THE INFLUENCE OF ORGANIC MULCH ON SOIL PHYSICAL PROPERTIES IN PINEAPPLE(Ananas comosus) PLANTATION UNDER TROPICAL MONSOON CLIMATE

Komariah[1], Hiroki Ueyama[2], Afandi[3], Kengo Itou[1], Masateru Senge[1]

I. Introduction Soil deterioration in pineapple culture is a problem in pineapple plantation in Indonesia, due to the long period of pineapple life cycle and tropical monsoon climate. The first harvest could take about 15-18 months from seedlings, optimum production still could be reached in the next 1,5 years. Long culture period, high annual rainfall and high mean temperature in tropical monsoon climate countries, resulting into the speedy decreasing of soil quality. Plant cannot only rely on natural soil chemical fertility to support the production, but using chemical fertilizers will not only nourish plants and microbes, but also may harmful effects on the soil and its life. Recent concerns about reducing environmental pollution, depleting non-renewable natural resources, and rising production costs have become strong economic and social forces responsible for the development of alternative production systems to address this problem, one of the solution is by using crop residue for mulching (Abdul Baki et al., 2002). This experiment was aimed to investigate the influence of rice husk, cassava skin and cassava bagasse for mulching on selected soil physical properties.

II. Materials and Method The experiment was located in a pineapple plantation named Great Giant Pineapple Company (GGPC) in province of Lampung, Indonesia, which laid on 4°59' of latitude and 105°13' of longitude. Investigation was conducted from July 2001 to September 2002, in randomized block design with four replications on Red-Yellow *Podzolic* soil. Each plot consisted of two beds with size of 0.6m x 15m for each bed. Each bed was planted with 60 smooth *cayenne* pineapple seeds in two rows. The experiment was conducted on plantation field and the treatments were: control, rice husk mulch, cassava bagasse mulch, cassava skin mulch, and black *polyethylene* film mulch. The mulching rate of each organic matter was 300 ton/ha and mulching was applied manually by hand. Seedlings started on June 2001 and mulching was completely applied on soil surface in late of July 2001. Soil physical properties that were observed are: Particle density, bulk density, organic matter, water-stable macroaggregate, water retention curve (water holding capacity/pF) and soil texture.

III. Result and Discussion Table 1 shows that particle density increased in almost all treatments and all depths, except treatment of rice husk mulch. In rice husk mulch treatment, soil particle density in depth until 15 cm decreased. Soil particle density readily influenced by organic matter,.

Table 1. Soil Physical Properties Change of Experimental Fields

Treatment	Depth (cm)	Particle Density		Bulk Density		Organic matter content		Water- stable macroaggregate		Total Available Water	
		initial	final	initial	final	initial	final	initial	Final	initial	final
		---------- g/cm^3 --------				---------- % ----------				----- % volume	
Control (No mulch)	0～5	2.670	2.687	1.14	1.10	3.4	2.8	28.4	33.3	9.0	9.5
	5～10	2.678	2.692	1.17	1.15	3.4	2.8	34.2	48.5	11.4	9.3
	10～15	2.689	2.688	1.17	1.24	3.5	2.9	30.4	47.0	11.1	9.1
	15～20	2.689	2.688	1.23	1.32	3.1	3.0	28.6	44.4	12.8	10.3
Rice husk mulch	0～5	2.687	2.671	1.06	1.04	3.3	3.6	35.1	35.7	8.7	9.7
	5～10	2.690	2.680	1.22	1.10	3.5	2.9	36.8	45.9	10.1	10.4
	10～15	2.684	2.676	1.32	1.04	3.4	3.3	37.6	42.8	11.2	10.5
	15～20	2.683	2.690	1.37	1.30	3.4	2.9	31.9	44.0	12.3	10.5
Cassava skin mulch	0～5	2.662	2.673	1.15	1.01	3.3	3.1	46.5	53.8	9.8	11.2
	5～10	2.669	2.671	1.18	1.08	3.4	2.7	35.1	53.8	10.3	9.3
	10～15	2.669	2.679	1.23	1.28	3.5	2.7	32.7	53.9	11.5	10.3
	15～20	2.662	2.683	1.18	1.25	3.3	2.6	31.2	51.9	11.8	10.5
Cassava bagasse mulch	0～5	2.653	2.671	1.13	1.08	3.1	2.7	28.5	53.3	10.5	10.6
	5～10	2.652	2.680	1.19	1.07	3.2	2.8	30.3	48.5	9.4	9.2
	10～15	2.649	2.669	1.35	1.13	3.2	2.9	35.8	46.6	10.8	9.8
	15～20	2.652	2.664	1.37	1.23	3.1	2.8	34.7	42.9	10.4	10.7
Black polyethylene film mulch	0～5	2.653	2.675	1.00	1.15	3.2	2.7	33.7	45.5	10.0	10
	5～10	2.677	2.710	1.16	1.14	3.2	2.7	27.3	39.5	9.1	9.1
	10～15	2.654	2.668	1.42	1.29	3.2	2.8	27.1	45.5	9.9	9.6
	15～20	2.680	2.674	1.32	1.30	3.2	2.7	14.4	51.7	10.5	11.1

