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RESEARCH ARTICLE

Increasing Production Of Purple Sweet Potato (*Ipomoea Batatas Poir*) By Treatment Of Shimmer Fertilizer and Kaliphos

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Abstract

The title of the research was "Increased Production of Purple Sweet Potato (Ipomoea batatas poir) with Vermicompost and Kaliphos Fertilizer Treatment". This research was carried out for 4 months in the experimental garden of the Faculty of Agriculture, Islamic University of Riau. The purpose of this study was to determine the effect of interaction and the main effect of increasing purple sweet potato production by the treatment of vermicompost and Kaliphos fertilizer. The design used was a completely randomized factorial design consisting of two factors. The first factor was vermicompost fertilizer (K) with 4 levels: 0. 550. 1.100. 1,650 g/bundle. The second factor is Kaliphos fertilizer: 0.5. 10. 15 g/plant. Parameters observed were the number of tubers per plant (fruit), tuber weight per tuber (g), tuber weight per plant (kg), tuber production per mound (kg), harvest index, and fresh chestnut weight per plant (kg). The last observational data were analyzed statistically and continued with the BNJ follow-up test at level 5 %.

The results of the study conclude that the interaction effect of vermicompost and caliphos fertilizer is significant on tuber weight per tuber, tuber weight per plant, tuber production per mound, harvest index, and fresh chestnut weight per plant. The best treatment dose was 1,650 g/mound and Kaliphos 15 g/plant (K3L3). The main effect of vermicompost fertilizer is real in all treatments. The best treatment dose is 1,650 g/mound (K3). The main effect of caliphos fertilizer is significant for all treatments. The best treatment dose is 15 g/plant (L3).

Keywords: *Production, Vermicompost, Kaliphos, Interaction, Tubers*

1. Introduction

1.1 Background of the problem

Sweet potato (*Ipomoea batatas L*) is a plant originating from the West Indies (Latin America). Sweet potato is widely available in Irian Jaya. Sweet potato is used as a staple food and is one of the most important palawija crops because it is a large non-oil and gas export commodity, especially with advances in technology for processing tubers into syrup, sugar, flour, sauces and alcohol. which is used as energy. Purple sweet potato contains starch, sugar and fiber such as cellulose, hemicellulose and pectin. Purple sweet potato is a type of tuber that has purple flesh color and contains nutrients that are important for the body. The purple color of the tubers is influenced by the presence of anthocyanins ranging from 51.50 to 174.70 mg, which contain phenolic chemical compounds such as vitamin C, β-carotene, thiamin, niacin, riboflavin, and minerals. Purple sweet potato can be used as a healthy food choice for the community. (Anonim, 2008).

The low production of sweet potatoes in Indonesia, especially in Riau province, is caused by a cultivation system that has not been carried out intensively, it is still traditional, and it has a small land area, and the use of agricultural land continuously without regard for its fertility. While the use of fertilizers is still lacking, this is due to the high price of fertilizers making it increasingly difficult for farmers to apply fertilization according to the recommended dosage. In addition, farmers unknown the proper use of fertilizers that must be given to increase the production of sweet potato plants.

The use of vermicompost fertilizer is an alternative that has the potential to increase sweet potato production, because vermicompost has several benefits, namely: increasing soil and plant productivity, speeding up harvest time, loosening or fertilizing the soil, and is good for planting media. In terms of the nutrients contained therein, the quality of this vermicompost fertilizer resembles that of inorganic fertilizers. when viewed from the completeness of the nutrients this fertilizer is much better because almost all the nutrients needed by plants are available and contain growth hormones that can maximize plant growth and yield. (Sutikno, 2009). Kascing organic fertilizer provides the highest yield of fresh tubers per hectare compared to cow manure and temesi compost, the use of vermicompost fertilizer on purple sweet potato varieties is still up to a dose of 15 t/ha, yields of fresh tubers on hectare (Goya, 2009).

