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Response of growth and development of butternut squash (*Cucurbita moschata*) to the combination of bioslurry and NPK fertilization

R Dermawan[1], Kaimuddin[1], N E Dungga[1], R Sjahril[1], A Mollah[1] and N S Yuniarti[1]

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radesya09@gmail.com

[1] Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Jl. Perintis Kemerdekaan KM 10 Makassar 90245, Indonesia.

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Abstract

This study aims to study the effect of bioslurry and NPK fertilizers and to determine the best dosage of bioslurry and NPK fertilizer on the growth and development of butternut squash. The study was conducted from December 2018 to 21 March 2019 in Purnakarya Village, Tanralili District, Maros Regency, South Sulawesi. The study was set as a trial using a split plot design. The main plot was three

bioslurry concentrations namely control, 100, and 200 mL L^{-1} bioslurry. The subplot was the application of NPK fertilizer types consisted of four levels, namely NPK Pak Tani (16-16-16), NPK Gold (16-10-18), NPK RG05 (15-10-30), and NPK Booster (12-6-22-3). The results of the experiment show that there was a significant interaction between bioslurry and NPK types on the stem diameter of butternut squash plants (bioslurry 100 mL L^{-1} and NPK Pak Tani). The bioslurry treatment showed a significant effect on fruit weight by the application of bioslurry 200 mL L^{-1} (978.42 g). NPK treatment significantly affected fruit length with use of NPK Pak Tani that resulted in the longest fruit (24.58 cm).

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R Dermawan, Kaimuddin, N E Dungga, R Sjahril, A Mollah, and N S Yuniarti

Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Jl. Perintis Kemerdekaan KM 10 Makassar 90245, Indonesia.

E-mail: radesya09@gmail.com

Abstract. This study aims to study the effect of bioslurry and NPK fertilizers and to determine the best dosage of bioslurry and NPK fertilizer on the growth and development of butternut squash. The study was conducted from December 2018 to 21 March 2019 in Purnakarya Village, Tanralili District, Maros Regency, South Sulawesi. The study was set as a trial using a split plot design. The main plot was three bioslurry concentrations namely control, 100, and 200 mL L^{-1} bioslurry. The subplot was the application of NPK fertilizer types consisted of four levels, namely NPK Pak Tani (16-16-16), NPK Gold (16-10-18), NPK RG05 (15-10-30), and NPK Booster (12-6-22-3). The results of the experiment show that there was a significant interaction between bioslurry and NPK types on the stem diameter of butternut squash plants (bioslurry 100 mL L^{-1} and NPK Pak Tani). The bioslurry treatment showed a significant effect on fruit weight by the application of bioslurry 200 mL L^{-1} (978.42 g). NPK treatment significantly affected fruit length with use of NPK Pak Tani that resulted in the longest fruit (24.58 cm).

1. Introduction

Butternut squash (*Cucurbita moschata*) is a type of pumpkin from a group of horticultural annual plants with high agribusiness prospects. The fruit has a unique shape like a nut and is quite popular in Indonesia [1]. Pumpkin is suitable for eating raw and processed into juice, jam, and baby food. In addition, it can be used as a spaghetti and cake coloring [2]. This plant can grow well in the tropical condition of Indonesia as long as rainfall is sufficient throughout the year. One of the constraints in developing the butternut squash in Indonesia is the quality of the fruit. Farmers often cultivate this type of pumpkin without regard to quality, resulting in low quality of fruit produced. The success of a plant to grow and produce well, in addition to being determined by genetic and environmental factors is also determined by the way of managing soil and plants such as the addition of nutrients through fertilization treatment [3].

Fertilizer plays a very important role in efforts to increase agricultural production, namely to provide nutrients needed by plants. Fertilizers that are widely used by farmers are inorganic fertilizers. Inorganic fertilizers are fertilizers resulting from chemical, physical and / or biological engineering processes and are the result of industrial or fertilizer manufacturing plants [4]. Three macro elements for the growth and production of plants are nitrogen, phosphor and potassium. These three elements are usually contained in a compound fertilizers in different composition. The use of inorganic fertilizers has several

disadvantages, namely the use of excessive doses can cause environmental pollution especially if its use continuously for a long time can cause land productivity to decline.

