrogen fertilization on corn yield

Tillage System	N (kg ha^{-1})	Corn Yield (kg ha^{-1})
No-Till	0	4,539
Minimum	0	4,495
Intensive	0	3,825
No-Till	200	7,058
Minimum	200	7,510
Intensive	200	6,104
Source of Differrent		**F –calc.**
N		34.44**
T		2.05^{nt}
NxT		0.24^{nt}

nt : Not Significantly Different at 5% ; ** : Significantly Different at 1%

In previous season, after plowing the long-term conservation tillage, nitrogen fertilization, N residue, and tillage system could increased the corn yield after 30-years croping (Yupitasari, 2018). As reported by Yupitasari (2018) in 31-years, minimum till and N fertilization 200 kg ha^{-1} still had highest corn yield.

CONCLUSION

SOC in particle size fraction was not effected by tillage and N fertilization. SOC in silt fraction was highest than other fractions. While corn yield in 200 kg N ha^{-1} had higher than without N fertilization.

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Ventilation Flow Rate and Photosynthesis Prediction based on Water Vapor Balance under Ventilated Greenhouse

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SUMMARY
The water vapor balance method was tested and evaluated in ventilated greenhouse soilless tomato crops grown under summer season in Gifu city, Japan. This study was conducted to estimate the ventilation flow rate and the net photosynthesis in the ventilated tomato greenhouse. The water vapor mainly released by transpiration that followed a periodic shape variation like a solar radiation and the amount of water vapor released from the greenhouse due to ventilation that proportional with outside wind velocity. The amount of water vapor was significant during summer. Using of the simple water vapor balance method that calculated from real-time transpiration measurement can predict ventilation rate and the net photosynthesis quiet well.

Introduction

Ventilation in a greenhouse systems is very important part to keep the air temperature condition, water vapor pressure deficit (VPD) at optimal conditions for plants when solar radiation is high. Ventilation is not only to create a good micro-climate condition for the plant but also photosynthetic and transpiration rate of the plants.

The net photosynthetic rate increases with increasing the CO2 concentration in the daytime and supply CO2 gains from the outside greenhouse through ventilation. However, the high of CO2 supply under ventilated greenhouse will be not efficient when the air flow to inside greenhouse was too high. Therefore, it should be evaluated and controlled that considered the area opening of ventilation.

In order to measure and estimate the ventilation characteristics of greenhouse was conducted with the decay method or tracer gas method (Baptista et al., 1999; Boulard and Draoui, 1995), heat balance method (Yasutake et al. 2017; Teitel and Tanny 1999), and regression method under greenhouse without plant (Yasutake et al. 2017). This paper was tested and evaluated of the ventilated greenhouse with the water vapor balance method for predicting the ventilation flow rate and the net photosynthesis for the soilless tomato crops.

Material and Method

The experiment was conducted in May – September 2018 in a single-span greenhouse of the Gifu University, Japan. The naturally ventilated greenhouse has 0.9m double glass vent openings each side and a roof vent. All the vent have worked automatically to keep the inside greenhouse temperature 25 C. the tomato plant, Momotaro variety, were planted north-south orientation along the axis of greenhouse. There are three treatments of opening the side vent opening with roof vent was always opened, SV12 (both upper and lower side vent open); SV1 (lower side ventilation open); and SV2 (upper side vent open).

Water vapor balance was analyzed by the mass balance method (eq. 1) with assumption there is no condensation on the inside surface of the glazing; and also there is no evaporation resulted from the soil because the greenhouse has covered by plastic.

Water vapor supply = water vapor losses /1/

$E_c + ET = E_v$ /2/

$E = E_v$ /3/

Considering the two sources of water vapor as one component (eq. 3), and then expressing the water vapor content within the greenhouse air as absolute humidity, g [H2O] kg-1 dray air [DA], then resulting mass balance equation is:

$AH_{out}.\ q_v.\ \rho = AH_{in}.q_v.\ P + E$ /4/

$q_v.\ \rho\ (AH_{out} - AH_{in}) = E.Af$ /5/

Where q_v was ventilation flow rate (m3 m-2 s-1); AH_{in} and AH_{out} were the absolute humidity of the air (g [H2O] kg-1 [DA]), inside and outside greenhouse respectively, and E was measured directly from the plant with a stem heat balance sensor attached to the stem of tomato plant. It recorded at 1, 15, and 60 minutes intervals with CR1000 data logger (sciences Campbel). Transpiration measurement with a sensor was compared with weighing lysimeter. This on-line monitoring of the ventilation flow rates were used to predict the net photosynthetic rate based on the carbon dioxide balance equation of the greenhouse from Takakura et al. (2017) model.

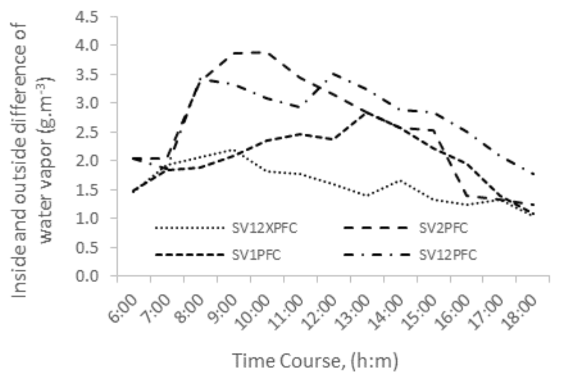

Fig. 2 Time Course of the inside and outside water vapor difference (the net radiation 700 w.m^{-2})

Result and Discussions

Fig. 1 shows that transpiration rate increased linearly with the net solar radiation. The transpiration rate is not only affected by the solar radiation but also by air flow around the crops inside greenhouse. SV12 opening treatments was more higher compared to SV1 and SV2. It can be elucidated that the effect of the large opening resulted the air flow to inside greenhouse. This result agrees with the others results experiments (Thongbai, Kozai, and Ohyama 2010; Kitaya et al. 2003)

Application of evaporative cooling technology affected the water vapor condition in the greenhouse. It can be seen from the below graph, that shows application of

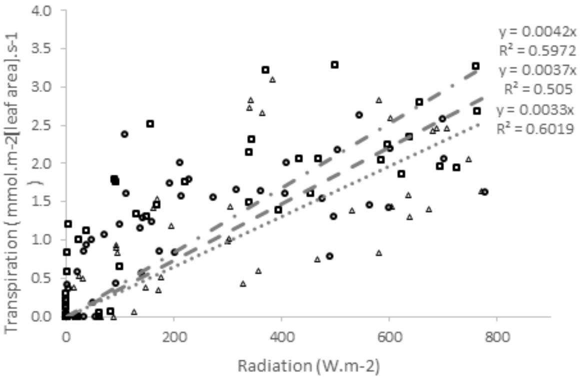

Fig.1 Relation between hourly averaged transpiration based on leaf area and net solar radiation above the canopy. SV12 opening vent (□); SV1 opening vent (Δ); and SV2 opening vent **(○).**

evaporative cooling on summer seasons to perform a good micro-climate environment inside greenhouse increased the difference of inside and outside water vapor. SV12 treatment combined with evaporative cooling was increased the water vapor about 60% compared to without evaporative cooling application.

The fluctuation of water vapor difference between inside and outside due to the ventilation flow rate. It can be explained based on a correlation between outside wind speeds to the ventilation flow rate. An increasing of wind speed from 0.2 until 1.5 m.s-1 followed by an increasing of the ventilation flow rate linearly (Fig. 3).

The analysis of the ventilation flow rate shows that the wind effect is almost linearly proportional to the wind speed between 0.1 – 1.0 $m.s^{-1}$, however it was limited by the opening are of side window opening area. On this experiment, on the day ventilation opened maximum (35 cm).

This results confirms previous studies which show the same pattern with different methods (Boulard T 1995; Teitel and Tanny, 1999). However, it also limited to maximum wind speed around the crops about 1 – 1.5 $m.s^{-1}$ after that it would be constant value because the air velocity induced ventilation greenhouse was dominant (Papadakis et al. 1996).

Furthermore, the canopy crop photosynthesis was predicted smoothly by real time measurement of transpiration combined with prediction ventilation flow rate based on leaf area method. From the Fig. 4, it is clear that net photosynthesis could be predicted with this new proposed method.

It shows that an increasing of flow rate around the plants

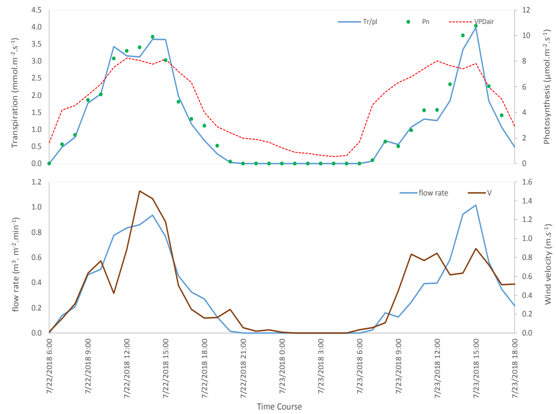

Fig. 4 Time Course of the net photosynthesis, transpiration and vapor pressure deficit (upper); wind speed and ventilation flow rate (below) under SV12 without PFC treatments (22-23 July,2018).

affected the net photosynthesis processes under high the net solar radiation about 600 W.m-2. The air movement around the plant canopies in the greenhouse system is very essential to obtain maximal gas exchange rates (Kitaya et al. 2004). The results of this study confirms

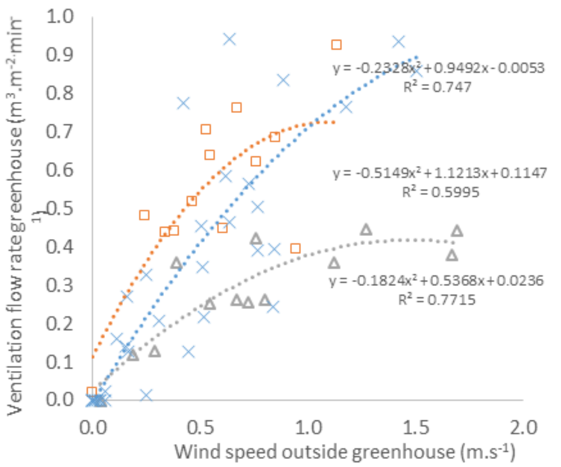

Fig. 3 Time Course of the inside and outside water vapor difference (maximum the net radiation 700 $w.m^{-2}$). SV12 opening vent with evaporative cooling (PFC) (□); SV1 opening vent with PFC (Δ); and SV12 opening vent without PFC **(○).**

that the importance of air movement for enhancing gas and water vapor exchanges in plant canopies

Moreover, this water vapor balance method that calculated from real-time transpiration measurement can predict ventilation rate and the net photosynthesis quiet well. It can be used for controlling air movement for enhancing the plant canopy photosynthesis with CO2 enrichment level or ambient CO2 concentration under ventilated greenhouse. Also, it can be used as reliable and predictive tools for the measurement of the net photosynthesis based on leaf area based.

Conclusion

A real time prediction of ventilation rates and photosynthesis tools based on transpiration data under ventilated greenhouse was proposed.

Opening side ventilation on the canopy tomato crops could be used as the best option for optimizing the evaporative cooling in summer seasons.

Acknowledgement

Financial support from a PhD grant of the Indonesia Endowment Fund for Education Ministry of Finance Republik Indonesia (LPDP – BUDI) and Ministry of Research, Technology and Higher Education of the Republic of Indonesia

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Aggregate Stability and Root Biomass Affected by Soil Tillage and Mulching in Green Nut Cultivation (*Vigna radiata* L.)

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Abstract

The bare intensife tillage applied on agricultural land can drastically reduce soil quality. One of the efforts to prevent it is by applying mulch and conservation tillage. The objective of this study was to determine the effect of minimum tillage and mulch on soil aggregate stability and root biomass. This study was designed in the field using a randomized block design (RBD) with 2 factors and 4 repetitions. The first factor was tillage (minimum tillage (T1) and intensife tillage (T2)). The second factor was mullch (without mulch (M1) and 5 Mg mulch ha^{-1} (M2)). The aggregate stability was determinate using water-drop method (WDM). The results showed that the minimum tillage affected the increasing soil aggregate stability of the 6 mm and 3 mm diameter aggregate before land preparation and after harvesting, except, the 3 mm diameter aggregate before land preparation. The minimum tillage also increased root biomass during the vegetative period of the plant. The treatment of 5 Mg mulch ha^{-1} affected in increasing the soil aggregate stability of 3 mm diameter aggregate after harvest but not the soil of 6 mm diameter aggregate. No interaction was found between the minimum tillage and 5 Mg mulch ha^{-1} on soil aggregate stability and root biomass.

Introduction

Land preparation was an important thing for any crop cultivation. Intensive tillage can damage soil structure but also stimulates soil oxidation in which the decomposition of organic matter much faster. The decrease of aggregate stability is very common in crop farming systems (Rachman and Abdurachman, 2006) since soil in intensive tillage when rain can break up the soil aggregate (Refliaty and Marpaung, 2010). Sarief (1989) reported that excretion and root penetration can stimulate or be affected by soil structure. The more roots found in the soil, the higher the root biomass results in the more stable soil structure will be. The objective of this research is to study the effect of minimum tillage and mulch on soil aggregate stability and root biomass.

Material and Method

The location of the research was carried out at the Integrated Field Laboratory, Lampung University. This study in the field was designed using a randomized block design (RBD) with 2 factors and 4 replications. The first factor was tillage (minimum tillage (T1) and intensife tillage (T2)). The second factor was mullch (without mulch (M1) and 5 Mg mulch ha^{-1} (M2)) The aggregate stability was determinate using water-drop method (WDM) (McCalla, 1944). The average results of the observed values of the data were tested by the BNT test level of 5%.

Result and Discussions

Effect on Soil Aggregate Stability

Table 1 showed that soil aggregate stability before land preparation was significantly higher for 6 mm diameter compare to that of intensive tillage and with no mulch, but not significantly in mm diameter .The tillage system treatment significantly reduced the stability of 6 mm and 3 mm soil aggregates after harvest. Mulching treatment was not significantly different from aggregate stability at all size and time of observation except for soil 3 mm diameter aggregates which showed significantly different observations after harvest. .

Effect on Roots Biomass

Root biomass in the minimum tillage was very significantly different compared to intensive tillage during vegetative period of the plants (Table 2). This is because the condition of minimum tillage is more able to provide space for roots to grow and develop. A good root growth process will increase root biomass. In addition, it is suspected that the breakdown of roots in the soil due to intensive tillage treatment so that the roots decompose faster, while in the minimum tillage which is only treated as needed does not damage the root growth rate. Prasetyo, et al., (2014) stated that maximum tillage was an act of reversing, cutting, destroying and leveling the soil by removing plant debris that interferes with growth, while minimum tillage is a sufficient soil cultivation by maintaining crop residues the former is still on the surface of the land.

Table 1. Aggregate stability of 6 mm and 3 mm diameter soil aggregates

Soil aggregate	Treatment	Soil aggegate stability (kinetic energy = J)	
		BL	AH
6 mm	T1	5,96 b	3,99 b
	T2	4,06 a	2,81 a
	F Test	*	*
	HSD 0,05	1,81	0,98
	M1	4,84	3,00
	M2	5,18	3,81
3 mm	T1	1,75	1,78 b
	T2	2,16	1,22 a
	F Test	ns	**
	HSD 0,01	-	0,41
	M1	1,92	1,35 a
	M2	1,99	1,65 b
	F Test	ns	*
	HSD 0,05	-	0,29

Table 2. Effect of the tillage system and mulch on root biomass in the green nut plants

Treatment	Root biomass (kg m^{-3})		
	BL	VP	AH
T1	0,69	3,22 b	0,48
T2	0,54	1,39 a	0,27
F Test	ns	**	ns
HSD 0,05	-	0,67	-
M1	0,61	1,98	0,40
M2	0,61	1,66	0,35
F Test	ns	ns	ns

Effect on C- organic

The content of total -C (%) in the tillage treatment and with mulch were not significantly different in all phases of observation . It is presumed that the source of organic matter given through mulch or from plant tissue that falls to the soil on the land had not been completely decomposed during the study period..

Correlation Aggregate Stability with Root Biomass

The correlation test results between aggregate stability and root biomass showed no significant correlation of the soil neither on 3 mm diameter of the aggregate nor on 6 mm

Correlation Aggregate Stability with Total-C of Soil

The correlation between soil aggregate stability and the total-C of 3 mm diameter was not significantly correlate but it was significantly correlate on the 6 mm diameter soil aggregate (Table 3). It was suspected that root exudates in the form of sugars and organic compounds that fill a large aggregate pore would be fragmented into smaller aggregates when the compound decomposes. Ladd, et al. (1996) reported that organic compounds such as organic acids and polysaccharides were able to bind soil particles into smaller, more stable aggregates of soil. Organic matter (polysaccharides) decomposes faster by microorganisms is a temporary aggregate binding agent (Tisdall and Oades, 1982).

