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Soil Chemical Properties and Chilli (*Capsicum Frustescens L*) Yields Following Ameliorants derived from Taliwang Pond- Sidemen and Biocompost Application on the Dryland Farming System of Western Sumbawa, Indonesia

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***Abstract*— *A field study was conducted to evaluate the effects of Taliwang Pond sidemen (TPS) and biocompost application on the soil chemical properties, growth performance and yield of chilli on the dryland farming system in Belo village, Jereweh Sub-district, Western of Sumbawa, Indonesia from February to May 2019. The experiment was set up using a Completely Randomized Design (CRD) consisted of two factors namely sidement (0 t ha^{-1} as S0 and 40 t ha^{-1} as S1) and biocompost (0 t ha^{-1} (K1), 10 t ha^{-1}(K2), 20 t ha^{-1} (K3), 30 t ha^{-1}(K4) and 40 t ha^{-1} as K5) with three replications. The results of study showed that the application of both TPS and biocompost improved soil fertility status (C, P and K) and increased growth and yields of chilli. It was recorded that the application of both TPS and biocompost at rates of 40 t ha^{-1} resulted in the highest yields of chille as results soil fertility improvement. The highest yied was reach two times as compared to the control (plot with no soil organic ammendement).*

***Keywords*— Taliwang pond sedimen, biocompost, and Chilli yield, dryland.**

I. INTRODUCTION

Cayenne pepper (Capsicum frustescens L) is a horticultural commodity that has high economic value in Indonesia. In West Sumbawa Regency (KSB), chilli production is still low so that chilli needs are still partially imported from outside the region. The low chilli production in the KSB is caused by one of the limiting factors related to the low status of soil fertility, including the low content of soil organic matter, unstable soil structure and nutrient poor soils such as N, P, and K. To overcome these problems, management efforts need to be made soil to improve and improve the quality of soil fertility through the addition of organic ameliorant.

Soil cleaners can be obtained from a variety of sources of ingredients containing organic matter, including from sedimentary materials / swamp sediment and compost swamp plant waste. Taliwang swamp sidemen has great potential to be used as soil amendment in the chilli planting system in dry land because it has a high C-organic content of 19.75%, other nutrient content such as total N-0.68%, P-available 8.26 ppm and K-swapped 4.51%, while compost from the Taliwang swamp plant contained 26.3% C-organic, N-Total 1.47%, P was available 0.90 ppm and K was swapped 1.86%. If both materials are added to the soil with low fertility status, it will naturally contribute to improving soil properties. Rosmarkam & Yuwono (2002) explains that sediments with organic matter content of ≥ 35% are classified as very high organic matter content.

The content of organic matter and other nutrients such as high phosphorus in the swamp sidemen is related to the substrate and organic materials that accumulate at the bottom of the water due to the decay of aquatic plants and the contribution of organic material derived from erosion upstream carried by the flow of rivers flowing into the swamps. Sediment is a good place to store phosphorus. Plants and animals that die will be broken down by decomposing bacteria which will then settle to the bottom of the water. Sinaga R. D., et al (2016), phosphorus-bound compounds in sediments can undergo decomposition with the help of bacteria or through the abiotic process to produce dissolved phosphorus compounds. Noor (2018) explained that plants that grow and develop in swamps have the potential to be used as a source of organic material that can improve physical fertility, chemistry and soil biology, including lotus (Nymphaea), water-nail plants (Salvinia natans), water hyacinth (water hyacinth) Eichornia crasipes), Kale (Ipomoea aquatica).

From the various potentials of Taliwang swamp sediments and plants as described above, an experiment has been carried out aimed to determine the effect of Taliwang swamp sedimentation and compost and the interaction of these two components on the chemical properties of the soil and the results of cayenne pepper.