Kaliphos MKP is an artificial fertilizer that contains a lot of K2O as much as 32.0% potassium is one of the essential macronutrients needed by plants in large quantities. The nutrients contained are following the needs of plants that require macro and micro cations such as sweet potatoes. The composition of the elements it contains is also very balanced thus the availability of nutrients that are ready to be absorbed by the roots in the generative phase and tuber formation will be fulfilled, especially during the nitrogen absorption phase in the formation of roots, stems, and leaves. Based on the description above, the author has finished researching "Increasing Production of Purple Sweet Potatoes (*Ipomoea batatas poir*)" with Vermicompost and Kaliphos Fertilizer Treatment.

2. Literature review

Sweet potato includes a single leaf that grows on the stem. The shape of purple sweet potato leaves (mendut) is pointed or serrated with green-purple leaf color, faded and purple color. And in the leaf axils grow several roots which can grow and become tubers (Jedeng, 2011). Sweet potato plants cannot tolerate waterlogging, and poorly drained soil can cause stunted growth, yellowing of leaves, and rotting tubers. Sweet potato can grow at soil acidity (pH) 4.5-7.5 but is optimal for tuber growth at pH 5.5-7. When young, sweet potato plants need sufficient soil moisture. Sweet potatoes prefer crumbly sandy loam soils that are well-drained, with adequate aeration. Soil compaction adversely affects the shape and size of tubers (Trisnawati, 2006).

According to Jedeng (2011), vermicompost fertilizer is a type of organic fertilizer produced by mixing earthworm media and earthworm manure. Vermicompost contains nutrients and ZPT such as gibberellin hormones, cytokinins, auxins, nutrients N, P, K, Mg, Ca, and Azotobacter, sp, which are non-symbiotic N-fixing bacteria needed for plant growth and development. Vermicompost contains 3.310% organic C, and 1.480% total N, which is very high. Judging from the nutrients contained therein, the quality of this vermicompost fertilizer resembles that of inorganic fertilizers. When viewed from the completeness of the nutrients this fertilizer is much better because the nutrients needed by plants are available and can improve the quality of plants (Sudiarto, 2001). Vermicompost fertilizer or used worm manure (Faces) in powder form, black which is smaller in size than ordinary soil particles, making it more suitable for plant growth which is useful for: 1) increasing productivity, 2) speeding up harvest time, 3) loosening or fertilizing the soil, 4) good for seeding planting media (Mulat, 2003).

Kascing is an organic material containing complete nutrients, both macro and micro elements which are useful for plant growth. The vermicompost composition includes N 0.63%, P 0.35%, K 0.20%, Ca 0.23%, Mg 0.26.2%, Na 0.07%, Cu 17.58%, Zn 0.007%, Mn 0.003%, Fe 0.790%, B 0.210%, Mo 14.48%, CEC 35.80 meg/100 gram and humus acid 13.1.88%. In addition, vermicompost contains azotobacter bacteria, sp, which are free N-fixing bacteria in the air (Mulat, 2003). Kaliphos MKP is an artificial fertilizer that contains a lot of K2O as much as 32.0% potassium is one of the essential macronutrients needed by plants in large quantities. Potassium is absorbed by plants in the form of K+ ions in the soil. These ions are dynamic, thus they are easily washed away by sandy soils and soils with low pH. Potassium is the most abundant nutrient element for sweet potato plants. The average use of caliphos fertilizer on sweet potato plants is 450 kg/ha, equivalent to 15 g/plant (Agustina, 2004). Phosphate As one of the main macronutrients for plants, the main problem with phosphate is its low availability for plants due to fixation by lansir absorbent p in the soil such as Al3+, Fe2+, and Mn2+. Fertilization is done every growing season causing more and more P deposits as soil P residues (Damanik et al. 2010). The nutrients contained are following the needs of plants that require macro and micro cations such as sweet potatoes. The composition of the elements it contains is also very balanced thus the availability of nutrients that are ready to be absorbed by the roots in the generative phase and tuber formation will be fulfilled, especially during the nitrogen absorption phases in the formation of roots, stems, and leaves.