Table 3. The correlation soil aggregates 6 mm and 3 mm diameter to C- organic (%)

Variable	Correlation coefficient Soil aggegate stability (kinetic energy = J)	
	6 mm	3 mm
C-organic	- 0,444 *	0,149 ns

ns = no significant effect, * = significant effect.

Conclusion

1)The minimum tillage improved the aggregate stability of the 3 mm and 6 mm diameter aggregate on the soil before land preparation and after harvest, but not in the soil of 3 mm diameter aggregate on before land preparation. The minimum tillage increase root biomass in the vegetative period of the plant, but not in before land preparation and after harvest.

2) Treatment of mulch 5 Mg ha^{-1} increased the stability of aggregate of 3 mm diameter of soil aggregate after harvest, but not for soil 3 mm diameter aggregate before land preparation. The mulch 5 Mg ha^{-1} did not increase root biomass.

3) No interaction was found between the minimum tillage and 5 Mg mulch ha^{-1} on soil aggregate stability and root biomass.

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

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Compost is a product of organic material processed by decomposer microorganisms such as fungi to be nutrients needed by plants. The purpose of this study was to understand the effect of compostinduced by cellulolytic (*Aspergillus fumigatus*) and ligninolytic fungi (*Geotrichum* sp.) apllicationon vegetative growth of red chil (*Capsicum annuum* L.). This research was conducted from October to December 2017 in the green house of the Faculty of Agriculture the University of Lampung, Indonesia. This study was carried out in a completely randomized design (CRD) with a dose of cellulolytic and ligninolytic compost: 0%, 10%, and 20% each (K= control, S1= Cellulose 10%, S2= cellulose 20%, L1= Ligninolytic 10% and L2= ligninolytic 20%). Parameters observed were plant height, fresh weight, dry weight, root shoot ratio, relative water content and chlorophyllof a, b and total content. Analysis of variance and LSD (Least Significance Difference) was carried out at 5% real level. The results showed that compost induced by cellulolytic fungi (*Aspergilus fumigatus*) and ligninolytic (*Geotrichum* sp) could increase significantly vegetative growth of red chili plants (*Capsicum annuum* L.) including plant height, fresh weight, dry weight, root shoot ratio, relative water content.butnot the chlorophyll content of a, b, and total. The the greatest measurenment of height, fresh weight, dry weight, root shoot ratio, relative water content was achieved by S2, L2, L2, K and L2 respectively

Soil Compaction, Water Content, Bulk Density and Soil Root Biomass Affected by Tillage and Fertilizer on Gedung Meneng Soil under Green Bean Growth

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SUMMARY

To slow down soil degradation can be overcome with minimum tillage and proper fertilizer. The objective of research was to study the effect of tillage and fertilizer on soil compaction, water content, bulk density, and root biomass. This research used Randomized Block Design. The treatments consist of minimum tillage with no fertilizer (T_0F_0), minimum tillage with fertilizer (T_0F_1), intensive tillage with no fertilizer (T_1F_0), and intensive tillage with fertilizer (T_1F_1). The rate of fertilizer was 1 Mg compost ha^{-1} and 200 kg compound NPK ha^{-1}. The result of the research showed that minimum tillage affected the highest of soil compaction in the depth of 0-5 and 5-10 cm, water content in the depth of 0-10 cm before land preparation, and root biomass in the depth of 0-5 and 5-10 cm. Minimum tillage with no fertilizer had the highest water content in the depth of 0-10 cm before land preparation. The effect of minimum tillage with fertilizer on water content was higher than that of intensive tillage with fertilizer. The treatment of no fertilizer affected on water content was higher than that of with fertilizer at the depth of 10-20 cm.

Introduction

Green beans are one of the important leguminous plants in Indonesia (Sunantara, 2000). The productivity of green beans in Lampung is still relatively low compared to the productivity of green beans on Java (BPS, 2016). Increasing the productivity of green beans can be achieved by optimizing the cultivation land carried out with good cultivation techniques and proper fertilization.

One of the techniques of crop cultivation is tillage. Improper tillage such as intensive tillage in a long time can reduce soil physical properties (Junedi et al., 2013). Proper tillage can be done with conservation tillage like minimum tillage or just tillage on strip of cropping. (Rachman, et al., 2003).

Farmers generally only use inorganic fertilizers that are able to provide nutrients in a relatively faster (Dewanto, *et al.*, 2013). But if the employing of inorganic fertilizers with excessive rates but rarely use organic fertilizers, it will cause soil conditions to quickly damage (Prasetyo, et al., 2014).

Dewanto et al. (2013) stated that the combination between organic and inorganic fertilizer was able to produced 600 kg ha^{-1} of dry shelled weight of maize, while no fertilizer only produce 300 kg ha^{-1} of dry shelled weight of maize. This shows that the employing of inorganic fertilizers must be balanced with organic fertilizer.

Material and Method

This study was conducted using factorial Randomized Block Design (RBD) with 2 factors and 4 replications (groups). The plot area of each group is 2.5 x 2.5 m^2. The first factor in this study was tillage (minimum tillage and intensive tillage) and the second factor was fertilization (with no fertilizer and with fertilizer), so there were 4 combinations of treatments, minimum tillage with no fertilizer (T_0F_0), minimum tillage with fertilizer(T_0F_1), intensive tillage with no fertilizer (T_1F_0), and intensive tillage with fertilizer (T_1F_1). The fertilizer treatment given was 1 Mg compost ha^{-1} + 200 kg compound NPK ha^{-1}.

Observation of soil compaction, water content, and bulk density was carried out before land preparation and post planting (65 days after planting). Measuring of soil compaction is using penetrometer. The depth observed is 0-5, 5-10, 10-15, and 15-20 cm. Soil sampling for measuring of water content and bulk density were using ring with the depth of the soil was 0-10 cm and 10-20 cm. Taking samples of root biomass using a drill by the depth of 0-5, 5-10 and 10-15 cm at the time of 65 days after planting. The root biomass taken is plant root biomass which is around the roots of green beans. Data analysis by using variance analysis. Homogeneity of variance was tested by Bartlet Test, and then the differences between the mean values were tested by BNT at the levels of 5% and 1%.

Result and Discussions

Soil Properties

Banuwa, et al. (2011) classified the soil in experiment site was Ultisols, soil structure from blocky, platy, and massive. with clay soil texture,bulk density between 1.13 - 1.21 g cm^{-3}, the total pore space ranged from 54.34 - 57.36%.

Soil Compaction

Soil compaction in minimum tillage was higher than in intensive tillage both before land preparation and post planting (Figure 1).

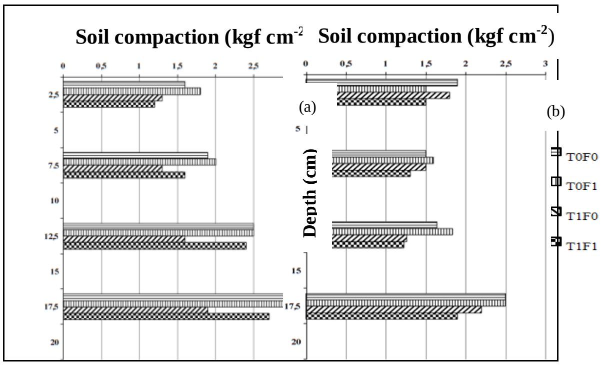

Fig 1. Soil compaction (kgf cm^{-2}) affected by tillage and fertilizer under green bean growth. (a) = before land preparation; (b) = after 65 days (post planting).

Water Content

Water content in the minimum tillage post planting significant higher than that of intensive tillage at the depth of 0-10 cm. This might due to the condition of the moisture in the minimum tillage being maintained, this causes the water content still high in the minimum tillage. Unlike with intensive tillage where the surface was open cause in rapid evaporation. This causes water content to be low.

The treatment with no fertilizer was significant in higher water content than that of the treatment with fertilizer of the soil before land preparation and after 65 days of planting. It was assumed that the combination of fertilizers between organic and inorganic at the beginning of planting was not in a balanced amount. If the organic fertilizer given was not in sufficient quantity, then the function of organic matter as a binder of water becomes reduced, while the inorganic fertilizer given absorbed water to dissolve the compound. As a result the water content in the land that given by fertilizer was reduced. Low water content can reduce microorganism activity. This was proven by Daniati (2018) who conducted research on the same land, but with different observation variables. Daniati (2018) stated that the activity of microorganisms in the treatment with no fertilizer was 6.14 mg^{-1} m^{-2}, while the treatment with fertilizers was only 4.82 mg^{-1} m^{-2}. Low microorganism activity in fertilizing treatment causes the decomposition process of organic matter which plays a role in binding water to be low. So that the water content in the fertilizer treatment is lower than with no fertilizer.

Figure 2 shows that the water content of all treatments of the time of post planting were higher than that of before land preparation. In the subsoil layer (10-20 cm), water content before land preparation showed a graph higher compared to the top layer (0-10 cm). This was presumably because the sub soil layer has less water loss due to evaporation than that of in the top soil layer, so that the water content in the sub soil layer is higher than the top soil layer.

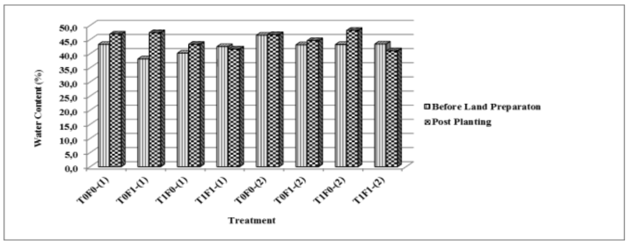

Fig 2. Water content affected by tillage and fertilizer under green bean growth

Bulk Density

Effect of the treatment on soil compaction was not significant different between before land preparation from and post planting. Solyati and Kusuma (2017) revealed that all treatments of soil tillage such as intensive tillage, minimum tillage, and no tillage were not significant on bulk density in 60 days after planting or just only one period of planting.

Figure 3 shows that the treatment given results in bulk density value ranging from 1.07 - 1.20 g cm^{-3}. According to Skop in Summer (2000), sandy soil that received pressure to produce a low pore space has a density of 1.4 - 1.9 g cm^{-3}, while clay soil which did not get high pressure from heavy loads will produce weight contents of 0.9 – 1. 4 g cm^{-3}. This shows that the bulk density is closely related to the type of texture and structure of the soil. According to Rachman (1987), if the soil was loose enough with bulk density less than 1.2 g cm^{-3}, then conservation tillage (no tillage or minimum tillage) was a highly recommended treatment method because the soil was sensitive to erosion.

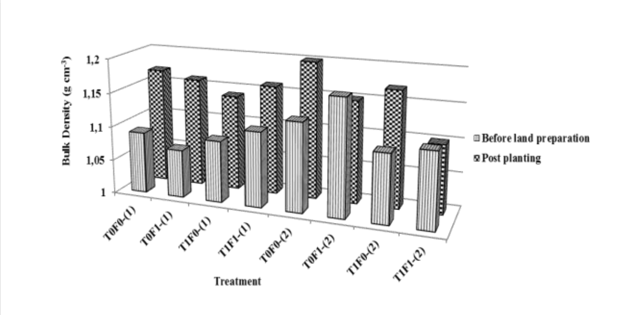

Fig 3.Bulk density affected by tillage and fertilizer under green bean growth.

The effect of treatments of tillage and fertilizer on the bulk density at the time of post planting tends to be higher than before land preparation.

Root Biomass

The effect of minimum tillage with fertilizer and with no fertilizer on root biomass was higher root biomass compared to that of intensive tillage with no fertilizer and with fertilizer. This could be due because of minimum tillage providing good growth space for plant roots. According to Wahyuni et al (2012) minimum tillage adequate to make a good soil structure and aggregate conditions compared to intensive tillage where in intensive tillage occur the process of flipping / unpacking the soil that could cause aggregate dispersion and pore blockage which could reduce the distribution of macro pores and increased micro pore amount (Wahyuni et al., 2012).

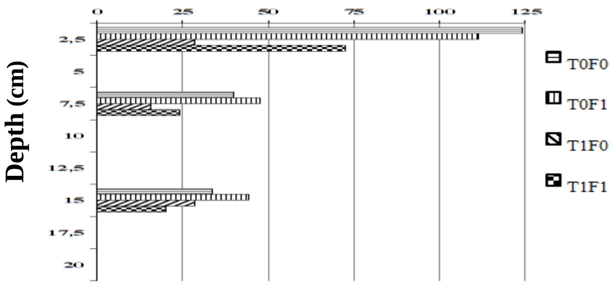

Fig 4. Root biomass (kg m^{-3}) affected by tillage and fertilizer.

Conclusion

Minimum tillage affected the highest compaction on the soil in the depth of 0-5 and 5-10 cm, water content in the depth of 0-10 cm before land preparation, and root biomass in the depth of 0-5 and 5-10 cm. Minimum tillage with no fertilizer affected the highest water content in the depth of 0-10 cm before land preparation. The effect of minimum tillage with fertilizer on water content was higher than that of intensive tillage with fertilizer. The treatment of no fertilizer affected on water content was higher than that of with fertilizer at the depth of 10-20 cm.

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Perceptions of farmers, Effectiveness of Farmers Group, and Diffusion of Innovation of Organic Farming System in Lampung Province

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SUMMARY
The use of pesticides and chemical fertilizers in improving crop productivity has effected on soil fertility and environmental pollution and the loss of natural predators that actually play a role in creating a balance of ecosystems. This research aims to find out: 1) farmer perception on organic farming system, 2) farmer group effectiveness in diffusion of organic farming system, 3) relationship farmer perception and farmer group effectivity with diffusion of innovation organic farming system, 4) factors most related to diffusion of innovation organic farming system, and 5) advantages of organic farming system and nonorganic farming system in rice cultivation. This research was conducted in Central Lampung District and Pringsewu District. The research method used was census and survey method. The results showed that: 1) The perception of farmers on organic rice is very profitable, easy to apply, produce healthy products for the body, can restore soil fertility, environmentally friendly, and can produce the same level of production non organic rice (2) Farmer group is very effective to disseminate new innovation of organic rice system to farmer society, 3) farmer perception, farmer fulfillment requirement, farmer group effectively have relation with diffusion of innovation of organic rice cultivation system 4) Organic rice cultivation is currently more profitable than non-organic rice because high productivity, high production prices, total farming costs are lower than non-organic rice farming and marketing of organic rice yields are easy.

Introduction

Lampung Province as one of the provinces in Indonesia has developed organic farming. One of the commodities being developed is organic rice. Based on data obtained from the Agriculture, Food and Horticulture Agency of Lampung Province in 2015, organic rice cultivation has been done in seven districts in Lampung Province, Tanggamus Regency, Pringsewu Regency, Lampung Tengah Regency, South Lampung Regency, West Tulang Bawang Regency, East Lampung Regency and West Lampung Regency. Organic rice cultivation prioritizes local potential and environmentally friendly so it will greatly support the restoration of soil health and health of its product users and has a high selling value and benefit farmers.

One of the areas currently developing organic farming system (paddy) is in Untoro Village, Trimurjo Sub-district, Central Lampung District and Fajar Esuk Village and Pujodadi Village in Pringsewu Sub-district, Pringsewu District. Although some farmers in these three regions have demonstrated success in organically cultivating rice, the innovation of organic rice cultivation is still not widely distributed to farmers in these three areas. Therefore, knowing the perception of farmers on innovation of organic farming system and the effectiveness of farmer groups in dissemination of innovation is interesting to be studied because the introduction of organic farming system in the region has been long enough.

Research Methods

This research was conducted in Untoro Village, Trimurjo Sub-district, Central Lampung and in Pajaresuk and Pujodadi Village, Pringsewu Sub-district, Pringsewu. The consideration of the location of the research is based on the three villages is a village that develops organic farming system and has been certified. The study time begins in July - December 2017. The research methods used in this study is survey method. The population in this study are organic rice farmers in Untoro, Fajaresuk, and Pujodadi Village. The total population of organic rice farmers in the three villages is as many as 35 people. Because the population is relatively small and relatively easy to reach, the sampling method used is the census method.

Primary data were collected through observation and direct interviews to farmers who planted organic rice using a questionnaire. Data processing used in this research using descriptive method, tabulation and statistic. Data analysis is done quantitatively. Hypothesis testing is done by using nonparametric statistic with Parsial of Kendall test (Siegel, 1997) with SPSS 17 program.

