Growth and Production Response of Several Local Sweet Potatoes (*Ipomoea batatas* L.) Clones on Multiple Trimming Levels

Ardhea Ade Putra Pratama, Nini Rahmawati and Asil Barus
Faculty of Agriculture, Universitas Sumatera Utara, Medan 20155, Sumatera Utara, Indonesia.

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Abstract: Trimming is an effort to reduce plant parts to optimize plant parts that are important for growth and production, to increase crop productivity. This research aim was to determine the growth and production response of several local sweet potato clones on several trimming levels. This research used a randomized block design with two factors, local sweet potato clones (local clone of Dusun Bintang Meriah, Sirube-rube, Dolok Sinumbah) and several trimming levels (without trimming, trimmed after tendrils reach 50 cm long, 75 cm long, and 100 cm long).This research was carried out in Balai Penelitian Tanaman Sayur, Tongkoh Village, Berastagi, Karo Regency from July 2018 to January 2019. The results showed that the local sweet potato clones had a good growth and production response to several levels of trimming. Three local clones did not affect significantly in the length of tendrils, tuber weight per sample, number of tubers per sample, crown wet weight, and harvest index. Trimming levels did not significantly affect the length of tendrils, tuber weight per sample, number of tubers per sample, and canopy wet weight, but significantly affect the harvest index. The best level of trimming was trimmed after the length of the tendrils is 75 cm.

1 INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) originating from West Indies or South America, is an additional food ingredient or substitute for rice that has received public attention. Aside from being a food ingredient, sweet potatoes are also used as industrial raw materials for example flour, liquid sugar, fodder, and alcohol (Sisharmini et al., 2005).

Data from the Ministry of Agriculture in 2016, production during the 1995-2016 period fluctuated but tended to increase. Sweet potato production in the 1995-2016 period increased, averaging at 0.11% per year, while in the period of 2012 to 2016, Sweet potato production decreased by an average of 4.14% per year. The increase in production growth on Java Island in the period of 1995-2016 rose by 1.03%, while outside of Java decreased by 0.06% per year.

There are several obstacles in increasing the productivity and income of sweet potato farmers in several countries. One of them is the lack of superior varieties suitable for cultivation with the local environment (Low, et al. 2009). Efforts that can be made to overcome this problem are by using superior seeds or high-yielding local seedlings, improving the management of sweet potato farming and by controlling the number of canopy above the ground (Sasongko, 2009). The use of local superior clones is a reliable technology not only in terms of increasing agricultural production but also can increase the income and welfare of farmers. Superior clones generally have prominent properties in terms of high yield and resistance to certain plant pest organisms. Using superior clones that are resistant to pests and diseases is the cheapest way to suppress plant disturbances without any worries on negative environmental impacts (Jayanto, 2009).

Improvement of cultivation methods is another effort that can be done to increase sweet potato production, one of which is by trimming the leaves. Extraction or trimming of sweet potato leaves during its vegetative stage has been common in many countries. Trimmed leaves are used for vegetables or animal feed. The plant's response to defoliation depends on more than the total amount of leaf lost. It is also known that the intensity of defoliation can vary along the gradient of nutrient availability and that defoliation can change the relationship of competition between species (Ahmed et al, 2012; Ahmadi et al, 2009).

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According to Panggabean et al., (2014), trimming is an activity to improve and optimize parts of plant organs by removing or reducing other parts of plant organs. Trimming is expected to increase photosynthesis results hence maximize growth and production. Suminarti (2016) research showed that in untrimmed sweet potato plants, there is less agronomic balance between parts of the organ above the ground and parts of the organ below the surface of the soil. Sweet potato plants which were trimmed once, produce tubers with a diameter, length and greater weight than ones without trimming. In addition, Irawati and Setiari (2006) stated that trimming can also improve lighting from sunlight to all parts of the plant hence the photosynthesis process can take place perfectly and can reduce moisture hence plants can avoid attacks from pests and diseases.

This research aim was to determine the growth and production response of several local sweet potato (*Ipomea batatas* L.) clones on several trimming levels.

2 MATERIALS AND METHODS

2.1 Research Area

The research was carried out on the field of Balai Penelitian Tanaman Sayur, Tongkoh Village, Berastagi, Karo Regency with an altitude of 1450 meters above sea level, starting from May 2018 to January 2019.

2.2 Procedures

This research used a randomized block design with two factors, the first factor was the type of local sweet potato clones (local clones of Dusun Bintang Meriah, local clones of Sirube-rube, local clones of Dolok Sinumbah) and the second factor was the level of trimming (without trimming, trimmed after tendrils length is 50 cm, trimmed after tendrils length is 75 cm, trimmed after tendrils length is 100 cm).

