Soil Conservation Utilization Of Organic Matterial And Plant System Of Production Potato (Solanum Tuberosum L) And Land Productivity

Mu'minah, Henry Kesaulya, Baharuddin, Muslimin Mustafa

Abstract: This study aims to (1) determine the effect of organic matter and planting systems , the production of potatoes and physical properties and chemical properties of the soil (2) know how much difference the productivity in the system of planting potatoes. The experiment was conducted in the village of Pattapang , District High Muzzle,Gowa. This study used a randomized design Separated (RPT). The first factor was the system of planting as main plots consisting of 2 treatment system that cut slope and direction of slope. The second factor was the dose of organic chicken manure as a subplot consisting of 4 levels of organic material that was no,10 tonnes/ha (8 kg /plot), 20 tonnes/ha (16 kg/plot) and 30 tonnes /ha (24 kg /plot). Thus there are eight treatment combinations,each combination was repeated 3 times and obtained 24 experimental plots. The results showed that the system does not affect the production of planting potato crop and soil physical and chemical properties. but a dose of organic material 30 tons / ha (24 kg/plot) shows the real effect on the physical and chemical properties of the soil. There was no interaction slope cutting and planting system in the direction of the slope with a dose of organic matter. Average productivity of the system of planting cut slope number of tubers per plant 11 bulbs, bulb weight of 38 tonnes/ha, while the direction of the slope system planting number of tubers per plant 9 bulb, tuber weight of 30.68 tonnes/ha. The usefulness of this study may be material information for farmers and policy makers. Advised farmers planting potatoes raised bed model with tilted 45^0 with consideration water use efficiency for potatoes.

Index Terms: *Organic matter, planting system, productivity soil conservation*

1 INTRODUCTION

Potatoes are one of the world's major food after rice, wheat, potatoes and corn but is relatively insensitive to losses due to salinity, drought, and low nutrient availability. Indonesian potato production around 950,000 tonnes per year of crop area of approximately 90,000 ha in 2011. Planting area and production in 2009 increased by approximately 25% compared to 2008 with domestic consumption levels around 939 tons year^{-1} or 97.5% of total production, (BPS, 2008). Potato production in South Sulawesi in 2011 reached 18 420 tonnes by 8208 ha crop area, production increased in 2009 is 20 859 tons to 10 253 ha of crop area, (BPS, South Sulawesi in 2011) [1]. Organic material, especially after so humus with C/N ratio 20 and 57% levels of C can absorb water 2-4 times the weight, (Indranada, 1985)[2]. With the water content of the topsoil into a buffer for water availability. Soil that contains a lot of organic matter requires more water to be stored as inventory, thus the soil moisture will be maintained better. The drops of rain that falls into the mineral soil surface has a mass force capable of breaking down and throw grains of soil that has been separated as spark erosion. Once the topsoil is saturated water, soil pore spaces quickly covered by fine particles, so that the excess water flows on the surface and carries off particles as erosion of the surface layer. With organic matter in the upper layer, erosion of the surface layer can be inhibited because the organic material acts as a shield.

- *Mu'minah: Department of Plant Cultivation,Polytechnic Foreign Agricultural Pangkep, Indonesia. Email: mutmainah2009@gmail.com*
- *Henry Kesaulya: Department of Agronomy, Pattimura University Ambon, Indonesia.*
- *Baharuddin: Research Centre for Biotechnology, Hasanuddin University, Makassar, Indonesia.*
- *Muslim Mustafa: Department of Soil Science, Faculty of Agriculture, Hasanuddin University.*

Pore closure can be reduced because the organic material to make more air cavities and more stable soil structure so that the soil particles are not easily separated (Arsyad, 1989) [3] Planting potatoes in dry land slopes generally strived to increase production, so the issue of land conservation is often overlooked. Dry land conditions in plateau slope is generally classified as unstable, prone to erosion and landslides . Farmers seek potato crops on land with slopes of 15 % and 35 % without regard to principles of soil and water conservation in the form of planting on mounds in the direction of the slope. In this connection, according to Arifin and Salah (2002)[4] planting potatoes in mounds in the direction of slope erosion potato growing season of 14 to 16.5 tonnes ha^{-1}. The results of the study Arifin *et al.* ,(2003)[5] suggested that planting potatoes are done in the direction of the slope on the slope 15 % - 30 % with Granola varieties, the rate of run-off and erosion can be reached 568.72 m3 ha^{-1} and 20.83 tons ha^{-1}. This condition leads to deterioration of land productivity,which will lower the potato production and farmers' income. Erosion/land degradation directly influence the rate of decline in land productivity, infiltration capacity, soil moisture, and topsoil erosion and nutrient depletion, all of which will determine the availability of water for plants for optimal growth. Planting system slice slope or contour planting of parallel lines can reduce erosion by 50% compared with the planting is done in the direction of the slope (Suripin, 2001)[6]. This occurs because the soil tillage according to the slope (direction of slope) hijacking or hoeing done extends downward slope to form grooves and lead to the concentration of water flowing rapidly toward the bottom. While the slice slope tillage or contour lines are formed parallel lines and the soil pile parallel grooves that follow the contour lines and are more effective when followed by contour planting (planting slice slopes). Slope was very large contribution to the rate of runoff and soil erosion on potato in Malino , because the cultivation is done with a management model that deviate from the proper conservation techniques, such as planting is done on the model of the direction of the slope of the mound. This is done mainly because of the reason that farmers planting on ridges that cut slope will decrease the quality of potato production.

