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Dr. Ir. Widyatmani Sih Dewi, MP

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PATTERN OF SOIL ORGANIC CARBON IN PINEAPPLE ESTATE AFTER ROTATION WITH CASSAVA AND KING GRASS UNDER MARGINAL TROPICAL SOIL OF LAMPUNG, INDONESIA

Afandi[1], Priyo Cahyono[2], And Purwito[2]

[1)]*Faculty of Agriculture, Lampung University, Jl. Sumantri Brojonegoro 1 Bandar Lampung, Indonesia*
[2)]*Research and Development PT.Great Giant Pineapple (GGP), Central Lampung,, Indonesia*

ABSTRACT

A soil survey was conducted to see the pattern of soil carbon organic in pineapple estate during pineapple growth after rotation with cassava (*Manihot esculenta* Crantz) and king grass (*Pennisetum purpureum)*. This research was conducted in PT.GGP, Central Lampung, Indonesia. The soil organic carbon was observed (a) after the harvesting of the rotated crop, (b) before planting of new crop of pineapple, and (c) 4 , 6, 8 months after planting. The soil organic carbon was initially increased after rotation, from 0,96% C in king grass and 1,02% C in cassava, to almost 1,2 % after 4 months, but decreased 1,06 % and 1,1 % C in cassava and king grass after 8 months. The low of soil organic carbon indicated that the fertility of the soil is very low, and the addition of soil organic carbon through crop rotation is not enough for pineapple cultivation.

Keywords: pineapple, crop rotation, cassava, king grass, tropical soil

INTRODUCTION

In estate scale, foliar fertilizer application of pineapple is a common practice. The fact that the pineapple population was very high per hectare, from 60,000 to 80,000 plants (Reinhardt *et al.* 2001; Hepton 2003), so the canopy of pineapple totally covered the soil at the age of 4-5 months, and as consequence it is difficult to give fertilizer through the soil. In addition to this, the pineapple has axillary roots which could absorb water and nutrients in the same way as soil roots do (Kelly and Bartholomew 1993; DPI 2009). Although foliar application could be give high yield of pineapple, however, supplying nutrient and water from the soils is still very important for supporting the root development, so the pineapple could be grown until the ratoon phase. One of the strategies which could be applied is improving the soil condition by adding organic matter through crop rotation. The common crops which were generally used for rotation in PT. GGP were cassava (*Manihot esculenta* Crantz) and king grass (*Pennisetum purpureum).*

Under the influence of humid tropical climate, the pineapple area of PT. GGP was dominated by Dystropepts, Kandiudults, and Kanhapludults (PT.GGP and Jurusan Ilmu Tanah FP UGM 1999) which characterized by clayey soil texture with low C-soil organic carbon (<1%) (PT.GGP 2010). Although pineapple could grow well under marginal soil, long time field experienced in PT. GGP showed that the

pineapple yield was generally increased after cassava rotation, although cassava is known very consumptive in taking soil nutrient. In case of king grass, the high amount of biomass, which could be 100 ton fresh biomass per hectare, is very potential as the source of organic material.

A soil survey was conducted in pineapple estate which belongs to PT. GGP, in Central Lampung, Indonesia, to see the pattern of soil organic in soil during pineapple growth after rotated with cassava and king grass.

MATERIALS AND METHOD

The research was conducted in pineapple plantation which is belongs to PT. Great Giant Pineapple (PT.GGP), Terbanggi Besar, Central Lampung. The experiment was done using survey method in the area which has been rotated with cassava and king grass. The total area investigated was around 1600 ha.

The cassava and king grass were planted using cuttings. The land preparations for both crops were almost the same. After pineapple were harvested, the area were chopping, followed by disc plowing , and ridging. The plan distance between rows was 55 cm. For cassava, the distance in rows was 80 cm.

The cassava and king grass were planted in 2008-2009. The cassava was grown until harvest (8 months), and after harvest, the leaves were incorporated into the soil. The king grass was grown for 4 months and all the biomass was incorporated into the soil.

The research was done from 2009-2010 which total area of 1600 ha. The soil sample for organic carbon analysis was taken from 9-15 locations for cassava and 41-82 locations for king grass. One location is around 5-20 ha. The soil samples were taken at 0-20 cm depth, with 3 soil samples in each locations and then composite as a single soil sample. The total organic carbon was analyzed using the method used by Balai Penelitian Tanah (2005).

The soil sample was taken several times, (a) after the harvesting of the rotated crop, (b) before planting of new crop of pineapple, and (c) 4 , 6, 8 months after planting. The pineapple growth cycle in PT. GGP with crop rotation was shown in Fig.1.

