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The Planting Media Management on Vegetative Growth of Cassava (Manihotesculentacrantz)

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Abstract**—** *The Media Management of Cassava (Manihotesculentacrantz), this research aims to increase the vegetative growth component of cassava clone L-18 SMEs. This research was carried out at an altitude of ± 50 m above sea level, on andosol of pH 5.20. Using Factorial Randomized Block Design (RFBD) as the environmental design with two factors, namely the first factor: tillage treatment with 3 levels: P0 = No tillage, P1 = Minimum tillage, P2 = Perfect tillage and the second factor was the treatment of compost organic matter with 4 levels: B0 = No organic matter (control), B1 = compost organic matter 5 tons/ha, B2 = compost organic matter 10 tons/ha and B3 = compost organic matter 15 tons/ha.The response variables observed and measured were increase in plant height (cm), increase in stem diameter (mm), number of leaf additions (strands), leaf stalk length (cm). The results shows that the management of planting media combined with minimal tillage with the application of 6.02-7.10 tons/ha of organic has a significant effect on the increase of plant height (cm), and the number of leaves (strands). The management of growing media without tillage with the addition of 7.94 tons/ha of organic has a significant effect on the increase of stem diameter (mm), and the addition of 15 tons/ha of organic significantly affected the increase in the number of leaves (strands) and petiole length (cm).*

Keyword**— Tillage, Organic Materials, Clones L-18 UKM.**

I. INTRODUCTION

Indonesia is said to be an agricultural country which is rich in food and self-sufficient in food. It is very ironic that Indonesia is currently said to be food insecure, due to the condition of Indonesia's food security is still low (Budiono, 2011) therefore domestic food security must be the main key (Latif. A, 2011) and the President of the Republic of Indonesia urges in order to maintain food availability to take advantage of home yard for plant cultivation (Anonymous, 2013).

Food is a basic need for humans for their survival, so that food sufficiency is a human right that must be fulfilled (Suryana. A, 2005).According to Ginandjar. K, (2005) food sources come from biological sources to be processed and utilized by humans as staple food and additional for the necessities of life.

The 1945 of Indonesian's Constitution Article 27 paragraph 2 states, "Every citizen has the right to a decent life", so that the National food security program refers to aspects of food security for human health (Food Security Agency, 2012).

Dependence on one food commodity must be reduced (Anonymous, 2009) and can be maintained, so that there is a need for a food diversification policy and not only dependence on one food commodity, so it is necessary to continuously socialize national food diversification based on local food.

The efforts to diversify food (transfer of staple foods) can maintain the stability of food security, so that it is not too dependent on rice (Hermanto. S, 2012). Food verification outside of rice has been developed in several areas by utilizing local food crops such as cassava (MzAmirul. T, 2011) and as a staple food variation (Sudarmonowati.E, 2013).

So that Indonesia does not lack food, it must utilize the right technology and existing natural resources, so that food is still available for the needs of the population (Budiono, 2011), by improving infrastructure between food producers and food users (Latif. A, 2011).

Cassava is one of the commodities of food diversity that is not foreign to the people of Indonesia. Generally, cassava plants are found in every area. Cassava can be processed into various forms of food. In Medan, cassava has been processed into souvenirs as "Bika Cassava". The Food Security Agency of North Sumatra has coined the term in the Toba Batak language, "Manggadong", which means let's eat cassava as a staple food. The author remembers that when she was a child, her parents always gave her cassava food before eating rice, so that only a little rice was eaten, because at that time it was difficult to obtain rice food. Therefore, the people of North Sumatra are no stranger to cassava food. In the current generation, especially in rural areas, the term "Mangadong" is no longer recognizable, because many agricultural lands have been converted to land functions and even cassava is grown mostly, "poison cassava", for the manufacture of tapioca flour and cannot be processed into a source of fast food.

The area of cassava food commodities tends to decrease by 0.3% annually, and the harvested area of North Sumatra cassava is 38,611 ha with a productivity of 26.1 t/ha (Jonharnas., et al 2012). The productivity of cassava as a food ingredient is still limited due to the absence of superior clones, not optimal cultivation methods and the utilization of existing natural resources.

Cassava production can be increased by means of cultivation techniques, the use of superior clones and the maximum use of natural resources, through soil processing and the use of organic matter. Generally, soil processing in cassava cultivation is carried out twice, namely tillage by reversing the soil and followed by loosening the soil which is called perfect tillage. Soil cultivation must be adjusted to the productivity of soil fertility, namely its structure and texture. Hakim, (1986) stated that continuous land cultivation can result in damage to soil structure, so that efforts are made so that the soil is not treated too often or is sufficient with minimum tillage.