Viewing habits Malino farmers planting potatoes in potato plants will increase the slope direction of the surface runoff and soil erosion that can reduce soil productivity that can result in land degradation. Based on information from farmers that farmers plant potato cropping system in the direction of the slope on the basis of consideration of drainage and water availability for crop potatoes. Based on this, we conducted this study, which analyzes the growth and production of potato crop by providing organic matter and crop and cropping system in the direction of the slope, with the aim to prove that the system of planting the cut slope is better than planting system that can change the direction of the slope so habits of farmers who have done less attention to soil conservation.

2. MATERIALS AND METHODS

2.1 Location and Area

The geographical position of the study site 5015'00 "LS and 119055'00" BT. What is material unless Gowa, District High Muzzle, precisely Pattapang village with an area of 65 km^2. What research is at an altitude of approximately 1300 - 1800 meters above sea level.

2.2 Climate

Rainfall areas of research ranging from 1698 to 4979 mm year^{-1} with an average annual rainfall of 3432 mm year^{-1} over the last 10 years. The maximum monthly rainfall of 1132 mm month^{-1} with an average monthly rainfall of 334 mm month^{-1}. The rainy season lasts from October to April, the peak rainfall occurs between December and January. While the dry season lasts from July to October and the transition between the rainy season and the dry season occurs between May and June. On this basis the regional climate types Malino by Schmith Fergusson included in climate type B. The average monthly temperature ranges between 19-23^{o}C. Thus Malino area is an area suitable for planting potatoes.

2.3 Geographic state

The district area of High Moncong by percentage slope and elevation above sea level is as follows and can be seen in table 1.

Table 1. The total area of district based on the percentage of High Muzzle slope and elevation above sea level

Altitute	Broad	Region	The Slope of The Land	Broad	Region
(m dpl)	Km2	(%)	(%)	km2	(%)
100 – 500	24,19	4,59	2 - 15	53,90	10,22
500 – 1000	128,10	24,29	15 - 40	217,94	41,32
> 1000	375,16	71,12	> 40	255,61	48,46

2.4 Soil

The type of soil in the highlands is dominated by Malino Ultisol soils with parent material of volcanic tufa (BP2TP. DAS IBT. 2001). Solum in soil (> 90 cm). The texture of the soil is generally sandy loam, clay loam and clay dusty, with a crumb or granular structure of the soil. See table 2 below:

Table 2. The results of the analysis of soil physical and chemical properties of early trial

Type of Analysis	Value	Criteria
Soil texture (%)		
• Sand	31	
• Dust	32,7	Dusty clay loam
• Clay	36,3	
Structure		Crumb
BD (gr cm^{-3})	1,052	Moderate
Permeability (cmjam^{-1})	1,471	Rather slow
Water retention (m^3 m^{-3})	0,277	Moderate
pH H_2O	5,7	Sour
Organic matter		
C-organic (%)	0,97	Very low
N-total (%)	0,1	Low
Ratio C/N	9,7	Low
HCl 25 % P_2O_5 (mg100^{-1})		
Olsen (P_2O_5) ppm	14,55	Very Low
HCl 25 % K_2O (mg 100^{-1} g)	17,58	Low
Cation exchange rate (me 100^{-1} g)		
• K	0,20	Low
• Na	0,25	Low
• Ca	3,86	Low
• Mg	2,18	High
Cation exchange capasity (cmol kg soil^{-1})	20,02	Moderate
Base saturation	32,42	Low

2.5 Materials and Devices

Materials used are: seed potato varieties Granola (G3), chicken manure, urea, TSP, and KCl , water, pesticides. The tools used were machetes, hoes, scales, abny level, buckets, meter, oven, shovel, plastic, scissors, labels, pH meter and stationery.