Result And Discussion

The perception of farmers of respondents on organic rice cultivation in the three villages studied in general is almost the same. Perceptions of production inputs, production processes, outputs, processing and marketing of produce all gained attention from farmers before they planted organic rice. In terms of inputs in the organic materials, farmers generally have difficulty in supply and still get help from government agencies such as organic fertilizers and pesticides. One of the obstacles by farmers in providing the above production facilities is the availability of livestock manure which is used as material for making organic fertilizer less available. In addition, the smell of livestock manure when processed into organic fertilizer and brought to farmland is also a separate problem.

In terms of aspects of the production process, farmers also face some of the fact that in organic rice cultivation it turns out the number of grass / weeds that grow on farm land is so much that it requires extra power to clean it. In addition, the type and number of pests encountered at the time of organic rice cultivation is also very diverse and many although it is not too adverse impact as found in non-organic rice cultivation. One cause of widespread plant pests encountered at the time of organic rice cultivation seems to be caused by the "natural enemies" of the pest itself on the farmland of organic rice cultivation. Thus, although the cultivation of organic rice is considered more "complicated" in its implementation compared with non-organic / conventional rice cultivation, but the satisfaction obtained in the above has made farmers want to keep planting organic rice.

If viewed from the aspect of output / yield produced in the cultivation of organic rice, then the output resulting from organic rice cultivation is lower when compared with the output of non-organic rice cultivation. The average productivity level of non-organic rice cultivation obtained by farmers is 6.03 ton / ha per season, while the average productivity of organic rice at first planted reaches 3.0 ton / ha per season. Nevertheless, with the longer time (more than 3 years), the current level of organic rice productivity (2017) has almost equaled the level of non-organic rice productivity (6 tons / ha). The impact of using organic materials used in organic rice cultivation can not seem to provide a high level of productivity, but it takes a long time to be absorbed in the soil and improve the soil structure.

It appears that many factors related to the perception of farmers on the easiness of organic rice farming innovation are accepted by farmers, both internal factors within the farmers themselves (such as the fulfillment of farmers' needs, healthy food demand, family encouragement, which come from outside the farmers (external) such as market availability, selling price of production, availability of input for organic rice cultivation and others. One of the decisive factors to the acceptance of organic rice cultivation innovation is the improved productivity level achieved from organic rice cultivation and easy marketing of products accompanied by high prices and the impact on increasing soil fertility owned by farmers.Thus, the perception of farmers as a result of sensing farmers against existing objects (organic rice cultivation) is instrumental to the ease of an innovation accepted by farmers. A good perception that is supported by the fact that the object is in accordance with the perception of the perception will largely determine the rapidity of an innovation accepted by the farming community. This is in accordance with Rachmat (2001) which say that experience greatly affects a person's perception of an object. The experience gained by farmers in the villages studied on improved organic rice cultivation has attracted other farmers who have not implemented organic cultivation to apply organic rice cultivation and strengthen the farmers who have grown organic rice to continue this type of rice farming. This fact is evident from the growing number of farmers who participated in planting organic rice in 2017.

The courage of a farmer to grow organic rice is considered by local farmers to risk failure if the cultivation of organic rice is not successful. However, based on the development of the level of production obtained from the recent cultivation of organic rice that almost equaled the level of non-organic rice production has reduced the doubt about the advantages of organic rice cultivation. Based on calculations made by organic rice farmers obtained the results that organic rice farming is currently more profitable compared with non-organic rice farming. Support from government agencies to farmers who grow organic rice also helps the pride of organic rice farmers, as well as the local community's appreciation of farmers who grow organic rice. In addition, training on organic rice cultivation also opened the farmers awareness that the return of soil fertility is needed so that agricultural activities can continue. In other that organic rice farming can meet the needs of organic farmers, both in terms of physiological needs, safety, social, appreciation and self-actualization. The ease of marketing the products, the high price of organic rice production and the increasing level of organic rice productivity has made organic farmers more confident and more disseminate to other farmers that organic rice cultivation is very profitable both economically, socially and environmentally friendly.

The role of farmer groups in increasing farming production has been found. Hasanuddin (2015) found that the role of farmer groups as a place of learning for farmers, as a means of cooperation between farmers and as a container business has proven effective in improving farmers 'productivity and farmers' income.In relation to the effectiveness of organic rice farming groups, the above can also be seen. This is evident from the growing number of farmers in the studied areas that grow the growing organic rice. The growing number of farmers who grow organic rice in the region can not be separated from the role of farmer groups (especially the board) in inviting and disseminating innovation of organic rice cultivation to the farmers of its members. The figures of the farmers 'group, the seriousness of the farmers' group, and the persistent invitations of the farmer group members to their members by showing the advantages and benefits of organic rice cultivation have gradually yielded results with the participation of other farmers for organic rice cultivation. Thus in this study it has been shown that the large role of farmer groups in spreading a new innovation to the farming community has a very big role, let alone the reality in the field supported by the advantages shown by the innovation. In addition, farmer groups have also been instrumental in developing marketing networks of production products and obtaining the necessary production facilities in organic rice cultivation. Thus the results of this study also supports the results of research Hasanuddin (2015) that the farmers are effective in spreading new innovations to the farmers and improve farmers' farm productivity, while in terms of increasing farm income there are factors that determine the price of the production, the total cost of farming, and the level of production obtained from the innovations introduced.

The diffusion of innovation and the adoption of new innovations to farming communities, including innovative organic rice cultivation, is not easy and fast to obtain. This can be seen from the fact that although in 2001 the Indonesian government has launched the program "Go Organic 2010", but until 2017 organic cultivation for agricultural commodities has not been done. The acceptance of a new innovation by the peasant community is determined by many factors. In addition to internal factors contained in the new innovation itself, external factors also affect the rapid slowness of an innovation accepted by the peasant community, including the role of farmer groups in disseminating the innovation.

Innovation organic rice cultivation in the area studied was first known in 2010 (Untoro Village), even in Fajar Esuk Village only known in 2013 and in Pujodadi Village in 2015 ago. The first initiative on organic rice cultivation was first introduced by the Public Works Department by introducing SRI system rice (System Rice Intensification) which is efficient in water use. The next stage is the involvement of the local Agriculture Department in accompanying and disseminating the innovation (organic rice cultivation) to the wider farmer’s community through field agricultural extension activities conducted by the Field Agricultural Extension (PPL). Based on observations in the field it appears that the intensity of interaction between farmers is very influential on the acceptability or not a new innovation by the farming community. In addition, support from government agencies and local village government and community leaders are also very influential on the slow pace of an innovation to be accepted by the farmer’s community. If the related to acceptance of organic rice innovation in the area study is closely related to all the items. The intrinsic properties contained in organic rice innovation and the extrinsic properties contained in organic rice innovation have proven to be highly related to the rapid slowing of organic rice innovations being accepted by farming communities. The first experience experienced by unsuccessful farmers in organic rice cultivation (producing only 1.5 tons / ha) affects the duration of organic rice innovation received by farmers, on the other hand the increase of organic rice productivity recently (5.9 tons / ha) accompanied by high product prices and a smaller total cost of organic rice farming resulted in the number of farmers willing to implement innovative organic rice cultivation is increasing. In addition, the availability of production markets, family support and government agencies as well as farmers' satisfaction with the performances of organic rice crops and their effects on the increase of soil fertility of farmland is another factor that causes more farmers in the area studied to apply organic rice cultivation. Thus the speed of an innovation accepted by the farmers is also determined by the security subsistence farmers if they accept a new innovation. The safer the "subsistence security" of the farmer when applying a new innovation, the more likely the new innovation is applied by the farmer. On the other hand, because farmers live in their communities and the local natural environment, the social environment and the ecological niche of farmers also determine the acceptance of a new innovation by the peasant community, including the perception of farmers towards the new innovation and the role of farmer groups. Table 1 below shows the relationship between farmers 'perceptions, the level of farmers' needs, the effectiveness of farmer groups, and the diffusion of organic rice cultivation innovations in the area under study.

Based on Table 1 it appears that perception variables of farmers, the level of farmers' fulfillment, and the effectiveness of farmer groups have a related (at 99% level) with the diffusion of innovation organic rice cultivation. Thus the results of this study indicate that the role of farmers' perceptions of an innovation, the role of farmer groups in the process of diffusion of an innovation, and the level of fulfillment of the needs of farmers by an innovation is crucial to the acceptability of an innovation by the farming community.

Table 1. Perceptions of Farmers', Farmer Group Effectiveness, and Diffusion Innovation of Organic farming system in Lampung Province,

Variable	Variable	Significance value	α	Decision
Perceptions of farmers	Diffusion of Innovation in Organic Rice Farming	0,000	0,05	Significant
Effectiveness of Organic Rice Farmer Group		0,000		Significant
Level of Fulfillment Requirement of organic rice farmers		0,001		Significant

Conclusions

Based on the results of research that has been done can be concluded as follows:1) Farmers' perception of organic rice is very profitable, easy to apply, produce healthy products for the body, can restore soil fertility, environmentally friendly, and can produce production level equal to non-organic rice production level, 2) Farmer groups are very effective in disseminating new innovations of organic rice cultivation system to farming communities, 3) Perceptions of farmers, the level of farmers' needs, the effectiveness of farmer groups has a related with the diffusion of innovation organic rice cultivation system, 4) Organic rice cultivation is currently more profitable compared to non-organic rice cultivation because in addition to high productivity is also supported by high production prices, total farming costs lower than non-organic rice farming and marketing of organic rice yield is relatively easy, and 5) Factors that are closely related to the perception of farmers and the effectiveness of farmer groups on organic rice cultivation are the factors of production of farming products, the provision of production facilities, marketing of production, and the benefits of organic rice farming.

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Production and harvested nutrient of cassava (*manihot esculenta l.*) affected by compost and its combination with NPK inorganic fertilizer for the 5th planting period

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SUMMARY

One of the reasons for decreasing cassava production is the degradation of soil quality especially in a humid tropical climate. To increase cassava production is usually by adding inorganic fertilizers. The objectives of this research were to determine the effect of compost and its combination with NPK inorganic fertilizer on the production, and harvested nutrient by cassava in the 5th planting period and to determine the combination of compost with inorganic NPK on the production, and harvested nutrient by cassava in the 5th period. Treatments in this research were T1 = control; T2 = 800 kg urea ha^{-1}, 300 kg TSP ha^{-1} and 600 kg KCl ha^{-1}; T3 = 400 kg urea ha^{-1}; 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1} and 1 Mg compost ha^{-1}, T4 = 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1} and 5 Mg compost ha^{-1} , T5 = 100 kg urea ha^{-1}, 50 kg TSP ha^{-1}, 100 kg KCl ha^{-1} and 10 Mg compost ha^{-1} and T6 = 20 Mg compost ha^{-1} with 3 replications. The results showed that the combination treatment of compost with inorganic NPK with a rate of 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and 5 Mg compost ha^{-1} produced the highest production, harvested C and harvested N in cassava compared to other treatments. While the treatment of compost at a rate of 20 Mg of compost ha^{-1} produced the highest harvested P and K in cassava compared to other treatments.

Introduction

In order to increase the productivity of cassava one of many ways is to apply fertilizer into the soil. In many cases, farmers usually using the synthetic inorganic fertilizer NPK such as in the form of urea, TSP and KCl. But continuous applying of inorganic fertilizer with every planting period can lead into the degradation of soil fertility. To encounter the problems, a combination of inorganic NPK and organic fertilizer can be used to help prolonged and maintain soil fertility. According to Subowo (2010) organic materials have important roles as a soil fertility stimulus, whether directly as a nutrient source for the plants or as food source for other organisms.

Materials and methods

The experiment in conducted the field with the treatments in 3 replications of T1= control; T2= 800 kg urea ha^{-1}, 300 kg TSP ha^{-1}, and 600 kg KCl ha^{-1}; T3= 400 kg urea ha^{-1}, 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1}, and 1 Mg compost ha^{-1}; T4= 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and Mg compost ha^{-1}; T5= 100 kg urea ha^{-1}, 50 kg TSP ha^{-1},100 kg KCl ha^{-1}, and 10 Mg compost; T6= 20 Mg compostants T1= control; T2= 800 kg urea ha^{-1}, 300 kg TSP ha^{-1}, and 600 kg KCl ha^{-1}; T3= 400 kg urea ha^{-1}, 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1}, and 1 Mg compost ha^{-1}; T4= 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and 5 Mg compost ha^{-1}; T5= 100 kg urea ha^{-1}, 50 kg TSP ha^{-1},100 kg KCl ha^{-1}, and 10 Mg compost; T6= 20 Mg compost. Plant and tuber dry matter, C-organic contents of both soil and plant, Total N of the soil and plant, available Phosphor of soil samples and P of the plant, exchangeable potassium of the soil and of the plant had been measured as described by Thom and Utomo (1991).

Result and discussions

The application compost and its combination with NPK inorganic fertilizer on T4 treatment produced the highest total fresh weight of the cassava. The effect of T4 was on total fresh tuber was significantly higher than that of the other treatments (Table 1).

However, the lowest tuber dry mass showing in Table 2 were in the treatment T1 and T2 which were significantly lower compare to that of treatment T3, T4, T5 and T6. Combination of compost and NPK fertilization was higher production compare to that of the only inorganic fertilization treatment. This result could be because of the combination of both organic (organitrofos) and inorganic (NPK) provides both of micro and macronutrients that necessary for the growth of the cassava.

Table 1. Effect of compost and inorganic fertilizer NPK on the gross weight of cassava

Treatment	Fresh weight (Mg ha^{-1})		
	Tuber	Tuber skin	Tuber total
T1	16,5 a	1,5 a	18,0 a
T2	25,2 a	1,1 a	26,3 a
T3	48,0 b	1,3 a	49,3 b
T4	63,1 c	2,0 b	64,6 c
T5	51,4 b	1,5 a	53,4 b
T6	44,1 b	2,0 b	46,1 b
LSD 5%	11,5	0,4	11,6

Using LSD 5% standard test

Table 2. Effect of compost and NPK inorganic fertilizer to the dry weight of cassava

Treatment	Dry Weight (Mg ha^{-1})				Total plant
	Stem	Leaves	Tuber	Tuber	
T1	12,2	3,4	14,6 a	1,1	34,1 a
T2	26,3	3,3	17,5ab	0,7	44,9 a
T3	27,3	3,6	33,5 c	0,8	65,2 b
T4	19,6	5,5	33,6 c	0,9	59,6 b
T5	16,7	3,4	33,5 c	1,4	54,9 b
T6	22,1	4,9	23,2 b	1,1	51,3 b
F test	ns	ns	*	ns	*
LSD 5%	-	-	0,71	-	16,8

Using LSD 5% standard test

However, the lowest tuber dry mass showing in Table 2 were in the treatment T1 and T2 which were significantly lower compare to that of treatment T3, T4, T5 and T6. Combination of compost and NPK fertilization was higher production compare to that of the only inorganic fertilization treatment. This result could be because of the combination of both organic (organitrofos) and inorganic (NPK) provides both of micro and macronutrients that necessary for the growth of the cassava.

Carbon

The highest of harvested carbon on tuber found on T4 treatment which was 11.61 Mg ha-1 followed by T3 and T5 treatments (Table 3). The highest of total harvested carbon by cassava also found on T4 treatment and was not significantly different compare to that of T6, T5 and T3 treatments. Based on those results, it can be concluded that the application of the combination of compost and NPK inorganic fertilizer caused a noticeable increased on the amount of total harvested carbon on the cassava plant and the tuber.

The application of compost and NPK inorganic fertilizer provide both of micro and macro nutrients that necessary for the cassava growth the harvested nutrients increase as the biomass of the cassava increased. According to Utomo et al (2016), carbon hold an important roles in the construction of organic material, it is because the most of the dry parts of a plant are organic material (47% carbon). This shows the importance of carbon as the one of main the main ingredient in a construction of a plant.

Table 3. Effect of compost and NPK inorganic fertilizer on the harvested carbon

Treatment	Carbon Transported by plant (Mg ha^{-1})				
	Stem	Leaves	Tuber	Tuber skin	Total plant
T1	3.5 a	1.0 a	4.9 a	0.5 b	9.1 a
T2	4,3 a	1,5 a	4,0 a	0,2 a	10,0 a
T3	4,3 a	1,5 a	8,6 b	0,4 ab	14,8 b
T4	3,8 a	1,7 a	11,6 c	0,3 ab	17,4 b
T5	4,5 a	1,3 a	8,8 b	0,6 b	15,1 b
T6	7,1 b	2,0 a	5,7	0,4 b	15,3 b
F test	*	Ns	*	*	*
LSD 5%	2,3	-	2,1	0,2	10,2

LSD 5% standard test

Nitrogen

The highest amount of harvested nitrogen of the cassava was found on the stem. The high amount of harvested N on T2 and T6 treatments could be caused by high rate application of urea and organitrofos fertilizer. In general, the highest harvested N in leaves and tuber and the harvested nitrogen in plant were found on T4 treatment (Table 4).