3. Research methodology

3.1 Experimental design

The design used in this study was a factorial Completely Randomized Design (CRD) consisting of two factors. The first factor was the K factor (Kalyphos Fertilizer) which consisted of 4 levels and the L factor (kaliphos fertilizer which consisted of 4 levels thus 16 treatment combinations were obtained, each treatment consisting of three replications thus 48 experimental units were obtained. Each treatment combination contained 4 plants and 2 plants were used as sample plants, the total number of plants was 192 plants. The treatment is as follows: The first factor is vermicompost (K) consisting of 4 levels:

K0 = Without vermicompost fertilizer
K1 = 550 g/bundle (7.5 tons/ha)
K2 = 1,100 g/bundle (15 tons/ha)
K3 = 1,650 g/bund (22.5 tons/ha)
The second factor, namely Kaliphos (L) consists of 4 levels:
L0 = Without caliphos fertilizer
L1 = 5 g/plant
L2 = 10 g/plant
L3 = 15 g/plant
From the two factors above, a combination of treatments is obtained in Table 1.1 below

Data from the last observations of each treatment were analyzed statistically if the calculated F is greater than the F table then it is continued with the Follow-Up Test for Honest Significant Differences (BNJ) at level 5%.

Table 3.1 Combination of Vermicompost and Kaliphos Dosage Application Treatment on Purple Sweet Potato Plants.

Treatment of Kascing Fertilizer (K)	Treatment of Kaliphos MKP (L)			
	L0	L1	L2	L3
K0	K0L0	K0L1	K0L2	K0L3
K1	K1L0	K1L1	K1L2	K1L3
K2	K2L0	K2L1	K2L2	K2L3

3.2 Research Implementation

A. Land Preparation and Land Processing

The place that has been used for research is measured first with an area of 14 x 5 meters. Then the land was cleared of dirt such as trash and wooden branches that would interfere with the research process using hoes, machetes, and rakes. After cleaning, the soil was loosened by turning the soil over using a hoe and rake. Then 48 (4 x 12) mounds were formed with mounds measuring 1.2 x 0.6 m, height 40 cm, spacing between bunds 30 cm, and spacing 90 x 60 cm. B. Labeling Labels are attached according to each treatment on the prepared bunds and then adjusted to the layout of the research in the field. Labeling is done one day before giving treatment, which aims to facilitate treatment and observation.

C. Material Preparation of Cuttings

The material used for cuttings is stem cuttings obtained from plants that are more than 2 months old and have not yet had roots on the stem nodes. The cuttings are cut with a

uniform number of buds, namely as many as 4 buds. The leaves on the cuttings of the planted plants are cut and one leaf is left on the top segment.

D. Planting

The cuttings used are 20 cm long, taken from the end of the stem, 2/3 of the lower part of the plant is immersed in the soil and 1/3 of the top. Then the hole is covered with soil and the tip of the seed is directed to the middle of the bed. In each bund, there are 4 plants.

E. Giving Treatment

a. Provision of Kascing Fertilizer Vermicompost fertilizer was given once during the study, namely one week before planting according to the dose of plant treatment, by sprinkling vermicompost fertilizer into the planting hole according to the dose, namely K0 = 0 g vermicompost/mound, K1 = 550 g / mound, K2 = 1,100 g vermicompost /mound, K3 = vermicompost 1,650 g/mound.

b. Application of Kaliphos Fertilizer Giving Kaliphos is done when planting using an array around the plant with a distance between 5 cm from the base of the plant stem. Treatment according to the dosage, namely L0 = Kaliphos 0 g/plant, L1 = Kaliphos 5 g/plant, L2 = Kaliphos 10 g/plant, L3 = Kaliphos 15 g/plant.

F. Maintenance

a. Sprinkling Watering is done twice a day, namely in the morning and evening. Watering is done using Gembor. Watering was stopped 21 days before harvest.

b. Weeding was carried out on weeds growing around the plants and the research area, and weeding was carried out 2 weeks after planting at intervals of 2 weeks. Weeds that grow around the plants are removed by hand, while those that grow in the ditches are weeded using a hoe. Furthermore, weeds were removed outside the study area.

c. hoarding Hoarding was carried out 5 times with an interval of 3 weeks, starting at the age of 14 HST, 35 HST, 56 HST, 77 HST, and 98 HST. to cover the tubers around the roots, to loosen the soil around the roots while controlling weeds around the plants.

d. Pruning is done on shoots that grow on the main stem. Shoots that grow more than one cut and leave only 1 bud. Pruning is done 1 time when the plant is 30 HST.