Inorganic compound fertilizers often used by farmers are thought to be more efficient in terms of distribution, storage, and application because the elements N, P, K are contained in one type of fertilizer. The use of compound fertilizer will encourage farmers to use fertilizer in full [5]. Various types of NPK circulating in the market with different N, P, and K nutrients, including NPK fertilizer Pak Tani (16-16-16), NPK Booster (12-6-22-3), NPK RG05 (15 -10-30), and NPK Gold (16-10-18).

Efforts to reduce the negative effects of the use of inorganic fertilizers is by the application of organic fertilizers such as bioslurry. However, the proportion of the balanced dose must be taken into account. The addition of organic material is very helpful in improving degraded soil, because the use of organic fertilizers can bind nutrients that are easily lost and help in the supply of soil nutrients so that fertilizer efficiency is higher. Nutrient content of organic fertilizer is low so it needs to be given in large volumes, the physical-chemical-biological composition of organic fertilizer varies so that the benefits inconsistent and requires a relatively long time [6].

Research in Indonesia with bioslurry also obtained an average increase in production. Bioslurry as an organic fertilizer has been widely used in agricultural areas in Indonesia for leaf and fruit vegetable commodities (tomatoes, chilies, chayote, cucumbers, etc.), tubers (carrots, potatoes, etc.), fruit trees (dragon fruit, mango, longan, orange, papaya, banana, etc.), food plants (rice, maize, cassava) and other plants (coffee, chocolate, coconut) [7]. Therefore, it is necessary to conduct a scientific study related to the use of different types of NPK fertilizer and bioslurry in improving the quality of butternut squash.

2. Methodology

This research was conducted in Purnakarya Village, Tanralili District, Maros Regency, South Sulawesi Province, from December 2018 to March 2019 in the form of an experiment based on a split plot design. Main plot was the application of bioslurry fertilizer consisted of three levels, namely control, 100, and 200 mL L^{-1} bioslurry per plant. Sub plots was the NPK fertilizer types, namely NPK Pak Tani (16:16:16), NPK Gold (16:10:18), NPK RG05 (15:10:30), and NPK Booster (12:6:22:3). Each treatment combination was repeated three times resulted in a total number of experimental plots of 36 plots.

2.1. Soil tillage and planting

Soil tillage was conducted using tractor followed by setting up a size of 100 cm x 100 cm beds with 30-40 cm height and 100 cm for distance between beds. Each bed was applied with 3 kg per plot cow manure and then mixed evenly and left for seven days before set up plastic mulch. Prior to planting, the butternut squash seeds were soaked in warm water for 30 minutes to speed up germination. The seeds then were placed on moist tissues for two days. The germinated seeds were transferred to pots contained a mixture of soil and manure at a ratio of 2:1. Seedlings were maintained for 11 days or until seeds have had 3-4 perfect leaves. Seedlings were then selected before transferring to beds, by looking at uniformly and healthy seedlings. Planting of the seedlings was carried out by carefully removing the seedlings from the pots and immediately planted in the hole that has been provided with a depth of 20 cm.

2.2. Treatment application

Bioslurry and NPK treatment were carried out started at 21 days after planting (DAP) and conducted once a week for 8 times fertilization. The application of bioslurry was carried out by pouring the fertilizer onto planting hole while NPK was applied by spreading it onto ground between the plants at 10 cm from the planting holes.

2.3. Data analysis

Data were analysed using a two way Analysis of Variance (ANOVA) to test the effect of the treatment given. If there is a significant effect of the treatment, then a further analysis was conducted to determine the difference between means using the Least Significant Difference (LSD) test at level of 5%.

3. Results

3.1. Stem diameter

Variance analysis show that the interaction between bioslurry concentration and NPK types significantly affected stem diameter growth at 5 weeks after planting (WAP) (table 1). Table 1 shows that the combination treatment of 100 mL L^{-1} bioslurry and NPK Pak Tani (16:16:16) resulted in the highest stem diameter of 25.53 mm compared to other bioslurry concentration and NPK types. The lowest average stem diameter of 20.81 mm was shown in the application of 100 mL L^{-1} bioslurry and NPK Booster (12: 6: 22: 3).

