

学 位 論 文 要 旨

学位論文 提出者	氏名	コ マ リ ア KOMARIAH	専攻	生物生産 システム学	講座	生産環境 整備学	分野	灌漑排水学
	学 籍 番 号		1 0 3 4 1 1 2 0 0 2					
学位論文 題 目	SOIL PHYSICAL PROPERTIES AS AFFECTED BY SELECTED ORGANIC MULCH AND FIELD MANAGEMENT							
論文審査 委員	氏名	千家 正照		天谷 教夫		西村 直正		

I. Introduction Mulching is one promising technology that is an integral component of conservation farming and is increasingly seen in the light of integrated soil management as an essential building stone for sustainable agriculture. The main points that should be noticed in mulching, especially the organic mulch is the availability of the organic material and the main purpose of the mulching related to the natural or environment condition and plants productivity.

II. Objective The objectives of this experiment are: (1) To investigate the characteristics of those materials in water use efficiency; the ability of transferring water in high and low amount of precipitation, and the ability of reducing evaporation; (2) To investigate the ability of those materials in playing the role as insulator to maintain the soil temperature uniformity; and (3) To investigate the characteristics of those materials in influencing soil physical properties; the ability to maintain or even increase soil structures and quality, to predict those materials contribution in Low External Input Agriculture (LEIA) method of supporting the sustainable agriculture for future.

III. Materials and Method The study of soil physical properties as affected by selected organic mulch and field management consisted of 2 experiments. The first was mulching and irrigation level effects to water use efficiency and soil physical properties under green pepper (*Capsicum Anuum* sp.). This experiment conducted from May to October 2003, in a plastic house located inside Gifu University farmland, included 5 different kinds of mulches as main treatment, namely, rice husk, rice husk charcoal, rice bran, rice straw and black vinyl mulch, and three levels of irrigation rate as sub-main treatment: 80% (0.8Eva), 60% (0.6Eva) and 40% (0.4Eva) of small-pan evaporation rate. Each treatment was performed on one bed, thus there were 18 beds for 18 treatments that were prepared in this research (6 mulching treatments \times 3 irrigation levels sub-treatments). The second experiment was mulching effects to water use efficiency and soil physical properties under maize (*Zea mays* L.) and without crops, conducted from April to July 2004 on field outside the plastic house, located inside Gifu University. There were five main treatments: control, rice husk mulch, rice bran mulch, rice straw mulch and black vinyl mulch, and two sub-main treatments: without any crops (only mulch) and with crop (maize), thus this experiment consisted of 10 treatments. The data that were collected included; microclimate, namely: air temperature, air relative humidity, solar radiation, albedo, evaporation, rainfall (exp. 2), wind velocity (exp. 2); soil properties, namely: soil moisture, soil temperature, soil heat flux, soil bulk density, soil moisture retention curve (*pF curve*), soil water stable macro aggregate, soil organic matter content, Carbon and Nitrogen content; and finally green pepper and maize yield.

IV. Results The results show that the characteristics of selected organic matters for mulching: rice husk, rice straw and rice bran could be understood only by using the data from experiment 2. Since experiment 1 encountered problem, the characteristics of soil husk charcoal could not be recognized. In the field with plants, soil could receive 25% more water than field without any crops. Soil that was mulched with rice husk received about 59% of rainfall, 70% in plot with rice straw mulch and 86.5% under rice bran mulch and only 4% under black vinyl mulch. Soil moisture repletion of organic mulches under maize canopy ranges from 12.5%~36.5% higher than those without crops. The cumulative soil moisture repletion under rice husk and rice straw was 80% of soil moisture repletion in control. Cumulative soil moisture depletion showed that those organic mulches could suppress soil water loss through evaporation up to 28%.

Under plastic house, where environmental condition is highly controlled, soil temperature under rice bran mulching after about 1 month since its application tended to be high, and then became low later due to the decomposition process that occurred slowly. But, soil temperature under rice bran mulch at open field constantly high as well as control and black vinyl mulch, presumably because decomposition process occurred speedily. Due to the black color of rice husk charcoal, it gave the same effect of influencing soil temperature similar to black vinyl mulch. In the meantime, soil temperature under rice husk and rice straw mulch tended to be low with small fluctuation.

During the experiment, rice husk contributed in increasing soil Total Available Water (TAW), soil water stable aggregate and a little to Soil Organic Matter (SOM). Rice husk charcoal had less influence on increasing bulk density, but significantly increased soil TAW, stable macro aggregate and soil C/N ratio. Rice straw mulching only play a little role in increasing soil bulk density, while rice bran mulching significantly increased SOM and C/N ratio. High yields of green pepper and maize were highly influenced by low soil temperature, while grain density of maize was highly influenced by soil organic matter.