2.6. Research Methods

1. The design of experiments

Research using Discrete Compartment Design (RPT) with treatment as the main plot, lanting system (main plot) and the provision of organic matter which chicken manure as a sub plot (sub-plots). The treatments studied were as follows:

Cropping system as the main plot (mainplot)
P1= System planting Slice slope
P2 = System planting parallel slope

Providing organic material as a subplot (subplot)
B0 = Without organic matter
B1 = 10 ton ha^{-1} (8 kg plot^{-1})
B2 = 20 ton ha^{-1} (16 kg plot^{-1})
B3 = 30 ton ha^{-1} (24 kg plot^{-1})

The combination of these treatments were repeated 3 times in order to obtain 8 x 3 = 24 experimental plots

2. Popolation and Sample

In this study, there were 24 experimental plots, each measuring experimental plots 2 m x 4 m, consists of 36 plants, so that the total population in this study population was 864. Sampling was done randomly, the number of samples taken is 16 samples at each plot trial so that the total sample taken is 24 x 6 is 384 samples.

3. Model Statistics
Statistical model for the experiment consisted of two factors (P and B) using Discrete Plot Plan (RPT) (Gaspersz , 1994) [7] are as follows:

$$Y_{ijk} = \mu + K_k + P_i + \delta_j k + B_j + (PB)_{ij} + \varepsilon_{ijk} ;$$

Where :

Y ijk = observation value (response) in the group of the k, are obtained because of the cutting and planting system in the direction of the slope and the provision of organic matter.

M = the average value of the real

Kk = additive effect of the k

Pi = effect of the treatment system and the planting of potatoes cut slope in the direction of the i

δjk = effect of error that appears in the i-th level of the system of planting potatoes and cut slopes in the direction of the k or the so-called Main plot error.

Bj = effect of treatment of organic materials j

(PB) ij = effect of interaction between the system and the planting of potatoes cut in the direction of the slope with the provision of organic matter.

ε ijk = effect of experimental error on the kth group who obtained combined treatment cut the potato crop planting systems and slopes in the direction of the i-th and the provision of organic matter j

4. Parameter Observation
The observations were observed in this study are as follows:

a. Parameter: Production Analysis
1. The number of tubers per plant (tuber)
2. Tuber weight per plant (g) and then converted tons ha^{-1}

b. Chemical properties of soil parameters include:
1. Soil pH
2. Cation excanhe capacity (CEC) soil
3. C. organic soil

c. Parameters of soil physical properties include:
1. Bulck Density
2. Permeability.

3. RESULTS AND DISCUSSION

3.1 Component Productiont

1. Number of Bulbs
Cropping system in the direction of the slope produced more number of tubers (10.28) bulbs but did not differ significantly with planting system slice slopes. Plants treated with 20 ton of organic matter ha^{-1} (B2) yields the highest average number of tubers (tuber 10.96) and significantly different from non-organic materials (8.75 bulb), but did not differ significantly with the number of tubers plants treated with organic ingredients 10 tonnes ha^{-1} (10.62 tuber) and 30 ton ha^{-1} (10.01 tuber). Organic materials of 10 tonnes ha^{-1} significantly different with no organic material, but different is not real with a 30 ton ha^{-1}. While 30 ton of organic matter ha^{-1} did not differ significantly with no organic material. The relationship between the dose of organic matter and the amount of potato tubers is presented in Figure 1.

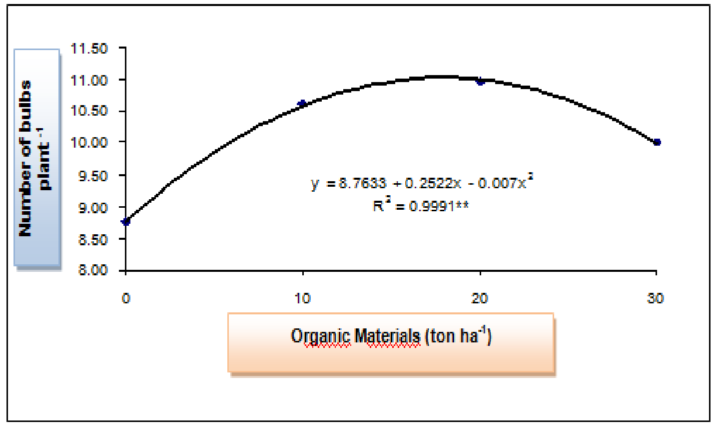

Figure 1: Relations Average Number Of Tubers Per Hill Potato Plants With A Dose Of Organic Materials

In Figure 1 looks the relationship between the number of tubers per plant potatoes at a dose of organic matter is a quadratic form. Maximum dose of organic matter is 18.014 tonnes ha^{-1} which produces as much as the number of tubers 11.03 with R2 values were 0.9991 (very real). The number of tubers that form tend to be much in the direction of the slope cropping system (10.28) compared with the slice slope (9.88). However with the formation of the number of tubers that many subsequent drop in tuber weight. Consequently bulbs that have grown into each other to compete for nutrients with the new bulbs emerge from stolon so many candidates tubers do not grow bigger because of a lack of nutrients. Based on the results Subhan, (1990) which states that the number of bulbs that will result in a lot of weight (weight) of tuber. Then also explained that in general, plants that have a number of pieces will have a little bit but the number of tuber weight (weight) per tuber greater. Treatment without organic material provides a low tuber yield and significantly different from the treatment of organic materials with a variety of doses. It is caused by a lack of nutrients available in the soil for plants to tuber formation, the number of tubers formed lower and vice versa when the nutrient elements in soil is available, the number of tubers will be more. This is consistent with the opinions expressed by Sharif, (1985) [8] that when a plant nutrient deficiency is required then the result will be decreased.