Table 1. Average of stem diameter of butternut squash at 5 weeks after planting (WAP) on different bioslurry concentrations and NPK Types.

Bioslurry	NPK type				$LSD_{0.05}$ Bioslurry
	Pak Tani (16:16:16)	Gold (16:10:18)	RG05 (15:10:30)	Booster (12:6:22:3)	
0 mL/L	22.84^{a}_{p}	22.81^{a}_{q}	24.47^{ab}_{q}	24.03^{b}_{q}	
100 mL/L	25.53^{b}_{q}	21.32^{a}_{p}	21.04^{a}_{p}	20.81^{a}_{p}	1.14
200 mL/L	25.36^{b}_{q}	23.16^{a}_{pq}	22.21^{a}_{q}	22.80^{a}_{q}	
$LSD_{0.05\ NPK}$	1.05				

Numbers followed by different letters in a same row (a and b) and column (p and q) are significantly different based on LSD at level of 5%.

3.2. Leaf area

Variance analysis results show that the application of bioslurry and NPK fertilizers did not significantly affect the leaf area of the butternut squash. Average increase in leaf area of the butternut squash at 5 WAP is shown in figure 1. Figure 1 shows that the highest average increase in leaf area of 149.75 cm^2 was shown by the application of 100 mL L^{-1} bioslurry and NPK Booster (12: 6: 22: 3). The lowest was found in the application of 200 mL L^{-1} bioslurry and NPK Booster (12: 6: 22: 3) (67.33 cm^2).

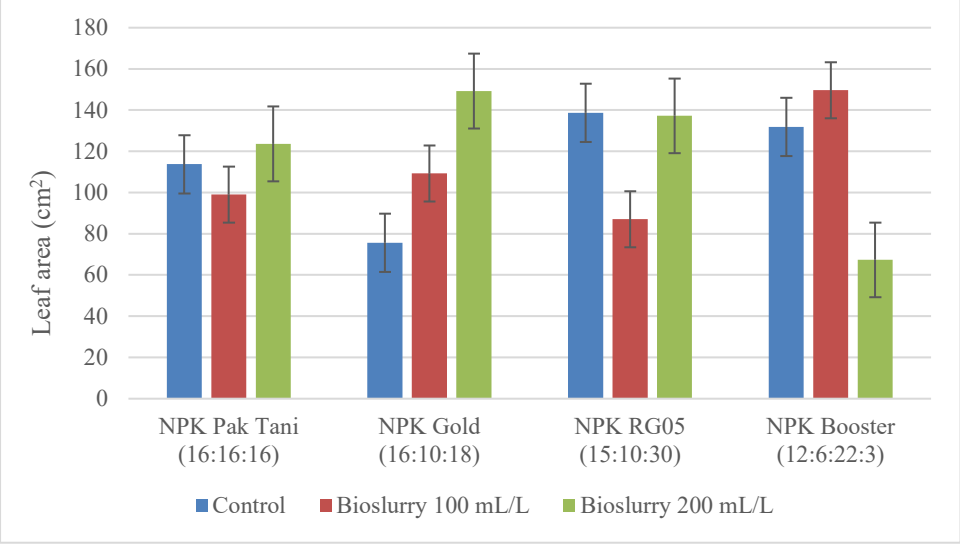

Figure 1. Average of increase in leaf area (cm^2) of butternut squash on different concentration of bioslurry and NPK fertilizer types.

3.3. Fruit weight

Variance analysis results show that the average weight of the butternut squash fruit were significantly affected by the application of bioslurry. No significant effect observed for the NPK fertilizer types treatment and no difference were found on the parameter of average fruit weight of butternut squash between the NPK fertilizer types. Average fruit weight of the butternut squash only varied between the concentrations of bioslurry (table 2). Table 2 shows that the highest average fruit weight was shown in the application of 200 mL L^{-1} bioslurry treatment (978.42 g) and significantly different from the bioslurry of 100 mL L^{-1} which was the lowest average of fruit weight (771.91 g).

