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GROWTH AND YIELD OF CASSAVA LEAVES TO THE DOSE OF MANURE AND THE POSITION OF PLANTING STEM CUTTINGS

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Abstract

The aim of the research was to determine the growth and yield of cassava leaf at the best dose of manure and planting position of cassava stem cuttings. The location of the research was carried out in the Garden of the Faculty of Agriculture UPN "Veteran" Yogyakarta, Condongcatur, Yogyakarta. The time of the research was carried out in November - February 2020 with the Regosol soil type and an altitude of approximately 110 m above sea level. This study used a field experiment with a factorial design which was arranged in complete randomized groups. The first treatment was the dose of manure, consisting of 4 levels: manure doses of 5 t/ha, 10 t/ha, 15 t/ha, and 20 t/ha. The second treatment was the planting position of the stem cuttings, consisting of 3 levels: vertical planting position, vertical planting position but the tip facing upwards was burned, and planting tilted at an angle of more than 60 degree. The results showed that the dose of manure did not show a significant difference to the growth and yield of cassava leaves. The planting position of cassava stem cuttings with normal cuttings gave the highest growth in the number of cuttings, shoot length, number of leaves, plant height and yield of fresh weight of cassava leaves. Interaction between manure dose and stem cuttings planting position.

Keyword: *Dosage of manure, Cutting position, Cassava leaves*

INTRODUCTION

Cassava leaves are a leaf vegetable that is much loved by the community which is used as fresh vegetables in Padang cuisine, coconut milk vegetables and as an ingredient for making cassava leaf tempeh and also as an ingredient for livestock and fish feed. According to farmers, harvesting cassava leaves is more profitable for farmers than harvesting cassava tubers. This is because cassava leaves can be harvested continuously for 20 days for 5 to 6 years, while cassava tubers can only be harvested once a year. Good cassava leaves, when cassava plants have HCN <40 ppm, and not those with HCN > 50 ppm which taste bitter (Balitkabi, 2018), because the leaves are consumed as vegetables.

Cassava leaves have a high mineral and vitamin content. Mineral elements are very important in their functions, including maintaining the colloidal state of several compounds in the body, maintaining acid-base balance, as activators of

certain systems, as components of enzyme systems. Vitamins are organic compounds needed by the body in small amounts for normal growth and maintenance of life (Antari and Umyasih, 2009). The mineral and vitamin content of cassava leaves can be seen in Table: 1.

Table 1. Mineral and vitamin content of cassava leaves and tubers

Constituents	Cassava leaves	Cassava tubers	Library (in Smith, 1988)
Calcium (mg/kg)*	1.1 – 1.4	0.02 – 0.35	*Chada (1961);
Phosphorus (mg/kg)*	0.25 – 0.30	0.07 – 0.46	Barrios Dan
Magnesium(mg/kg)*	-	1.10	Bressani (1967);
Copper (mg/kg)*	8.0	-	Devendra (1977);
Iron (mg/kg)*	450	8 – 65	Hutagalung (1977)
Manganese (mg/kg)*	46.0	18.0	
Vitamin A (IU)**	100,000 – 300,000	55	**De Brochard *et al.*
Riboflavin (mg/kg)**	2.5 – 4.3	0.3 – 0.8	1957); Jones(1959);
Thiamin (mg/kg)**	0.3 – 2.7	0.4 – 1.6	Chada (1961);
Niacin (mg/kg) **	8.5 – 35.3	0.6 – 1.6	Muller *et al*. (1975);
Vitamin C (IU)**	520 – 1,800	5 – 360	Hutagalung (1977).

Source: Antari and Umiyasih, 2009.

Table 1 shows that except for the mineral phosphorus content, the mineral and vitamin content of cassava leaves is more than that of cassava tubers. The benefits of cassava leaves include anticancer, prevent constipation and anemia, and increase endurance. The high calcium content is very good for preventing bone diseases such as rheumatism and gout. Cassava leaves contain cuprofilin which can significantly reduce cholesterol, triglycerides, blood serum lipids. Cuprophyllin in cassava leaves is found in the chlorophyll. Chlorophyll and some of its derivatives have antioxidant and anticancer properties (Tuhenay, 2018).

