

Application of Rapid Multiplication Technique Using Mini Cutting and NPK Compound Fertilizer to Increase Production of Sweet Potato Cuttings (*Ipomoea batatas* L.)

Ni Kadek Ema Sustia Dewi^A, M. Rahmad Suhartanto^{*B}, Suwanto^B

^A Seed Science and Technology, Faculty of Agriculture, IPB University, Jalan Meranti, Bogor 16680, Indonesia

^B Department of Agronomy and Horticulture, Faculty of Agriculture, IPB University, Jalan Meranti Road, Bogor 16680, Indonesia

*Corresponding author; e-mail: tantosuhartanto63@gmail.com

Abstract

Rapid Multiplication Technique (RMT) is a technique used to produce large scale cuttings of sweet potato in a short period by using mini cuttings and proper fertilizer management. The research was carried out from October 2019 to March 2020 and composed of two experiments. The first experiment involved a randomized complete block design, with clones ("Ase Kapas" and "Ase Merah") as the first factor, and tuber weight (150 ± 25 g, 250 ± 25 g, and 350 ± 25 g) as the second factor. The second experiment was arranged in a split-plot design involving different doses of NPK compound fertilizer (as main plot) and different source of cuttings (as subplots). The different doses included NPK 16:16:16 at $100 \text{ kg}\cdot\text{ha}^{-1}$ (0.3 g per polybag), $200 \text{ kg}\cdot\text{ha}^{-1}$ (0.6 g per polybag), $300 \text{ kg}\cdot\text{ha}^{-1}$ (0.9 g per polybag), and without fertilizer as control. The source of cuttings were from the tip, middle and bottom stem of the plants. Results showed that the "Ase Kapas" showed the highest number and the longest shoots, number of nodes, and length of vines. Additionally, tuber weight of ± 350 g produced the highest number of shoots. When it comes to NPK compound fertilizer treatment, a dose of 0.9 g per polybag increased cutting production in "Ase Kapas", and also responded better to fertilizer treatment. On the other hand, dose of 0.3 g increased cutting production in "Ase Merah". "Ase Kapas" produced more cuttings from the middle stem, whereas "Ase Merah" produced more cuttings from the tip. The application of RMT in "Ase Kapas" produced cuttings with ratio of 1:31, which is higher than those in "Ase Merah" with a ratio of 1:17.

Keywords: tuber, vines, vegetative, clones, propagation

Introduction

Sweet potato (*Ipomoea batatas* L.) is one of the main food crops that is common in Indonesia. Despite large production of sweet potato in the country, which was at an average of $15.35 \text{ tons}\cdot\text{ha}^{-1}$ in 2012-2016, there is potential to produce more and reach up to $25\text{-}35 \text{ tons}\cdot\text{ha}^{-1}$ (Pusdatin, 2016). The increase in sweet potato production requires the use of quality cuttings, which is a critical factor in plant productivity.

In general, farmers in Indonesia use sweet potato cuttings (tip or stem) from previous cropping (Saleh et al., 2008). The use of these cuttings that have been propagated four to five generations from the parent plant has been found to decrease the quality of seedlings (De Silva, 1990). Based on previous study, tuber weight does not affect the quality of seedlings produced. However, small tuber weights produce less shoots than large tuber weights (Wahyuni, 2011).

Research on sweet potato plants showed that large tuber weights have better growth and stem length than small tubers (Adhikari, 2005). A large tuber weight also results in a higher fresh tuber weight compared to a small tuber weight (Arifin et al., 2014). A massive difference at the beginning of growth will be a potential capital to produce further growth differences (Sitompul and Guritno, 1995).

Efforts to produce a large amount of cuttings can be made with Rapid Multiplication Technique (RMT). RMT is a technique for producing large quantities of cuttings in a short period of time. This technique is often carried out in Africa by using mini 3-node cuttings with a length of $\pm 10\text{-}20$ cm (Stathers et al., 2018). The use of mini cuttings (1-3 internode) can be done if the availability of cuttings is limited (Wahyuni, 2016). According to Maulida (2016), the treatment of 3-5 nodes on sweet potato plants produce relatively

the same number of seedlings, so the use of mini cuttings can be an alternative solution. The size of cuttings, stem thickness, and the distance between the node types of plants that are erect or spread are some of the properties that contribute to the successful multiplication of planting material (Gruneberg et al., 2008).