Table 2. Average fruit weight of butternut squash on different concentration of bioslurry and NPK fertilizer types.

Bioslurry	NPK type				Average	$LSD_{0.05\ Bioslurry}$
	Pak Tani (16:16:16)	Gold (16:10:18)	RG05 (15:10:30)	Booster (12:6:22:3)		
0 mL/L	783	919.33	1004	951	914.33 b	
100 mL/L	970.66	703.66	711	702.33	771.91 a	100.86
200 mL/L	1072.33	1139	815	887.33	978.40 b	
Average	941.99	920.66	843.33	846.88		

Numbers followed by different letters in a same row (a and b) and column (p and q) are significantly different based on LSD at level of 5%.

3.4. Fruit length

Variance analysis show that NPK fertilizer types treatment had a significant effect on the average of fruit length of the butternut squash, while the application of bioslurry and the interaction of both treatments had no significant effect on the parameter. Table 3 shows that the highest average fruit length of 24.58 cm was shown by the use of NPK Pak Tani (16:16:16) and significantly different from the NPK Gold treatment (16:10:18), NPK RG05 (15:10: 30), and NPK Booster (12: 6: 22: 3). The lowest average fruit length of 22.43 cm is shown by the NPK Gold treatment (16:10:18).

Table 3. Average fruit length of butternut squash on different concentration of bioslurry and NPK fertilizer types

Bioslurry	NPK type				Average
	Pak Tani (16:16:16)	Gold (16:10:18)	RG05 (15:10:30)	Booster (12:6:22:3)	
0 mL/L	22.84	22.81	24.47	24.03	23.54
100 mL/L	25.53	21.32	21.04	20.81	22.18
200 mL/L	25.36	23.16	22.21	22.80	23.38
Average	24.58b	22.43a	22.57a	22.55a	
$LSD_{0.05\ NPK}$	1.99				

Numbers followed by different letters in a same row (a and b) and column (p and q) are significantly different based on LSD at level of 5%.

3.5. Sweetness of the fruit

The variance analysis show that the concentration of bioslurry, the type of NPK and the interaction of both treatment did not have significant effect on the sweetness of the butternut squash fruit. Figure 2

shows that the highest average fruit sweetness was obtained from the application of 100 mL L^{-1} bioslurry and NPK Pak Tani (16:16:16), which is 10.37 °brix while the lowest (6.99 ° brix) was obtained from the application of 100 mL L^{-1} bioslurry and NPK Gold (16:10:18).

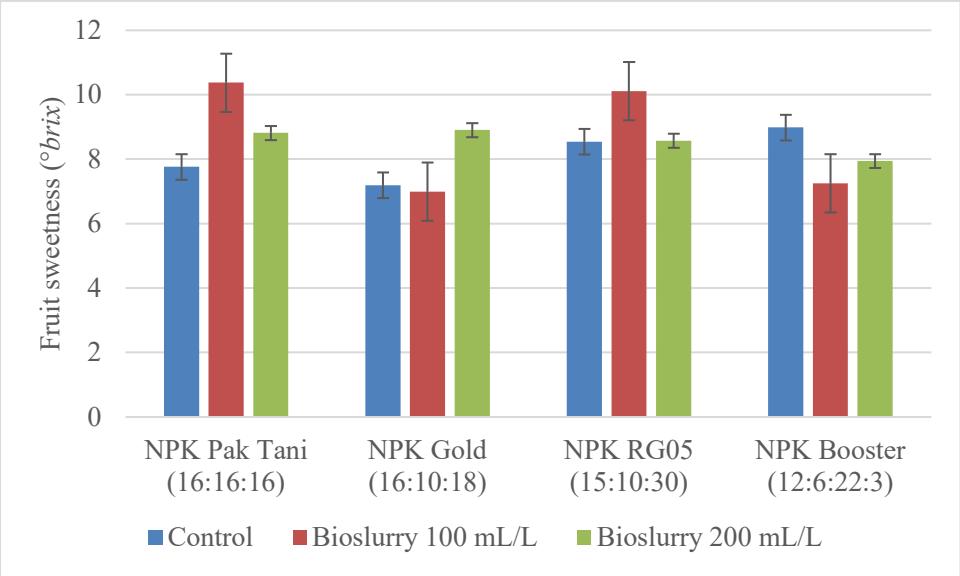

Figure 2. Average fruit sweetness of butternut squash on different concentration of bioslurry and NPK fertilizer types.