Table 4. Effect of compost and NPK inorganic fertilizer on the harvested nitrogen

Treatment	Harvested Nitrogen (kg ha^{-1})				Total
	Stem	Leaves	Tuber	Tuber skin	
T1	38,1 a	15,7 a	27,5 a	4,6 ab	86,1 a
T2	93,9 d	17,3 a	30,7 a	3,1 a	145,1 b
T3	66,3 c	17,7 a	65,2 c	2,6 a	151,8 b
T4	48,3 b	34,9 c	80,6 d	4,2 ab	168,1 c
T5	63,2 c	17,0 a	53,3 b	7,2 b	140,8 b
T6	84,6 d	22,3 b	60,2 bc	5,9 b	173,1 c
LSD 5%	9,72	3,67	10,83	2,75	11,10

LSD 5% standard test.

Phosphor

The highest amount harvested phosphor in them stem, leaves and total plant was found on T6 treatment (Table 5). Furthermore, the highest harvested phosphor in tuber skin found on T5 treatment and it was not significantly different compare to that of T6 treatment. On the other hand, the highest harvested phosphor in tuber found on the treatment T4. Generally the lowest amount of harvested phosphor in each plant's part found on the control and T2 treatment.

Table 5. Effect of compost and NPK inorganic fertilizer on the harvested phosphor

Treatment	Harvested Phosphor (kg ha^{-1})				
	Stem	Leaves	Tuber	Tuber	Total
T1	18,6 a	5,1 b	17,3 a	1,1 ab	42,1 a
T2	26,9 b	2,8 a	17,1 a	0,7 a	47,4 a
T3	34,3 c	5,8 b	26,6 b	0,9 ab	67,5 b
T4	33,7 c	8,3 c	34,7 c	1,0 ab	77,8 bc
T5	36,2 c	6,2 b	29,0 b	1,5 b	72,7 b
T6	49,5 d	12,1 d	25,4 b	1,3 b	88,3 c
LSD 5%	6,7	2,0	5,0	0,5	11,2

Column that followed by the same alphabet, did not differ significantly on the LSD 5% standard test

Potassium

Generally, the highest potassium harvested in stem, leaves, tuber, and tuber skin was found on T6 treatment (Table 6). The application of compost, which was produced from the fresh cow manure as an ingredient could be the reason of this.

Table 6. Effect of compost and NPK inorganic fertilizer on the harvested potassium

Treatment	Harvested Potassium (kg ha^{-1})				
	Stem	Leaves	Tuber	Tuber	Total
T1	33,7 a	6,5 a	8,4	1,2 a	49,8 a
T2	77,9 c	9,9 a	11,4 b	1,1 a	100,3 c
T3	58,8 b	8,9 a	23,7 d	2,3 b	93,7 c
T4	32,9 a	15,2 c	23,1 d	2,4 b	73,6 b
T5	61,5 b	11,5 b	20,2 c	2,4 b	95,6 c
T6	83,4 c	17,0 c	24,5 d	3,6 c	128,6 d
LSD 0,05	11,1	3,5	2,1	0,9	12,7

LSD 5% standard test

CONCLUSION

1. The application of combined compost and NPK inorganic fertilizer with the rate of 200 kg urea ha-1, 100 kg TSP ha-1, 200 kg KCl ha-1, and 5 Mg compost ha^{-1} (T4) produced the highest yield of cassava compared to that of the other treatments in the 5th planting period.
2. The application of combination of compost and NPK inorganic fertilizer with the rate of 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, dan 5 Mg compost ha^{-1} and 20 Mg compost ha^{-1} (T4 and T6) produced the highest harvested C and N, while the application of 20 Mg compost ha^{-1} (T6) produced the highest transported P and K on the cassava in its the 5th planting period.

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SIMULATION OF CAVENDISH BANANA TRANSPORTATION

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SUMMARY

Mechanical damage in banana fruit will cause injury in certain part which may decrease the quality and selling value of banana fruit. From aforementioned issues, it is important to know the mechanical damage percentages in Cavendish fruit which is caused by vibration during the simulation, and the result of the research showed that Cavendish banana which getting vibrated has brush and scratch injury for all condition (ripening or non-ripening). Split injury happens only in Cavendish which is in ripening condition. The highest damage occurs in brushing injury of banana almost of 100%. Based on analysis of variance (ANOVA), grouping is significant for TSS and firmness, but the weight lose parameter is not significant. The further test of LSD indicates that the treatment of vibrating (1hz or 1.67hz) has not significant for TSS. Whereas, it looks significance for control banana. Moreover, vibrating and non-vibrating fruits is not significant for firmness.

Introduction

Cavendish Bananas is a popular tropical fruit commodity in the world. Lampung Province is the one of provinces where produces the high volume of banana. But, the road infrastructure in Lampung is still deficient and has lot of pothole, so it might be causing mechanical damage to banana fruit that will be distributed in another region. Mechanical damage in banana fruit will cause injury in certain part which may decrease the quality and selling value of banana fruit.

This research will simulate the differences fruit conditions when vibrated and the differences of vibration frequencies to know damage that occurs during the distribution of Cavendish bananas and to know the effect and also the percentage of mechanical damage from differences fruit condition and vibration frequency during distribution.

Material and Method

The tools used are digital scales, penetrometers, refractometers and calipers. And the materials used are Cavendish bananas and cardboard boxes. This research use design of experiment randomized block design with 2 experimental groups and 3 treatments. Fruit grouping based on the condition of the fruit when it was vibrated, namely A1 = ripening and A2 = not ripening and the treatment based on the vibration frequency B0 = not vibrated (control), B1 = 1hz and B2 = 1.67 hz.

The first step in this research is sorting the bananas at PT NTF East Lampung to select bananas which only get a little affected by the harvesting process. After sorting, the banana fruit trough the ripening process in the ripening house of PT NTF. That process for the fruit grouping, first the fruit condition is ripening and the second not ripening during the simulation. Next the bananas are arranged into two piles in a box measuring 35cm long, 30cm wide and 30cm high. And then a transportation simulation using a simple vibrating simulation engine made by Yoga Barlie Satria students of Agriculture Engineering, University of Lampung . The simulation was carried out for 2 hours on all treatment repetitions.

Result and Discussions

1.Mechanical Damage

Measurement of mechanical damage do one day after the banana is vibrated. This measurement is visually by seeing bruise, split and scratch injury on the skin of a banana. Storage damage rates were calculated from the percentage of damage in each treatment. The average derived from observing results in Figure 1.

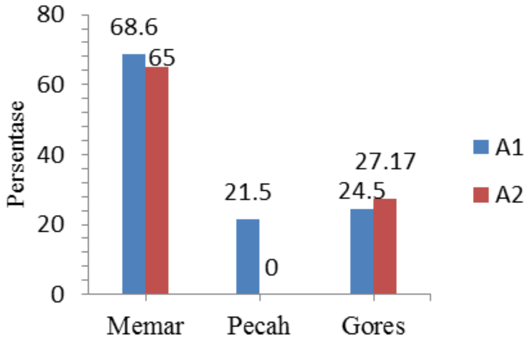

Fig.1 Banana Fruit Damage Percentage on Fruit

From Figure 1 the largest percentage of injuries occur in bruises is 68.6% in ripening condition bananas (A1) and the smallest percentage of split injury is 0% in non-ripening condition bananas (A2).

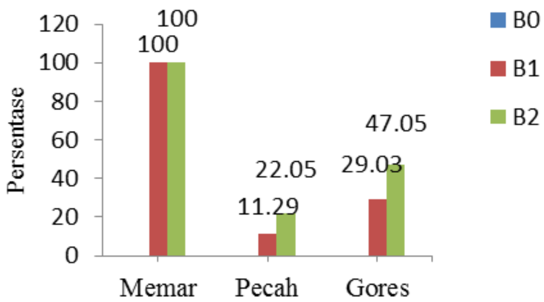

Fig.2 Banana Fruit Damage Percentage on Differences of Frequency Vibration

Non-ripened banana skin condition occurs more scratch because the skin is hard, but does not occurs split injury. Therefore, the fruit distribution process is carried out when condition of fruit is non-ripening, to minimize broken split injury caused by vibrations during the distribution process, as done by PT NTF when distributing process. Split injury on bananas will reduce the purchasing power of banana distributors such as supermarkets. The injuries from the simulation can be seen in Figure 3, Figure 4, and Figure 5.

Scratch and bruise injury that occur vibration during distribution can be minimized by adding reducer between the banana comb and between banana combs with packaging. Split injury can be minimized by distributing in non-ripening banana condition

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Fig.3 Split Injury **Fig.4** Scratch Injury **Fig.5** Bruise Injury

Bruises, splits and scratches that occur during the distribution will increase respiration rate of the Cavendish banana, so the higher damage, the shorter shelf life of the banana.

1. Weight Loss

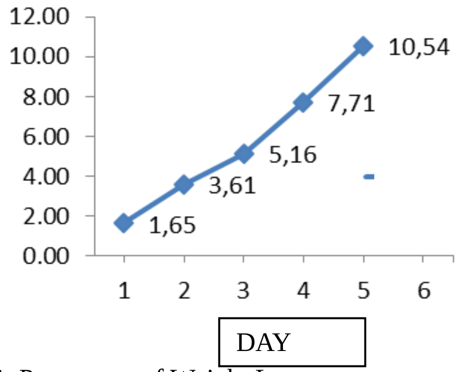

Fig.6 Percentage of Weight Loss

From this research known that all treatments did not affect the decrease in weight loss of Cavendish bananas.

2.Total Soluble Solids

During the storage, occurs the chemical change in the Cavendish banana, one of these changes is the sweet taste that shown in total dissolved solids. Total soluble solids in cavendish bananas during storage, tend increase and will decrease when entering the senescence process

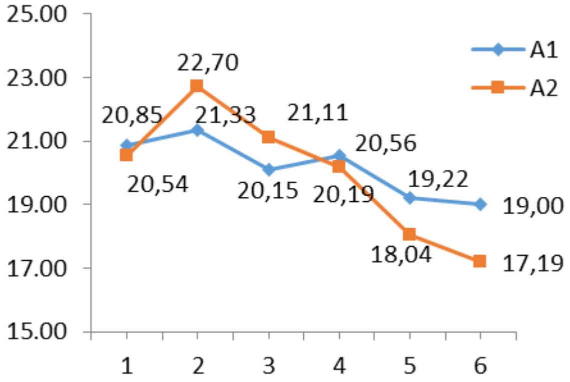

Fig. 7 The effect of Fruits Conditions when vibrated to TSS

In Fig.7, we can see that the vibrations in ripening condition fruit (A1), rate of TSS declines is more stable than the vibrations in non-ripening conditions (A2). Decreases in TSS will affect the fruit ripening rate, it means the faster TSS decrease, the faster fruit senescence too. So that it can be concluded the ripening process do after vibration make the banana fruit senescence faster.

3.Fruit Firmness

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In Fig.8 we can see in the research data shows that the average of firmness level cavendish banana fruit from the treatment sample continues decrease with the length of storage time, this means the banana more mature and towards to senescence. The decrease of firmness banana skin is thought to be influenced by cell turgor which is always changing in line with fruit ripening. As expressed by Pantastico (1989) the value of fruit

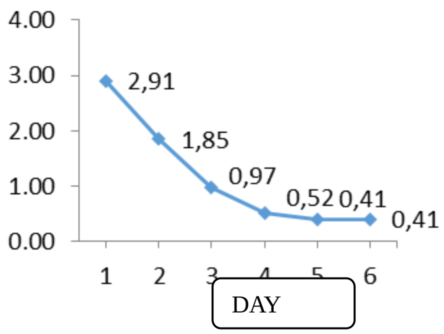

Fig. 8 The effect of Fruits Conditions when vibrated to TSS

compressive strength on day 0 was higher than fruit on day 4. The change in texture occurs due to changes in physical properties during fruit ripening.

Firmness in bananas continues decrease according to the data obtained from research. This also occurs in other fruits as revealed by Fauzia (2013) that there was a clear difference in the condition of avocados at the beginning and after the fourth day.

The transportation process make the mechanical damage on banana increase because there are so many pothole in the street that can make the more vibration . This is in line with Sharma and Singh (2011) who stated that the loss of vegetable products can be caused by poor transportation facilities, poor management and markets, or because of poor postharvest handling by farmers, traders and consumers.

Conclusion

Vibration treatment affects the mechanical damage of the Cavendish banana. The level of mechanical damage affects the ripening rate of the Cavendish banana, the higher damage, the faster the fruit will senescence. The treatment that has the highest damage is found in the sample with a vibration frequency treatment of 1.67 hz.

There are bruises on all treatments. The highest percentage of split injury is in bananas that was ripening when it vibrated. The percentage of split injury in frequency 1.67 hz = 39.5% and in the frequency of 1 hz = 21.9%. The highest percentage of scratch injury is on bananas that non ripening when it vibrate with frequency 1.67 hz by 50%.

Fruit grouping factors based on condition of the fruit when vibrated and the Treatment Factor based on difference vibration frequency only affects in TSS

The effect of the condition of bananas when vibrated is not significant in TSS. And the vibrated bananas are not significant too with non vibrated bananas.

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THE APPLICATION OF HOT WATER TREATMENT IN MANGO CV ARUMANIS

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SUMMARY

Mango cv Arumanis fruit (Mangifera indica L.) is one of the tropical fruit that has high demand to be exported because this mangoes have unique flavor and aroma. Not only do this characteristics appeal many consumers to buy this product but attrack fruit flies to invest their eggs. The infestation of fruit flies occurs during cultivation. Thus, fruit flies raids cause Indonesian fruit exports to be hampered by strict quarantine rules. The implementation of the non-tariff export-import policy related to Sanitary and Phytosanitary (SPS) is an obstacle to export of Indonesian mangoes into the world market because these fruits have not been free from fruit flies' infestation. *Hot water treatment* (HWT) is one technology that can be applied in post-harvest handling to suppress the growth of fruit flies (*Bactocera papayae*) in mango after harvesting. The purpose of this research was to investigate the effect of temperature hot water treatment and storage temperature on fruit flies mortality and quality of mangoes . This research used a factorial group randomized design. The first factor was HWT temperature at 50°C, 53°C for 10 minutes, and also the control. The second factor was storage temperature at 16° C and 28° C. The results showed that the mortality test of *B.papayae* used HWT treatment reach to 32.25% which higher and more effective than control treatment less at 25.75%. Based on analysis of variance, the temperature has no significant effect on weight shrinkage, the total soluble solid, vitamin C of mangoes cv arumanis. The temperature of storage showed no effect on weight shrinkage, the total soluble solid, and vitamin C of mangoes. While the time of storage has significant effect on weight loses and total soluble solid, but not for vitamin C content.

Introduction

Mango cv Arumanis fruit (Mangifera indica L.) is one of the tropical fruit that has high demand to be exported because this mangoes have unique flavor and aroma. Not only do this characteristics appeal many consumers to buy this product but attrack fruit flies to invest their eggs. The infestation of fruit flies occurs during cultivation. Thus, fruit flies raids cause Indonesian fruit exports to be hampered by strict quarantine rules. The implementation of the non-tariff export-import policy related to Sanitary and Phytosanitary (SPS) is an obstacle to export of Indonesian mangoes into the world market because these fruits have not been free from fruit flies' infestation. *Hot water treatment* (HWT) is one technology that can be applied in post-harvest handling to suppress the spreading of anthracnose disease in red chili plants. Coating treatment with antimicrobial is also needed to prolong shelf life to help to supply chilies and surpress the price of chilli that keeps increasing.

Hot water treatment (HWT) is one technology that can be applied in postharvest handling. This treatment uses a combination of temperature and immersion time at a certain temperature. The coating treatment using anti-microbial natural materials is also considered necessary to suppress the spread of diseases that we consider already invested in fungus. Kusmiadi, R., et al (2011) stated that the coating on the fruits using a combination of beeswax with antimicrobials made from ginger extract can suppress the rot of the base of the bark fruit at a concentration of 30% or more. The purpose of this study was to obtain the right WHT technology to kill mango fruit flies up to 99%.