The level of multiplication using RMT can produce a ratio of 1:30 -1:50 after \pm 4 months if proper fertilization and management were conducted (Stathers et al., 2013). The application of RMT is also based on the high demand for materials. This can be overcome by extending the maintenance time of cuttings. The cuttings can be harvested several times if the crops culture were managed well. The first harvest of cuttings was carried out at 6 to 7 weeks after planting. Cuttings are made to leave 15 cm from the base of the stem, then left to grow until 6 to 7 weeks after the first harvest. This practice is called 'ratoon' and can be performed three times (Stathers et al., 2018). The use of appropriate fertilizers, particularly compound NPK compound, can result in the production of large numbers of sweet potato cuttings. The usual recommended dosage of NPK fertilizer (17:17:17) is achieved by applying 42 g.m^{-1} fertilizer after planting sweet potato cuttings (FAO, 2010).

Determination of the appropriate planting material and proper application of fertilizer are needed to obtain the best seedlings from cuttings. The shorter the cuttings used, the more efficient the use of planting material. In this study, Rapid Multiplication Technique, involving the use of mini cuttings and application of NPK fertilizers, was conducted. These treatments were selected to determine the number of cuttings produced and the best NPK fertilizer management to produce the largest number of first-generation sweet potato cuttings.

Material and Methods

The study was conducted in a 25% paranet shade (75% light transmission) based on Robert et al. (1988) at the Cikabayan Experimental Farm, Dramaga, West Java, from October 2019 to March 2020. Determination of fresh and dry weight of samples was carried out at the Seed Storage and Testing Laboratory and Postharvest Laboratory of IPB University. Soil and leaf nutrient analysis was carried out at the Testing Laboratory of the Department of Agronomy and Horticulture, IPB University.

Effect of Clones and Tuber Weights on Sweet Potato Growth and Cuttings Production

A randomized complete block design using two factors (sweet potato clones and tuber weights) was prepared to determine the effect of tuber weights on shoot growth potential. Two sweet potato clones were used namely, "Ase Kapas" and "Ase Merah". These clones were widely planted by farmers at Cikarawang for commercial purposes. Tuber weights were of the following: $150 \pm 25 \text{ g}$, $250 \pm 25 \text{ g}$ and $350 \pm 25 \text{ g}$. The experiment consisted of 6 treatment combinations which were replicated four times. Consequently, there were 24 experimental units with 10 samples per experimental unit. A total of 240 polybags containing samples were used for this experiment. Tubers were planted using a 30 cm x 30 cm polybag with a volume of 6 kg of growing media. The planting media used were manure and soil in a ratio of 1:1. Before planted in polybags, the tubers were sprayed with a fungicide solution with a.i. 80% of mancozeb at 4.8 g.L^{-1} , then aerated.

Basic fertilizer application was made one day after planting by applying fertilizer around the tubers in each polybag. Fertilizers used were Urea at 100 kg.ha^{-1} (0.3 g per polybag), SP-36 at 75 kg.ha^{-1} (0.23 g per polybag) and KCl at 100 kg.ha^{-1} (0.3 g per polybag). The fertilizer for each polybag was mixed into one so that the total fertilizer used was 0.83 g per polybag. Measurements were conducted for the following parameters: number and length of shoots at ages 6, 9, 12, 15, 18 days after planting (DAP), number of nodes and length of vines at ages 3 to 8 weeks after planting (WAP), number of vines from shoots, and number of cuttings with length of 30 cm.

Effect of The Origin of Cuttings and Dosages of NPK Compound Fertilizer on Production of First Generation Sweet Potato Cuttings

A split-plot (main plot and subplot) design with a two-factor (dose of fertilizer and source of cuttings) was used to determine the effect of fertilizer dosage and origin of cuttings on the efficient production of first generation cuttings. In the main plot, NPK compound fertilizer of the following dosage were administered: without fertilizer as control, 100 kg.ha^{-1} (0.3 g per polybag), 200 kg.ha^{-1} (0.6 g per polybag), and 300 kg.ha^{-1} (0.9 g per polybag).