The purpose of tillage is to create space for plants to grow, so that roots can support growth and development on it (Arsana, 2007). Plants can grow optimally, if the soil is loose, the tillage layer is 25-35 cm and drained. Lack of tillage can cause roots not to develop, so plant growth is depressed and yields are low (Somaatmadja, 1991). Many "palawija" farmers apply without tillage using herbicides with the active ingredient glyphosate to eradicate weeds (Tjokrowardojo, 2001 in Mulyadi et al., 2007).

The tillage layer can become dense (difficult to process) due to low organic matter, so that the addition of organic matter to the tillage layer can improve the physical, chemical and biological fertility of the soil, to support increased vegetative growth, especially the production of cassava tubers in order to maintain and increase soil fertility. food security in North Sumatra, namely using the L-8 clone of SMEs with production potentials that can reach 25-50 kg per tree or the equivalent of 120-200 kg/ha.

II. REVIEW OF LITERATURE

The Land as Treatment

The land was divided into three replicates with a total land area of 52.5 x 12 m (630 m2). The research site was sprayed with contact grass poison and left for 2 weeks until it was completely dry, then the plot area for the combination treatment was 3 x 3 m (9 m2). Land preparation is adjusted to the tillage treatment.

No Tillage

Weeds from herbicide sprays are left to dry for 2 weeks on the land. After 2 weeks the dried weeds were removed from the soil surface and without tillage.

To minimize the bias of tillage treatment, the treatment without tillage and minimum tillage was carried out simultaneously with complete tillage in the second week. Then in the three tillage treatments, planting holes were made at the growing point measuring 20 x 20x20 cm (the size of a hoe) for placing organic compost and planting cassava cuttings of clone L-18 SMEs that have rooted according to the recommended planting distance of 150 x 150 cm.

Minimum Tillage

The weeds were first sprayed with herbicide with the active ingredient "paraquat" and allowed to dry for 2 weeks on the soil surface. Weeds that have dried are scraped off the soil surface to facilitate tillage. Soil is cultivated only once in a row of crops.

Perfect Tillage

One week after the herbicide spray, the dried weeds are removed from the soil surface to facilitate tillage. Then the first hoeing is done and left for a week. One week later, a second hoeing is carried out while loosening and smoothing the soil.

2.6. Organic Material Treatment

Organic matter is given to the available planting holes measuring 20 x 20 x 20 cm as a place for sowing compost organic matter. Compost organic matter was given according to the level of treatment, ie without compost organic matter as a comparison/control followed by compost organic matter 5 tons/ha (1.1 kg/plant), 10 tons/ha (2.2 kg/plant) and 15 tons/ha (3.3 kg/plant). Compost organic matter is given per planting hole and the planting hole is covered with excavated soil.

The Clone of Cassava Planting L-18

The transportation of cassava stem cuttings from the nursery to the research location was attempted to avoid

damage to the root cuttings of cassava clones L-18. One day after tillage and application of organic compost, cassava stem cuttings were planted. The cuttings must be planted carefully, because the grafted cassava stem cuttings have formed roots, stem shoots and leaves, so they are not damaged or broken. Cassava cuttings resulting from grafting are first selected for the number of seeds needed, namely with the criteria of the same stem cutting length, stem diameter and number of stem and leaf shoots trying to be uniform, notattacked by pests/diseases, the age of stem cuttings is the same.

Before planting the seedling cuttings, it is watered first, so that the condition of the seeds is fresh at the time of planting. The grafted cassava stem cuttings were planted in the planting hole/perpendicular growing point as deep as 10 cm from the base of the stem, and the grafting eye (stem and leaf shoots) faced the sun and then the planting hole was covered again with soil and watered.

The Plant Care and Maintenance

Care and maintenance of cassava plants is carried out starting at the age of one week after planting (WST) and continued once every two weeks after planting by observing the growth and development conditions of the plant and the weather conditions of the research location.

The Stitching

Crop embroidery was carried out at all locations of the research plot and if it was found that the cuttings of the L-18 UKM clones died, then the seedlings were replaced with the same age of seedlings. Crop embroidery is done until the age of 4 weeks after planting.

The Weed Weeding and Hoarding

Weeds (nuisance plants) that grow around the plants are controlled manually. Weed control was carried out from the age of 3 months after planting as well as the implementation of hoarding on cassava stems. Weed control and hoarding are then carried out after the plants are 24 weeks after planting.

The Sprouting/Removal of Shoots

The removal of shoots on the main stem is carried out after the plant is 16 weeks after planting and is only done once. Shoots that grow on the main stem are maintained only 3 shoots and if more than 3 shoots do remove shoots using a knife or scissors carefully so as not to damage other shoots. The former removal is smeared with liquid wax so that it is not easy to enter the source of fungal diseases.