Material and Method

The materials used in this research are mangoes cv arumanis obtained from mangoes's exporter in Cirebon, West Java and eggs of *Bactrocera papayae* species from rearing result in Balai Besar Peramalan OPT Kotabaru, Karawang. The equipment used in the research are *water bath* for HWT treatment, chambers, rheometer (CR-300 model) to measure the level of hardness, digital scales (Mettler PM-4800), digital camera, burette, erlenmeyer tube and dropper/pipette. The preparation of the research was carried out by cleaning and sorting mangoes cv arumanis samples to maintain the uniformity of the samples. The mangoes were divided into samples for control (without treatment) and samples for Hot Water Treatment (HWT). The entire combination of treatments in this research was stored at different temperature at 16° C and 28° C.

This research divided into three stages such 1) Artificial inoculation; 3). Mortality test of *Bactrocera papayae*, and 3) measurement of quality content in different temperatures storage (cooling temperature (16°C) and room temperature (28°C). Aritificial inoculation was conducted using 100 fruitflies's eggs/gauze which was inoculated inside of mangoes surfaces. Then the mangoes skin was covered with the tape which is resistant to hot temperature and was saved at different temperatures (16 and 28 oC). Observations on larvae were carried out by disecting of mangoes and calculation the number of live larvae was carried out in 7th days after the treatment.The quality observation on mangoes were done in accordance with parameters of weight shrinkage, total soluble solid (TSS), and vitamin C.

Result and Discussions

Temperature Distribution

The first thing that was done in this study was to calibrate the water temperature between the water bath and the sensor. This aims to calculate the temperature accuracy in the water bath. Calibration is carried out at ten minute intervals for approximately 2 hours. Changes in water temperature and calibration result equations can be seen in Figure 1.

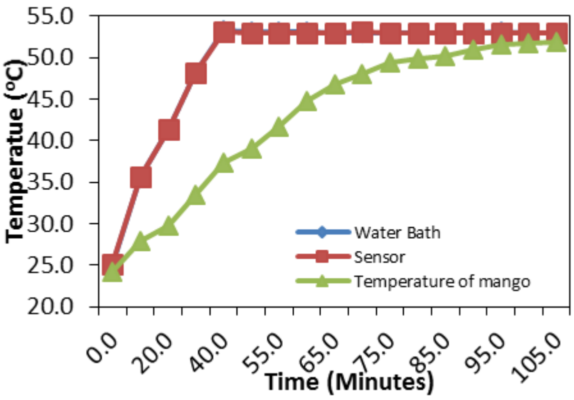

Figure 1. Simulation of temperature distribution

The Figure 1 illustrates the temperature distribution in water bath, sensor, and mangoes surface. In general, there are no differences in water bath and sensor temperature indications, while the temperature of mangos increases during the simulation. More specifically, the temperature trend of water bath and sensor in 40 minutes of observation inclines dramatically reaching up to 53°C, in the next minutes the indicated temperature of water in water bath and sensor rise steadily.

Otherwise, the temperature of mango surface climbs considerably during the simulation and pick to 53°C in 105 minutes. It seems approximately with temperature of water bath and sensor indicators.

Mortality test of *Bactrocera papaya*

Fruit flies is a major problem in the production of tropical fruits, especially in mangoes fruits which will affect in economic value. Naturally, the infestation of fruit flies occurs during cultivation, more than 30% mangoes have been destroyed by fruit flies.

According to Figure 2, the mortality test of *B. papayae* was conducted in different treatments (artificial inoculation and natural infestation while it was considered occurring during cultivation). The result showed the mortality of fruit flies of HWT treatment on artificial inoculation reach of 32,25%, while control treatment indicates to 25,75%. It is clear that HWT can press the developing of fruit flies larvae. Next, for natural infestation, the growth of fruit flies larvae not found on HWT and control samples of mangoes. Based on Sugianti, et al (2012) mortality test results at doses of 0.75 kGy irradiation could kill fruit flies reaching up to 100% mortality, in contrast when this treatment applied to fruit that was considered infested in the field was still found a growing larvae on the 21st day of storage.

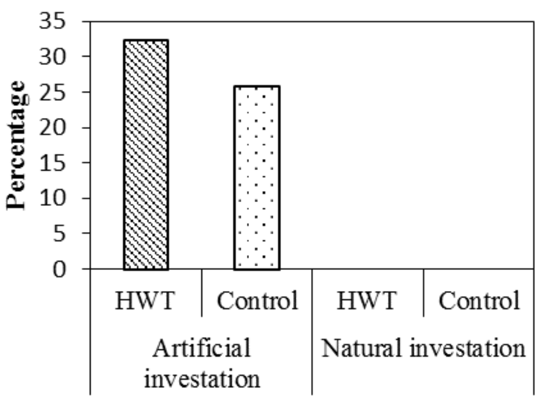

Figure 2, The Percentage of Mortality Test

Weight shrinkage

From the result of the analysis of 5% variance level, the temperature factor has no significant effect on the decrease of weight loss storage. The temperature of storage showed no effect on weight shrinkage. However, the time of storage has significant effect on weight loss. Next, Duncan's advanced test of temperature during influential days can be seen in Table 1.

Table 1. The Duncan further test of weight shrinkage

Day storage	Mean (Duncan group)
1st day	6.952c
2nd days	11.088bc
3rd days	14.363abc
4th days	17.425ab
5th days	18.254ab
6th days	22.293a

Based on Duncan's further analysis, the effect of time storage has the different effect on weight shrinkage specifically in 1st day and 6th days storage. Moreover, Figure 2 depicts the percentage of increasing weight shrinkage between HWT and control mangoes. It can be seen that hot water treatment could suppress the weight loss on mangoes. According to Martoredjo (2009), the optimal heating temperature in horticultural products for its control of Anthracnose disease is by treating hot water at 55° C for 5 minutes or combined with fungicide until the temperature could be lowered to 52-53°C.

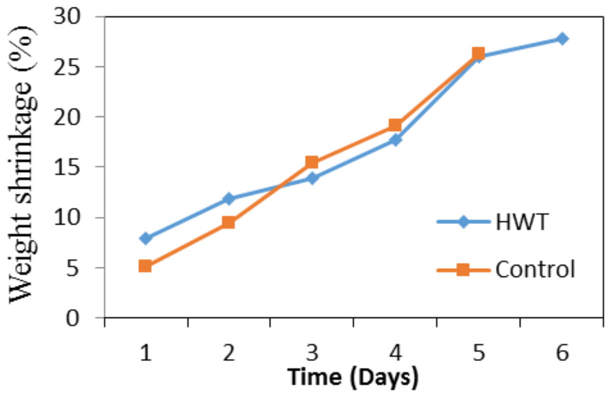

Figure 3. Rising weight lose on red chili during storage

Total Soluble Solid (TSS)

Overall, the totall soluble solid (TSS) of mangoes even HWT or control treatments decrease during storage. Mangoes was experiencing in HWT treatment for the first week storage approximately of 15.5°Brix which was smaller than control mangoes, however in the second period the HWT can maintain the quality of mangoes than control treatment. The control mangoes could determine by the second week because senescence process, contrast to the mangoes with HWT treatment. The HWT treatment can extend the shelf-life of mangoes until the third week, although the TSS contain decrease dramatically which presented in Figure 4.

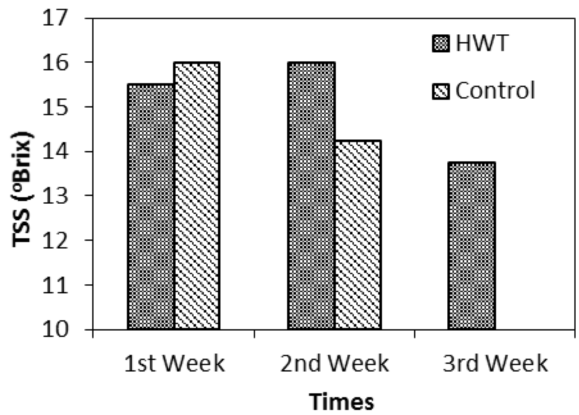

Figure 4. Total soluble solid in mangoes

Based on the analysis of 5% variance level, the temperature factor has no significant effect on the total soluble solid. The temperature of storage showed no effect on the total soluble solid. However, the time of storage has significant effect on total soluble solid. Next, Duncan's advanced test presents the time of storage in the first and second weeks have no differences in total soluble solid, whereas in the third week has significant effect on TSS.

Vitamin C

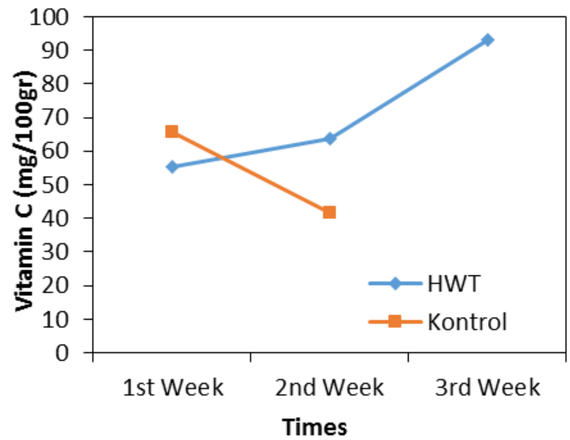

Figure 4. Vitamin C content in mangoes cv Arumanis

In general, from Figure 4 reports there was the different trends between HWT and control treatment the vitamin C of mangoes. The content of vitamin C on mangoes which treated by HWT climbs dramatically, in contrast with control treatment that experienced decrease of vitamin C content. In the first week, Control has higher of the vitamin C content than HWT treatment. However, vitamin C in mangoes which conducting with HWT treatment exceed to control treatment. On the other hand, HWT treatment can stimulate the vitamin C content until the third weeks.

Based on variance analysis, the temperature factor has no significant effect on the total soluble solid. The temperature of storage showed no effect on the total soluble solid. The time of storage has no significant effect on vitamin C. Low ethylene levels in fruits indicate high levels of vitamin C, while high levels of the presence of ethylene hormone indicate low vitamin C levels Julianti (2011). Ethylene content affects the level of ripeness of zalacca fruit. The high ethylene content in zalacca, shows the maturity level of zalacca fruit which is higher which affects the level of vitamin C of zalacca. The higher the level of ripeness of zalacca fruit, the more vitamin C decreases (Laurie, et al, 1996).

Conclusion

Hot water treatment can press the developing of *B.papayae* larvae. The mortality test of *B.papayae* used HWT treatment reach to 32.25% which higher and more effective than control treatment less at 25.75%. Based on analysis of variance, the temperature has no significant effect on weight shrinkage, the total soluble solid, vitamin C of mangoes cv arumanis. The temperature of storage showed no effect on weight shrinkage, the total soluble solid, and vitamin C of mangoes. While the time of storage has significant effect on weight loses and total soluble solid, but not for vitamin C content.

Acknowledgement

The research team would like to thank all parties of Bogor Agricultural University and Indonesian Center for Agricultural Post Harvest Research and Development which give a funding for this research.

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

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SUMMARY

In Indonesia cassava is the third main staple food after rice and corn. Increased cassava production can be done by improving agronomic technic, such as by tillage and more suitable cropping patterns. Tillage and weed control can affect the growth, production and uptake of nutrients in cassava. The objective of this research was to determine the effect of tillage and herbicides which can affect the production and harvested nutrient in cassava. The treatments being repeated 4 times of T1H0 = minimum tillage, T1H1 = minimum tillage + herbicide, T2H0 = full tillage, T2H1 = full tillage + herbicide. The results showed that (1) The minimum tillage + herbicide produced the highest harvested N and K in cassava compared to that of the other treatments; full tillage + herbicide produced the highest harvested P and C of cassava compared to that of the other treatments, (2) Minimum tillage + herbicide produced the highest fresh weight of tubers and dry weight of plants compared to other treatments.

Introduction

In Indonesia cassava is third main staple food after rice and corn. In addition to domestic consumption, Indonesia is also one of the countries that export cassava, finally the demand for cassava production is always increasing both in Indonesia and abroad. But the production itself decreases and cannot meet those needs. Efforts that can be made to increase cassava production are processing soil and herbicides. The objectives of this research were to determine the effect of tillage and herbicides which can affect the production and harvested nutrient in cassava.

Material and Method

The field experiment was conducted at Integrated Field Laboratory, University of Lampung. The treatments being arranged in non factorial Random Block Design (RBD) and repeated 4 times were T1H0 = minimum tillage, T1H1 = minimum tillage + herbicide, T2H0 = full tillage, T2H1 = full tillage + herbicide. The dry tuber., total-C of both soil and plant, totaol-N of soil samples and plant, available P of soil samples and the plant, exchangeable K and potassium of the plant had been measured as described by Thom and Utomo (1991).

Result and Discussions

Effect of on Harvested Nutrient of Cassava

Nitrogen (N)

The treatment of the minimum tillage + herbicide affected the highest harvested N in tubers, stems and in total plants compared to that of the other treatments (Table 1). Fuady (2010) reported that in treated soil was limited and not treated at all, the mineralization rate was moderate and rather slow, so that the organic N level of the soil was more sustained in the soil so it would not be easily lost and could be utilized by plants.

Table 1. Effect of Tillage and Herbicides on Nitrogen

Treatment	Harvested N (kg ha^{-1})				
	Tuber	Tuber Skin	Stem	Leaves	Total Plant
T1H0	33,8 ab	2,4	46,4 a	10,0	92,7 a
T1H1	51,1 c	3,8	104,2 c	9,5	168,6 c
T2H0	20,4a	3,1	50,6 a	13,5	87,6 a
T2H1	35,9b	2,2	67,0 b	12,9	118,0 b
F Test	*	ns	*	ns	*
HSD 0,05	14,1	-	10,6	-	19,5

Phosphor (P)

The cassava yield in the treatment of the minimum tillage + herbicide produced the highest harvested P but not significantly different from the treatment of the minimum tillage and full tillage + herbicide (Table 2). The highest harvested P of cassava tubers was found at the minimum tillage treatment.

Table 2. Effect of Tillage and Herbicides on Phosphor

Treatment	Harvested P (kg ha^{-1})				
	Tuber	Tuber Skin	Stem	Leaves	Total Plant
T1H0	16,9 b	1,1	27,9 b	3,1	49,1 b
T1H1	18,8 b	1,7	23,9 ab	3,1	47,4 b
T2H0	9,3 a	1,2	23,1 a	4,0	37,7 a
T2H1	16,2 b	1,1	31,7 b	4,5	53,9 b
F Test	*	ns	*	ns	*
HSD 0,05	6,3	-	4,6	-	8,2

Potassium (K)

The harvested K in tuber and the cassava plant affected by the treatments of minimum tillage + herbicide and full tillage + herbicide was higher compare to that of the treatments of minimum tillage and full tillage (Table 3). The quantity of harvested K was found mostly in the cassava stem.

Table 3. Effect of Tillage and Herbicides on Potassium

Treatment	Harvested K (kg ha^{-1})				
	Tuber	Tuber Skin	Stem	Leaves	Total Plant
T1H0	37,4 a	9,4	97,1 a	12,1	155,9 a
T1H1	62,4 b	10,5	119,0 b	12,0	203,9 b
T2H0	31,7 a	9,9	94,7 a	15,3	151,6 a
T2H1	45,9 a	8,7	129,3 b	16,3	200,3 b
F Test	*	ns	*	ns	*
HSD 0,05	17,4	-	17,9	-	27,0

Carbon (C)

The highest harvested C by cassava was found in the full tillage + herbicide treatment which was significantly different compare to the other treatments (Table 4). The low carbon harvested by cassava was similar to the yield of tubers in the full tillage was observed being rotten before harvested in the poorly drainage soil.

Effect on Production of Cassava

The highest production of tubers was found in the treatment of minimum tillage + herbicide (Table 5). This was observed that the tubers in the treatments of both full tillage (with and without herbicide) were undergoing decay caused by a poorly soil drainage during high rainfall before harvesting.

Table 4. Effect of Tillage and Herbicides on Harvested Carbon of Cassava

Treatment	Harvested C (Mg ha^{-1})				
	Tuber	Tuber Skin	Stem	Leaves	Total Plant
T1H0	5,1 b	0,3	4,1 b	0,8	10,4 b
T1H1	6,6 b	0,4	3,3 a	0,8	11,1 b
T2H0	2,9 a	0,4	3,9 b	0,7	7,9 a
T2H1	4,9 b	0,4	9,9 c	1,2	16,4 c
F Test	*	ns	*	ns	*
HSD 0,05	2,0	-	0,8	-	2,3

The dry weight (biomass) of cassava in the full tillage without herbicide was the lowest compare to the other treatments (Table 6). There were no significant different of cassava total biomass among minimum tillage with and without herbicide and full tillage with herbicide.