Pineapple Cassava (8 months) Harvest Land preparation Pineapple
King grass (4 months)

Fig. 1. The pineapple growth cycle in PT. GGP with crop rotation

The data was analyzed using simple statistic analysis, such as mean (average), standard deviation, and coefficient of variation, and graph.

RESULTS AND DISCUSSION

The fresh biomass from harvested pineapple was around 120 ton/ha which contained around 32,3% of carbon organic. In PT GGP, the king grass could produce fresh biomass around 62 ton/ha with 30,1% of carbon organic, while the parts of cassava which was left in the land after harvesting was the cassava leaves which estimated around 13 ton/ha which contain about 30% of carbon organic.

The average of organic carbon observed after crop rotation was shown in Fig. 2. and the detailed data were shown in Table 2 and 3. As shown in Fig.2., the organic carbon was initially increased after crop rotation, both for cassava and king grass. Before planting, the soil organic carbon reached 1,12% C for king grass rotation, while at cassava rotation the value was 1,21%. After 4 months, the soil organic carbon was around 1,2 % , and decreased after 8 month, 1,16% for king grass and 1,06% for cassava.

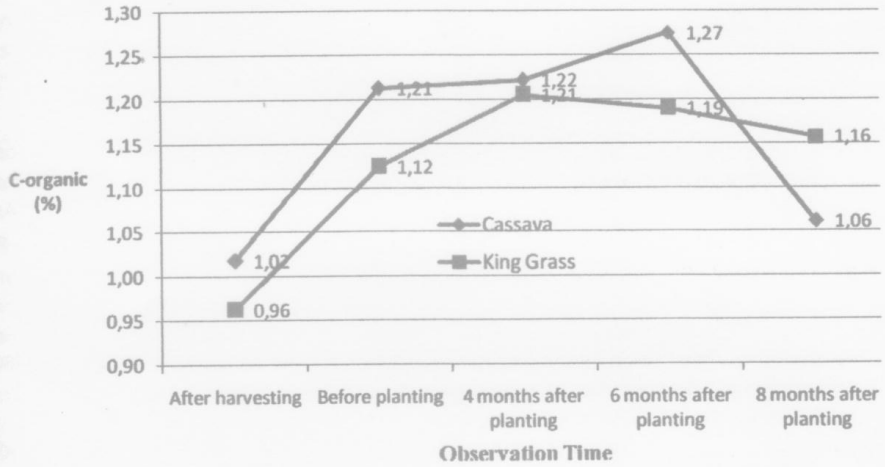

Fig.2. Pattern of C-organic in pineapple growth after rotation with cassava and king grass

The decreased of organic carbon in the soil after 8 months could be dangerous for the pineapple because this crop will enter generative phase to produce fruits for the next four months. At this phase, the foliar fertilizer, especially nitrogen must be reduced significantly, because the high nitrogen in the leaves will decrease pineapple's flowers and give high nitrate in the fruit. So, the crop will depend on the nutrient status of the soil which is fertilized the previous four months and the low organic matter indicated that the soil fertility was low, and unfortunately fertilizer application to the soil could not be done due to the high density of pineapple population.

This study showed that under humid tropical climate, the biomass of king grass as well as cassava could contribute the increasing amount of soil organic until 4-6 months after incorporated into the soil, however, for pineapple cultivation which have a very long time cycle, it is not enough. Field experience in GGP showed that the high yields of pineapple were usually found in the soils which have at least 2% of soil organic carbon.

Table 2 . Analysis of C-organic after king grass rotation

Observation time	Number of locations	Average (%C)	Standard Deviation	Coefficient of variation
After harvesting	82	0,96	0,18	18,57
Before planting	82	1,12	0,14	12,82
4 months after planting	82	1,21	0,19	15,58
6 months after planting	63	1,19	0,12	10,31
8 months after planting	41	1,16	0,15	12,55

Table 3. Analysis of C-organic after cassava rotation

Observation time	Number of locations	Average (%C)	Standard Deviation	Coefficient of variation
After harvesting	13	1,02	0,19	18,32
Before planting	9	1,21	0,27	22,49
4 months after planting	15	1,22	0,23	18,45
6 months after planting	15	1,27	0,13	10,28
8 months after planting	13	1,06	0,19	18,25

CONCLUSSIONS

Crop rotation in the form of cassava and king grass in pineapple plantation initially gave significant increase of soil organic carbon, however, after 8 months the soil organic carbon decreased under the requirement of pineapple needs. As consequent, the cultivation of pineapple still needs additional of organic matter in addition to crop rotation.

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