Fertilization

The fertilization by chemical means is not carried out at the beginning of planting until the age of 12-16 weeks after planting, in order to obtain homogeneity of vegetative growth observations, because the treatment of organic compost fertilizer was given at the beginning of planting cassava seed cuttings. After the plant is 20 weeks after planting, then NPK fertilization is carried out at 15:15:15.

The Response Variable Observation

Variables observed growth components:

Increase in Plant Height (cm), Increase in Stem Diameter (mm), Increase in Number of Leaves (strands), Petiole Length (cm), One Leaf Area (cm2), Number of Bulbs Formed (bulbs).

III. THE RESEARCH METHOD

The research was conducted at the location of community-owned agricultural land in April - September 2021.The ingredients consist of: SME clone L-8 seeds, municipal waste compost organic, NPK fertilizer, “gramoxsone” herbicide, round up, fungicide and insecticide, liquid wax.

The tools consist of: hoe, rake, tape measure, ruler roller, bucket, knapsack sprayer, scales, scissors, knife, saw, plastic rope, tacks, markers, labels and other necessary stationery.

Factorial Randomized Block Design with two factors, namely: 3 levels of tillage treatment: P0 = No Tillage, P1 = Minimum Tillage, P2 = Perfect Soil Treatment and organic compost treatment consists of 4 levels: B0=Without organic (control), B1= with organic matter 5 tons/ha, B2= with organic matter 10 tons/ha, B3= with organic 15 tons/ha. Repeated 3 times with the determination of the layout of the study as an experimental unit, replications and samples were carried out randomly.

IV. THE RESULTS AND DISCUSSION

The Growth Component

Table 1. Average Plant Height Gain (cm) Cassava Clone L-18 Age 23 and 25 WAP on Planting Media Management

Olah Tanah	Bahan Organik	Pertambahan Tinggi Tanaman Pengamatan (MST) 23	25
		.... cm	
P_0 = (TOT)	B_0 (Tanpa Bahan Organik)	23.43c	45.49bc
	B_1 (5 ton/ha)	24.98abc	51.47bc
	B_2 (10 ton/ha)	26.77ab	44.24bc
	B_3 (15 ton/ha)	26.48ab	69.48ab
P_1 = (OTM)	B_0 (Tanpa Bahan Organik)	25.16abc	51.35bc
	B_1 (5 ton/ha)	25.57abc	75.98ab
	B_2 (10 ton/ha)	26.03abc	50.52bc
	B_3 (15 ton/ha)	24.80bc	45.08bc
P_2 = (OTS)	B_0 (Tanpa Bahan Organik)	26.12abc	47.16bc
	B_1 (5 ton/ha)	25.81abc	27.83c
	B_2 (10 ton/ha)	24.12bc	28.30c
	B_3 (15 ton/ha)	27.63a	90.59a

Note: The mean number followed by the same letter in each column of the same treatment is not significantly different at the 5% level based on Duncan's distance test.

The increase in plant height had a significant effect and was obtained on the management of planting media with a combination of minimum tillage and the application of 5-10 tons of organic matter/ha, namely

observations at the age of 23 WAP (27.63 cm) cm and age 25 WAP (90.59), and not significantly different from management of other growing media.

The lowest increase in plant height was obtained in the management of combined planting media without tillage and without giving organic matter at 23 WAP and at 25 WAP (23.43 cm) occurred in perfect tillage 5-10 tons/ha (P2B1 and P2B2). Observation of plant height increase can be seen in the following figure.

The relationship between the management of planting media, a combination of tillage and the addition of organic matter to the increase in plant height cassava clones L-18 SMEs aged 23 and 25 MST can be seen in Figure 1.