3.6. Fruit thickness

The variance analysis show that the concentration of bioslurry, NPK type and the interaction of both had no significant effect on the thickness of fruit flesh. Figure 3 shows that the thickest fruit was obtained from the bioslurry control treatment (0 mL L^{-1} bioslurry) and NPK Booster (12: 6: 22: 3) of 21.86 mm while the lowest average value for the parameter of fruit thickness was resulted from the application of 200 mL L^{-1} bioslurry and NPK Gold (16:10:18) which was 19.72 mm.

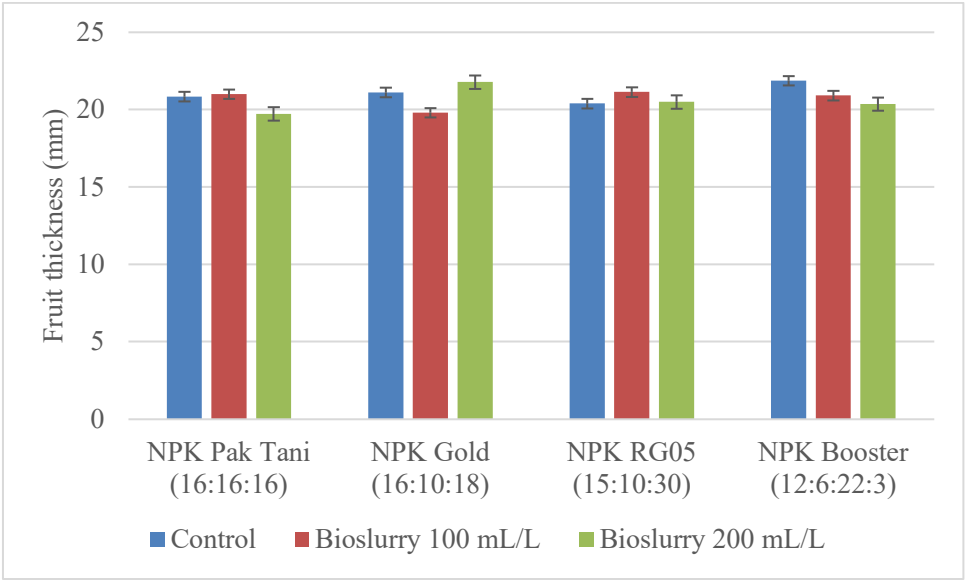

Figure 3. Average fruit thickness of butternut squash on different concentration of bioslurry and NPK fertilizer types.

3.7. Fruit hardness

The variance analysis showed that the concentration of bioslurry, the type of NPK and the interaction of both did not significantly affect fruit hardness. Figure 4 shows that the highest average fruit hardness obtained from the application of 200 mL L^{-1} bioslurry and NPK Gold (16:10:18) which was 65.33 N while the lowest was from the use of 100 mL L^{-1} bioslurry and NPK Gold (16:10:18) which was 46.22 N.