This research started from land preparation, making beds, preparing the seedlings, mulching, planting, plant maintenance, fertilizing, and analyzing morphological parameters including tendrils length, canopy wet weight, number of tubers, tuber weight per sample and harvest index.

2.3 Data analysis

Retrieval of morphological character data, namely the length of tendrils carried out when the plant was at 12 weeks after planting (WAP). Observation of plant wet weight, number of tubers, tuber weight per sample and harvest index were observed when the plants were at 20 WAP.

Data were analyzed statistically by the F test and continued by the Duncan Multiple Range Test (DMRT) test at α 5%.

3 RESULTS AND DISCUSSIONS

3.1 Vegetative Growth of Sweet Potatoes

The local clones had no significant effect on the parameters of tendrils length but had significant effect of canopy wet weight (Table 1). Clones from Dusun Bintang Meriah had the highest tendrils length compared to other local clones. Dolok Sinumbah clone produced the highest canopy wet weight compared to other treatments. This was due to the three clones come from the area relatively had similar altitude with the growing environment of cultivated sweet potatoes. Kays et al. (2005) reported that vegetative growth and the yield of local sweet potato tubers were strongly influenced by the growing environment. Okogbenin et. al., (2013) also stated that plant growth would be better in areas that have relatively high light intensity.

Table 1: The length of tendrils and canopy wet weights of several local sweet potatoes clones

Local Clones	Length of Tendrils (cm)	Canopy Wet Weights (g)
Dusun Bintang Meriah	76.65	901.79 b
Sirube-rube	65.88	864.67 c
DolokSinumbah	67.29	906.65 a

Description: The numbers followed by the same letters showed no significant difference in the Duncan Multiple Range Test at the level of α = 5%.

The trimming levels showed no significant effect on the length of tendrils and canopy wet weight (Table 2). Treatment without trimming resulted with the highest length of tendrils and canopy wet weight when compared with other treatments. Novianti (2016) research also showed the same results, namely trimming treatment resulted in an average

growth of shorter stem length than treatment without trimming, whereas trimming treatment resulted in higher growth rate of primary branch length than treatment without trimming. Jayanti et. al., (2016) also stated that trimming sweet potato plants can break apical dominance, thus inhibiting the development of plant stems.

Table 2: Length of tendrils and canopy wet weights on various levels of trimming.

Without Trimming	Length of Tendrils (cm)	Plant Wet Weight (g)
Without Trimming	75.78	1.150.89
Trimmed when reach 50 cm	67.39	678.36
Trimmed when reach 75 cm	66.42	800.83
Trimmed when reach 100 cm	70.17	934.06

In line with the length of the tendrils, untrimmed sweet potato plants showed the highest plant wet weight increased up to 66.66%, compared to the wet weight of the trimmed plants.Plants which were trimmed after the tendrils length reach 50 cm had the lowest plant wet weight. The results showed that the wet weight on sweet potato plants would be lower if the plants were trimmed on the shorter tendrils length. Yooyongwech et. al., (2014) also related the decrease in leaf production with the age of sweet potato plants and emphasized that the leaf area is very important in determining the growth and level of accumulation of dry matter at the storage root.

3.2 Sweet Potato Production

The data in table 3 showed that the number of tubers and tuber weights in the local sweet potato clones did not show any significant differences. The local Dolok Sinumbah clone produced the highest number of tubers per sample compared to other local clones which differed from 7.73% compared to the number of tubers in clones from Dusun Bintang Meriah. On the contrary, the highest tuber weight per sample was produced by the local Dusun Bintang Meriah clone compared to other local clones. Villordon et al., (2009) stated that sweet potato yields varied greatly. Differences in yields are related to various factors such as cultivars, propagation matters, environment and soil. Propagation matters and the same cultivation environment in this research were thought to cause the number of tubers and tuber weight per sample not significantly different between those local clones.

Table 3: The effect of several local sweet potato clones on the number of tubers and tuber weight per sample.

Local Clones	Number of tubers/sample (tuber)	Tuber weight / sample (g)
Dusun Bintang Meriah	4.27	988.10
Sirube-rube	4.42	777.48
DolokSinumbah	4.60	895.42

The data in Table 4 showed that trimming treatment had no significant effect on the number of tubers and tuber weight per sample. The treatment of trimmed after 75 cm resulted in the highest number of tubers which increased by 11.14% compared to plants that were not trimmed.Astrini (2012) stated that the treatment of trimming on sweet potato plants can increase tuber yield. This was due to the reduced of shoot dominance and the increased of lateral growth.Fitohormones, auxins and cytokines that are produced at the shoots can stimulate the growth of side shoots, resulting in a growth balance of the canopy and tubers which will increase the assimilate allocation to the tubers.