e. Stem Reversal Stem reversal is done when the sweet potato stems grow out of the mounds and the nodes of the stems swell and give off roots. Reversal is done by turning the stem downwards upwards thus the roots that grow at the nodes of the stem do not stick to the ground anymore. Furthermore, plant stems that come out of the mounds are collected in the middle of the mounds. Stem reversal was carried out 3 times during the study, namely when the plants were 30, 60, and 100 hst..

f. Control of pests and diseases

Pest and disease control is carried out preventively and curatively. Preventive control is to prevent pest and disease attacks by keeping the research location clean of weeds and other waste that can host pests and diseases, as well as the application of pesticides, namely dithan M-45 to prevent disease attacks with a dose of 2 g/liter of water, which is sprayed on plants 2 weeks after sowing.

G. Harvest Harvesting is done after the plants are 4 months old with the criteria of yellowish green leaves, pink tuber skin color, and purple tuber flesh. Harvesting is done by scraping the soil around the base of the plant stems, after the tubers are seen the tubers are removed and cut from the plant stems. After being harvested, the tubers are cleaned of adhering soil.

3.3 Observation Parameters

A. Number of Bulbs per Plant (fruit) This observation was carried out by counting all the tubers formed in the sample plants. Then the data obtained from the observations were averaged and then analyzed statistically and presented in tabular form.

B. Tuber Weight per Tuber (g)
This measurement was carried out by weighing the tubers formed one by one in the sample plants. Then the data obtained from the observations were analyzed statistically and presented in tabular form.

C. Tuber Weight per Plant (kg)
Observations was made after the tubers were cleaned of adhering soil by weighing the tubers per plant on the sample plants. Then the data obtained from the observations were analyzed statistically and presented in tabular form.

D. Tuber Production Per Bundle (Kg)
Observation of tuber production per bund This is done by weighing all the tubers produced in each bund. The data obtained were analyzed statistically and presented in tabular form.

E. Harvest Index
Observation of the harvest index was carried out at the end of the study by weighing the sample tuber weight and then dividing it by the approximate weight using the formula: A/B. Information: A = wet tuber weight (g), B = approximate weight

F. Wet Stove Weight per Plant (kg)
Observation of fresh body weight per plant was carried out by taking all parts of the plant in the sample plants, the data obtained from the observations were analyzed statistically and presented in tabular form..

3. Results and Discussion

1. Number of Bulbs per Plant (fruit)
The results of observations on the number of tubers planted with purple sweet potato plants, but in particular, vermicompost fertilizer and caliphos fertilizer had a significant effect. The average number of tubers planted with purple sweet potato after planting was tested after analysis of variance showed that the interaction between Kascing Fertilizer and Kaliphos Fertilizer had no significant effect. the average number of purple sweet potato tubers after the BNJ advanced test at the 5% level is shown in Table 2.1

Table 4. 1 Average Number of Tubers per Plant with Vermicompost Fertilizer and Kaliphos (fruit).

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer (g/plant)				Average	
	L0 (0)	L1 (5)	L2 (10)	L3 (15)		
K0 (0)	2,33	2,33	2,67	2,83	2,54	c
K1 (550)	3,17	3,17	3,33	3,67	3,33	b
K2 (1.100)	3,67	4,17	4,67	4,83	4,33	a
K3 (1.650)	3,83	4,83	5,00	5,50	4,79	a
Average	3,25 c	3,63 bc	3,92 ab	4,21 a		
KK = 11,39%	BNJ K&L = 0,47					

The data in Table 4.1 shows that the main treatment of vermicompost fertilizer had a significant effect on the

number of tubers per plant, where the application of vermicompost fertilizer at a dose of 1,650 g/mound (K3) produced the highest number of tubers, 3 tubers and was not significantly different from the K2 treatment. The main effect of Kaliphos fertilizer was to have a significant effect on the number of tubers planted, where the application of Kaliphos fertilizer at a dose of 15 g/plant (L3) produced the highest number of tubers, 3 tubers and was significantly different from the L1 treatment. In addition, in the opinion of Sumartono (2013) that tuber formation is strongly influenced by environmental conditions or growing media, lack of oxygen as a result of poor soil aeration can often inhibit cell division and enlargement in tuber roots and the development of new tubers.