2. Weight Bulbs
Plants treated with 20 tonnes of organic matter ha^{-1} (B2) yields averaging heaviest tubers per plant (871.04 g) and per hectare (39.20 tonnes) and significantly different from non-organic material (637.92 g or 28.71 tonnes ha^{-1}), but did not differ significantly with organic matter 10 tonnes ha^{-1} (772.71 g or 34.77 tonnes ha^{-1}) and 30 tonnes ha^{-1} (774.58 g or 34.86 tonnes ha^{-1}). Similarly, organic materials 10 and 30 tonnes ha^{-1} significantly different from non-organic materials. The relationship between organic matter and heavy dose of potato tubers per plant is presented in Figure 2.

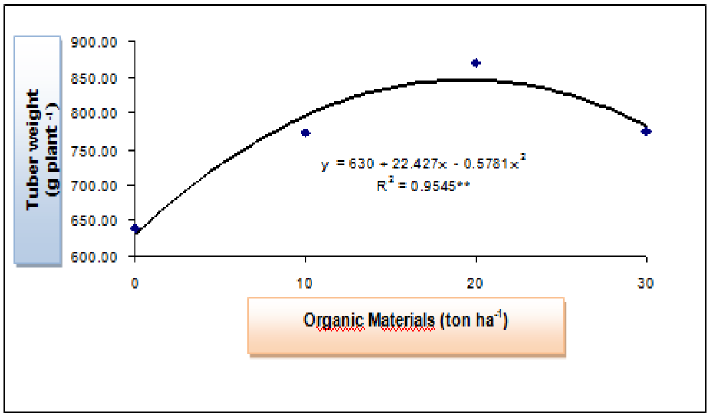

Figure 2: Relations Average Tuber Weight Of Potato PlantsPer Hill At A Dose Of Organic Materials

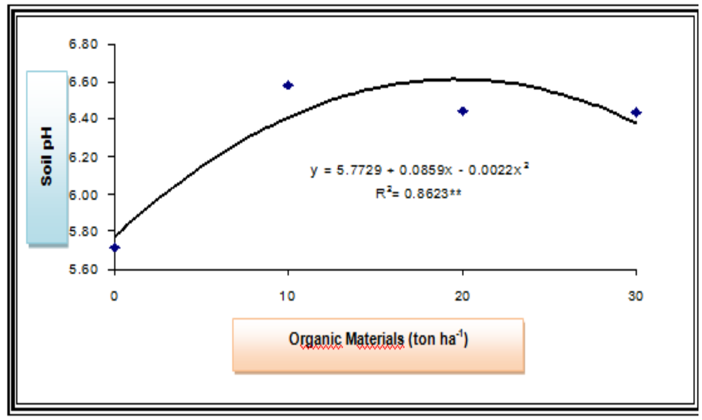

Figure 3. Relations Average Soil Ph Of Potato Plants With A Dose Of Organic Mater

Potato production was seen in the direction of the slope planting system with the average production of 38.09 tonnes ha^{-1}, with the number of tubers formed per clump 10.28 compared with the average slice slope planting production 30.68 tonnes ha^{-1}, with the number of tubers formed by clumps of 9.88 (Figure 2). The low production in the cropping system for cut slopes due to the growth of potato late blight disease (Phytoptora infestans) and bacterial wilt (Pseudomonas solanacearum) attack many plants, according to the information of local farmers that the disease is an endemic disease that attacks potato plants. The high intensity of the attack of late blight and bacterial wilt in potatoes grown in the rainy season are influenced by temperature, soil moisture and precipitation (Anonymous, 1982)[9]. Highest blight found in cut slope planting system with an attack intensity 18.98%, while the slope of the intensity of direct planting system attack on 14.57%. This caused, in addition to climatic factors also influence land management practices in this direction are cutting beds slope or contour ridges to cut drainage and soil moisture around the roots is high enough to influence the development of disease, especially late blight. But on the contrary the rate of surface runoff or erosion of soil fertility to be low so that the land could be better in the future suitanable and tuber development more evenly.