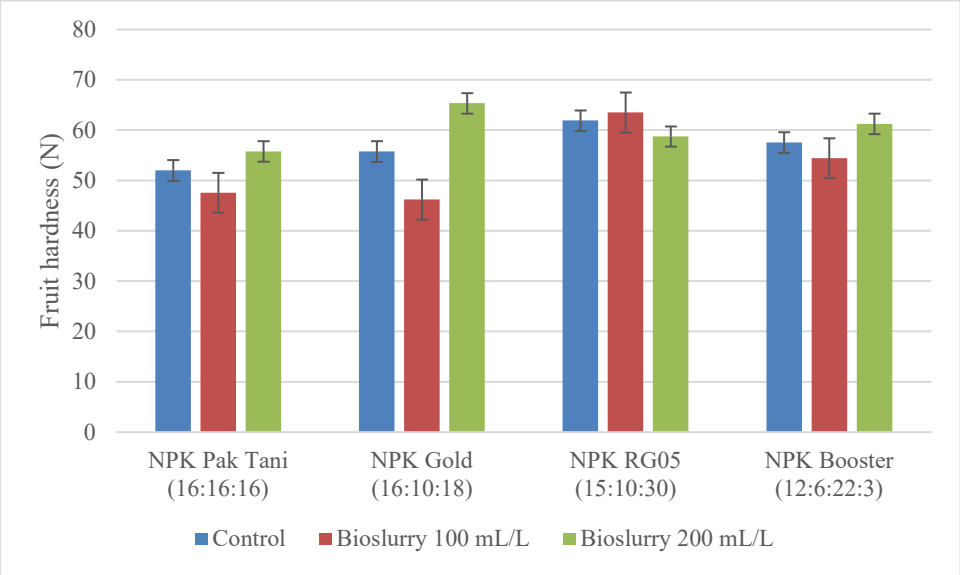

Figure 4. Average fruit hardness of butternut squash on different concentration of bioslurry and NPK fertilizer types

4. Discussion

The recent study reveals that the use of bioslurry and different types of NPK fertilizers to some extent can increase the growth and production of butternut squash. Growth parameter such as the stem diameter of the butternut squash increased with the application of bioslurry of 100 mL per litre with NPK Pak Tani that have a ratio of NPK at 16:16:16. In the other fruit quality parameters such as fruit length and brix level also showed best response of butternut squash to this type of NPK fertilizer. Composition of the elements of N, P and K in a fertilizer determine the impact to plant growth and development.

According to Marschner [8], in addition to N, the P and K elements in plants help in the process of photosynthesis where the results of photosynthesis, hence lacking one of these elements, the photosynthetic process will decrease. On the other hand, phosphate plays an active role in transferring energy in cells and also converts carbohydrates into sugars and can increase the efficiency of chloroplast work, the more phosphate is absorbed, the faster the formation of flowers and fruit. The balanced composition in the NPK Pak Tani fertilizer provides optimal nutrition for the fruit formation and development of the butternut squash. A complete and balanced fertilization greatly affects the growth and yield of plants because it can add and restore nutrients that have been lost both washed and carried by plants at harvest [9].

The availability of sufficient nutrients and can be absorbed quickly for plants but can not be separated from the influence of organic matter which has micro nutrients in helping the process of growth and absorption of nutrients optimally and effectively. Rohcmah and Sugiyanta [10] states that the combination of organic and inorganic fertilizers in plants can increase the effectiveness of plant agronomy when compared to only using inorganic fertilizers. Melons accumulate nutrients N, Ca, K, P, Mg, S, B, Fe, Mn, Zn, Cu, while those that affect the level of sweetness are allegedly N, Ca and K [11]. The content of the NPK Pak Tani which balanced with bioslurry containing 0.07-0.38% K can be sufficient to support the quality of the taste of the butternut squash. Study of Dibia and Narka [12]

showed that the highest sugar content of honey pumpkin is shown by the application of 200 t / ha KCL + 20 t / ha organic fertilizer. The treatment gives the same KCL fertilizer as the other treatments, the difference is that organic fertilizer is given higher than the other treatments. Based on these studies it can be seen that high K content influences the taste of pumpkin honey. Zeng and Brown [13] state that, K plays a role in preventing leaves, flowers and fruit from falling off easily, improving fruit size and quality and adding sweetness to the fruit.