Giving caliphos to sweet potato plants can increase the number of tubers per plant. Giving caliphos as much as 15 g/plant has an effect on the number of tubers per plant compared to no caliphos fertilizer. It is suspected that applying caliphos fertilizer to sweet potato plants can provide the nutrients needed by plants such as P and K elements thus plant growth, both stems, leaves and plant roots become better and more tubers are formed. The low number of tubers per plant in the treatment without casting and caliphos fertilizers was due to the effect that growth and tuber formation did not take place properly. As a result, the growth and development of roots are hampered by the availability of soil nutrients that do not support them because there is no treatment (fertilization)..

2. Tuber Weight per Tuber (g)

The results of observing tuber weight per tuber after analysis of variance (appendix 4b) showed that both interaction and the main effect of Kascing Fertilizer and Kaliphos Fertilizer had a significant effect on tuber weight per tuber. BNJ test results at the 5% level can be seen in Table 4..2

Table 4.2 Average Weight of Tuber per Tuber with Vermicompost and Kaliphos Fertilizer (g)

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer (g/plant)				Average
	L0 (0)	L1 (5)	L2 (10)	L3 (15)	
K0 (0)	97,5 h	140,0 fgh	180,4 fg	380,2 de	199,5 d
K1 (550)	105,4 gh	200,3 fg	285,9 def	500,3 bc	272,9 c
K2 (1.100)	160,5 fgh	250,6 efg	435,1 cd	580,1 b	356,6 b
K3 (1.650)	245,7 efg	370,0 de	560,3 b	645,4 a	455,4 a
Average	152,8 d	240,2 c	365,4 b	526,7 a	
KK = 7,55%	BNJ K&L = 70		BNJ KL : 58		

Table 3.1 shows that interactively the increase in purple sweet potato production with the treatment of vermicompost and caliphos fertilizers was significant in tuber weight per tuber. Where the best treatment was found in the application of vermicompost fertilizer 1,650 g/mound and kaliphos fertilizer 15 g/plant (K3L3) which had the heaviest tuber weight per tuber of 645 g and was not significantly different from the K3L2 treatment, but significantly different from other treatments. Meanwhile, the lowest tuber weight per tuber was found in the K0L0 treatment with a weight of 97.5 g. Subhan, (2004), states that the macro-nutrient content of inorganic fertilizers is needed for plant growth because inorganic fertilizers can provide nutrients in a relatively short time, produce available nutrients that are readily absorbed by plants, and contain more nutrients, the most abundant elements. Dominant elements found in inorganic fertilizers are N, P, and K. Following the statement of Djalil et al. (2004) that the element potassium plays an important role in the formation and translocation of carbohydrates for plants. The availability of sufficient potassium for cassava plants causes the process of forming carbohydrates and their translocation to tubers to run smoothly. The depth of the roots of sweet potato plants is not more than 45 cm. Usually, 15% of all the roots that are formed will thicken and form barn roots that grow shallow. The tuber size increases as long as the leaves are still actively photosynthesizing.

3. Tuber Weight per Plant (kg)

The results of observing tuber weight per plant after analysis of variance (appendix 4c) showed that both interaction and the main effect of Kascing Fertilizer and Kaliphos Fertilizer had a significant effect on tuber weight per plant. BNJ test results at the 5% level can be seen in Table 4.3

Table 4.3 Average Weight of Tuber per Plant with Vermicompost and Kaliphos Fertilizer (kg).

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer (g/plant)				Average
	L0 (0)	L1 (5)	L2 (10)	L3 (15)	
K0 (0)	0,14 h	0,28 fgh	0,40 fg	0,53 de	0,34 d
K1 (550)	0,24 gh	0,42 fg	0,47 def	0,73 bc	0,47 c
K2 (1.100)	0,37 fgh	0,47 efg	0,58 cd	0,89 ab	0,58 b
K3 (1.650)	0,44 efg	0,55 de	0,87 ab	1,06 a	0,73 a
Average	0,30 d	0,43 c	0,58 b	0,80 a	
KK = 4,60%	BNJ K&L = 0,12		BNJ KL : 0,18		

The numbers in the columns and rows followed by the same lowercase letters are not significantly different according to the Honest Significant Difference (BNJ) test at level 5 %.