3.2 Components of soil chemical

1. Soil pH

Organic materials of 10 tonnes ha^{-1} (B1) produces the highest average soil pH (6.58) and significantly different from non-organic materials (5.72), but did not differ significantly with organic matter 20 tonnes ha^{-1} (6.45) and 30 ton ha^{-1} (6.44). Similarly, organic materials 20 and 30 tonnes ha^{-1} significantly different from non-organic materials. The relationship between the dose of organic matter and soil pH on the location of the experiment is presented in Figure 3. In Figure 3 looks at the relationship between the pH of soil organic matter in the form quadratic dose. Maximum dose of organic matter was 19.52 tonnes ha^{-1} which produces soil pH of 6.61 with a value of R2 is 0.8623 (very real).

Giving of organic material effect on the change in pH caused by protonation and deprotonation of organic colloids classified payload dependent pH (pH dependent charge). At pH 4.0 to 8.0 CEC value of organic colloids can be increased by 100% as a result of the addition of organic matter, so the CEC of soil organic matter can be 2-30 times the CEC colloidal minerals. Therefore, soil organic matter can bind macro elements on cation or anion exchange footprint, while for micro elements and heavy metal compounds or chelate through the exchange mechanism (Suriadikarta et al .,(2002)[10]. The correlation between the dose of organic matter with a pH of soil in the experiment can be seen in Figure 3. Soil organic matter is composed of fulvik acid and humic acid . O fulvik acid containing elements of more humic acid , humic acid otherwise contained more C chain (Van Veen and Kuikman, 1990)[11]. Organic acid functional groups that make up the soil organic matter is very varied and has a high reactivity . Presence of reactive groups that was instrumental in cation exchange process and the formation of complex bond and chelate . Based on the formation of bonds between metals and soil organic matter , can be divided into : (1) for metals essential as monovalent cations (K^+ , Na^+ , etc.) and divalent cations (Ca^{2+} , Mg^{2+}) bound by carboxylate groups form a simple salt (RCOONa , RCOOK) through cation exchange, (2) metal essential to form a bond coordinate with organic ligands, such as Cu^{2+} , Zn^{2+} ,CO^{2+},Mn^{2+}, (3) metal unneeded plants but accumulated in the soil will be sequestered complex organic molecules through bonding , such as Cd^{2+} , Pb^{2+} , Hg^{2+} , Cr^{3+} (Stevenson, 1982)[12].

2. Ratio C/N

Ratio C/N showed that the organic material of 30 tonnes ha^{-1} (B3) yields the average ratio of C/N soil highest (18.10) and significantly different from non-organic materials (10.02), but did not differ significantly with organic matter 10 (16.75) and 20 tonnes ha^{-1} (17.90). Similarly, organic materials 10 and 20 tonnes ha^{-1} significantly different from non-organic materials. The relationship between the dose of organic matter and the ratio C/N soil test locations are presented in Figure 4.

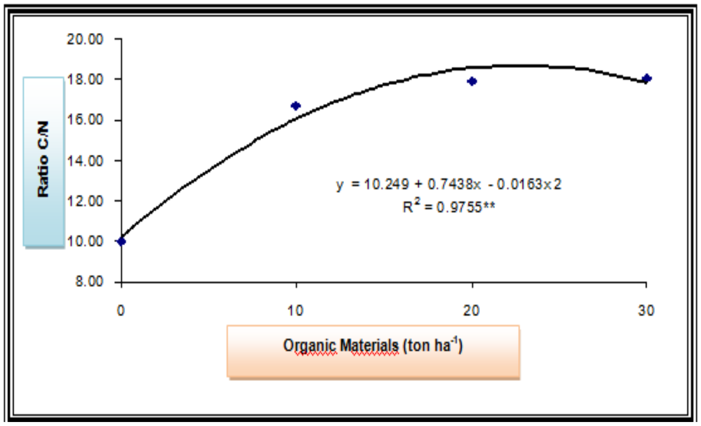

Figure 4. Relations Average Ratio C / N Soil Potato Plant With A Dose Of Organic Materials

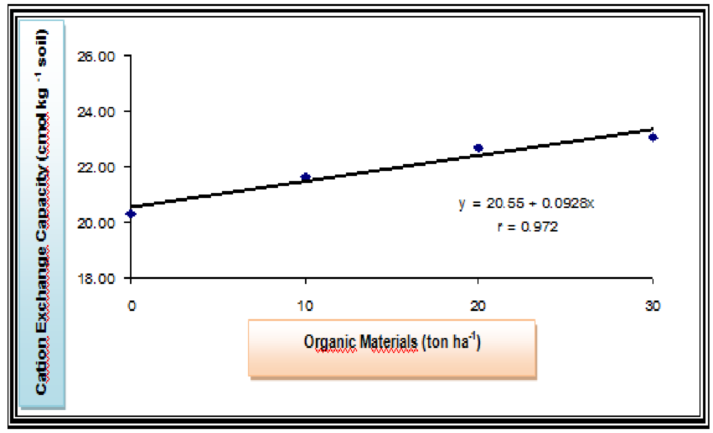

Figure 5. Relations Average Cation Exchange Capacity Of The Soil With Organic Matter Doses