II. MATERIALS AND METHODS

Field trials have been carried out on the dry land in Belo Village, Jereweh District, West Sumbawa Regency 8º51 'LS and 116o49' East with a height of 11 meters above sea level, during the rainy season from February to May 2019. Sidemen used were collected from the basic surface area swamp in the form of muddy solids at a depth of 1 m with a distance of ± 70 meters from the edge of the swamp. 250 kg of fresh sidemen were collected and dried until water levels were close to 14%. While composting uses biomass from aquatic plants (weeds) taken from swamps, finely chopped and dried and mixed with bran, husk and brown sugar with a 10% mixture amount of Taliwang swamp plants prepared. The material that has been mixed is watered with EM4 solution. Mixing is done slowly and evenly until the water content is ± 30-40%. The desired water content is tested by grasping the material, marked by not dripping water when the material is grasped and will bloom when the grip is released. Then the mixed material is put into a sack and the pile of material is covered with a tarp. Curing process lasts for 14 days. After the material becomes compost, the sack can be opened. This compost is characterized by its black, crumbly, non-hot, and odorless color. In such conditions, Taliwang swamp compost can be used as fertilizer. Furthermore, the Taliwang swamp sediment and compost were tested for their chemical content at the Soil Science Laboratory of the Faculty of Agriculture, University of Mataram.

The experiment was designed using a Completely Randomized Design (CRD) consisting of two factors. The first factor is the sidimen application which consists of 2 measurements, namely without sediment (S0) and sediment 40 t.ha-1 (S1). The second factor is the application of Taliwang swamp compost which consists of 5 levels, namely 0 t.ha-1 (K1), 10 t.ha-1 (K2), 20 t.ha-1 (K3), 30 t.ha-1 (K4) and 40 t.ha-1 (K5). The observed variables include variables of soil properties and agronomy. Soil properties observed both before and at the end of the experiment included pH (pH-meter), C-organic content (Walkley and Balack methods), N (Kjeldhal), available-P (Bray-1) and K-exchangeable (NH4OAc extractors) . Laboratory analysis of soil properties was carried out at the soil laboratory, Faculty of Agriculture, Unram. Agronomic measurements include the amount of flowers, fruit and dry weight of the fruit. Experimental data were analyzed by analysis of variance (Analysis of variance, ANOVA) at 5% significance level.

III. RESULTS AND DISCUSSION

1. Effects of Taliwang Swamp Plant Sediment and Compost on Land Chemical Properties

Analysis of soil properties before and after the experiment is shown in table 1. Data Table 1 shows that the administration of Taliwang swamp plant sediments and compost can improve soil properties especially the availability of P and K nutrients.

Table 1. Average soil properties before and after the application of Taliwang swamp sediment and compost

No	Treatment	Soil Chemical Properties				
		pH	C-org	Total-N	P (Bray-1)	K-dd
1	Control	6.60	0.91	0.07	92.17	3.37
2	Compost	7.64	0.82	0.11	101.61	3.98
3	Sediment	7.53	0.81	0.12	95.20	3.99
4	Sediment + Compost	7.53	1.07	0.13	116.06	4.10
5	Before the experiment	6.30	1.06	0.06	4.49	2.28

According to Handayani et, al., (2007) soil quality, cannot be separated from soil fertility status. Soil fertility is the effect of a combination of three main interacting components namely the chemical, physical and biological nature of the soil. Soil fertility in the narrow sense is the availability of plant nutrients at a certain time. The higher the availability of nutrients, the more fertile the soil will be, and vice versa.

Table 1. shows that the soil before the experiment had a low nutrient content, but after the application of sediment and compost there was an increase especially in the nutrient content of P and K.

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While at the end of the experiment the content of C and N slightly increased. In composted plots, the N content which was originally 0.06% increased to 0.11%. In the treatment sediment treatment compartment, the total N increased to 0.12% while in the plot receiving sediment material and compost, the total N reached 0.13%. The increase in N nutrients is not too high, it is suspected because N is mobile in the soil and has been absorbed by many vegetative plant formation. In accordance with what Munawar stated (2011) that the element N is needed in large amounts for the entire vegetative growth process.

The increase in available P reached 101.61 ppm on the use of compost from the initial soil which originally had a P-available content of 4.49 ppm. With the use of sediment increased to 95.20 ppm and with the combination of available sediment and compost P increased to 116.06 ppm.K-exchange increased by 3.98% in the use of compost from the initial soil which originally contained K exchanged by 2.28%, with the use of K sediment exchanged to 3.99% and by combining sediment and compost Taliwang swamp plant K-swapped to 4.10%.