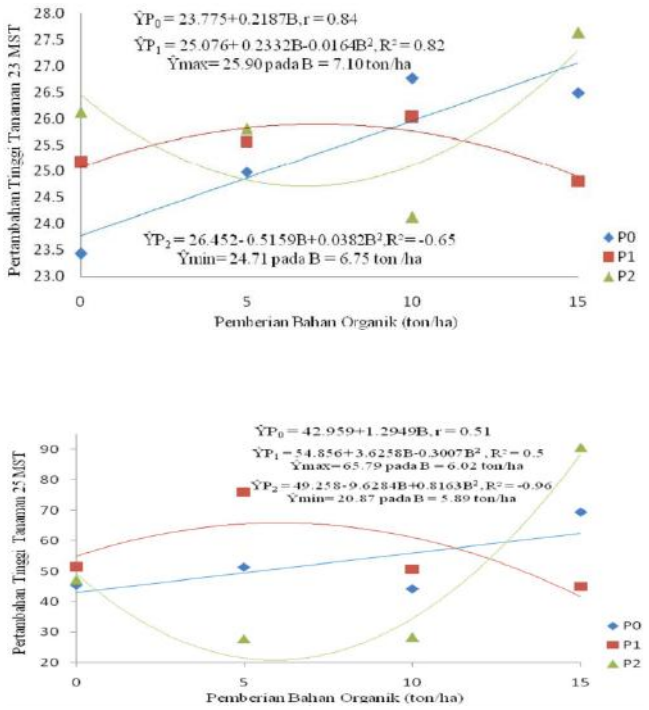


Fig.1: Plant Height Increase (cm) Cassava Clones L-18 SMEs Age 23 and 25 WAP on Planting Media Management

Figure 1 shows the maximum plant height increase at the age of 23 WAP (25.90 cm) in the management of combined minimum tillage (OTM) soil media with the application of organic matter 7.10 tons/ha and the increase in plant height continued to increase until the age of 25 WAP (65.79 cm), namely, combination of minimum tillage with an organic matter requirement of 6.02 tons/ha.

The management of perfect tillage planting media is tillage that is commonly carried out intensively, namely twice with the aim that the soil properties, the soil composition is looser (Larson, 1964) and followed by the application of organic compounds such as "humic" acid and "fulplic" acid which is maximally capable of increase the value of CEC, the soil is more loose and saves a lot of water (Titiek, 2011). Thus the plant is able to form a deeper, more flexible root system and will affect absorptionnutrients and water so that it has an impact on increasing stem diameter better.

Table 2. Average Increase in Stem Diameter (mm) Cassava Clones L-18 Age 23 and 25 WAP in Soil Media Management

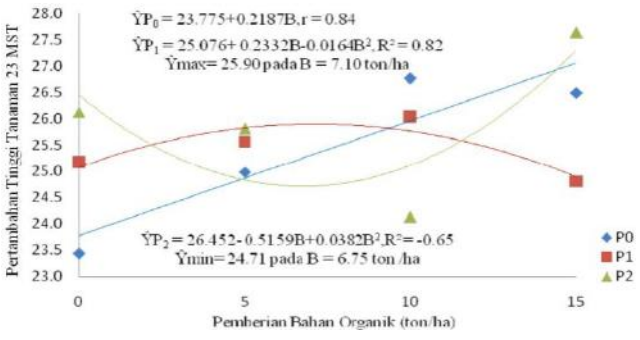
Olah Tanah	Bahan Organik	Pertambahan Diameter Batang Pengamatan (MST) 23	25
		.... mm	
P_0 = (TOT)	B_0 (Tanpa Bahan Organik)	23.43cd	45.49bc
	B_1 (5 ton/ha)	24.98bc	51.47bc
	B_2 (10 ton/ha)	25.10bc	44.24bc
	B_3 (15 ton/ha)	23.82bcd	49.48bc
P_1= (OTM)	B_0 (Tanpa Bahan Organik)	21.97d	52.02bc
	B_1 (5 ton/ha)	24.80bc	49.32bc
	B_2 (10 ton/ha)	25.16bc	28.30bc
	B_3 (15 ton/ha)	25.57abc	52.42bc
P_2= (OTS)	B_0 (Tanpa Bahan Organik)	23.79bcd	26.16c
	B_1 (5 ton/ha)	24.12bc	27.26bc
	B_2 (10 ton/ha)	25.63ab	64.83ab
	B_3 (15 ton/ha)	27.21a	97.20a

Note: The mean number followed by the same letter in each column of the same treatment is not significantly different at the 5% level based on Duncan's distance test

Table 2, The increase in stem diameter has a significant effect on the management of mixed soil media with minimum tillage with organic matter 15 tons/ha, at 23 WAP (25.57 mm), while at 25 WAP (97.20 mm) the management of mixed tillage media was perfect. with 15 tons/ha organic matter and significantly different from the management of other growing media.

The lowest stem diameter was obtained in the management of soil media at a combination of minimum tillage without organic matter at 23 WAP and at perfect tillage and without organic matter at 25 WAP.

The relationship between media management without tillage and organic matter on the increase in stem diameter of cassava plants from Clones L-18 UKM is shown in Figure 2.