Figure 4 looks at the relationship between the ratio of C/N soil with organic material shaped quadratic dose. Maximum dose of organic matter was 22.82 tonnes ha $^{-1}$ which resulted in the ratio C/N for 18.73 with R2 value is 0.9755 (very real). Dose organic material effect on the ratio of C/N soil in the experiment. Dose of 30 tons of organic matter ha $^{-1}$ (B3) yields the average ratio of C/N highest ground (18.10) compared to non-organic materials (10.02). Ratio C/N is generated at dosing of 30 tons of organic matter ha^{-1} (18.10) is the ratio C/N is better, as proposed by Suriadikarta et al .,(2002)[10] that any organic fertilizer ready for the market should be qualified namely: (1) the C/N ratio is a maximum of 20, (2) organic matter content up to 60%, (3) a maximum moisture content of 35%, (4) any organic fertilizer packaging must be included nutrient content, pH and EC. C/N ratio of the organic material is an important aspect in composting and decomposition rate of organic matter. Microorganisms require carbon source for growth and nitrogen for protein synthesis. Organisms typically requires 30 parts by weight of carbon to 1 part nitrogen so that the C/N ratio of 30 is the most efficient value for the composting process (Suriadikarta et al., 2002)[10]. A further decomposition of organic materials that are characterized by a C/N is low, whereas the C/N is high indicates further decomposition or not a new start (Van Veen and Kuikman, 1990)[11]

3. Cation Exchange Capacity

Organic material 30 ton ha^{-1} (B3) yields the highest average soil CEC (23.07 cmol kg^{-1} soil) and significantly different from non-organic materials (20.32 cmol kg^{-1} soil) and 10 ton of organic matter ha^{-1} (21.67 cmol kg^{-1} soil), but did not differ significantly with organic matter 20 ton ha $^{-1}$ (22.71 cmol kg $^{-1}$ soil). Meanwhile, 20 ton of organic matter ha^{-1} significantly different from non-organic materials, but did not differ significantly with organic matter 10 ton ha^{-1}. The relationship between the dose of organic matter and CEC soil test locations are presented in Figure 5.

In Figure 5 shown the relationship between the cation exchange capacity of the soil with organic matter dose was positively correlated in a linear fashion, which means each added dose of organic matter will improve the soil cation exchange capacity. Of the linear equation (y = 20.55 + 0.0928 x) indicates that every additional one unit dose of organic matter to a certain extent will increase soil cation exchange capacity of 0.0928 cmol kg $^{-1}$ soil. 30 tons of organic matter ha^{-1} (B3) resulted in the highest mean soil CEC (23,07 cmol kg $^{-1}$ soil) compared to treatment without application of organic manures, soil CEC (20,32 cmol kg $^{-1}$ soil). Suriadikarta et al., (2002) [10] suggested that the chemical properties of soil organic matter that is very important is the Traffic exchange of cations and anions are very high. CEC is possible due to the high ionization reactive functional groups such as amino, amine, amide, alcohol, aldehyde, carboxyl, carboxylic, phenol, ketone, ether, quinone, and the resulting peptides source of negative charge. Positive surface created by the protonation of amine groups. At pH 4,0 to 8,0 CEC value of organic colloids can be increased by 100%. CEC of soil organic matter can be 2-30 times the CEC colloidal minerals. Therefore, soil organic matter can bind macro elements on the site cation and anion exchange, while the micro elements and compounds of heavy metals through exchange mechanism. Further Suriadikarta et al., (2002)[10] stated CEC clay is generally more stable against changes in pH. Research shows that at pH 3.5 CEC clay and organic-C of 199,5 cmol/kg soil and 45,5 %, while at pH 6,5 turns , respectively 325.5 cmol/kg soil and 63 %. Correlation between soil CEC with a dose of organic matter showed a positive correlation or linear-shaped, which means that any increase in dose of organic matter will improve the soil CEC (Figure 5). This is because organic matter can improve jerap and cation exchange capacity, which is easily interchangeable cations also increased. In line with this Sholeh and Arifin (2002)[13] explains that the organic material has a significant contribution to the CEC, so the higher the CEC of organic matter is also high. Thereby increasing soil CEC is expected to NH_4^+ is not easily leached, it can increase availability of N.