The problem faced is the use of an unclear dose of manure and the planting position of cassava stem cuttings on the growth and yield of cassava leaves. As an illustration, the dose of cow manure on vegetable crops is around 10-20 t/ha (Musnamar, 2004). Cow manure has 80% water content, 16% organic matter, 0.3% N, 0.2% P2O5, 0.15% K2O, 0.2% CaO and a C/N ratio ranging from 20-25. The application of manure to vegetable crops reaches 20-30 t/ha, while dry land food crops such as corn, soybeans, upland rice and others are 1-2 tons/ha (Balitbang Tanah Sumberdaya, 2006). In addition, it is also about the planting position of cassava leaf stem cuttings, whether by planting in a vertical planting position, tilting planting position with more than 60^0 angles or vertical planting position but the end facing upwards is burned. Burning the ends of the cassava stem cuttings with the intention of stopping the growth of the cassava stems upwards. With the burning, more shoots will appear and more cassava leaves will be harvested.

The aim of the study was to determine the best dose of manure and the planting position of cassava stem cuttings on the growth and yield of cassava leaves. Therefore, it is necessary to conduct research on the dose of manure and the planting position of cassava leaf stem cuttings.

LITERATURE REVIEW

Cassava leaves are cassava plants that are harvested instead of cassava tubers, measuring 22 cm in length as measured from the growing point (top of the plant) down to the top of the cassava plant stem. Leaf cassava plants are harvested when they are 25-40 days after planting, and are harvested after 20 days continuously. If the cassava leaves are left alone, the stem growth can reach approximately 3 m, for this reason, the leaves and stems are trimmed so that the stem growth is around 1 m. This can be done because of the growth of apical dominance in cassava stems, for this reason, cassava leaves and stems are trimmed. According to a personal communication from Kartika Noerwijati, SP, MP from Balitkabi Malang, the variety used in this study is the fake sticky rice variety, it is characterized as follows: single leaf because there is only one leaf per petiole. The tip of the leaf is tapered, the leaves have 5-7 strands (leaflets) and the skin of the tuber is white instead of brown, that's why it's called fake sticky rice, while if the skin color is brown it's called real sticky rice. The name of the fake sticky rice variety in various regions has different names, including the Sumatran variety for Gunung Kidul and Bantul, the Special Region of Yogyakarta, and the other salidri varieties for the area around Gedong Songo, Bandungan Semarang, Central Java. In addition, many regions in Indonesia have planted cassava plants for food, including the Adira-1, Malang-1, Malang-2, Darul Hidayah varieties, and for industrial raw materials, including the Adira-2, Adira-4, UJ-3, UJ-5, Malang-4, and Malang-6 (Sundari, 2010). In principle, all cassava leaves can be used as leaf vegetables, if cassava plants with HCN content < 40 ppm are not bitter.

Cassava leaves are known to contain flavonoid and phenolic active compounds. Flavonoids and phenolics are secondary metabolites produced by plants and have many functions, one of which is as an antioxidant. Antioxidant compounds inhibit the activity of free radicals in the body by donating electrons to free radical molecules so that these molecules become stable (Saleh, et al., 2016). For more details, the benefits of cassava leaves for body health are as follows: increasing appetite, maintaining pregnancy to overcome anemia, treating diarrhea, treating intestinal worms, overcoming stroke, increasing body resistance/immunity, eye health, overcoming blurred vision, preventing osteoporosis, preventing osteoporosis. premature aging, overcoming external wounds, increasing energy, helping increase body metabolism, overcoming digestion, helping diet, helping to regenerate cells, high antioxidants, treating rheumatic problems, overcoming wrinkles, containing vitamin A, and treating fever (Maryana and Bargumono, 2020).

Cassava leaves can be processed into routine or vitamin P which has extraordinary benefits. According to a pharmacist from the Department of Pharmacy, Andalas University, West Sumatra, Prof. Amri Bakhtiar MS DESS Apt, vitamin P is useful for strengthening the capillary structure and reducing the permeability or flexibility of blood vessels. In the world of medicine, rutin is often used to treat various diseases caused by blood vessel disorders such as bleeding from the lining of the eye, hypertension, hemophilia, migraines, headaches, and bleeding gums. For patients with thrombocytopenia (a disease caused by a reduced number of red blood cells), rutin can stimulate the production of platelets. The technology for obtaining a rough routine is relatively simple, so it can be applied by any cottage industry. The trick is to mash fresh cassava leaves and soak them in an organic solvent such as sodium hydroxide (NaOH) with a concentration of 1% for 24 hours while stirring occasionally. After that, separate the solvent with filter paper. Then let the solvent stand until a precipitate forms. This precipitate is purified so that pure routine (vitamin P) is obtained.