Table 5. Effect of tillage and herbicide on to the fresh weight of cassava tubers.

Treatment	Fresh weight of tubers (Mg ha^{-1})		
	Tuber	Tuber skin	Tuber + Tuber skin
T1H0	38,1 a	2,3	40,4 a
T1H1	58,6 b	2,8	61,4 b
T2H0	28,3 a	2,4	30,7 a
T2H1	34,0 a	2,3	36,3 a
F Test	*	ns	*
BNT 0,05	17,1	-	17,6

Table 6. Effect of tillage and herbicide on the dry weight of cassava.

Treatment	dry weight of cassava (Mg ha^{-1})				
	Tuber	Tuber Skin	Stem	Leaves	Total Plant
T1H0	16,3 b	1,1	15,2 a	1,9	34,5 b
T1H1	18,9 b	1,4	16,3 ab	1,8	38,4 b
T2H0	9,3 a	1,2	14,1 a	2,3	26,9 a
T2H1	15,9 b	1,1	18,7 b	2,8	38,0 b
F Test	*	ns	*	ns	*
BNT 0,05	6,2	-	2,7	-	6,9

Conclusion

(1) The treatment of minimum tillage + herbicide affected the highest harvested N and K in cassava compared to other treatments, while the treatments of full tillage + herbicide affected the highest harvested P and total-C of cassava compared to other treatments. (2) The treatment of the minimum tillage + herbicide affected the highest fresh weight of tubers and dry weight of plants compared to other treatments.

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Production and Harvested Nutrients of Sugarcane 1st Ratoon (*Saccharum officinarum* L.) Affected by Organic and Inorganic Fertilizer

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SUMMARY

Most of constraints in the cultivation of sugarcane in Indonesia can be low organic matter, low nutrient content and relatively acidic in pH. The combination of organic and inorganic fertilizers is one of the ways to overcome the problems. The objectives of this research were to study the effect of NPK inorganic fertilizer, organic fertilizer and its combination on the growth, production and N, P, K nutrient harvested by sugarcane 1st ratoon. This study consisted of 5 treatments A (100% inorganic fertilizer), B (100% Organic fertilizer), C (100% inorganic fertilizer + 50% Organic fertilizer), D (100% Organic fertilizer + 50% inorganic fertilizer) and E (No Fertilization). The results showed that the treatment of NPK inorganic fertilizer and its combination with, organic fertilizer were significantly increased the production and harvested nutrient of the sugarcane 1st ratoon. Treatments of 100% NPK, 100% NPK + 50% organic and 50% NPK + 100% organic were significantly affected N, P, K harvested nutrient and sugarcane plants but not significantly different. Their effects were significantly higher than that of 100% organic and without fertilization

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Introduction

Indonesian sugarcane productions from 2013 to 2015 are quite variative. In the year of 2013, sugar production reaches 2.55 million Mg and experiences an increase on 2014 to 2.53 million Mg (Badan Pusat Statistik, 2015). Therefore, to increase the total production of the soil are needed, one of such ways is by applying organic and inorganic (Kariyasa, 2005). Organic fertilizer has a very important roles in improving the physical, chemical and biological properties of the soil (Atmojo, 2003). One of the organic fertilizers that can be used is organonitrofos fertilizer which is made from 80% cow's manure and 20% nature phosphate rock and then N fixing and P solvent bacteria were added (Nugroho *et al*, 2012). This objectives of the study were to study the effect of the organonitrofos fertilizer and its combination with inorganic fertilizer on the production and harvested nutrient of sugarcane 1st ratoon.

Material and Methods

The experiment was conducted using completely randomized design with 5 treatments and 3 repetition with the total of 15 experiment plots. Each plots was 5 m x 4 m in size, the space between each plots was 1 m and space between each rows was 75 cm. The treatments of this experiment were A (Urea 300 kg ha^{-1}; TSP 150 kg ha^{-1}; KCl 300 kg ha^{-1}), B (Organonitrofos 10 Mg ha^{-1}), C (Urea 300 kg ha^{-1}; TSP 150 kg ha^{-1}; KCl 300 kg ha^{-1}; Organonitrofos 5 Mg ha^{-1}), D (Urea 150 kg ha^{-1}; TSP 75 kg ha^{-1}; KCl 150 kg ha^{-1}; Organonitrofos 10 Mg ha^{-1}), and E (without fertilizer). The weigh of the biomasss, oven-dried biomass, the soil's pH, some of the nutrients in the soil like available phosphor, total nitrogen, exchangeable of potassium, total carbon, and harvested nutrients by the plant had been measured using the methods described by Thom and Utomo (1991) and further statistically analysed using the methods described by Susilo (2013).

Results and Discussions

Table 1 showed that the A, B, C, and D treatments had not significantly affected on the sugarcane and sugar production. There was no significant effect of treatment B and treatment E on the sugar production. This result was similar with the result of Satgada's (2017) experiment showed that the application of 100% NPK + 50% organonitrofos combination was the highest sugarcane production, but was not significantly difference from 100% NPK application. The result from Zulkarnain's (2017) experiment also showed that the application of 100% NPK has out the highest sugar production and has not significantly different with 100% organonitrofos. However, 100% NPK + 50% organonitrofos treatment showed the sugar production also has not significant with 50% NPK + 100% organonitrofos.

Table 1. The effect of NPK and organonitrofos fertilizer on the production of sugarcane

Treatment	Biomass *	Sugarcane production (Mg ha^{-1})	Sugar production (Mg ha^{-1})
A	8,05	158,38 b	12,75 b
B	7,93	115,47 ab	9,16 ab
C	7,47	161,46 b	12,06 b
D	7,11	150,37 b	10,69 b
E	7,03	81,58 a	5,73 a
LSD5%	-	3,95	4,10

Using LSD test 5% standard.

Influence on total harvested nutrients

Table 2 showed that the application of NPK, organonitrofos fertilizer and their combination were not significantly different with harvested carbon total but significantly different on the harvested nitrogen, phosphor, and potassium of sugarcane 1st ratoon.

Table 2 .The effect of NPK and Organonitrofos fertilizer on total harvested nutrients

Treatment	C (Mg ha^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
A	10,04	317,46bc	76,70c	230,05c
B	5,72	270,29ab	51,77ab	138,63ab
C	12,48	397,67c	70,67bc	247,06c
D	9,23	292,53bc	61,37bc	203,15bc
E	6,27	157,22a	33,42a	90,47a
F test	tn	*	*	*
LSD 5%	-	116,24	24,12	74,32

The results showed that the application of NPK, organonitrofos fertilizer and their combination had no significant influenced on the harvested carbon total. This result was similar to that of the experiment of Amalia (2017) which showed the combination of 100% NPK + 50% organonitrofos produced the highest amount of harvested carbon in the leaves compared to other treatments, and 100% NPK was produced the second highest of harvested carbon. Carbon has a important roles in the formation of organic materials, about 47% of plant's dry mass is carbon (Utomo *et al*, 2016).

The C treatment was capable to producing the highest harvested nitrogen in the plant and had no significant different to that of treatment A and D. The effect of treatment B on harvested nitrogen was not significant different to that of treatment E. This results also showed that the application of 100% NPK was the same influence on harvested nitrogen as 50% NPK + 100% organonitrofos and 100% NPK + 50% organonitrofos. Amalia (2017) showed that the combination of 100% NPK + 50% organonitrofos produced the highest total harvested nitrogen and was not significant different to that of 100% NPK treatment. And 50% NPK + 100% organonitrofos was produced the second highest harvested nitrogen.

Treatment A produced the highest of harvested phosphor of the sugarcane but was not significant different from that of treatment C and D. The application of 100% organonitrofos was able to compensate 50% NPK application (D) since the harvested phosphor on the treatment was not significant different from that of treatment A. This result was similar with reported by Satgada (2017) wich showed the application of 100% NPK or combination between NPK and organonitrofos fertilizer produces the highest amount of harvested phosphor compared to that of the application of 100% organonitrofos treatment and no fertilizer treatment. The results of Dermiyati *et al* (2014) experiment also showed that the addition of organonitrofos to the combination of Urea 150 kg ha^{-1}, SP-36 50 kg ha^{-1}, KCl 100 kg ha^{-1}, Organonitrofos 1000 kg ha^{-1} produced the highest harvested phosphor on the corn when compared to other treatments.

Treatment C produced the highest harvested potassium of the sugarcane but it was not significant different from that of treatment A and D. The treatment B produced harvested potassium having not significantly different compre to that of treatment E. This result was similar to that of Agustina (2017) wich showed the 100% NPK treatment combined with 50% organonitrofos produced the highest harvested potassium of sugarcane of the 1st harvest but it was not significant different compare to that of 100% NPK treatment. Harvestad potassium in the stem was higher compared to the harvested potassium in the leaves. This can be as a result of potassium being accumulated mostly in the sugarcane stem. On the average, a healthy sugarcane contains more than 200 kg ha^{-1} of potassium and the application of potassium around 120 kg ha^{-1} can increase sugarcane production to 4,81% on its 1st ratoon (Kwong, 2002).

Correlation between soil nutrient contents and nutrient absorption

The contents of N-Total in the soil had a positive correlation to the harvested nitrogen in 1st ratoon of sugarcane (r = 0.71; Table 3). This showed that the increase of soil's N-total was caused by the addition of inorganic fertilizer NPK, organonitrofos fertilizer and their combination will increase nitrogen absorption by plant. Available Phosphor was in soil also had a positive correlation to harvested phosphor of sugarcane 1st ratoon (r = 0.68; Table 3). Satgada's experiment result (2017) showed the available phosphor in soil has a positive correlation to the harvested phosphor by the sugarcane on its harvest (r = 0.79). Furthermore, Table 3 also showed that exchangeable of potassium of the soil had a positive correlation to the harvested potassium by the plant. This result was similar to the result reported by Agustina's experimentation (2017) showing that the addition of NPK fertilizer and organonitrofos fertilizer or their combination between the two can increase the amount of exchangeable potassium inside the soil and in turn increase potassium absorption by sugarcane 1st ratoon.

Table 3. Correlation between soil nutrient contents and nutrient absorption

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No	Correlation test	Equation	R
1	N-total with transported N	y=-179,44+186,49x	0,71*
2	Available P with transported P	y=15,43+4,85x	0,68*
3	Exchangable K with transported K	y=-69,40+1036,62x	0,78**

* = significant on 5% r; ** = significant 1%

Conclusion

1. The effect of 100% NPK , 100% NPK +50% organonitrofos and 50% NPK + 100% organonitrofos on the sugar production and harvested nutrients (NPK) were not significant different, but showed a significantly higher result compared to that of the 100% organonitrophos and non fertilizer treatment.
2. The soil contents of total Nitrogen, available Phosphor and exchangeable of potassium had a positive correlations with harvested N, P, K by sugarcane 1st ratoon.

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Biogas Production From Oil Palm Empty Fruit Bunches through Dry Fermentation Process: Preliminary Results

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SUMMARY

The purpose of this paper was to present a preliminary result of biogas production from oil palm empty fruit bunches (EFB) through dry fermentation process. Research was conducted at Agroindustrial Waste Management Lab. of the Agroindustrial Technology Department, the University of Lampung. Two sources of bacteria were used for comparison, namely fresh cow dung collected from local cow farmer near the university and effluent from a digester working with palm oil mill waste water. The EFB, obtained from Bekri Palm Oil Mill of PTPN VII, was merely shredded prior to fermentation process to facilitate the mixing with bacteria sources. Biogas production was conducted using 220 liter capacity drum digester. Parameters to be observed including biogas production (daily and cumulative), biogas yield (per VS removed), and biogas composition. Results showed that total biogas yield of EFB with cow dung reached 1652 L within 41 days of solid retention time (SRT) and 1235 L from EFB plus effluent with 46 days of SRT. Methane content of the biogas was comparable, namely 36.1% for the case of EFB plus cow dung and 40.1% for EFB plus effluent.

Introduction

Two important waste from palm oil mill is POME (Palm Oil Mill Effluent) and EFB (Empty Fruit Bunches). Currently, POME was treated using sedimentation ponds and used for land application afterward. Modern application of POME is used for biogas generation through anaerobic process. The EFB can be used as fuel in the boiler furnace for electricity generation and process hot water. Common usage of EFB is for soil mulching after. Some industries are using the EFB and POME together to produce compost [1]. Composting of EFB together with POME minimizes nutrient losses and concentrates all nutrients from POME and EFB in one product [2]. The process is usually performed using open windrow system with the addition of POME.

The composting process can also be conducted using dry anaerobic digestion with the benefit of producing biogas during the digestion. Dry anaerobic digestion is able to overcome disadvantages of wet fermentation which adversely affect the economic feasibility of solid feed digestion [3]. The purpose of this paper was to present preliminary results of biogas production from EFB through dry fermentation process.

Material and Method

Research was conducted Waste Management Lab., Dept. of Agroindustrial Technology, University of Lampung. EFB, obtained from Bekri Palm Oil Mill of PTPN VII, Lampung, was shredded prior to incubation. Cow dung was collected from local cow farmer in Sidosari Village, Natar, South Lampung. Another bacteria source was effluent (digestate) collected from a POME-based small scale anaerobic digester located in the Department of Agroindustrial Technology.

A 220 liter capacity plastic drum was modified as digester equipped with water shower and gas piping (Figure 1). Inside of the drum was equipped with perforated floor to facilitate leaching. Shredded EFB (14 kg) was thoroughly mixed with fresh cow dung (4 kg). The mixture was loaded into the drum. Before digester was sealed, substrate mixture was sprayed with water (10 L). The leachate was collected and recirculated daily. For experiment using bacteria source from wet digester effluent, 14 kg of shredded EFB was loaded into the equivalent drum. The drum was then sealed and about 10 L effluent was daily sprayed into the drum. Organic matter content of fresh and spent EFB was analyzed by burning the material in a furnace (Barnstead Thermolyne 1300) at a temperature 500 oC for 2 hours. The volume of biogas production was monitored daily using simple water displacement method. Biogas composition was measured using a GC (Shimadzu C114843).

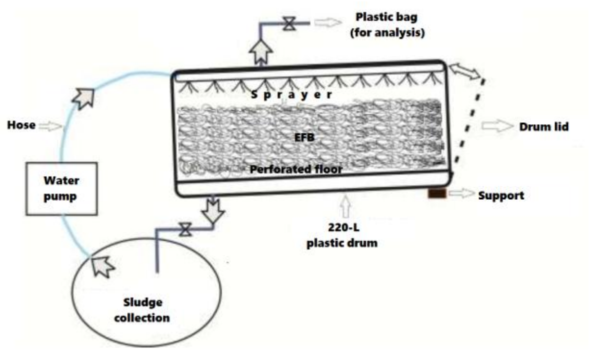

Fig. 1 Schematic for anaerobic dry digestion of EFB

Result and Discussions

Figure 2 and 3, respectively depicted daily and cumulative biogas production from EFB with cow dung and with wet digester effluent. It can be seen that digestion process requires 41 days and 46 days SRT (solid retention time), respectively for EFB with cow dung and EFB with effluent. Biogas production from EFB using cowdung was higher than that of EFB using effluent. During that time, biogas production reached 1652 L (average 40.3 L/day) for EFB with cow dung case, and 1235 L (average 26.8 L/day) for EFB with effluent. This difference may be due to the addition of biogas produced from cowdung alone.

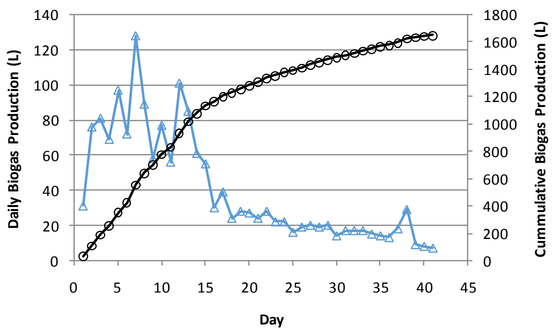

Fig. 2 Schematic for anaerobic dry digestion of EFB

As presented in Table 1, methane content for both cases was also comparable, respectively 36.1 % for cowdung case and 40.1 % for effluent case. The low methane content was also reported by others [4].