Table 4: Number of tubers and tuber weights per sample against various levels of trimming

Trimming Levels	Number of tubers/sample (tuber)	Tuber weights /sample (g)
Without Trimming	4.22	821.94
Trimmed when reach 50 cm	4.47	942.31
Trimmed when reach 75 cm	4.69	1.007.44
Trimmed when reach 100 cm	4.33	776.31

The tuber weight illustrates the ability of a plant in translocating the assimilate to the part of the storage organ from the total assimilation obtained. Table 4 showed the highest tuber weight was also produced on plants that were trimmed after the length of tendrils was 75 cm which increased by 42.65% compared to the lowest tubers weight on the plants that trimmed after the length of tendrils was 100 cm. The same results were also conveyed by Rahmiana et. al., (2015) that the tuber weight of trimmed sweet potatoes plants increased compared with without trimming. The thing that needs to be considered in sweet potato cultivation is the level and phase of trimming, if the trimming is too excessive or the phase is less precise it can reduce tuber production. Lebot (2009) and An et. al., (2003) stated that excessive trimming in sweet potatoes will negatively affect the production and cause a decrease in crop yields.

Table 5: The effect of local sweet potato clones on harvest index

Lokal Clones	Harvest Index
Dusun Bintang Meriah	0.50
Sirube-rube	0.44
DolokSinumbah	0.47

According to Wahyuni et. al., (2004) the harvest index can be used as a parameter to see the proportion of photosynthate allocation efficiency and photosynthate translocation for more tubers hence the proportion of tuber weight must be more than 50% of the total weight of the plant.Based on the harvest index observations in some local sweet potatoes clones were not significantly different (Table 5). Local clones from Dusun Bintang Meriah produced the highest harvest index compared to local clones of Sirube-rube and local clones of Dolok Sinumbah.The harvest index value (HI) is obtained from the ratio of yield (tuber) compared to the total biomass, according to Wahyuni et. al., (2004), clones with high tuber yields generally followed by a high harvest index.This statement was in accordance with the research results that the tubers production of clone from Dusun Bintang Meriah was the highest compared to other local clones which showed that the clone was more often divided photosynthates to the tubers yield. Sitompul (2016) also explained that plants which have a high harvest index, the economic yield will be high too, this is presumably because the harvest index is carbon mobilization.

Table 6: The effect of the trimming level on the Harvest Index

Trimming Level	Harvest Index
Without Trimming	0,33 b
Trimmed when reach 50 cm	0,53 a
Trimmed when reach 75 cm	0,53 a
Trimmed when reach 100 cm	0,43 b

Description: The numbers followed by the same letters showed no significant difference in the Duncan Multiple Range Test at the level of $\alpha = 5\%$.

The data in table 6 showed that the treatment of trimming levels had a significant effect on the harvest index. The treatment of trimmed after 50 cm and 75 cm had the highest harvest index compared to other trimming level treatments. These results indicated that proper trimming on sweet potatoes affected the amount of photosynthate produced and supports more photosynthate translocation into the tubers. This was due to the trimmed plants had fewer number of leaves and minimizes the effect of shade between the leaves, hence leaves can function as a source. Astuti et. al., (2012) explained that the number of leaves influences the plant growth because it is related to the ability to carry out photosynthetic activities. Efficient leaves for photosynthesis are leaves that can absorb sunlight optimally. Treatment of leaf trimming at a certain level will increase yield, but excessive leaf trimming will not increase crop yields and even can reduce the yield. This was because the photosynthetic rate from remaining leaves was not capable to compensate for the increasing photosynthate requirements. Suminarti et al (2016) also stated that the number of canopy above the ground can affect photosynthetic ability, hence the ability to translocate assimilates is also affected, namely assimilate translocation to the part of the storage organ from the total assimilation obtained.

4 CONCLUSIONS

The local sweet potato clones had a good growth and production response to several levels of trimming. The three local clones were not significantly different in the parameters of tendrils length, tuber weight per sample, number of tubers per sample, and harvest index. But significantly different in the parameter canopy wet weight. The treatment of trimming levels did not significantly affect the length of tendrils, tuber weight per sample, number of tubers per sample and canopy wet weight, but significantly affected the harvest index parameters. The best trimming levels was trimmed after 75 cm long.

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