Table 4.3 shows that the increase in purple sweet potato production with vermicompost and caliphos fertilizer treatment was significant in tuber weight per plant. Where the treatment of vermicompost fertilizer 1,650 g/bundle and Kaliphos dose of 15 g/plant (K3L3) had the heaviest tuber weight per plant, namely 1.06 kg/plant, not significantly different from the K2L3 and K3L2 treatments, but significantly different from other treatments. Meanwhile, the lowest tuber weight per plant was found in the K0L0 treatment with a weight of 0.14 kg. The tuber weight per plant of purple sweet potato in the K3L3 treatment was a combination that showed that the dose for each treatment was following the needs of the purple sweet potato plant, thereby affecting plant growth and development. This is due to the ability of plant organs, such as roots, to absorb and penetrate the soil to absorb nutrients, water, and oxygen in the soil. The ability of the stem organs to supply nutrients and water to the leaves and carry out the process of photosynthesis and respiration thus photosynthate increases as a result, more and more carbohydrates are formed, which in turn stimulates plant growth and development.

In addition, the development of the generative phase is closely related to vegetative growth, if the vegetative growth is good it will support the generative phase. Besides this, it is also influenced by the presence of cation exchange capacity, namely the ability of the soil to provide or receive cations, nutrients, or plant nutrients. this is because vermicompost fertilizer provides balanced and available amounts of N, P, K, Ca, and Mg nutrients, increases organic matter content, increases the soil's ability to bind loosely, and provides plant growth hormones. The process of formation and enlargement of tubers requires a sufficient amount of K nutrient. Providing sufficient K in addition to increasing tuber weight, also increases starch content and reduces HCN content in tubers, as well as adding nutrient requirements for each plant is different.

Guwet (2009), in the results of his research, stated that the high tuber weight per sweet potato plant was due to the number of tubers and tuber weight per tuber. This is because there is a directly proportional relationship between the number of tubers and the weight of tubers per tuber in affecting the weight of the tubers planted. The higher the number of tubers per tuber, the tuber weight per plant will also be higher. Meanwhile, if the number of tubers and tuber weight per tuber is low, the tuber weight per plant will also be low.

4. Tubers Production on Bundle (Kg)

Observations on tuber production in a mound after analysis of variance (appendix 4d) show that both interaction and the main effect of Kascing Fertilizer and Kaliphos Fertilizer have a significant effect on tuber production in a mound. The results of the Honest Significant Difference Test (BNJ) at the 5% level can be seen in Table 4.4

Table 4.4 Average tuber production a bund with Kascing and Kaliphos Fertilizers (kg).

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer				Average
	L0 (0)	L1 (5)	L2 (10)	L3 (15)	
K0 (0)	0,37 h	0,69 fgh	0,99 fg	1,32 de	0,84 d
K1 (550)	0,59 gh	1,05 fg	1,19 def	1,83 bc	1,16 c
K2 (1.100)	0,93 fgh	1,17 efg	1,43 cd	2,23 ab	1,44 b
K3 (1.650)	1,11 efg	1,38 de	2,18 ab	2,65 a	1,83 a
Average	0,75 d	1,07 c	1,45 b	2,01 a	
KK = 4,80%	BNJ K&L = 0,28			BNJ KL : 0,62	

The numbers in the columns and rows followed by the same lowercase letters are not significantly different according to the Honest Significant Difference (BNJ) test at the 5% level %.

Table 4.4 shows that interactively, the increase in purple sweet potato production with the treatment of vermicompost and caliphos fertilizers significantly affected tuber production a mound. Where the best treatment was found in the application of vermicompost fertilizer 1,650 g/mound and a dose of Kaliphos 15 g/plant (K3L3). Where the application of vermicompost fertilizer 1,650 g/mound and a dose of kaliphos 15 g/plant had the heaviest tuber production a mound of 2.65 kg not significantly different from the K2L3 and K3L2 treatments but significantly different from the other treatments. Meanwhile, the lowest production of tubers a mound was in the K0L0 treatment with a weight of 0.37 kg. Efforts that can be made to increase sweet potato production are through the use of superior seeds, improving the management of sweet potato farming by using balanced fertilizers in the right dose, time, and method according to the conditions and chemical properties of the local soil (Sasongko, 2009). The tuber production a mound of purple sweet potato in the K3L3 treatment was a combination that showed that the dose for each treatment was following the needs of the purple sweet potato plant thus it affected plant growth and development. This is due to the ability of plant organs, such as roots, to absorb and penetrate the soil to absorb nutrients, water, and oxygen in the soil. The ability of the stem organs to supply nutrients and water to the leaves and to carry out the process of photosynthesis and respiration thus photosynthate increases as a result, more and more carbohydrates are formed, which in turn stimulates plant growth and development..