In the subplot, the source of cuttings came from the following: tip, middle and the lower stem cuttings with three nodes each. Each treatment was replicated four times resulting in 48 treatment combinations. One experimental unit consisted of seven polybags containing one cutting per polybag. This experiment

was carried out in parallel on “Ase Kapas” and “Ase Merah”.

Cuttings were planted using a 30 cm x 30 cm polybag with a volume of 6 kg of growing media. The planting media used were manure and soil in a ratio of 1: 1 (v/v). Cutting materials were cut every three nodes for the treatment of tip cuttings and stems, then soaked with a fungicide containing a.i. 80% mankozeb at 4.8 g.L⁻¹ for 15 minutes. Cuttings were planted in the morning on polybags that contain planting media provided that one node was in the media, leaving one leaf.

Application of fertilizer treatment was made one day after planting and after the first harvest by sowing fertilizer around the cuttings in each polybag according to the treatment. Seedlings that were 7-weeks-old were harvested with the provision of 30 cm from the shoots (Kepmentan, 2016). Harvesting was done by cutting all primary and secondary branches starting from the base of the branch using cuttings scissors. Stems were left at 15 cm from the ground to prevent pests from infecting planting material (Stathers et al., 2018). Sweet potato cuttings were harvested again when sweet potato plants reached 7 weeks after the first harvest. Pest was controlled using insecticide containing a.i. 25 g.L⁻¹ deltamethrin to control caterpillars and grasshopper attack. Insecticide with a.i. 0.05% carbosulfan was also used to control ants and insects in the soil at the beginning of planting (Indiati and Saleh, 2010). Fungicide containing a.i. 80% mankozeb was also administered.

Growth measurement include the number and length of primary and secondary branches, total dry weight, life percentage, and leaf colour index. Measurement of average cuttings production from tips and stems at 7 and 14 WAP, combined harvest and total of cuttings were also conducted. Soil analysis were conducted before planting. Leaf nutrient was analyzed at 7 WAP by compiled sampling for each treatment from four

replications. Data were analyzed using SAS 9.4 with ANOVA at 95% confidence interval, which was used to determine the effect of each treatment. Significant differences between treatments were separated using the Tukey test at a level of 5%.

Result and Discussion

Effect of Clones and Tuber Weights on Growth and Cutting Production of Sweet Potato

Before planting, the soil in the Cikabayan was found to be slightly acidic, the C-Organic content was very low, the total N was low, total P was very high, and the total K was moderate. Due to these condition, fertilizers were applied. In general, significant effects on growth were observed on different clones. However, there was no significant effect on plant growth among different tuber weights. The “Ase Kapas” clones showed better growth than the “Ase Merah”. Moreover, the “Ase Kapas” produced more shoots that were found to be greater in length (Figure 1 A-B), longer vines and more number of nodes (Figure 2 C-D) compared to the “Ase Merah”.

The difference in morphological characteristics of plants during growth can be attributed to the differences in the genetic characters of the plant clones or varieties used. Different varieties showed different growth performance. This was also observed in previous studies such as the one by Muli and Mwakina (2016) where SPK004 variety showed the highest growth power of 97.8% compared to the Bungoma, K135, and Mtwapa varieties 8. The vines of the “Ase Kapas” clones were longer compared to “Ase Merah” because shoots of “Ase Kapas” develop faster so that the shoots are higher (Figure 2 C). The length of the vines and the number of nodes had increased significantly every week (Figure 2 C-D).