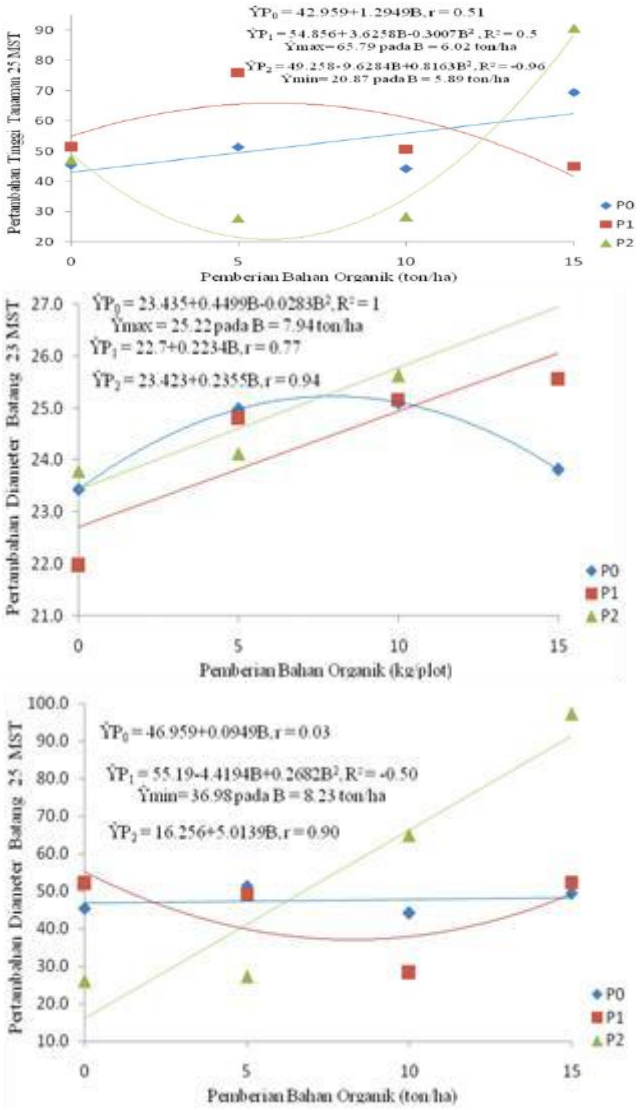


Fig.2. Increase in Stem Diameter (mm) Cassava Clones L-18 SMEs Age 23 and 25 WAP on Soil Media Management

Figure 2, The results of the graph show the management of growing media without tillage with the application of organic matter 7.94 tons/ha aged 23 WAP can maximize the increase in stem diameter (25.22 mm), and the management of growing media without minimum tillage and perfect tillage with the addition of organic matter 15 ton/ha can increase the increase in stem diameter to a certain extent.

While at the age of 25 WAP, there was a graphic change from positive quadratic to positive linear and almost horizontal, increasing the increase in stem diameter to a certain extent in the management of combined planting media without tillage and perfect tillage with the addition of 15 tons/ha of organic matter.

The increase in plant height was followed by an increase in stem diameter in the management of soil media combined with perfect tillage with the addition of 15 tons/ha of organic matter. Atman Roja, (2009) states that such soil conditions can ensure the circulation of O2 and CO2 in the soil, especially in the perfect tillage layer, so that the activity of microorganisms and root function is more optimal, due to the availability of plant nutrient needs.

Table 3. Average Number of Leaves (strands) of Cassava Clones L-18 Age 23 and 25 WAP on Soil Media Management

Olah Tanah	Bahan Organik	Pertambahan Jumlah Daun Pengamatan (MST) 23	25
		.... helai	
P_0 = (TOT)	B_0 (Tanpa Bahan Organik)	23.43cd	35.49b
	B_1 (5 ton/ha)	24.98bcd	37.47b
	B_2 (10 ton/ha)	25.10bcd	38.24b
	B_3 (15 ton/ha)	24.82bcd	38.48b
P_1 = (OTM)	B_0 (Tanpa Bahan Organik)	24.37bcd	32.68b
	B_1 (5 ton/ha)	24.47bcd	36.65b
	B_2 (10 ton/ha)	24.50bcd	40.52b
	B_3 (15 ton/ha)	27.46a	41.42b
P_2 = (OTS)	B_0 (Tanpa Bahan Organik)	23.22d	26.16b
	B_1 (5 ton/ha)	25.48bcd	27.83b
	B_2 (10 ton/ha)	25.63b	27.26b
	B_3 (15 ton/ha)	28.24a	59.30a

Note: The mean number followed by the same letter in each column of the same treatment is not significantly different at the 5% level based on Duncan's distance test

Table 3, The increase in the number of leaves had a significant effect on the management of minimum tillage plant media with the application of organic matter 15 tons/ha at 23 WAP (27.46 strands) significantly different from the management of perfect tillage plant media with the addition of 15 tons/ha organic matter and significantly different with the others. Furthermore, at the age of 25 WAP, the number of leaves increased to (59.30 strands) in the management of planting media with a combination of perfect tillage with the addition of 15 tons/ha of organic matter and significantly different from other combinations of planting media management. The lowest increase in the number of leaves at the age of 23.25 WAP was obtained in perfect tillage without organic matter.