Agustina (2004), explained that element N is a constituent of leaf chlorophyll, protein, and fat thus it can stimulate early growth. Element P is an element that makes up cells, fats, and proteins and it will trigger root growth. Element K functions to stimulate the translocation of carbohydrates from leaves to other plant organs, especially other plant organs, especially carbohydrate-storing plant organs such as sweet potatoes.

5. Harvest Index The results of observing the harvest index after carrying out an analysis of variance (appendix 4f) show that in terms of interaction as well as the main effect of Kascing Fertilizer and Kaliphos Fertilizer, it has a significant effect on the harvest index. BNJ test results at the 5% level can be seen in Table 4.5

Table 4.5 The average harvest index with the provision of Kascing Fertilizer and Kaliphos.

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer (g/plant)				Average
	L0 (0)	L1 (5)	L2 (10)	L3 (15)	
K0 (0)	0,12 h	0,18 gh	0,18 gh	0,55 bc	0,26 d
K1 (550)	0,23 fgh	0,26 fgh	0,30 e	0,46 c	0,31 c
K2 (1.100)	0,34 de	0,44 cd	0,48 bc	0,46 c	0,43 b
K3 (1.650)	0,44 cd	0,54 bc	0,59 b	0,85 a	0,60 a
Average	0,28 d	0,36 c	0,39 b	0,58 a	
KK = 8,82%	BNJ K&L = 0,04		BNJ KL : 0,11		

The numbers in the columns and rows followed by the same lowercase letters are not significantly different according to the Honest Significant Difference (BNJ) test at level 5 %.

Table 4.5 shows that the response of plants to Kascing Fertilizer and Kaliphos Fertilizer has a significant effect on the harvest index. Where the treatment of vermicompost fertilizer was 1,650 g/mound and Kaliphos dose of 15 g/plant (K3L3) had the heaviest harvest index of 0.85 and was significantly different from other treatments. While the lowest harvest index was found in the K0L0 treatment with a weight of 0.12. The main effect of treatment of worm castings had a significant effect on the harvest index. Where the application of vermicompost fertilizer at 1,650 g/mound (K3) has a harvest index weight of 0.60 and is significantly different from other treatments. Likewise, the Kaliphos treatment had a significant effect on the harvest index. Where the treatment of Kaliphos 15 g/plant (L3) had a harvest index weight of 0.58 and was significantly different from other treatments.

This is following the statement of Mardawilis (2007), high yields of plant production will be obtained in plants where the fulfillment of nutrients occurs properly. Furthermore, Elisa (2004), stated that even though a bombed of fruit causes a low fruit weight, the high number of fruit produced by these plants causes plant production to remain high which will be different from the production produced by plants that have a bit of fruit even though the fruit weight is higher. tall. According to Rukmana (1997) in Suhendi (2014), the harvest index is a comparison between production yields and plant biomass weight (characterized) which describes the level of plant productivity. A high harvest index indicates that the productivity of these plants is high. In addition, the high value of the harvest index in the castor fertilizer treatment was 39.3% due to the high productivity of plant tubers by providing vermicompost fertilizer which can meet plant nutrient needs, especially element K which plays a role in the translocation of photosynthetic products in the form of carbohydrates from leaves to plant tubers. According to Rahni, (2012) added, applying fertilizer up to a certain dose can increase the harvest index because it can increase economic results in the form of plant weight. The harvest index is the ratio of tuber weight to biomass weight. The higher crop index indicates that the photosynthetic partition in the canopy is translocated to the tuber. Furthermore, the uptake of element K by plants.