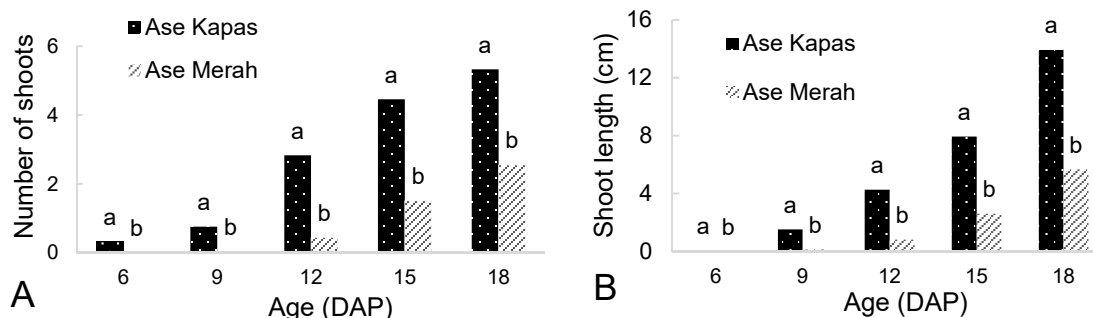


Figure 1. (A) Increase in number of shoots and (B) Shoot lengths in “Ase Kapas” and “Ase Merah” at ages 6, 9, 12, 15, 18 DAP. Note: Data with the same letter in each DAP was not significantly different according to Tukey test at $\alpha = 0.05$

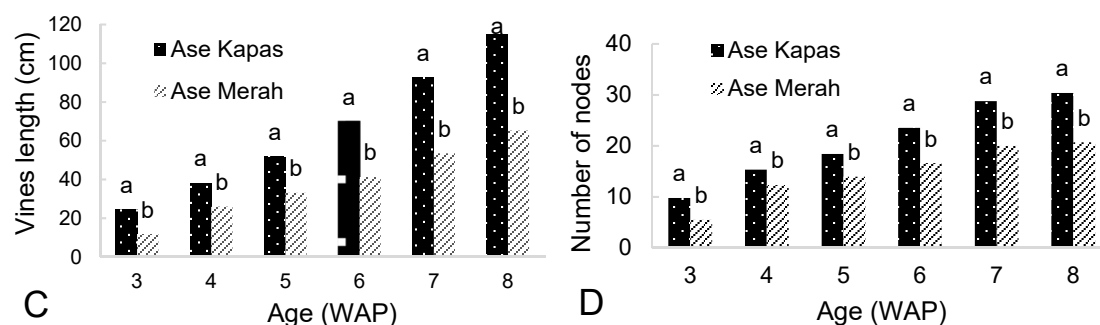


Figure 2. (C) Vines length and (D) increase in the number of nodes of “Ase Kapas” and “Ase Merah” at age 3-8 WAP. Note: values with the same letter at each DAP was not significantly different according to Tukey test at $\alpha = 0.05$

Tubers with weights of 350 ± 25 g and 250 ± 25 g resulted in the production of more vines and cuttings, with the former producing more vines and more cuttings of 30 cm in size compared to the latter. However, the observed differences were not significant (Table 1). Therefore, at generation zero (G0), tuber weights ranging from $250\text{-}350 \pm 25$ g can be used for cutting production. It was demonstrated in one study that greater tuber weight produced more shoots, because it had more food reserves than the smaller tuber weights (Atu, 2013).

skin color and intermediate orange flesh color.

Production of the First Generation of Sweet Potato Cuttings as Affected by Origin of Cuttings and NPK Fertilizer Dose

Sweet Potato “Ase Kapas”

Prior to planting, the soil at the Cikabayan was found to have acidic pH, low C-Organic content, moderate N-Total, high available P, and moderate K. The

Table 1. Effects of tuber weight on the number of vines from shoots (8 WAP) and number of cuttings with size of 30 cm

Tuber weight (g)	Number of vines from the shoot (8 WAP)	Number of cuttings (30 cm)
150 ± 25	13.04b	12.24b
250 ± 25	15.56ab	14.75ab
350 ± 25	17.99a	16.75a

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$.

Table 2. Effects of tuber weights on the number of nodes at 7 WAP of the different clones of sweet potato

Clones	Tuber weight (g)		
	150 ± 25	250 ± 25	350 ± 25
“Ase Kapas”	31.20a	30.05a	25.15b
“Ase Merah”	20.48c	20.03c	19.53c

Note: Values followed by the same letters are not significantly different according to Tukey test at $\alpha = 0.05$

When comparing the different clones used, it was observed that the larger/heavier tubers used in “Ase Kapas” resulted in the production of fewer nodes. In “Ase Merah” the heavy tubers did not affect the number of nodes produced. Additionally, the number of nodes produced by “Ase Merah” for all tuber weight classes is less than in “Ase Kapas” (Table 2).