Organic C decreased initially containing 1.06% by giving compost to 0.82%, by giving sediment to 0.81% and by giving sediment and compost to 1.07%. This is thought to be due to uptake by plants and activation of soil microorganisms in increasing nutrients and regulating substances grow. The effect of organic matter on soil biology is to increase microbial activity in the soil and from the results of this microbial activity will be released various growth regulators such as auxin and vitamins that will have a positive impact on plant growth (Sutanto, 2002). Despite a decline in organic C, the provision of organic matter in the soil must be carried out to maintain and increase land productivity. Nikmah (2010) states that continuous planting can deplete soil organic matter. Therefore, the addition of organic material must still be done every time planting to overcome soil degradation (decreased fertility) soil). The provision of organic fertilizer in addition to increasing soil physical fertility, can also increase the availability of nutrients (P and K) for plants. Sutanto (2002) revealed that the addition of organic matter to the soil can increase the availability of nutrients in the soil and be able to improve plant growth and increase soil moisture content.

The results of the diversity analysis showed that the sediment had a significant effect on organic C, total N, available P and K nutrients, compost had no significant effect on the supply of organic C but had a significant effect on the supply of nutrients N, P, K and interactions between sediments occurred and compost in P and K. nutrient elements Analysis of variance (anova) and further tests of Taliwang swamp sediment and compost treatment of organic C, N-total, P-available and K-exchanged C elements can be seen in table 2.

Table 2. Analysis of variance (ANOVA) and further tests of sediment and compost treatment of organic C, N-total, P-available and K-exchanged elements

Treatment	Observation variable C- organic (%)	N-Total (%)	P- available (ppm)	K- swapped (%)
S0	0.84b	0.10b	99.73b	3.89b
S1	1.02a	0.13a	111.89a	4.08a
BNJ	0.15	0.01	3.39	0.46
K0	0.86a	0.09b	93.68c	3.73c
K1	0.93a	0.12ab	105.77b	3.73c
K2	0.96a	0.11ab	106.84b	3.96b
K3	0.89a	0.12ab	109.12ab	4.21a
K4	0.99a	0.13a	114.99a	4.28a
BNJ	0.34	0.03	7.70	0.29

Note: Numbers followed by different letter notation in the same column and row are significantly different based on the tukey test at the 5% level.

Provision of 40 t/ha of sediment on land can increase organic C to 1.02% compared to without sediment only containing 0.84%. Provision of 40 t/ha of sediment gives a significant effect on increasing total N by 0.13% while without administration of total N sediment by 0.10%. Sediment has a significant effect on P. nutrient availability. By administering 40 t/ha the sediment will increase 111.89 ppm P nutrient higher than without the administration of sediment 99.73 ppm. Whereas the exchanged K increased to 4.11% compared without the provision of sediment which had an exchangeable K content of 3.89%.

Compost has a significant effect on N-total, P-available and K-exchanged nutrient content, but does not have a significantly different effect on organic C. N-total increased at 40 t/ha to 0.13% compost, available P increased to 114.99 ppm at 40 t/ha, while exchanged K increased by 4.28% at 40 t/ha Taliwang swamp compost.

2. Interaction of Sediment and Compost Giving of Taliwang Swamp Plant to Soil Nutrients (C, N, P and K)

The interaction of sediment and compost treatment occurs significantly in the availability of P and K nutrients for plants. Analysis of the interaction of sediment and composter treatment on the P-available and K-exchanged elements can be seen in Table 3.

Table 3. Interactions of Taliwang's swampy sediment and compost treatment on P-available elements

P available	Compost s (C)					
	K0	K1	K2	K3	K4	BNJ P-tersedia
Sediment (S)	(without compost)	(10 ton/ha)	(20 ton/ha)	(30 ton/ha)	(40 ton/ha)	
S0	92.17d	99.67cd	99.35d	104.18bcd	104.70bcd	12.88
S1	95.20d	110.56bc	114.33ab	114.66ab	125.29a	
K was switched	Compost s (C)					
	K0	K1	K2	K3	K4	BNJ
Sediment (S)	(tanpa kompos)	(10 ton/ha)	(20 ton/ha)	(30 ton/ha)	(40 ton/ha)	K-tertukar
S0	3.47d	3.62cd	3.83bcd	4.27a	4.24a	0.46
S1	3.99abc	3.99abcd	4.09bc	4.15cd	4.31a	

Note: Numbers followed by different letter notation in the same column and row are significantly different based on the tukey test at the 5% level.