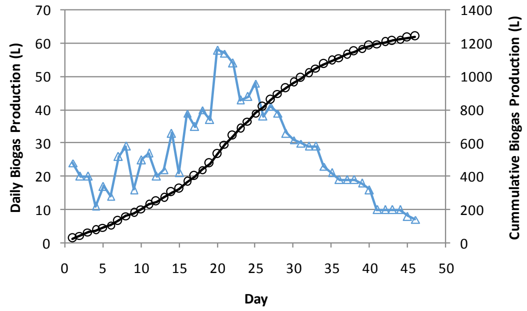

Fig. 3 Schematic for anaerobic dry digestion of EFB

Table 1 Biogas composition (% vol)

Gas Composition	EFB + CD	EFB + DE
N_2	21.5 %	13.1 %
CH_4	36.1 %	40.1 %
CO_2	42.2 %	46.7 %

Fig. 4 Burning test for biogas produced from efb through dry anaerobic fermentation.

The biogas produced was also tested by burning it in a simple burner. As can be seen from Figure 4, the gas was successfully burnt and produced blue flame quite similar to the flame resulted from LPG.

Table 2. Proximate analysis of substrates.

Parameter	Initial	Final (EFB+CD)	Final (EFB+DE)
Water content (%, wb)	64.2	75.1	72.9
Total Solid, TS (%, wb)	35.8	24.9	27.1
Organic matter (% TS)	91.6	88.0	88.9
Ash (% TS)	8.4	12.0	11.1

Table 2 showed proximate analysis of the substrates before and after process. During anaerobic fermentation that going on six weeks, organic matter slightly decreased from 91.6% to 88% with cow dung and to 88.9% with wet digester effluent. The fibers of EFB were still physically strong. This implied that the biogas might be produced mainly from the degradation of such organic materials as oil and debris that are attached in the EFB. Compost resulted from this process, however, need to be analyzed deeply and compared to those one produced from conventional open windrow.

Conclusion

Preliminary results showed that dry anaerobic digestion is potential to be applied for biogas production using EFB as substrate. Biogas productivity from dry anaerobic digestion of EFB was comparable with both bacteria sources, namely 1,137.0 L/kg VSremoved with cowdung and 1,120.6 L/kg VSremoved with wet digester effluent.

Acknowledgement

The research was financially supported from MP3EI program 313/UN26/8/PL/2014 (2 June 2014).

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The Current Status of Authentication of Indonesian Specialty Coffees Using UV-Visible Spectroscopy and Chemometrics

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SUMMARY

Along with the increasing popularity and appreciation of Indonesian specialty coffee and the availability of a very limited supply of specialty coffee has made specialty coffee an expensive commodity compared to commercial or regular coffee. Adulteration of specialty coffee cannot be avoided due to limited production of specialty coffee and increasing of price of specialty coffee. For this reason, it is highly needed to develop technological innovation that is able to ensure the authenticity of specialty coffee and be able to distinguish specialty coffee from regular coffee. In this paper, we summarized the application of UV visible spectroscopy and several chemometrics methods for determination geographic origin of Indonesian specialty coffees. In this research, several specialty coffees from different origin (Gayo, Kintamani, Wamena etc.) were used. All coffee samples were ground using a home-coffee-grinder. We sieved all coffee samples through a nest of U. S. standard sieves (mesh number of 40) on a Meinzer II sieve shaker for 10 minutes to obtain a particle size of 420 µm. The experiments were carried out at room temperature (around 27-29°C). All samples were extracted with distilled water and then filtered. For each samples, 3 mL of extracted aqueous sample then was pipetted into 10 mm cuvettes for spectral data acquisition. The spectral data were acquired using a Genesys 10s UV-visible spectrometer in the range 190-1100 nm. The results demonstrate that UV visible spectroscopy coupled with several chemometrics methods provides sensitive and accurate analytical method to distinguish Indonesian specialty ground roasted coffee.

Introduction

Coffee is highly consumed worldwide and one of the most important food commodities. Specialty coffee has higher quality and price than regular coffee. For this reason, the certification of specialty coffee in order to check the authenticity of specialty coffee is highly needed.

The development of analytical method for a rapid and/or accurate determination of authenticity of specialty coffee would be of help for both producers and importers. Previous several researches reported effective detection of coffee adulteration using spectroscopic methods: NIR spectroscopy [1], MID spectroscopy [2] and NMR spectroscopy [3].

Recently, the use of UV-visible spectroscopy has attracted great attention for food authentication due to its several advantages: low cost spectrometer, easy to use spectrometer, free-chemical waste and the spectrometer is available and accessible in most laboratory in Indonesia. In this paper we summarized the current status of authentication of Indonesian specialty coffees using UV-Visible spectroscopy and chemometrics from previous published articles.

Material and Method

We prepared several ground roasted specialty coffees from local market in Bandar Lampung, Indonesia. Each sample has 1 gram pure specialty ground roasted coffee. Sample preparation including sieving and grinding was done based on previous reported studies [4-6]. Spectral data acquisition was done on aqueous coffee samples. For this, an extraction of coffee samples were performed based on previous researches [4-6].

UV-visible spectral data measurements of all samples were done with a Genesys 10s UV-Vis Spectrometer (Thermo Fisher Scientific, USA) equipped with a 10 mm quartz cell. Spectral measurements were measured in the range of 190-1100 nm with 1 nm resolution. Distilled water was used for blank measurement.

For chemometrics analysis, several classification methods (unsupervised and supervised) were reported such as PCA (principal component analysis), PCA-DA (principal component analysis-discriminant analysis) and PLS-DA (partial least squares-discriminant analysis). The calculation was done using the Unscrambler 9.7 (CAMO, Norway).

Result and Discussions

Firstly we reported the application of UV-visible spectroscopy and chemometrics (PCA and PLS-DA) for authentication of three Indonesian specialty coffees (Gayo, Kintamani and Wamena) [7]. Using two PCs (PC1 explained 69% of the total variance in the data set, while PC2 explained 24%), Kintamani coffee samples were well separated from the Wamena and Gayo coffee samples, as shown in Figure 1. In contrast, the Kintamani coffee samples were close to the Wamena coffee samples alone.

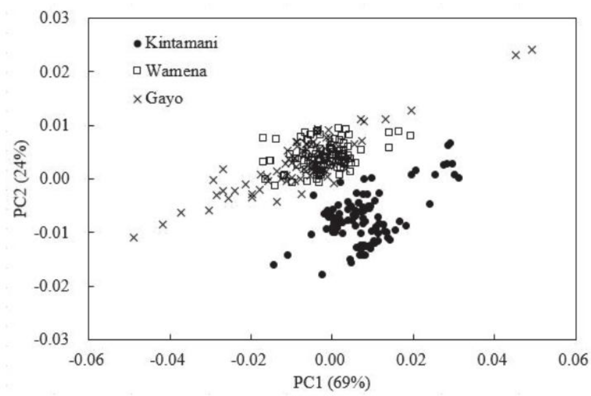

Fig.1 The PCA score plots of the three different coffee samples groups (Kintamani, Gayo and Wamena) based on pre-processed spectral data [7]

The feasibility of employing UV-visible spectroscopy and PLS-DA method for discrimination between Arabica Gayo, Kintamani and Wamena ground roasted coffee was confirmed. The best PLS-DA model accurately classified the specialty coffee samples of the prediction sample set with prediction ability of 100% of correct classification for Gayo, Kintamani and Wamena, respectively [7].

We also reported the use of UV-visible spectroscopy to discriminate between two specialty coffees from Aceh (Gayo Wine and Gayo normal) [8].

The result of PCA was depicted in Fig. 2. The score plot of the first two principal components (PCs) clearly shows that Gayo Wine and Gayo normal samples were well-separated along PC1: Gayo normal samples have negative PC1 scores, whereas Gayo Wine samples have positive PC1 scores. The PC1 scores alone accounted for more than 90% of the spectral data and the cumulative percent variance (CPV) of the first two principal components (PC1+PC2) was found to be 97% of the total variance in the spectral datasets.

The best PCA-DA model was presented in plot of samples versus y-predicted values both for calibration and validation (y=1 for Gayo Wine and y=0 for Gayo normal). The threshold value is 0.5 line. It shows that all samples in calibration and validation are located very close to its class resulted in 100% of accuracy, sensitivity and specificity.

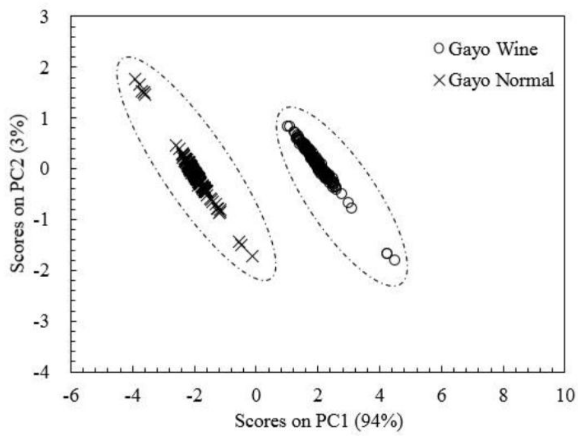

Fig. 2 Principal component analysis plot of PC1 and PC2 of Gayo Wine and Gayo normal in the range of 250-450 nm [8].

Conclusion

In this paper we reported the current situation of Indonesian specialty coffee authentication using UV-visible spectroscopy and chemometrics. The result of two published articles were summarized here. PCA can be used to discriminate the samples and see the clustering of specialty coffee samples. Both PCA-DA and PLS-DA can be used to develop authentication model for Indonesian specialty coffee. The results were very promising. PLS-DA can discriminate between Gayo, Kintamani and Wamena. Using PCA-DA, Wine and Normal Gayo coffee can be properly classified.

Acknowledgement

The authors thank the University of Lampung and the Indonesian Ministry of Research, Technology and Higher Education (Kemenristekdikti) for funding this research under Research Grant PENELITIAN STRATEGIS NASIONAL INSTITUSI (PSNI) [grant No. 393/UN26.21/PN/2018].

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The Diversity of Arbuscular Mycorrhiza Fungi at Rhizosphere of Cassava of Thailand Clone Cultivated in Lampung Timur and Tulang Bawang Barat

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SUMMARY

Arbuscular mycorrhiza fungi (AMF) naturally are found in the soil, however its effectiveness, population and diversity is vary ant tend to low due to continuous use of high rate chemical fertilizer and pesticides, mono culture practices, intensive tillage using heavy machinery, etc. Therefore the aim of this study was to explore the population and diversity of AMF from 2 different location of central cassava production in Lampung i.e. Lampung Timur and Tulang Bawang Barat. Population of AMF was counted directly from rhizosphere soil of cassava Thailand clones and the diversity of AMF was assested by pot culture. The results showed that the population and the diversity of AMF in rhizosphere soil of Thailand clones in Tulang Bawang Barat was not significantly different from Lampung Timur. Total AMF type isolated from Lampung Timur was 11 species while 13 species were isolated from Tulang Bawang Barat.

Introduction

Indonesia is one of the world largest producer of cassava (*Manihot utilisima*) after Brazil and Thailand. Based on Ditjen Perkebunan Indonesia (2009), in year 2009 land cultivated with cassava in Indonesia was 1,199,504 hectares with a production of about 22.4 million tons (the productivity was about 18.45 ton/hectare). The cassava was cultivated in Sumatera, Java, Kalimantan and Sulawesi. In Sumatera, the largest area of cassava is in Lampung Province. The total area of cassava in Lampung was 316,806 hectares where 117,556 hectares was in Tulang Bawang Regency, 95,614 hectares was in Lampung Tengah Regency, and the rest are scatter in 8 other regencies (BKPM, 2012).

Cultivation of cassava in Lampung under subsistent or semi-commercial scale is often in poor Podsolik Merah Kuning (Ultisol) soil. The Ultisol soil characteristics were low pH, low fertility, high available Al, low cation exchange capacity, low avaiable P, and low organic matter content (Prasetyo and Suriadikarta, 2006). This situation together with the fact that this crop extracts large amounts of nutrients from the soil (Pellet and El-Sharkawy, 1993) making addition of nutrient (fertilizer) to the soil after each harvest mandatory if the subsequent yield is to be worthwhile. However, the use of high rate chemical fertilizer for the long period has negative impact on soil fertility, soil compaction, and soil microorganism.

Arbuscular mycorrhizal fungi (AMF) are ubiquitous symbionts formed in roots of a large majority of higher plants except those belonging to families Brassicaceae, Chenopodiaceae, Caryophyllaceae and Cyperaceae. The symbiosis is characterized by bidirectional movement of nutrients, where carbon flows to the fungus and inorganic nutrients move to the plant, thereby providing a critical linkage between the plant root and soil. Under diverse stress conditions the hyphae of the fungi exploit water and mineral (especially P) from soils better than the roots and effectively transfer them to the plants. The hyphae are fine and highly branched able to intensively explore a soil volume, less efficiently explored by plant roots. The fungi also can improve soil aggregation through binding and aggregating soil particles by intensively growing mycelium, primarily due to physical entanglement (Quilambo, 2003; Smith and Read, 2008).

AMF naturally are found in the soil including in rhizosphere of cassava. However, population and diversity is very low due to continuous use of high rate chemical fertilizer and pesticides, mono culture practices, intensive tillage using heavy machinery, etc. (Sieverding, 1991; Rosendahl, 2008). The population of AMF may be affected by biotic factors such as plant species and abiotic factors such as temperature, soil pH, soil moisture, organic matter content, phosphorus and nitrogen, and heavy metal concentrations (Brundrett and Ashwath, 2013; Bedini et al., 2013; Omorusi dan Ayanru, 2011; Lekberg et al., 2008). Nowadays, about 160 species of fungi had been identified belong to arbuscular mycorrhiza fungi from 7 generas i.e. Glomus, Entrophospora, Acaulospora, Archeospora, Paraglomus, Gigaspora, and Scutellospora (Morton and Benny, 1990). Therefore, this research aimed to determine population and diversity of AMF in the rhizosphere of Thailand clone of cassava which are cultured in the Regencies of Lampung Timur and Tulang Bawang Barat.

Material and Method

Soil Sampling

In order to meet the objectives of the project, the rhizosphere soil of cassava were collected from Lampung Timur and Tulang Bawang Regency. The soil was taken from cassava farms belongs to small holders (1—2 ha). In each regency, 7 replicates soil sample were collected using randomized sampling design. For every replicate, rhizosphere soil was collected from 12 cassava plants (soil were collected from two points per plant at 15—20 cm depth). The samples then bulked and mixed thoroughly to constitute one replicate (± 5 kg weight), kept in plastic bags and labeled precisely. Therefore, the total of 7 soil samples were collected from each regency.

Soil Analysis

The chemical (pH, N, P, K, Ca, Mg, C-org, CEC) and physical (soil texture) properties of the soil were determined by sending the soil sample to Soil Laboratory Analysis at Department of Soil Science, Faculty of Agriculture, University of Lampung. For chemical and physical analysis purposes, the soil were allowed to dried by open it at room temperature for 7 days and then sieved with 2 mm mesh sieve. The total population of AMF spore presence inside the soil were checked using wet sieving method (Sieverding, 1991) to isolate the spores and count it under stereo microscope manually.

Pot Culture

AMF is obligate fungi, they need plant as the host to grow and develop and cannot be propagated in agar media or in vitro. The success of AMF production is affected by the host and media used in propagation (Setiadi, 2004). Therefore, in this study different host and media will be used in trap culture to propagate propagule of FMA (spore, hyphae, infected root, etc.) present in the soil. The spore from trap culture were then used to identify the type of AMF to Genera level.

The AMF propagule inside the soil samples were trapped by planting some different host (sorghum, maize, and *Pueraria javanica*) in 1000 ml pot size. The soil samples from one regency containing of 7 soil samples were compiled into 1 homogenous sample. A total of ± 300 g of soil samples were introduced into polybags which contained a mixture of sand and zeolite media of ± 600 g. The germinated seed of host plant was planted on soil samples and cover back with a mixture of sand and zeolite media. Seven replicates were prepared for each host plant. The planted polybags were kept in green house for 3 months (sorghum and maize) or 4 months (*P. javanica*). Two weeks before the end of experiment, the plants were allowed to dry by stop watering to trigger AMF hyphae produce spore. The spores were collected from a mixture of zeolite and sand media from each polybag using wet sieving method by Sieverding (1991). Identification of isolated spores to level of genera were done through observation spore's characteristics such as the present of bulbose suspensor, germination shield, auxiliary cell, sporopherous saccule type, subtending hyphae, spore walls, and spore reaction to melzer solution.

Result and Discussions

Population of AMF spore from cassava rhizosphere of Thailand clone showed that number of AMF spore at Lampung Timur Regency was significantly not different with the number of spore in Tulang Bawang Barat (Table 1).