number of primary branches in shoot cuttings aged 4 to 7 WAP was greater than the cuttings in the middle and lower parts, but the number of secondary branches was fewer. The length of the primary and secondary branches in the tip cuttings were shorter than the cuttings in the middle and bottom (Table 3). The results of this study were consistent with the research of Ajie and Setiawan (2017) that the source of cuttings originating from tips produces more branches than stem cuttings. Tip cuttings have high levels of auxin associated with the influence of apical dominance. Apical dominance results in more

According to CIP (1991), “Ase Kapas” has a spreading plant type, round tuber shape with creamy skin color and white flesh color. Meanwhile, “Ase Merah” has a semi-erect plant type, elliptic tuber shape with red

dominant development towards the top. Increasing plant growth will increase the number of nodes and will trigger the emergence of primary branches. Increasing the number of primary branches causes the primary branches to get shorter because photosynthates produced by plants will be distributed to each primary branch. In contrast to tip cuttings, the middle and bottom cuttings have longer primary branches because the number of primary branches is less so photosynthates turn to lateral growth.

Secondary branches are branches that grow on the axils of the primary branches. The number and length of secondary branches in the cuttings at the middle and bottom are more than those from tip cuttings (Table 3)

The application of fertilizer increased the total cutting dry weight to a dose of 0.6 g, and there was no increase in growth with fertilizer application of more than 0.6 g per polybag (Table 4). Growth and leaf color were not affected by NPK compound fertilizer

Table 3. Effects of origin of cuttings on the number and length of primary and secondary branches of G0 "Ase Kapas" cuttings

Source of cuttings	Age (WAP)						
	1	2	3	4	5	6	7
Number of primary branches							
Tip	0.00b	0.00b	0.38b	3.02a	4.31a	4.42a	5.46a
Middle	0.40a	1.90a	1.96a	2.02b	2.21b	2.35b	2.22b
Bottom	0.23a	1.92a	1.98a	2.04b	2.25b	2.65b	2.46b
Length of primary branch (cm)							
Tip	0.00b	0.00b	1.28b	5.44c	12.53c	33.16b	54.97c
Middle	0.36a	4.22a	13.26a	31.27a	48.72a	75.01a	118.38a
Bottom	0.23ab	3.97a	10.19a	24.71b	38.51b	63.13a	92.30b
Number of secondary branches							
Tip				0.00b	0.00c	1.06b	3.06b
Middle				0.73a	3.40a	5.02a	7.52a
Bottom				0.40ab	1.67b	3.59a	6.06a
Length of primary branch (cm)							
Tip				0.00b	0.10b	2.43c	9.38b
Middle				1.54a	3.58a	12.28a	27.14a
Bottom				0.46b	2.95a	7.14b	23.14a

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$; WAP = weeks after planting

Table 4. Effect of source of cuttings and NPK compound fertilizer dosage on growth, leaf color and total dry weight of G0 "Ase Kapas" cuttings

Treatment	Growth percentage (%)	Leaf color 7 WAP	Total dry weight (g)
			5 WAP
Fertilizer (g)	0	96.43	35.45
	0.3	94.05	35.32
	0.6	96.43	34.73
	0.9	94.05	35.82
Source of cuttings	Tip	100.00a	35.81ab
	Middle	95.54ab	36.06a
	Bottom	90.18b	34.11b

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$; WAP = weeks after planting

application. Based on source of cuttings, those from tips and middle had higher growth percentage dry weight compared to those that came from bottom cuttings. According to Lencha et al. (2016), tip cuttings with soft stems produce roots earlier than the

Provision of NPK compound fertilizer up to 0.9 g per polybag did not affect the production of the first generation (G1) cuttings in both cuttings from tip and stems at 7 WAP harvest. At 14 WAP, 0.9 g of fertilizers produced the highest cuttings from tips and stems.

Table 5. Nutrient levels of N, P and K on the leaves of sweet potato “Ase Kapas” G0 cuttings at 7 WAP

Fertilizer dosage (g)	Tip			Middle			Bottom		
	N	P	K	N	P	K	N	P	K
0	4.20	0.46	4.924	5.11	0.47	5.304	4.80	0.51	5.192
0.3	4.32	0.54	5.016	4.02	0.48	6.176	4.45	0.43	5.243
0.6	4.18	0.52	5.454	4.47	0.45	5.733	4.29	0.52	6.404
0.9	4.28	0.49	4.501	4.61	0.50	4.376	4.03	0.47	4.491
SD	0.066	0.035	0.391	0.449	0.021	0.768	0.322	0.041	0.792

middle and bottom parts, which could be attributed to the age of the cuttings, moisture content and the rate of assimilation of the content of the cuttings. The critical value of Soil Plant Analysis Development (SPAD) which shows that plants are nutrient deficient is around 35 (Doberman and Fairhurst, 2000). Middle cuttings show a more intense leaf color than the tip and bottom cuttings.