The results of variance showed that the highest increase in P and K nutrients occurred in S1K4 treatment. P is available at 125.29 ppm S1K4 treatments, far higher than controls and other treatments. K exchange in S1K4 increased to 4.31% compared to control (S0K0) and other treatments. In general, P-available and exchanged K developed well when the administration of Taliwang swamp sediment and compost was increased

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3. The effect of the provision of sediment and Taliwang Swamp Plant Compost on the Result of Chili

Interest Amount

Sutrisna and Yanto (2014) state that the presence of sufficient N, guarantees good growth, higher yields and fully developed fruit. The element P influences a lot on flowering and its development, fruit hardness, fruit color, vitamin content and accelerates fruit maturation. Element K influences the increase in sugar content, vitamin content, total acid content and increases the amount of fruit harvested

Table 4. Factors for the treatment of sediment and compost as well as further testing of the average number of cayenne pepper plants at the age of 56hst to 98 hst

Treatment	Amount of interest			
	56 hst	70 hst	84 hst	98 hst
S0	11.72b	14.09b	38.67b	45.73b
S1	28.88a	38.81a	90.67a	98.07a
BNJ	7.10	8.64	36.06	27.07
K0	11.93b	13.67b	48.26b	46.77d
K1	16.24ab	24.18ab	54.07b	60.35cd
K2	20.90ab	26.39ab	64.58b	71.86bc
K3	23.93ab	33.21ab	68.34ab	85.66ab
K4	28.50a	34.66a	88.80a	94.88a
BNJ	16.18	19.69	21.96	16.14

Note: Numbers followed by different letter notation in the same column and row are significantly different based on the tukey test at the 5% level.

Table 4 shows that the treatment of sediment and compost has a significant influence on the flowering of cayenne pepper plants. This can be seen in the results of the ANOVA variations at each observation interval. The best increase in the amount of flowers occurred in the provision of sediment 40 t/ha with an average number of flowers reaching 32.55 flowers at 56 days after planting, 39.23 flowers at 70 days after planting, 83 flowers at 84 days after planting and 104 flowers at 98 days after planting, whereas without sediment administration the average number of flowers at 56 days after birth is 7.06 flowers, 11.26 flowers at 70 days, 33.30 flowers at 84 days and at 98 days after only reaching 47.7 flowers.

In compost treatment, the highest number of flowers occurred in the provision of compost of 40 t/ha at the age of 98 days as many as 94.88 pieces, while without the provision of compost that was 46.77 fruit per planted flowers. This is presumably due to the role of P and K nutrients available through the provision of Taliwang swamp compost. The availability of these nutrients can increase the growth and productivity of chili plants (Alhrout, 2017). Between the two treatments there was no significant interaction seen on the number of flowers observed.

Number of Fruits

The number of fruits per plant increased with increasing doses of Taliwang swamp sediment and compost as shown in table 5.

Table 5. Factors for the treatment of sediment and compost as well as further testing of the number of cayenne pepper at the age of 56 hst to 98 hst

Treatment	Amount of fruit			
	56 hst	70 hst	84 hst	98 hst
S0	0.38b	4.90b	8.81b	30.08b
S1	0.52a	15.4a	25.47a	60.49a
BNJ	0.09	11.66	10.44	25.51
K0	0.170c	5.854b	7.54c	25.62c
K1	0.33bc	7.48b	12.69bc	36.88bc
K2	0.45b	10.67ab	15.71b	38.75bc
K3	0.53b	11.48ab	23.99a	57.83ab
K4	0.78a	15.33a	25.75a	67.36a
BNJ	0.09	6.98	6.25	25.51

Note: Numbers followed by different letter notation in the same column and row are significantly different based on the tukey test at the 5% level.