Another preparation made from cassava leaves is in the form of cassava leaf tempeh. Cassava leaves contain 11,000 IU of vitamin A and 275 mg of vitamin C in 100 grams. Oranges only contain 50 mg, while 1 glass of apple juice has 20 IU of the vitamin. Both nutritional content is beneficial for eye health and immunity, especially in children. This means that cassava leaf tempeh is an option to meet the needs of the two essential vitamins. A sheet of cassava leaves has many benefits, through routine bioflavonoids, namely in (a) agro-industry/agriculture: antifeedant, growth regulator; (b) chemical industry: masks, dyestuffs; (c) cosmetics: sunscreen, antiacne; (d) as a drug: isokuersitrin which is divided into 3 kinds of functions, namely antioxidant, antiinflammatory and maintaining blood vessel permeability. In addition to isoquersitrin, it is also used as quercetin which is divided into 8 kinds of functions, namely food stimulant, platelet increase, immunomodulator, antiulcer, antiprostate, anticancer, anti-inflammatory and antioxidant. In addition to bioflavonoids, cassava leaf tempeh (CLT) is also used, namely for (a) food: fresh CLT into curry, and (b) feed: CLT flour in the form of feed and CLT pellets in the form of fish feed (Trubus Editor, ?).

To obtain cassava leaf plants that grow healthily and produce maximum production, they must meet the needs of plant nutrients. The nutrients needed by plants are classified into several classifications as shown in the following table:

Table 2. Classification of Plant Nutrients (Davidescu & Davidescu, 1988 in (Rosmarkam and Yuwono, 2002)

Group	Essential		Non-Essential	
	Primary	Secondary	Increase Production	Not Increase Production
Macro	N, P, K	Ca, Mg, S	Na	Si, V, Ar, Ba, Be, Bi, Br, Cr, F, Li, Pb, Rb, Pt, Sr, Se
Micro	Fe, Mn, Zn, B, Cu	Mo, Co, Cl	Al, I	

Based on Table 1 it can be seen that macro nutrients are nutrients needed by plants in relatively large quantities. Micronutrients are nutrients needed by plants in relatively small amounts. Micro nutrients are needed in small amounts but these nutrients are very important in supporting physiological processes and plant growth. In addition, there are essential nutrients and non-essential nutrients. Essential nutrients are nutrients whose role cannot be replaced by other elements, and if plants lack these elements, plants will grow abnormally. Non-essential nutrients are nutrients that have a relatively small role in plant growth and their role can be replaced by other nutrients (Purba, et al., 2021a)

Manure to meet the needs of macro nutrients and micro nutrients. Manure part of the organic fertilizer. As an organic material that is multifunctional in the soil. Organic matter is able to change soil properties, both physical, chemical and biological properties of the soil. Organic matter content is the most important indicator and key to the dynamics of soil fertility. Organic matter has a multifunctional role, which is able to change the physical, chemical and biological properties of the soil. In addition, organic matter is also able to play a role in activating compounds arising from their dynamics as growth regulators, sources of enzymes (catalysts of compound reactions in the metabolism of life) and biocide (disease and pesticides made from organic materials). Organic matter is said to be able to change the physical properties of the soil, because the physical condition of hard/clay (solid) soil will be able to turn into loose soil in the presence of organic matter. As a result, soil porosity and permeability are getting better so that air aeration increases, this is useful to avoid water saturation which causes root rot. Organic matter is a source of nutrients in the soil. Organic matter affects soil fertility indirectly. Organic matter plays an important role in improving soil physical fertility. Organic matter affects soil aggregation which affects infiltration, movement and retention of groundwater, soil aeration and root penetration. Organic matter also affects the biological properties of the soil. Organic matter also increases microbial activity in the decomposition process of organic matter. Soil rich in organic matter is very fertile (Purba, et al., 2021b)