3.3 Components of soil physical

1. Bulk Density

Treatment without organic matter (B0) produced the highest average soil bulk density (0,84 g cm^{-3}) and significantly different from 20 ton of organic matter ha^{-1} (0,78 g cm^{-3}) and 30 ton ha^{-1} (0,73 g cm $^{-3}$). Similarly, 10 tons of organic matter ha^{-1} significantly different with 20 and 30 ton ha $^{-1}$, and 20 ton ha^{-1} different 30 tons ha^{-1}. The relationship between the dose of organic matter and soil bulk density on the location of the experiment is presented in Figure 6.

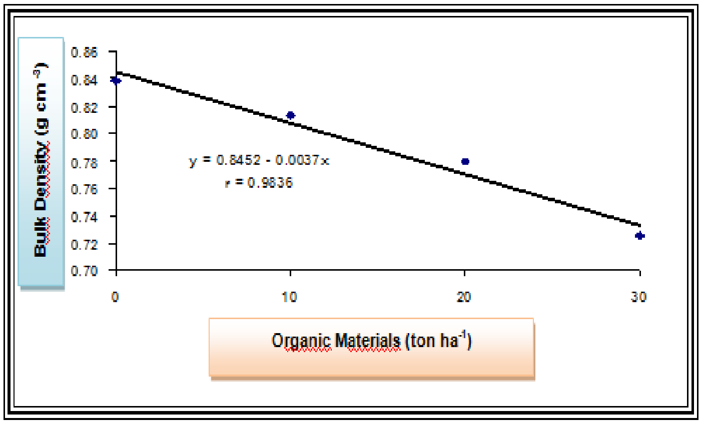

Figure 6. Relationship With The Average Bulk Density Of Soil Organic Matter Dose

In Figure 6 shown the relationship between soil bulk density with a dose of organic matter are negatively correlated in a linear fashion, which means each added dose of organic matter will reduce soil bulk density. Of the linear equation (y = 0.8452 + 0.0037x) indicates that every additional one unit dose of organic matter to some extent will reduce the permeability of 0.0037 g cm^{-3}. Value of bulk density (BD) on the ground that given manure is lower than the control because the value of porosity (total pore space) is higher. This increase may occur in the aeration pore space and pore water providers, so it is a good thing in the Ultisol (Abdurachman and Hidayat 1999)[14]. As with the land in the study is the type Ultisol having granular and crumb structure so that soil aggregates are formed is more stable due to the addition of organic material between the soil particles. The addition of sufficient organic material, causing the soil becomes more friable and better for the growth of plant roots, and better also in relation to the prevention of soil erosion due to more stable aggregates (Barus and Suwardjo, 1988)[15].

2. Permeability

Organic material 30 tonnes ha^{-1}(B3) produced the fastest average soil permeability (76.60 cm $hour^{-1}$) and significantly different from non-organic materials (20.358), 10 ton of organic matter ha $^{-1}$ (42.63 cm hour $^{-1}$) and 20 tonnes ha^{-1} (63.18 cm $hour^{-1}$). Organic materials of 20 tonnes ha^{-1} significantly different with no organic matter and 10 tonnes ha^{-1}, as well as 10 tons of organic matter ha^{-1} significantly different from non-organic materials. The relationship between the dose of organic matter and soil permeability test locations are presented in Figure 7. In Figure 7 shown the relationship between the permeability of the soil with organic matter dose was positively correlated in a linear fashion, which means each added dose of organic matter will improve soil permeability. Of the linear equation (y = 22.451 + 1.8864 x) indicates that every additional one unit dose of organic matter to some degree will increase the permeability of the soil by 1.8864 cm hour $^{-1}$.