Table 5 shows that sediment has a significant effect on increasing the number of fruits at each observation interval. At the age of 98 days without the provision of sediment the number of fruits produced was only 30.08 fruit crops, but by giving sediment the average number of fruits could reach 60.49 fruit crops. As with compost sediment, it also affects the increase in the number of cayenne pepper. At the age of 98 days after giving 40 t / ha of cayenne compost can produce 67.36 fruits per crop, whereas without compost the number of fruits is only 25.62.

The addition of fruit is thought to be due to the sedimentation and compost of Taliwang swamp plant which is able to activate soil microorganisms in increasing N, P and K nutrients. These elements have their respective roles in sustaining plant growth. Nitrogen is a constituent of plants that determines the quality of plant organic matter. Nitrogen is present in a variety of plant protein compounds, nucleic acids, hormones, chlorophyll and a number of primary and secondary metabolite compounds. Nitrogen is also essential for cell division, cell enlargement, and for growth (Gardner et al., 1991). Phosphate compounds in plants act as energy dealers and energy storage needed for growth and reproductive processes (Salisbury and Ross, 1995). Potassium serves as a transportation medium that carries nutrients from the roots including P nutrients to the leaves and translocates assimilates from the leaves to the entire plant tissue. According to Lingga and Marsono (2001) the main function of potassium (K) is to help the formation of protein and carbohydrates. Potassium also plays a role in strengthening the body of the plant so that leaves and fruit do not fall easily. So that with the availability of nutrients N, P, and K plant growth for the better. Plant growth is good then the production will also be good.

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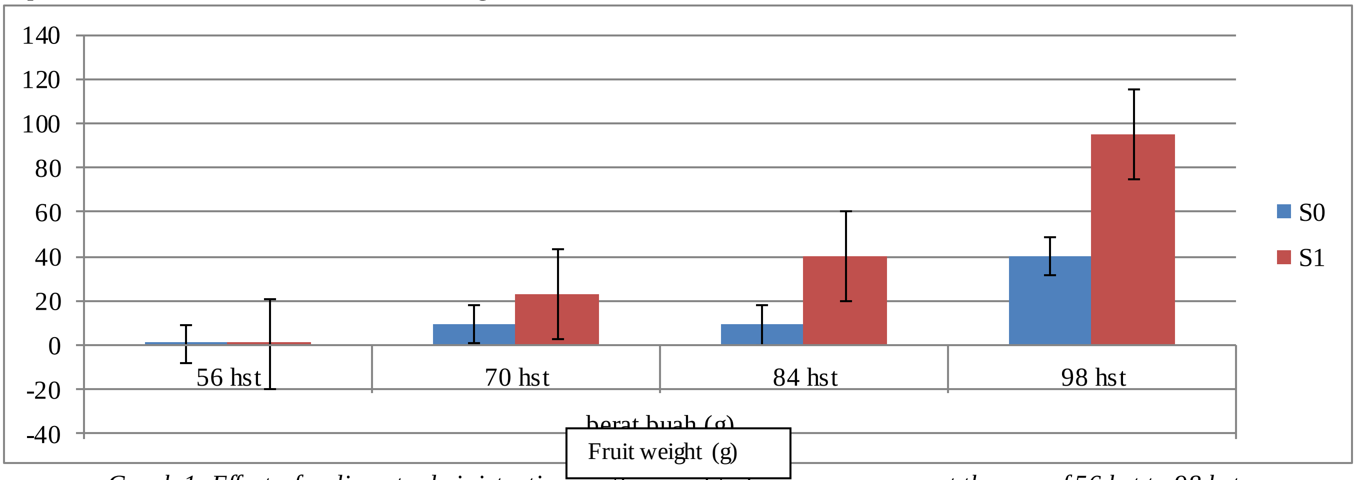
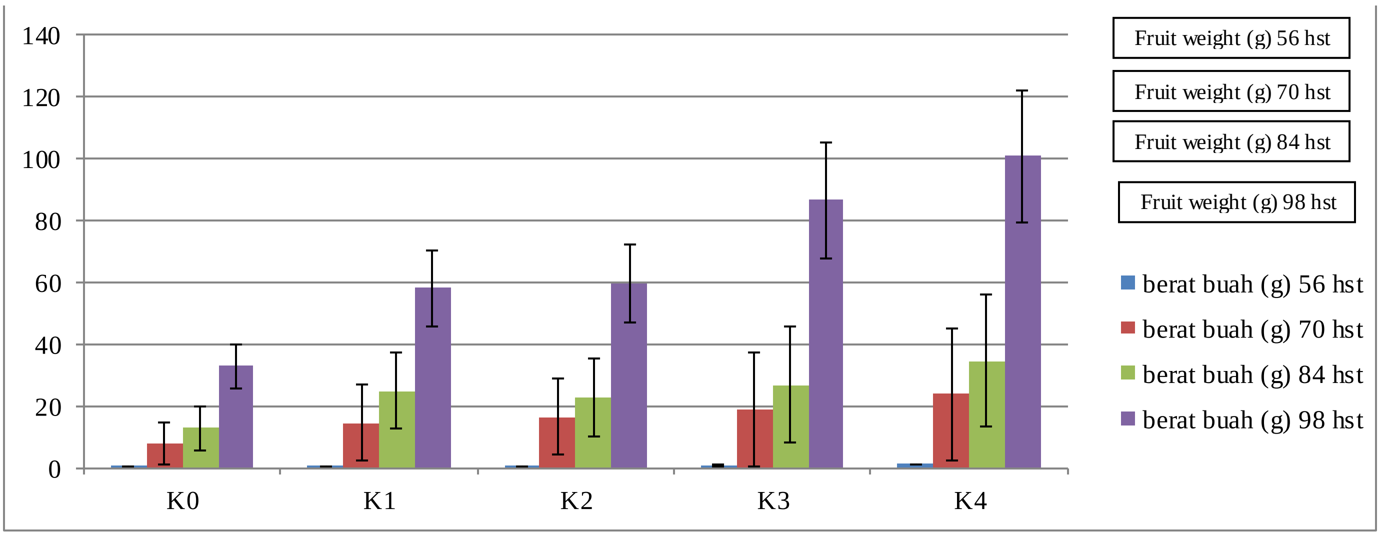
Fruit Weight