The relationship between the combination of planting media management and the provision of organic matter on the number of leaves of the cassava plant clone L-18 UKM can be seen in Figure 3.

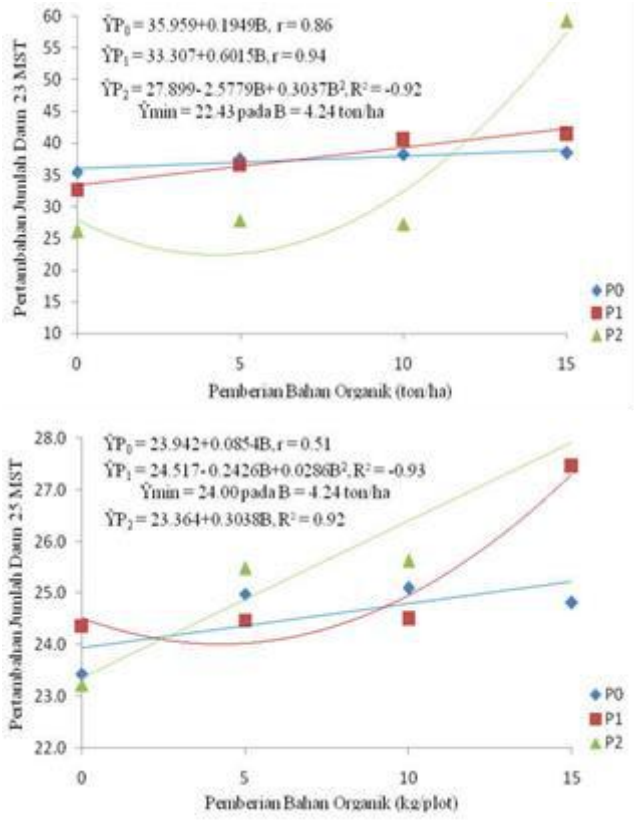


Fig.3: Increase in the number of leaves (strands) of cassava clones L-18 UKM Age 23 and 25 WAP on Soil Media Management

Figure 3 shows an increase in the number of leaves increased in the management of combined planting media without tillage, minimum tillage with the addition of 15 tons of organic matter/ha and perfect tillage, the increase in the number of leaves was low (22.43) strands with the addition of organic matter 4.24 tons/ha aged 23 MST. The management of planting media without tillage and perfect tillage with the addition of 15 tons/ha of organic matter at the age of 25 WAP increased the number of leaves to a certain extent (positive linear) and a negative quadratic (decreased) occurred in the increase in the number of leaves, namely (24.00 strands) in tillage. minimum soil with organic matter application of 4.24 tons/ha.

Minimum and perfect tillage with the addition of 15 tons/ha of organic matter can improve soil physical and chemical properties to obtain optimum plant growth and development with soil carrying capacity. (YuliWidyastuti and SugengSugiarso, 2003).

The availability of nutrients and water in the planting medium will increase the component of increasing the number of leaves. The higher the number of leaves, the higher the sunlight reception and the increased photosynthesis. Increased photosynthesis followed by increased respiration will cause metabolic processes to take place better and will support plant growth and development (Ruiz-Lozano et al, 2000 in Girsang, 1999).

Table 4. Average Leaf Stem Length (cm) Cassava Clone L-18 Age 23 WAP on Soil Media Management

Olah Tanah	Bahan Organik	Panjang Tangkai Daun Pengamatan (MST) 23
		.... cm ....
P_0 = (TOT)	B_0 (Tanpa Bahan Organik)	45.49b
	B_1 (5 ton/ha)	51.47b
	B_2 (10 ton/ha)	44.24b
	B_3 (15 ton/ha)	49.48b
P_1 = (OTM)	B_0 (Tanpa Bahan Organik)	54.68b
	B_1 (5 ton/ha)	49.32b
	B_2 (10 ton/ha)	57.19b
	B_3 (15 ton/ha)	52.42b
P_2 = (OTS)	B_0 (Tanpa Bahan Organik)	41.16b
	B_1 (5 ton/ha)	37.83b
	B_2 (10 ton/ha)	51.63b
	B_3 (15 ton/ha)	78.93a

Note: The mean number followed by the same letter in each column of the same treatment is not significantly different at the 5% level based on Duncan's distance test

Table 4, The length of the longest petiole has a significant effect on the management of planting media with a combination of perfect tillage with the addition of 15 tons/ha organic matter at 23 WAP (78.93 cm) and significantly different from the management of other growing media. The shortest petiole length was obtained in the management of planting media with a combination of perfect tillage with the addition of 5 tons of organic matter/ha and it was not significantly different from the management of other growing media.