The application of organic fertilizers and inorganic fertilizers on agricultural land has advantages between organic fertilizers compared to inorganic fertilizers. The advantages of organic fertilizers include (a) containing complete but few macro and micro nutrients, (b) can improve soil structure so that the soil becomes loose, (c) has a high water holding capacity, (d) some plants fertilized with organic fertilizers are more resistant to disease, (e) increases the activity of beneficial soil microorganisms, (f) has a positive residual effect, meaning that the positive effect of organic fertilizer on plants in the following season is still there so that growth and productivity are still good. While inorganic fertilizers include (a) only containing one or several nutrients but in large quantities, (b) cannot improve soil structure,

instead their use in the long term causes the soil to become hard, (c) often makes plants vulnerable (not resistant). against disease, (d) inorganic fertilizers evaporate easily and are leached, therefore an improper application will be in vain because the nutrients present are lost due to evaporation or washing by water, (e) cannot increase the activity of soil microorganisms, and (f) does not have a positive residual effect (Simamora and Salundik, 2006)

As it is known that the propagation of cassava leaves and cassava tubers is the same, namely by vegetative propagation using cassava stem cuttings. The nutritional content (foodstuff) of cuttings, especially protein and carbohydrates, greatly influences the growth and development of roots (Savitri, et al., 2014). The presence of carbohydrates in the cuttings is the largest source of energy and carbon during the rooting process. There is a lot of accumulation of carbohydrates at the base of the cuttings, so that only the base can grow roots. In addition, the protein formed will be used as a building block for plant organs such as roots, stems and leaves (Pamungkas, et al., 2009). In addition, if the auxin in the cuttings is higher than the cytokinins, it will trigger root growth at the base of the cuttings. Rooting that occurs in cuttings is caused by an auxin drive from shoots and leaves (Savitri, et al., 2014). At the base of the cuttings have a high C/N ratio, cuttings with a high C/N ratio will more easily and quickly form roots. If the C/N is low, root initiation is hampered, even though the carbohydrate content in cuttings is high, because the high nitrogen element causes low rooting processes. To grow roots on cuttings, energy is needed from carbohydrates and proteins contained in cuttings (Pamungkas, et al., 2009).

Vegetative propagation by cuttings is more profitable than other propagation. The advantage of cuttings propagation is that only a small amount of cutting material is needed but can produce a lot of plant seeds, the resulting plants have the same age, size and nature of the plants produced as the parent, and perfect plants can be obtained (having roots, stems and leaves). in a relatively short time (Wudianto, 2002). The disadvantage is that not many types of plants can be propagated in this way so that their use is limited (Setiawan, 2001). Cuttings (cutting or stump) or cutting is growing parts or pieces of plants, so that they become new plants (Prastowo et. al., 2006). Cuttings is an induction stimulation of adventitious roots and shoots (Harjadi, 1979). The success of propagation by cuttings is indicated by the regeneration of roots and shoots on the cutting material so that they become new plants (Widiarsih, et. al., 2008). According to Kusuma (1990), roots that arise on cuttings are caused by auxin encouragement from shoots and leaves. Healthy shoots on stems are a source of auxin and are an important factor in rooting. The amount of auxin contained in the cutting organs varies. Cuttings with higher auxin content will be better able to grow roots, and will produce a higher percentage of cutting survival than cuttings with low auxin

content. Factors that affect the growth of cuttings are the physiological condition of the parent plant (stock plant), the age of the parent plant, the type of cutting material, the timing of cuttings, growth regulators, the presence of shoots and leaves, the age of the cutting material, and environmental conditions (Dawson and King, 1994) as well as one's skill in cutting plants.

RESEARCH METHODOLOGY

The place of research was carried out at the Faculty of Medicine's Practical Garden. Agriculture UPN "Veteran" Yogyakarta, Condongcatur, Yogyakarta. The altitude of the place is about 110 m above sea level with Regosol soil type. The time of the research was carried out in November – February 2020. The materials needed were cassava leaf cuttings taken from the hamlet of Jambon Kalurahan Bawuran, Kapanewon Pleret, Bantul Regency, and cow manure. The tools used include hoes, plastic buckets, rulers, 2 kilos scales, analytical scales, gas compost and stationery.

The research method used was a factorial field experiment with two treatments arranged in a completely randomized block design which was repeated 3 times. As the first treatment is the dose of manure, consisting of 4 levels: dose of manure 5 t/ha (D1), dose of manure 10 t/ha (D2), dose of cow manure 15 t/ha (D3), and dose of manure cage 20 t/ha (D4). The second treatment was the planting position, consisting of 3 levels: cassava leaf stem cuttings planted in a vertical planting position (V1); vertical cropping position but the tip facing up is burned (V2) and the cropping position is tilted with more than 60 degree angle (V3).