Treatment of sediment and compost and the interaction between the two treatments gave a significant effect on the weight of chillies at all observation intervals. The increase in the weight of cayenne is thought to be because sediment and compost are able to provide a large amount of P and K nutrients. These elements are very important for fruit formation and fruit weight. Primanto (1998) states that in the generative period plants need a lot of nutrients to produce energy for plants, namely phosphorus and potassium. Energy is needed by plants in forming flowers, fruit and other growth processes. The effect of sediment and compost on the weight of cayenne pepper at the age of 56 hst up to 98 hst can be seen in graphs 1 and 2



Graph 1. Effect of sediment administration on the weight of cayenne pepper at the age of 56 hst to 98 hst

Graph 1. shows that giving 40 t/ha of sediment can increase the average fruit weight of cayenne pepper. The effect of sediment is greater on the average fruit weight when cayenne peppers reach adulthood. At the age of 56 HST, the weight of cayenne pepper did not show a significant difference between sediment and those without sediment. Weight of fruit at the age of 56 hst 0.7 g in plants that received sediment and 0.46 g in plants that were not given sediment. Significant improvement began to be seen in the observation of 70 days to 98 days. At the age of 98 days the weight of the fruit without the administration of sediment was only 39.87 g, but with the administration of 40 t/ha of sediment, the average fruit weight could reach 94.93 g or 2 times heavier compared to plants without sediment administration.



Graph 2. The effect of compost on the weight of cayenne pepper at the age of 56 to 98 hst

Graph 2. Shows that compost treatment has a significant effect on average fruit weight at all observation intervals. The higher the amount of Taliwang swamp compost, the higher the weight of cayenne pepper.

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From observations of 56 DAT to 98 DAT, 40 t / ha of compost had the highest fruit weight, namely 1 g at 56 DAT, 23.8 g at 70 DAT, 34.41 g at 84 DAT and 100.61 D at 98 DAT while plants without compost has the lowest weight at each observation interval which is 0.32 g at 56 days after planting, 7.89 g at 70 days after planting, 12.67 g at 84 days after planting and 32 g at 98 hst after planting.