In leaf area parameter, the interaction of 100 mL per litre bioslurry and NPK Booster (12: 6: 22: 3) shows the highest value compared to other bioslurry and NPK interactions. This is thought to be due to the high potassium content in NPK Booster which has an important role in the process of plant physiology so that it affects the leaf area development in the butternut squash plant. According to Hardjowigeno [14] potassium is very important in the process of plant physiology. Potassium can increase plant photosynthesis through increased photophosphorylation that produces ATP and NADPH which play a role in the process of photosynthesis and plant metabolism. Addition of Mg as much as 3% in the NPK Booster helps the plants in synthesizing chlorophylls. The element Mg in plants functions as a central atomic component of chlorophyll, and in grain plants, Mg helps phosphate metabolism, plant respiration and activators of several enzyme systems [15].

5. Conclusions

Based on the results of research that has been done, it can be concluded as follows:

- The interaction of 100 mL L^{-1} bioslurry fertilization and NPK Pak Tani (16:16:16) gives the best results on stem diameter of 25.53 mm.
- Fertilization of 200 mL L^{-1} bioslury which gives the best results on the weight of the honey pumpkin is 978.42 g. NPK fertilization of Pak Tani which gives the best results on the length of the pumpkin honey is 24.58 cm

References

[1] Kurniati F, Hodiyah I, Hartoyo T, & Nurfalah I 2018 Respons labu madu (*Cucurbita moschata* Dusrch) terhadap zat pengatur tumbuh alami berbagai dosis *Agrotech. Res. J* **2** 16-21.
[2] Paulauskiene A, Danilcenko H, Pranckietiene I & Taraseviciene Z 2018 Effect of different fertilizers on the mineral content of pumpkin fruit *J Elementol.* **23**.
[3] Soedarya A P 2009 *Agribisnis Labu Kuning* (Bandung: CV. Pustaka Grafika).
[4] Novizan 2005 *Petunjuk Pemupukan yang Efektif* (Jakarta: Agromedia Pustaka).
[5] Herdiyanti T 2012 *Pengurangan Dosis Pupuk NPK Pada Padi Sawah (Oryza Sativa L.) Musim Tanam Keempat di Karawang* [Theses] (Bogor: Institut Pertanian Bogor).
[6] Firmansyah M A 2011 *Peraturan Tentang Pupuk, Klasifikasi Pupuk Alternatif Dan Peranan Pupuk Organik Dalam Peningkatan Produksi Pertanian* (Kalimantan Tengah: BPTP).
[7] Biru 2012 *Pedoman & Pengguna Pengawas Pengelolaan dan Pemanfaatan Bio-Slurry* Kerja Sama Indonesia-Belanda (Jakarta: Program Biru).
[8] Broadley M R 2012 *Marschner's Mineral Nutrition of Higher Plants* (Massachusets: Academic Press).
[9] Nyanjang R, Salim A A & Rahmiati Y 2003 Penggunaan pupuk majemuk NPK 25-7-7 terhadap peningkatan produksi mutu pada tanaman teh menghasilkan di tanah andisols. PT. Perkebunan Nusantara XII in *Pros. Nasional Gambung*.
[10] Rohcmah H F & Sugiyanta 2010 Pengaruh pupuk organik dan anorganik terhadap pertumbuhan dan hasil padi sawah (*Oryza sativa* L.) in P*ros. Seminar Departemen Agronomi dan Hortikultura IPB*.
[11] Melo D M, Charlo H M O, Castoldi R, Gomes R F, Braz L T 2013 Nutrient accumulation in "Fantasy" net melon cultivated on substrate *J. Siencias Agrarias* **34** 1673-1682.
[12] Dibia I N & Narka I W 2017 *Meningkatkan Produksi Dan Rasa Manis Buah Labu Madu (*Cucurbita moschata*) Dengan Pupuk Organik Dan Pupuk Kalium Pada Latosol Coklat Kekuningan* (Denpasar: Fakultas Pertanian Unud).

[13] Zeng Q, Brown P H & Holtz B A 2001 Potassium fertilization affects soil K, leaf K concentration, and nut yield and quality of mature pistachio trees *HortScience* **36** 85-89.
[14] Hardjowigeno S 2003 *Ilmu Tanah* (Jakarta: PT. Mediyatama Sarana Perkasa).
[15] Winarso S 2005 *Kesuburan Tanah Dasar Kesehatan dan Kualitas Tanah* (Yogyakarta: Gava Media).