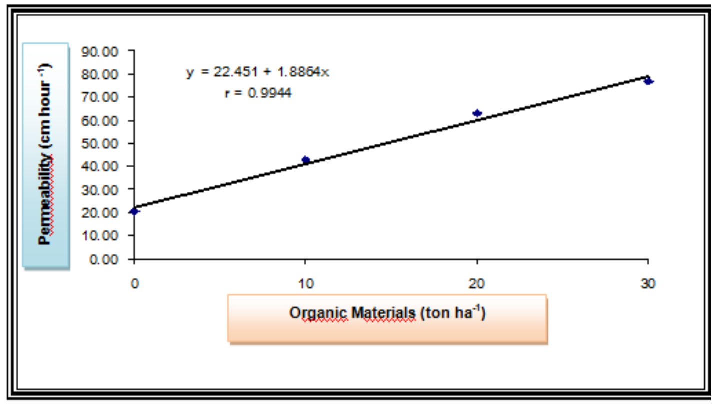

Figure 7. Relations Average Permeability Soil Organic Matter Doses

In Figure 7 shows the relationship between the permeability of the soil with organic matter dose positively correlated in a linear fashion , which means any increase in dose of organic matter will increase soil permeability . Of the linear equation (y = 22.451 + 1.8864 x) indicates that each additional unit dose of organic matter to a certain extent will increase the permeability of the soil by 1.8864 cm $hour^{-1}$. The correlation between the permeability of the soil with organic matter dose was positively correlated shaped or linear , which means that any increase in dose of organic matter will increase soil permeability or increase the infiltration capacity of the soil (Figure 7). It is also in line with research Hussein et al., (1999)[16] which states that the runoff that occurs in the direction of the beds slope greater than the flow on the bed surface contour or cut slopes, with high organic C content, soil permeability faster than the soil infiltration rate more quickly. Hussein et al., (1994) [16] suggested that the conditions of good aeration pore permeability with a quick pace up very quickly to ensure the growth of plants protected from the dangers of water stagnation. The high total soil pore space due to application of organic manures cause high porosity so that high soil infiltration capacity.

4. CONCLUSION

Slice slope planting system not unlike the system in the parallel of the slope of the potato crop production. 30 tonnes of chicken manure ha^{-1} shows the effect of increasing the content of organic C, N in the soil, Ratio C/N, CEC, permeability, and lower soil bulk density. No interaction between the organic material and planting system in the parallel of the slope in slicing or the production of potatoes. Average productivity in cropping systems to cut the number of tubers per plant slopes of 11 bulbs; tuber weight 38.09 tons ha $^{-1}$, while the direction of the slope planting system the number of tubers per plant 9 bulbs; tuber weight 30.68 tonnes ha $^{-1}$.

REFERENCE

[1]. BPS Sulawesi Selatan. 2011. Sulawesi Selatan dalam Angka. Badan Pusat Statistik Provinsi Sulawesi Selatan, Makassar.

[2]. Indranada, H. K. 1985. Soil Fertility Management. Earth Literacy. Jakarta.

[3]. Arsyad, S. 1989. Soil and Water Conservation. Publisher IPB. Bogor.

[4]. Arifin, Z and M. Salah, 2002. Conservation Farming Potato Plant Based on sloping land Plateau, in the Journal of Agriculture BPTP East Java. (http / / www.bptp-jatim-deptan.go.id/info-rekomendasi.html). Accessed on December 20, 2005.

[5]. Arifin, Z., M Salah.,Hardiyanto., Suseno And Istiqomah., 2003. Integrated Farming Systems to Crop Plants Potato Feed for Dryland conservation bench terraces Plateau. in the Journal of Agriculture BPTP East Java. (Online) (http / / www.bptp-jatim-deptan.go.id/info-rekomendasi.html) Accessed July 20, 2006.

[6]. Suripin, 2001. Conserving Soil and Water Resources. Publisher ANDI. Yogyakarta.

[7]. Gaspersz, V. 1994, Rancangan Percobaan untuk Ilmu-Ilmu Pertanian, Biologi dan Teknik, CV. Armico, Bandung.

[8]. Sarief, E. S. 1985. Soil and Water Conservation, Library Buana. Bandung.

[9]. Anonymous.1982. Pests and diseases in potato crops. Ciawi Agricultural Information Center. Department of Agriculture 55p.

[10]. Suriadikarta, T. Prihatini, D. Setyorini, W. Hartatik., 2002. Soil Organic Materials Management Technology. Center for Research and Development of Land and Agro-climate. Agency for Agricultural Research and Development, Department of Agriculture. Bogor.

[11]. Van Veen J.A and P.J Kuikman, 1990. Soil structural aspects of decomposition of organic matter by micro-organisms. Biogeochemistry 13:213-233.

[12]. Stevenson, F.J. 1982. Humus Chemistry Genesis, Composition, Reaction. John Wiley and Sons. New York.

[13]. Sholeh. M. and Z. Arifin, 2002. Conservation Farming Potato Plant Based on sloping land Plateau, in the Journal of Agriculture BPTP East Java. (http://www.bptp-jatim-deptan.go.id/info-rekomendasi.html). Accessed on December 20, 2005.

[14]. Abdurachman, A and A. Hidayat, 1999. Pengelolaan sumber daya lahan dan air untuk mendukung pembangunan pertanian. Seminar Nasional Sektor Pertanian sebagai Andalan Ekonomi Nasional. Jakarta 26-27 Juli 1999.

[15]. Barus, A. and H. Suwardjo. 1988. Rehabilitasi tanah padat akibat pembukaan lahan secara mekanis dengan tanaman penutup dan pengolahan tanah. hlm. 7–16. Laporan Hasil Penelitian Pascapembukaan Lahan Menunjang Transmigrasi di Kuamang Kuning, Jambi. Pusat Penelitian Tanah, Bogor.

[16]. Husein Suganda, Harry Kusnadi, and Law Kurnia. 1999. Effect of row direction and plant beds in controlling erosion in highland vegetable cultivation. Journal of Soil and Climate 17: 55-64. Soil and Agro-climate Research Center. Bogor.