Figure 1. Number of AMF spore at cassava rhizosphere of Thailand Clone in Lampung Timur and Tulang Bawang Barat Regencies

Location	Number of Spore per 50 g soil
Tulang Bawang Barat	583.0 a
Lampung Timur	536.7 a

Number of AMF spore from the two regencies was not affected by abiotic factors such as soil chemical and physical properties. Number of AMF spore in the soil were considered very high, about 500 spores per 50 gram soil in both regencies. This may be due to that cassava is highly mycorrhizal dependent (Opik et al., 2006). One type of AMF is attributed to cassava i.e. *Glomus manihotis* because this species is frequently found in association with cassava root (Sieverding, 1991).

The result of soil analysis can be seen at Table 2. In general, the characteristics of the soil from these to regencies not much different especially for pH and available P (low) which mostly affect the existing of AMF in the soil (Rosendahl, 2008). This situation may be a reason why the number of AMF spore or population from these two regencies were not significantly different.

Table 2. Soil characteristic from rizhosphere soil of cassava of Thailand Clone at Lampung Timur and Tulang Bawang Barat Regencies

	Value	
Chemical/physical Charateristic	Tulang Bawang Barat	Lampung Timur
pH	4,29	4,54
P-available(ppm)	14,43	8,82
K-dd (me/100g)	0,14	0,07
N-total(%)	0,10	0,06
Fe(ppm)	46,69	57,05
C-org (%)	1,38	0,68
Al-dd (me/100 g)	0,70	0,43
Sand	40,30	56,31
Silt	08,61	12,53
Clay	46,16	31,16

Based on pot culture data, it signified that the type of AMF in Tulang Bawang Barat is varied more (12-13 types) compared to East Lampung (8-11 types). Types of AMF derived from the host plant maize were higher than the other host plant for soil samples from Tulang Bawang Barat and Lampung Timur (Table 3). This indicates that the AMF derived from the rhizosphere of Thailand clone from the two regencies is more compartible with the maize host plant. In addition, the maize host plant was one of the most popular host plants in AMF propagation because this plant can associate with a wide range of AMF species (Sieverding, 1991).

Furthermore, AMF diversity in soil samples from Tulang Bawang Barat was higher than in Lampung Timur. The higher diversity can be attributed to the fact that the host plants in Tulang Bawang Barat are not only cassava, but also chili. The farmer planted cassava and chili alternately in rotation program. Meanwhile, there is no rotation of cassava with other crops in Lampung Timur. Types of plants that exist in an ecosystem will affect the type and population of AMF (Rosendahl, 2008). The same result were reported by Higo *et al.* (2013) and Jansa *et al*. (2003) who mention that the crop rotation has the potential contribution to a higher AMF diversity.

Table 3. Number and type of AMF spore from pot culture of soil sample taken from cassava rhizosphere of Thailand clone at Lampung Timur and Tulang Bawang Barat.

Location	Host Plant	Number of AMF Type
Lampung	Maize	11
Timur	Sorghum	8
	Pueraria javanica	11
Tulang	Maize	13
Bawang	Sorghum	12
Barat	*Pueraria javanica*	12

Acknowledgement

The author would like to thank to staff of Labortorium Produksi Perkebunan, Faculty of Agriculture, The University of Lampung for their help in conducting this research.

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Effect of Ridges and Organic Fertilizer on Erosion and Nutrients Loss

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SUMMARY

Ridges system and organic fertilizer contribute to suppressing erosion in land degradation and decreasing soil fertility. This study aims to determine the effect of applying different ridges system and the organic fertilizer on erosion and nutrients loss on 12.5% slope land. This study used a Randomized Complete Block Design (RCBD) which was arranged factorially with two factors, ridges and organic fertilizer (organonitrofos) applied to 4 groups. The ridges factor consists of G1 (ridges in the same direction with the slope) and G2 (ridges in the opposite direction with the slope), while the organic fertilizer factor consists of P0 (Organonitrofos 0 tons/ha) and P1 (Orgononitrofos 20 tons/ha). The results showed that the application of the ridges in the opposite direction with the slope significantly reduce the amount of erosion, and nutrients loss compared to ridges in the same direction with the slope. Physical obstacles formed by ridges in the opposite direction with the slope will force water to infiltrate into the soil so that the runoff rate, erosion, and nutrients loss can be reduced significantly. In reverse, the organic fertilizers does not affect those variebles. This happens because organic fertilizers do not significantly increase water absorption in full tillage soils.

Introduction

Soil cultivation is an activity to improve soil conditions with the process of reversal, destruction and leveling of land (Utomo, 2012). Soil can improve water infiltration and aeration, and control pests and plant debris. Soil treatment can increase soil resistance to penetration of vertical movements of groundwater or more commonly called soil infiltration power. According to Putte et al. (2012) runoff is rainwater or part of rainwater that falls and flows above the surface of the land that flows towards deposition areas such as rivers, reservoirs or the sea. The surface flow that occurs becomes a trigger for erosion which results in land degradation. Conservation tillage systems are needed to reduce the amount of surface runoff and erosion (Banuwa, 2013). According to Meijer et al. (2013) soil treatment can significantly affect soil susceptibility to erosion which can increase erosion rates.

Erosion is the occurrence of moving or transporting soil or parts of soil from one place to another by natural media. In the event of erosion, the soil or parts of the soil from an eroded plce, transported then deposited in another place (Arsyad , 2010). In nature there are two main causes that are active in this process, wind and water. In wet tropical climate regions such as Indonesia, water is a major cause of erosion (Arsyad, 2010).

In the use of sloping lands, erosion is often a problem. The steeper the slope, the more erosion that occurs (Arsyad, 2010).

The method of tillage and planting above the ridge in the same direction with the slopes combined with high rainfall will increase in erosion (Utami, 2001). Therefore conservation activities need to be taken to overcome these problems by doing soil cultivation and planting over the ridges in the opposite direction with the slopes. Planting on the ridges in opposite direction with the slopes can protect the water and provide water to infiltrate into the soil so that the surface flow drops significantly which can further reduce the rate of erosion that transports nutrients and soil organic matter (Banuwa, 1994) .

Other activities that can be taken to reduce erosion is by using organic fertilizer. The addition of organic fertilizer can improve soil structure so that the soil is more resistant to damage due to blows of rain so it can reduce erosion. In addition, fertilization provides additional nutrients for plants so that nutrient requirements during growth can be fulfilled. One type of organic fertilizer that can provide sufficiently high N and P nutrients is organonitrofos fertilizer. Organonitrofos fertilizer is one form of organic fertilizer from 70-80 % cow dung and 20-30 % Rock phosphate, with the addition of N fastening microbes and solvent P (Nugroho et al., 2012). Based on the description above, the purpose of this study is to identify the role of soil conservation actions and organic fertilizer application (organonitrofos) on erosion, nutrients and organic matter loss of cassava crops (*Manihot esculenta* Crantz) at the Integrated Field Laboratory of Agriculture, University of Lampung .

Materials And Method

Study area

The research was conducted at the Integrated Field Laboratory and the Soil Science Laboratory, Faculty of Agriculture, University of Lampung. The research was carried out only until the generative phase of cassava plants (*Manihot esculenta* Crantz) that was from April 2018-December 2018.

Nutrients and c-organic analysis

N total analized by Kjehdahl distillation method, available P by Bray-1 method, exchange K (NH_4 OAc 1 N), c-organic (Walkey & Method Black).

Data analysis

This study used a Randomized Complete Block Design (RCBD) which was arranged factorially with two factors, ridges and organic fertilizer (organonitrofos) applied to 4 groups. The ridges factor consists of G1 (ridges in the same direction with the slope) and G2 (ridges in the opposite direction with the slope), while the organic fertilizer factor consists of P0 (Organonitrofos 0 tons/ha) and P1 (Orgononitrofos 20 tons/ha). There are 4 combinations are obtained treatment, i.e. as the following :

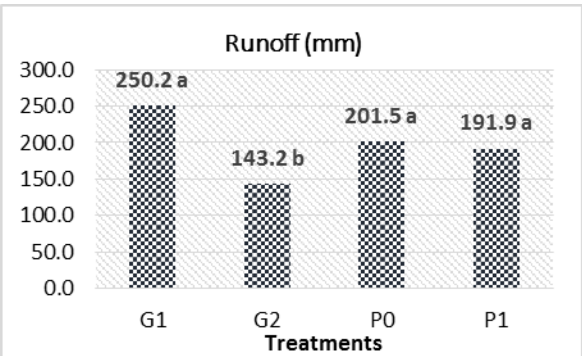
1. Ridges in the same direction with the slope + Organonitrofos fertilizer 0 ton/ha (G1P0)
2. Ridges in the same direction with the slope + Organonitrofos fertilizer 20 ton/ha (G1P1)
3. Ridges in the opposite direction with the slope + Organonitrofos fertilizer 0 ton/ha (G2P0)
4. Ridges in the opposite direction with the slope + Organonitrofos fertilizer 20 ton/ha (G2P1)

In this study four repetitions were performed for each treatment so that 16 experimental units were obtained,

Results And Discussion

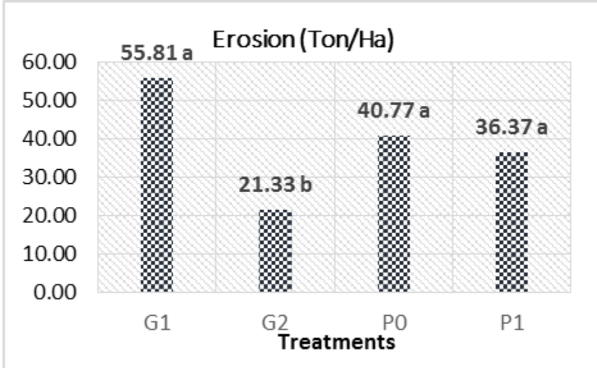
Runoff and Erosion

The results of statistical tests showed that the treatment of ridges affected the surface flow and erosion of cassava crops planted on 12,5% slope land. The mean comparison of treatments on erosion and runoff are presented in Fugure 1 and Figure 2.



Using LSD Test 5%,

Fig 1. Mean comparison of treatments on runoff



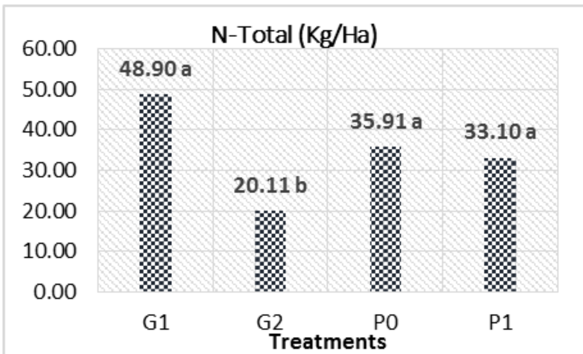
Using LSD Test 5%,

Fig 2. Mean comparison of treatments on erosion

Figure 1 show that the ridges in the same direction with the slope treatment increases the runoff significantly compared to the ridges in the opposite direction with the slope. Soils with a ridges system in opposite direction with the slope can reduce surface runoff from 250.2 mm to 143.2 mm when it was compared to ridges in the same direction with the slope. Figure 2 show that the ridges in the opposite direction with the slope treatment decrease erosion significantly from 55.81 tons / ha to 21.33 tons / ha. The use of organonitrofos organic fertilizers does not affect the amount of runoff and erosion.

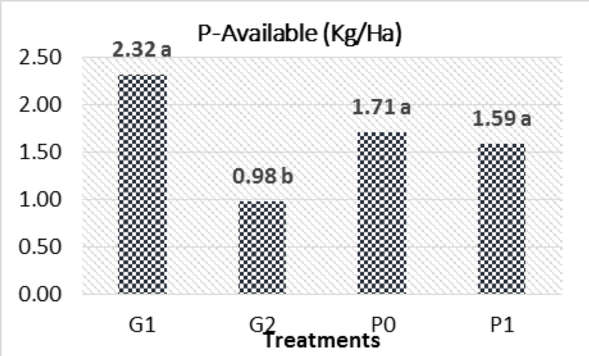
Nutrient and c-organic loss

Nutrients and c-organic loss from the surface of the soil is one of the main consequences of erosion. By erosion, the topsoil which contains a lot of nutrients and organic material will be transported, so that some nutrients are also transported to another place. The mean comparison of each treatments are presented in Figure 3 to Figure 6.



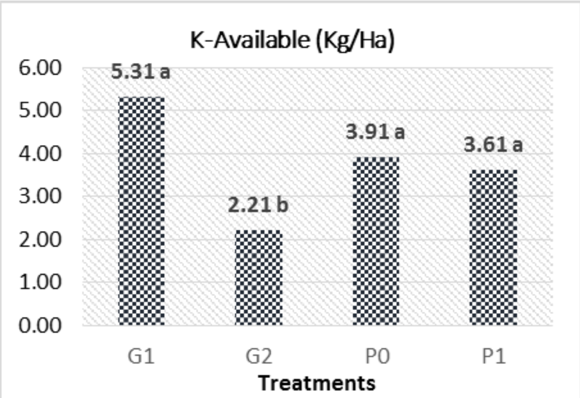
Using LSD Test 5%,

Fig 3. Mean comparison of treatments on N-Total loss



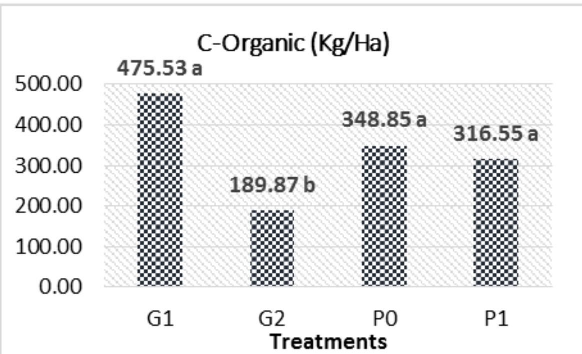
Using LSD Test 5%,

Fig 4. Mean comparison of treatments on P-Available loss



Using LSD Test 5%

Fig 5. Mean comparison of treatments on K-Available loss



Using LSD Test 5%,

Fig 6. Mean comparison of treatments on C-Organic loss

Figure 3 to Figure 6 shows that the ridges system in the opposite direction with the slope significantly decrease the loss of N , P, K and C-Organic elements from the soil. The use of ridges in the opposite direction with the slope can reduce the loss of N-total from 48,9 kg/ha to 20.11 kg/ha, P-available from 2.32 kg/ha to 0.98 kg/ha, K-available from 5.31 kg/ha to 2,21 kg/ha and C-Organic from 475.53 kg/ha to 189,87 kg/ha. The use of organonitrofos fertilizers does not affect nutrient loss in eroded soil.

Discussion

The runoff from the ridges in the opposite direction with the slope significantly lower compared to ridges in the same direction with the slope. This is because the ridges in the opposite direction with the slope will hold the surface flowing when there is rain in each ridge. Sutrisno (2013), states in his research that planting peanut crop on ridges in the opposite direction of the slope in Suka Resmi Village, Cianjur, significantly reduce runoff. The retention of surface runoff by ridge, causes many opportunities to seep into the soil so that the surface flow decreases, so the speed will be greatly reduced. However, organonitrofos, organic fertilizers does not affect the rate of runoff and erosion, this is because organonitrofos fertilizer does not affect the absorption of water by the soil even with addition organic fertilizer with a dose of 20 tons / ha.

Erosion that occurs in the slope conservation action with ridge in the same direction with the slope will be higher than ridge in the opposite direction with the slope, this is also supported by Henny (2011), which states that planting potatoes on ridge in the opposite direction with the slope can reduce erosion to 81, 21%. Ridge in the opposite direction with the slope can also significantly inhibit the loss of N, P, K and C-Organic nutrients compared to the slope in the direction of the slope. This is because the loss of nutrients and organic matter is directly related to the amount of erosion and the concentration of nutrients and organic matter in the sediment. Banuwa (1994) state that ridge in the opposite direction with the slope can reduce runoff and erosion due to the presence of a fairly tight ridge at each row of plants so that the volume and speed of surface runoff are reduced and transport capacity is low which in turn erosion is also low. According to Arsyad (2010), the topsoil as thick as 15-30 cm has more nutrients and organic matter than the lower layer. If the nutrients and organic materials lost are transported by erosion, the soil fertility will be reduced so that it can reduce the ability of the soil to support plant growth. Noor (2006) states that erosion can change from very fertile to be infertile. This is because the minerals contained in the soil have eroded, where the nutrients needed by the plant have been lost.

Conclusion

1. Ridges in the opposite direction with the slope significantly reducing the amount of erosion, runoff, and nutrients loss.
2. Organonitrofos fertilizer addition has no significant effect on all variables.

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ISBN : 978-4-909365-04-0