According to O’Sullivan et al. (1997), nutrient levels critical to the deficiency in sweet potato plants are N=4.2%, P=0.22%, and K=2.6%, and the range of nutrient adequacy is N=4.3 to 5.0%, P=0.26 to 0.45%, and K=2.8 to 6.0% in experiments with culture media. Application of fertilizer at 0.3 g resulted in sufficient N in the tip cuttings. In the middle cuttings, providing fertilizer of all dosages resulted in the adequacy of nitrogen, except at 0.3 g. The application of 0.0 g and

0.3 g fertilizer doses at the bottom cuttings showed nutrient adequacy, but the higher the dose of fertilizer given, the lower the nutrient content (Table 5). Each clone has a different amount of nutrient requirements which are thought to affect the nutrient content of N, P, and K in plant leaves. “Ase Kapas” clones showed that the higher the fertilizer dose, the higher the N nutrient content in the tip cuttings. Lower cuttings are more mature plant tissues, so it is assumed that they do not require a lot of nutrient uptake. According to Marschner (2012), nitrogen, phosphorus, and potassium are nutrients that have high mobility in the phloem and can be re-mobilized from mature leaves to newly growing organs. Nutrient levels of P and K showed nutrient adequacy both in the tip, middle and bottom cuttings. P and K nutrient levels indicate nutrient adequacy in both tips, middle and bottom.

Table 6. Effect of source of cuttings and NPK compound fertilizer dosage on average production of G1 “Ase Kapas” cuttings

Treatment	Number of cuttings at 7 WAP		Number of cuttings at 14 WAP		Combined number of cuttings		Total
	Tip	Stem	Tip	Stem	Tip	Stem	
Fertilizer dosage (g)							
0	4.78	5.77	7.78b	4.25b	12.56b	10.02	22.58b
0.3	4.58	4.92	9.19ab	6.61ab	13.78ab	11.53	25.30ab
0.6	4.72	5.10	10.67ab	7.50ab	15.39ab	12.60	27.97ab
0.9	4.80	6.03	12.25a	8.64a	17.05a	14.67	31.72a
Source of cuttings							
Tip	4.46	4.06b	11.40	7.42	15.85	11.48	27.33
Middle	5.46	7.27a	9.38	6.50	14.83	13.78	28.60
Bottom	4.25	5.02b	9.15	6.33	13.40	11.35	24.75

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$.

The number of cuttings from the tip in the combined harvest also showed the highest value at a dose of 0.9 g, but fertilizer application did not show any significant difference in the production of cuttings from stem cuttings. A dose of 0.9 g of fertilizer produced the highest number of total cuttings of 31.72.

The use of tip cuttings tends to result in higher tuber production. This is supported by a previous study by

Djufry et al. (2011) who reported that the highest yield of sweet potato of Papua Solossa variety was from tip (14.26 t.ha⁻¹) and stem cuttings (13.18 t.ha⁻¹).

Sweet Potato "Ase Merah"

Growth and leaf color in "Ase Merah" plants showed similar results with various doses of fertilizer and cutting sources (Table 7). In terms of total dry weight,

Table 7. Effect of source of cuttings and NPK compound fertilizer dosage on growth, leaf color and dry weight of G0 sweet potato "Ase Merah"

Treatment		Growth percentage (%)	Leaf colour 7 WAP	Total dry weight (g) 5 WAP
Fertilizer dosage (g)	0	98.81	38.05	6.29b
	0.3	98.81	38.19	8.14ab
	0.6	100.00	40.27	8.87ab
	0.9	100.00	39.12	10.09a
Source of cuttings	Tip	100.00	39.13	9.00
	Middle	100.00	38.61	8.98
	Bottom	98.21	38.98	7.06

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$.