The relationship between the combination of planting media management and the application of organic matter to the leaf stalk length of cassava clones L-18 UKM can be seen in Figure 4.

Figure 4, Observation of 23 WAP the length of the petiole decreased or minimum (37.54 cm) in the management of planting media with a combination of perfect tillage with organic matter 3.34ton/ha, however, in the management of growing media without tillage, and minimum tillage when combined with the addition of 15 tons/ha of organic matter, the leaf stalk length still increases to a certain extent.

Sarno (2006) and Simatupang (2008), state that conservation tillage includes minimum tillage and perfect tillage is able to improve or maintain land productivity compared to no tillage followed by the provision of maximum organic matter which can increase the carrying capacity of the soil to produce plant growth (YuliWidyastuti and SugengSugiarso, 2003).

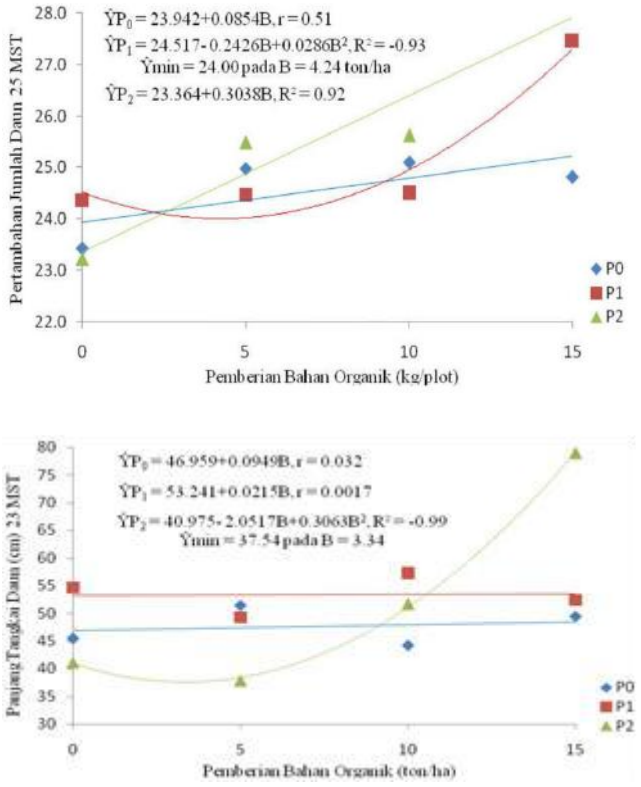


Fig.4: Average Leaf Stem Length (cm) Cassava Clone L-18 Age 23 WAP on Planting Media Management

V. CONCLUSION

1. Management of combined planting media without tillage with the addition of 7.94-ton/ha organic matter can increase the increase in stem diameter (mm), increase in number of leaves (strands), leaf stalk length (cm) of cassava plants Clones L-18 UKM with the addition of 15 tons of organic matter/ha.
2. Management of planting media combined with minimum tillage with the application of organic matter 6.02-7.10 tons/ha can increase the increase in plant height (cm), and increase in the number of leaves (m2) of cassava plants Clones L-18 SMEs.

REFERENCES

[1] Anonim, 2009. Peneliti Temukan Varietas Baru UbiKayu.http://klipingut.wordpree.com/07/12/18/peneliti-temukan-varietas.Kliping Cyber Media. 1 hal. Diakses : Tanggal 27 Oktober 2013.

[2] Anonim, 2013. Ubi Kayu Makmur (UKM) dan Pupuk Singkong. http://www.ubikayumakmur.indonetwork.co.id/3986821/pupuk-singkong1 hal. Diakses : Tanggal 21 Mei 2013.

[3] Arsana. IGK.D, 2007. Peningkatan Produksi Kacang-kacangan dan Umbi-umbian Mendukung Kemandirian Pangan. Pengkajian *Shuttle Breeding* Kacang Tanah di Lahan Kering Beriklim Kering Dataran Rendah Gerokgak-Buleleng. Balai Pengkajian Teknologi Pertanian, Bali. Hal 200-2004.