The implementation of the research is that the soil is processed first with a hoe so that the land becomes loose. Then the soil is made beds with a width of 100 cm and a length of 300 cm. Furthermore, the application of fertilizer with a dose (dose) of cow manure according to the treatment which has been converted according to the size of the bed according to the treatment. The fertilized soil bed is then covered with silver mulch on top. By using a hole punch, a planting hole is made with a spacing of 60 cm x 65 cm.

Cassava leaves were taken from healthy plants and were more than 7 months old. The seed used for cuttings is a good middle part of the stem. The seeds were then cut into 20 cm cuttings. The beds are given irrigation water (watering), then proceed with planting. Vertical planting position is cuttings planted by plugging into the planting hole as deep as 5 cm. The position of the cuttings should not be reversed, the base becomes the tip. The vertical planting position has the ends burned. Oblique planting position is stuck in a tilted position to form more than a 60 degree angle. Maintenance of cassava seed cuttings, among others, if there are pests and diseases that attack cassava plants, is carried out by controlling pests and diseases using vegetable pesticides. Harvesting of cassava leaves is collected at the age of 35 days, and then it is done every 20 days.

Data were taken and collected from 5 sample plants for the growth components of cassava leaves including number of shoots, shoot length, number of leaves and plant height and crude fiber content observed at 35 days of age. The yield component of cassava leaves taken from 10 plants was the fresh weight of cassava leaves observed at 80 days of age. The data from the observations were analyzed for diversity at the 5% level and if there was a significantly different effect, it was continued with Duncan's multiple distance test at 5% level.

RESULTS AND DISCUSSION

The results of observations on the growth of cassava leaves after being analyzed showed that the treatment dose of manure and planting position of cassava stem cuttings on the number of shoots cuttings, shoot length of cuttings, number of leaves and plant height of cassava are shown in Table 3.

Table 3. Dosage of manure and planting position of leaf cassava stem cuttings on plant growth of cassava leaves

Treatments	Dosage of manure (t/ha)			
Parameters	5	10	15	20
1. Number of cuttings (fruit)	2,11 a	2,53 a	2,16 a	2,22 a
2. Length of cutting shoots (cm)	20,32 a	17,75 a	21,37 a	19,75 a
3. Number of leaves (fruit)	23,44 a	25,78 a	26,49 a	24,51 a
4. Plant height (cm)	28,09 a	25,42 a	27,29 a	26,72 a
	Cuttings planting position			
	Normal	Edge burned	Italics over 60 degree	
1. Number of shoots cuttings (fruit)	2,73 p	1,88 q	2,15 q	
2. Length of cutting shoots (cm)	23,82 p	19,61 q	15,95 r	
3. Number of leaves (fruit)	33,22 p	20,25 q	21,70 q	
4. Plant height (cm)	32,00 p	27,05 q	21,59 r	
	Interaction between treatments			
1. Number of cuttings shoots (fruit)	(-)			
2. Length of cutting shoots (cm)	(-)			
3. Number of leaves (fruit)	(-)			
4. Plant height (cm)	(-)			

Note: Numbers followed by the same letters are not significantly different.
The sign (-) indicates the interaction is not real.

Table 3 shows that the dose of manure did not show a significant difference to the number of cuttings shoots, cutting shoot lengths, number of leaves and plant height of cassava leaves. This means that all cassava leaf growth parameters have the same response to the dose of cow manure. For this reason, in order to determine

the correct dose of manure, further research is needed, and the dose of cow manure is not only 20 t/ha, but needs to be increased again, for example with a dose of 30 t/ha or 40 t/ha. Cow manure has 80% water content, 16% organic matter, 0.3% N, 0.2% P2O5, 0.15% K2O, 0.2% CaO and a C/N ratio ranging from 20-25, 2006).