Table 8. Leaf N, P and K levels of G0 sweet potato "Ase Merah" at 7 weeks after planting

NPK fertilizer (g)	Tip			Middle			Bottom		
	N	P	K	N	P	K	N	P	K
0	3.41	0.38	4.587	3.32	0.42	4.826	3.39	0.47	5.497
0.3	3.44	0.45	6.288	3.75	0.52	6.247	3.40	0.41	5.909
0.6	3.71	0.44	6.656	3.68	0.47	6.935	3.66	0.44	7.702
0.9	3.85	0.50	6.305	3.89	0.46	6.147	3.80	0.47	3.203
SD	0.213	0.049	0.93	0.243	0.041	0.881	0.202	0.029	1.850

Table 9. Effects of source of cuttings and NPK compound fertilizer dosage on average production of the first generation (G1) of "Ase Merah" cuttings

Treatment factor	Number of cuttings at 7 WAP		Number of cuttings at 14 WAP		Combined number of cuttings		Total
	Tip	Stem	Tip	Stem	Tip	Stem	
Fertilizer dosage (g)							
0	1.86b	0.36	8.61b	1.69	10.48b	2.06	12.53b
0.3	2.00ab	0.50	11.75a	2.83	13.75a	3.34	17.10a
0.6	3.42a	0.61	10.22ab	2.19	13.64a	2.81	16.45a
0.9	2.60ab	0.39	11.17a	2.17	13.75a	2.56	16.31a
Source of cuttings							
Tip	2.20	0.23b	11.27	2.44	13.46	2.67	16.13
Middle	2.98	0.83a	10.00	2.27	12.98	3.11	16.09
Bottom	2.23	0.33b	10.04	1.96	12.27	2.29	14.60

Note: Values followed by the same letters in the same column are not significantly different according to Tukey test at $\alpha = 0.05$; WAP = weeks after planting

the use of 0.9 g fertilizer resulted in the highest value. However, the differences in dry weight among plants treated with different fertilizer doses from 0.3 to 0.9 g were not significant.

Initially, the tip, middle and bottom cuttings had N nutrient deficiency. However, with increasing fertilizer doses the leaf N increases (Table 8). Leaf nutrient concentration will increase with increasing availability of soil nutrients (Barbosa et al., 2014). The higher the application of the N fertilizer dose, the greater the N nutrient content and uptake (Barbosa et al., 2014). The tip middle and bottom cuttings showed adequacy of P and K. Application of 0.6 g fertilizer dose produces the highest K nutrient adequacy value compared to other fertilizer doses.

At 7 WAP, the use of a 0.6 g fertilizer resulted in the production of the highest number of cuttings. At 14 WAP, harvest and total harvest dose of 0.3 g fertilizer produced the highest number of tip cuttings. On the other hand, the use of different sources of cuttings did not show differences in the production of new cuttings at all harvest ages and combined harvest (Table 9).

Conclusion

The use of different clones of sweet potato has an effect on the production of high quality cuttings. This could be attributed to morphological and genetic differences in clones/varieties. In this study, "Ase Kapas" were shown to produce more shoots and nodes, and longer shoots and vines than "Ase Merah". Tuber weight of 250 to 350 g produced greater number of vines and cuttings of 30 cm compared to a tuber weight of 150 g for both clones. "Ase Kapas" produced more nodes than "Ase Merah". The greater the weight of "Ase Kapas" tubers, the fewer nodes were produced. In "Ase Merah", the tuber weight differences did not affect the number of nodes produced. The use of different doses of NPK fertilizers have different effects on sweet potato clones, with "Ase Kapas" being more responsive to fertilizer treatment than "Ase Merah". Increasing the dosage of NPK compound fertilizer (16:16:16) to 0.9 g per polybag in "Ase Kapas" allowed increased production of G1 cuttings. On the other hand, the production of G1 cuttings in "Ase Merah" did not increase despite more than 0.3 g per polybag of NPK fertilizer was applied. "Ase Kapas" produced more cuttings from the middle stem whereas "Ase Merah" produces more cuttings from the tip. The ratio of "Ase Kapas" cutting production from application of RMT was 1:31, which was higher than those from "Ase Merah" with a ratio of 1:17

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