[4] Atman.R, 2009.Ubikayu, VarietasUngguldanTeknologiBudidaya.BalaiPengkajianTeknologiPertanian, Sumatera Barat. Makalah, Pelatihan Specific LokalitaKabupaten 50 Kota Sumetara Barat. Hal, 2-15.

[5] Badan Ketahanan Pangan, 2012. Pedoman Pelaksanaan Penangangan Keamanan Pangan Segar. Peraturan Kepala Badan Ketahanan Pangan, Kementerian Pertanian, Jakarta. Hal. 1-29.

[6] Budiono, 2011. Indonesia Dihantui Kerawanan Pangan. Puncak Peringatan Hari Pangan Sedunia ke-31, Kabupaten Bone Bolango, Grontalo.http://bkp.deptan.go.id/node/231. 1 hal. Diakses : Tanggal 20-1-2012.

[7] Gomez, K.A dan A.A. Gomez, 1984. Statistical Procedures For Agricultural Research 2 nd Edition, Wiley. Pp. (100 – 104).

[8] Ginandjar Kartasasmita, 2005. Ketahanan Pangan dan Ketahanan Bangsa. Pengembangan Ketahanan Pangan Berbasis Kearifan Lokal, Dies Natalis ke-45 Universitas Pasundan. www.ginandjar.com. Diakses : 20-1-2011. Hal. 1-8.

[9] Jonharnas., Lubis, M. H., Jamil. A, 2012. Dukungan Sumberdaya Genetik Varietas Lokal, Ubikayu Terhadap Ketahanan Pangan di Sumatera Utara. Seminar Nasional dan Kongres Sumber Daya Genetik, Diselenggarakan atas Kerjasama Badan Litbang Pertanian (Komnas SDG), Kementerian Pertanian dan Pemda Provinsi Sumatera Utara, (Komda SDG Provinsi Sumatera Utara). Hal. 12.

[10] Hakim, 1986. Ilmu Tanah Fakultas Pertanian Unila Lampung. Hal. 468.

[11] Hermanto. S, 2012. Tekan Impor Beras Dengan Diversifikasi Pangan. Pengamat Pertanian, Institut Pertanian Bogor. http://www.mediaindonesia.com/read/2012/28/301814/4/2/tekan. 1 hal

[12] Latif. A, 2011. Konsep Ketahanan Pangan Agar Direalisasikan. Masterplan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia (MP3EI). Lembaga Ilmu Pengetahuan Indonesia. http://www.bisnis.com/articles/konsep-ketahanan-pangan-agar-direalisasikan. Diakses:tanggal 20-1-2012. 2 Hal.

[13] Mulyadi., Q. Dadang., A. Pramono, 2007. Peningkatan Produksi Kacang-kacangan dan Umbi-umbian Mendukung Kemandirian Pangan. Pengaruh Residu Bahan Organik dan Olah Tanah Terhadap Hasil Kedelai Setelah Padi Walik Jerami Sawah Tadah Hujan. Loka Penelitian Pencemaran Lingkungan Pertanian dan Balai Pengkajian Teknologi Pertanian Jawa Timur. Hal 312-319.

[14] Sarno, 2006. Pengaruh Pengapuran Terhadap Pertumbuhan dan Produksi Jagung pada Tanah yang Diperlakukan Dengan Sistim Olah Tanah Jangka Panjang. Fakultas Pertanian, Universitas Lampung. Hal: 1-2.

[15] Simatupang, R.S. 2006. Pengembangan Eks-PLG Teknologi Olah Tanah Konservasi. Balai Penelitian Pertanian Lahan Rawa. Hal: 1-3.

[16] Somaatmadja. S, 1991. Kacang Tanah (*Arachis hypogeae* L.). Penerbit C.V. Yasaguna, 46 Hal.

[17] Sudarmonowati. E, 2013. Kegiatan Penelitian Ubi Kayu. Pusat Penelitian Bioteknologi LIPI.http://www.biotek.lipi.go.id/index.php/news/biotek/907-kegiatan penelitian. Hal. 1. Diakeses : tanggal 24 April 2013.

[18] Suryana. A, 2005. Kebijakan Ketahanan Pangan. Kepala Badan Litbang Pertanian, Departemen Pertanian. Makalah Disampaikan pada Symposium Nasional Ketahanan Pangan dan Keamanan Pangan pada Era Otonomi dan Globalisasi, Faperta IPB. Hal. 259-273.

[19] Yuli Widyastuti. Y dan Sugeng.S, 2003. Pengaruh Beberapa Tingkat Dosis Pupuk Organic dan Tiga Jenis Tanah pada Pertumbuhan dan Kandungan Minyak Aksiri Ketumbar. Jurnal Bahan Al am Indoensia. Vol 2 (3).