An interaction between sediment and compost treatment occurred on the weight of cayenne pepper as shown in table 6.

Table 6. Interaction Factors of sediment and compost treatment on the weight of cayenne pepper

56 hst	Kompos (K)					
	K0	K1	K2	K3	K4	BNJ
Sediment (S)	(without compost)	(10 ton/ha)	(20 ton/ha)	(30 ton/ha)	(40 ton/ha)	
S0	15.09c	39.91bc	43.08bc	47.79bc	53.50bc	47.51
S1	50.29bc	75.85b	75.85b	124.97a	147.72a	

Note: Numbers followed by different letter notation in the same column and row are significantly different based on the tukey test at the 5% level.

Table 6 shows that sediments and compost are able to increase the weight of crop fruit. Provision of sediment and compost with increasing amounts helps plants produce fruit with a higher weight. This is thought to be due to the P and K nutrients produced through the provision of Taliwang swamp sediment and compost. P and K are very important for fruit formation in accordance with the report of Dewi (2016) which states that the presence of phosphate elements in plants can increase fruit yields. After the fruit is formed phosphate plays a role in the weight of the fruit to form proteins, minerals and carbohydrates in the fruit. Fruit weight is an indication of the results of photosynthesis stored in fruit flesh and other constituent parts of the fruit (Novizan, 2002). The percentage of flower to fruit is also influenced by nutrient Potassium. As stated by Lingga & Marsono (2001) that Potassium plays a role in strengthening the body of the plant so that leaves, flowers and fruit do not fall easily.

IV. CONCLUSION

Based on the results and discussion described above, the following conclusions can be drawn:

1) The application of Taliwang Sediment and compost for the Swamp plant does not have a significant effect on the supply of organic N and C, but it is very influential on increasing P and K nutrients.
2) Taliwang swamp sediment and compost have a significant effect on increasing the number of flowers, fruit and weight of cayenne pepper
3) Provision of 40 t / ha of sediment and 40 t / ha of Taliwang swamp compost can increase the number of flowers, fruit and weight of cayenne fruit up to 2 times compared without the provision of Taliwang swamp sediment and compost.

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REFERENCES

[1] Alhrout H. 2017. Response of Growth and Yield Components of Sweet Pepper to Tow Different Kinds of Fertilizers under Green House Conditions in Jordan. *Journal of Agricultural Science*. 9(10):265-272. DOI: 10.5539/jas.v9n10p265

[2] Dewi W. W. 2016. Response of Goat Manure Dose to Cucumber Growth and Yield (*Cucumis sativus* L.) Hybrid Varieties. *Jurnal Viabel Pertanian*. 10(2):11-29.

[3] Gadner, F. P., R. B. Pierce, dan R. L. Mitchell. 1991. Cultivation Plant Physiology. UI Press, Jakarta.

[4] Handayani E. P., Yatmin., dan Supriyadi. 2015.Effect of Ameliorant Type and Dosage on Growth and Yield of Rice (Oryza Sativa L) During Planting Period 1 and 2. Proceedings of the National Seminar on Specific Location Agroinovations for Food Security in the Era of Economic Community ASEAN

[5] Lingga P. & Marsono. 2005. Instructions for use of fertilizers, Penebar Swadaya. Jakarta. 250 hlm.

[6] Munawar A. 2011. Soil Fertility and Plant Nutrition.Institut Pertanian Bogor Press. Bogor. 240 hlm.

[7] Noor R. 2018.Lebak swamp weeds as a Potential Source of Organic Materials. Swamp Farm Research Institute. National Seminar on Swamp Farming

[8] Primanto H. 1998. Fruit Fertilization. Penebar Swadaya, Jakarta.

[9] Rosmarkam A., dan N.W. Yuwono. 2002. Soil Fertility. Kanisius.Yogyakarta

[10] Sutrisna N. & S.Yanto. 2014. NPK Formula Test in the Lembang Highland Cayenne Pepper Plantations. West Java. Agros. 16(1):172-181.