[1]Gifu University,[2] Gifu Prefecture, [3]Lampung Univesity ***keyword**: organic mulch, soil physical properties, Indonesia*

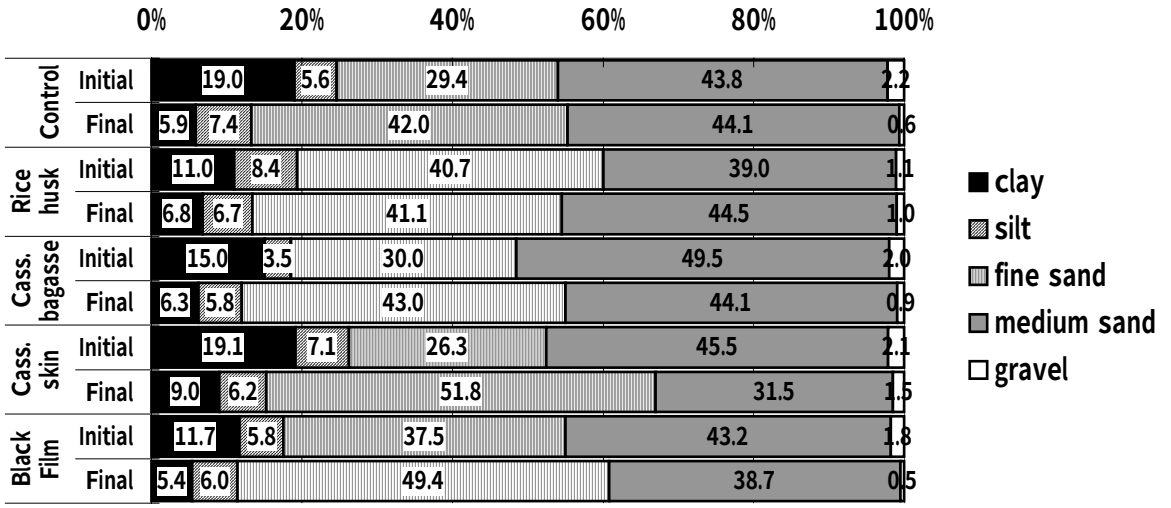

Figure 1. Soil texture change of average depth (0-25 cm) for 15 months (July 2001 to October 2002)

the higher organic matter in soil the lower soil particle density The decreasing of soil particle density in rice husk mulch could be understood because decomposition process of rice husk occurred slowly, thus the supply of organic matter into soil was minimum. The condition is assumed resulting into the decreasing of soil particle density, which is also shown by the low decreasing of soil organic matter under rice husk mulch treatment, as an affect of low organic matter input into soil. On the other hand, the decreasing of soil organic matter under cassava skin treatment was higher than that of control. Presumably, cassava skin significantly supplied organic matter into soil, and during 15 months most of the organic matter was converted into non-organic matter through decomposition process. Therefore, the decreasing of organic matter in soil under cassava skin mulch was high.

Generally, soil organic matter decreased in all treatment of all depth. It is assumed that the decomposition process of cassava bagasse occurred speedy, which was showed by its color that changed from white to dark very quickly in the field. The speedy decomposition process quickly converted organic matter (cassava bagasse) into non-organic matter and soon exploited by plants. Therefore, soil organic matter under cassava bagasse mulch highly decreased. In black film mulch treatment, there was no organic matter organic matter supply into soil, thus almost there was no organic matter dynamics in this treatment. Since the organic matter content highly related with clay content, soil texture observation result in figure 1 shows that without mulching, clay highly decreased in control. The slow and low decomposition of rice husk could effectively prevented clay leaching because rice husk still covered soil surface, thus minimized the wash down of clay into deeper soil layer during rainfall, as well as black plastic mulch. The high contribution of organic matter into soil by cassava skin and cassava bagasse is predicted minimizing the clay leaching.

Soil bulk density of surface layer, until about 10 cm, generally decreased in all treatment, due to the plants' litter that slowly crushed and physically increased soil pores, except under black film mulch. In the deeper soil layer (10cm-25cm), soil bulk density under cassava bagasse mulch significantly decreased compared to other organic mulch treatments. Soil water-stable macroaggregate significantly increased under cassava skin mulch in all layers, due to the high supply of organic matter into soil, compared to other treatments. It is predicted that the high ability of rice husk mulch in minimizing the clay leaching played role in increasing the total available water (pF2.5 – pF4.2) than that of cassava skin and cassava bagasse mulches..

IV. Conclusion. Applying rice husk for organic mulching for 15 months contributed minimum improvement of soil physical properties because the decomposition process of rice husk mulch occurred very slowly, while cassava bagasse mulching decreased bulk density in all layers and cassava skin mulching significantly increased soil water-stable macro aggregate.

Reference

Abdul-Baki, Aref A., John R. Teasdale, Robert W. Goth, and Kathleen G. Haynes (2002): Marketable yields of fresh-market tomatoes grown in plastic and hairy vetch mulches. HortScience.37(6): 878-881