Table 3 also shows the planting position of cassava stem cuttings showing significant differences in the number of shoots, shoot length, number of leaves and plant height. The cutting position normally resulted in the number of cuttings shoots, cutting shoot length, number of leaves, and plant height of cassava leaves were greater than the cutting position with the ends burned and the cuttings positioned at an angle of more than 600°. The length of shoot cuttings and plant height of cassava leaves at the slanted cutting position was more than 600 degrees lower than the cutting position with burnt tips and the normal cutting position. This can happen because the tilted planting position of more than 600 angles has interfered with the transport of auxin from the shoots to the bottom. This is related to basipetal auxin transport, ie auxin is transported from the shoots to the bottom, so that roots will appear at the base of the cuttings, because the function of auxin is to stimulate root initiation in stem cuttings. Besides being influenced by the hormone auxin, root growth is also influenced by the presence of carbohydrates in cuttings, where carbohydrates are the largest source of energy and carbon source during rooting (Pamungkas et al., 2009).

The results of observations after being analyzed showed that the yield of cassava leaves on the dose of cow manure and the planting position of stem cuttings included the results of crude fiber content at 35 DAP and fresh weight of leaf cassava at 80 DAP can be shown in Table 4.

Table 4. Dosage of manure and planting position of stem cuttings on the yield of crude fiber content at the age of 35 DAP and fresh weight of cassava leaves at the age of 80 days after planting.

Treatments	Dosage of manure (t/ha)			
Parameters	5	10	15	20
1. Crude fiber content (%)	3,31 a	3,48 a	3,43 a	3,27 a
2. Fresh weight of cassava leaves (kg)	1,27 a	1,28 a	1,43 a	1,32 a
	Cuttings planting position			
	Normal	Edge burned	Miring lebih 60^0	
1. Crude fiber content (%)	3,58 p	3,40 p	3,14 p	
2. Fresh weight of cassava leaves (kg)	1,45 p	1,39 pq	1,13 q	
	Interaction between treatments			
1. Crude fiber content (%)	(-)			
2. Fresh weight of cassava leaves (kg)	(-)			

Note: Numbers followed by the same letters are not significantly different.
The sign (-) indicates the interaction is not real.

Table 4 shows that the dose of manure and the position of planting stem cuttings on crude fiber content shows no significant difference, which means the use of manure doses of 5 t/ha, 10 t/ha, 15 t/ha and 20 t/ha will produce cassava leaves the same, and the position of planting stem cuttings also produces the same cassava leaves. Crude fiber is part of the carbohydrate nutrients that are not easily soluble in water consisting of cellulose, hemicellulose and lignin. Crude fiber is the part of food that cannot be hydrolyzed by chemicals, which is used to determine the crude fiber content, namely sulfuric acid (H2SO4 1.25%) and sodium hydroxide (NaOH 3.25%). Meanwhile, dietary fiber is part of the material that cannot be hydrolyzed by digestive enzymes. The main role of fiber in food is its ability to bind water, cellulose and pectin. With the presence of fiber, helps speed up the remains of food through the digestive tract to be secreted out. Without the help of fiber, feces with low water content will stay in the intestinal tract longer and have difficulty passing through the intestine to be excreted because the peristaltic movements of the large intestine become slower (Bagen, 2012).

Table 4 also shows the planting position of cassava leaf cuttings against the fresh weight of cassava leaves showing that there is a significant difference where the planting position of the cuttings is normally heavier than the planting position of the cuttings which are tilted at an angle of more than 600. The position of planting the cuttings with the ends burned is the same as the position for planting normal cuttings or an inclined planting position that is more than an angle of 60 degrees. This is because the tilted planting position of more than 600 has disrupted the auxin transport from the shoots to the bottom. This is related to basipetal auxin transport, namely auxin is transported from the shoot to the bottom, so that roots will appear at the base of the cuttings, because the function of auxin is to stimulate root initiation on stem cuttings. Apart from being influenced by the auxin hormone, root growth is also affected by the presence of carbohydrates in the cuttings, where carbohydrates are the largest source of energy and carbon during rooting (Pamungkas et al., 2009).

From Tables 3 and 4 it appears that the interaction between the dose of manure and the planting position of the cassava leaf stem cuttings showed a negative interaction, which means that there was no significant difference in all observed parameters. Interaction is the tendency of a factor to have a different effect on various levels of other factors (Sutjihno, 1992).

CONCLUSION

1. The dose of manure did not show a significant difference on the growth and yield of cassava leaves.
2. The planting position of cassava stem cuttings with normal planting cuttings gave the highest growth in the number of shoots, length of shoots, number of leaves, plant height and yield of fresh weight of cassava leaves.
3. Interaction between manure dosage and planting position of stem cuttings.

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