5. 6. Wet Stove Weight on Plant (kg)

The results of observations of wet chestnut weight on plant after analysis of variance (appendix 4g) showed that both interaction and the main effect of Kascing Fertilizer and Kaliphos Fertilizer had a significant effect on the harvest index. BNJ test results at the 5% level can be seen in Table 4.6

Table 4.6 Average wet chestnut weight on plant with Kascing and Kaliphos Fertilizers.

Kascing Fertilizer (g/guludan)	Treatment of Kaliphos Fertilizer (g/plant)				Average
	L0 (0)	L1 (5)	L2 (10)	L3 (15)	
K0 (0)	0,55 g	0,74 ef	0,70 f	0,75 ef	0,69 d
K1 (550)	0,60 g	0,71 f	0,76 def	0,78 de	0,71 c
K2 (1.100)	0,72 ef	0,73 el	0,82 cd	0,85 c	0,78 b
K3 (1.650)	0,82 cd	1,07 b	1,08 b	1,56 a	1,13 a
Average	0,67 d	0,81 c	0,84 b	0,99 a	
KK = 2,45%	BNJ K&L = 0,22		BNJ KL : 0,62		

The numbers in the columns and rows followed by the same lowercase letters are not significantly different according to the Honest Significant Difference (BNJ) test at level 5%.

Table 4.6 shows that the response of plants to Vermicompost Fertilizer and Kaliphos Fertilizer has a significant effect on fresh chestnut weight /plant. Where the treatment of vermicompost fertilizer was 1,650 g/bundle and Kaliphos dose 15 g/plant (K3L3) had the heaviest wet body weight / plant, namely 1.56 kg, and was significantly different from other treatments. While the lowest wet chestnut weight / plant was in the K0L0 treatment with a weight of 0.55 kg. As for the main effect of the treatment, the application of vermicompost fertilizer had a significant effect on wet chestnut weight /plant. Where the application of vermicompost fertilizer was 1,650 g/mound (K3) had a wet chestnut weight / plant of 1.13 kg and was significantly different from other treatments. Likewise, the Kaliphos treatment had a significant effect on fresh chestnut weight / plant. Where the treatment of giving Kaliphos 15 g/plant (L3) had a wet chestnut weight / plant of 0.99 kg and was significantly different from other treatments. The high wet body weight / plant in the vermicompost fertilizer treatment of 1,650 g/mound was caused by the application of vermicompost fertilizer with high concentrations to meet the nutrient requirements needed by plants thus plant canopy growth, both stems, stems and leaves of plants grow well. Vermicompost fertilizer can restore mineral elements to the soil, in 1 m3 vermicompost fertilizer can restore about 1.5 kg of N. The N nutrient contained in vermicompost fertilizer affects the development of plant crowns. Adrianto and Indarto (2004), stated that pruning of sweet potato plants plays a significant role in efforts to determine the success of increasing yields because it can cause stunted vegetative growth. Inhibition of vegetative growth through pruning aims to direct the use of nutrients to generate growth thus the tubers are produced in a maximum quantity and weight. The application of caliphos fertilizer to plants can meet the nutrient needs of plants thus the growth of plant stems can grow and develop properly.

5. Conclusion

Based on the research that has been done, it can be concluded that:

1. The interaction of vermicompost and caliphos fertilizers had a significant effect on the number of tubers/plant, tuber weight/tuber, tuber weight/plant, tuber production/mound, tuber length, harvest index, fresh chestnut weight per plant. The best treatment was found in vermicompost fertilizer 1,650 g/mound and kaliphos 15 g/plant (K3L3).
2. The main effect of application of vermicompost fertilizer and caliphos fertilizer had a significant effect on the number of tubers/ plant, tuber weight/ tuber, tuber weight/ plant, tuber production a mound, tuber length, harvest index, fresh chestnut weight per plant. The best treatment was found in vermicompost fertilizer 1,650 g/mound (K3).
3. The main effect of caliphos fertilizer dose was significant on the number of tubers per plant, tuber weight/ tuber, tuber weight/ plant, tuber production per mound, tuber length, harvest index, and fresh chestnut weight/ plant. The best treatment at the dose of Kaliphos 15 g/plant (L3).

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