Effect of the ridge size on the growth and production of several sweet potato clones (*Ipomoea batatas* L.)

S Tiffani¹, N Rahmawati¹2* and H Setiado¹²

¹Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.
²Centre for Roots and Tuber Study, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.

E-mail: *nini@usu.ac.id

**Abstract.** The ridge size can increase the growth and production on several sweet potato clones. This research aim was to determine the effect of bed size (0, 15 and 30 cm) on the growth and production of several sweet potato (*Ipomoea batatas* L.) clones (Sari Varieties, Cengkeh Turi Accessions, Tanah Seribu Accessions). This research was conducted at Jalan Eka Warni, Gedung Johor Subdistrict, Medan Johor District, Medan from March-July 2019. The results of this research indicated that the growth and morphological production of several sweet potato clones had a significant effect on the parameters of fresh shoot weight per sample, number of tubers per sample and tuber weight per sample and no significant effect on the parameters of stem length and harvest index. Likewise, the ridge size had no significant effect on stem length, fresh shoot weight per sample, number of tubers per sample, tuber weight per sample and harvest index. Tanah Seribu Accession was the best clones when compared to Sari Variety and Cengkeh Turi Accession and 15 cm was the best ridge size.

1. Introduction
Sweet potato plant is a commodity with high economic value and has many benefits as alternative foodstuffs [1]. Some sweet potato clones have poor adaptability to the environment and cultivation techniques, hence there is a need for cultivation techniques improvement to save production inputs and time that can support increased growth and production. Intensification efforts that can be carried out to increase sweet potato production include the use of superior seeds, an improvement on sweet potato farming management by using a balanced dosage of fertilizers as well as the right time and method according to the conditions and chemical properties of the local soil [2].

Ridge or raised beds are made to facilitate planting, taking care of the plant, and harvesting. Yoandari et al [3] indicated that sweet potato growth and production is influenced by the height of the beds. The ridge size that are too high tend to cause long and deep tuber forms which make it difficult at harvest. Conversely, excessively shallow ridge size can disturb the growth or development of sweet potatoes, and facilitate Boleng or Lanas pest insects by *Cylas sp* [4].

Sweet potato has a considerable diversity consisting of local clones and some superior clones [4]. The obstacle in the development of sweet potatoes is the low level of the use of superior clones [5]. Richardson [6] stated that the local sweet potato clones indicated different responses to various environmental conditions, tuber production and quality as well as cultivation techniques.
This research aim was to determine the effect of the ridge size (0, 15, and 30 cm) on the growth and production of several sweet potato (*Ipomoea batatas* L.) clones (Sari Varieties, Cengkeh Turi Accessions, and Tanah Seribu Accessions).

2. Material and method

The research was conducted in March-July 2019 in the experimental land of Jalan Eka Warni, Gedung Johor Subdistrict, Medan Johor District, Medan. This research used a randomized block design with two factors, the first factor was sweet potato clones (Sari Varieties, Cengkeh Turi Accession, and Tanah Seribu Accessions) and the second factor was the ridge size (0, 15, and 30 cm). This research started from land preparation, making ridge size, planting material preparation, planting, fertilizing, taking care of the plant, harvesting, and observing the morphological parameters including stem length, number of tubers per sample, plant wet weight per sample, tuber weight per sample, and harvest index.

Data collection on morphological characters that is stem length, was carried out when the plants were 2 WAP to 10 WAP (WAP = weeks after planting). Observation of the number of tubers per sample, fresh shoot weight per sample, tuber weight per sample and harvest index were observed when the plant was 16 WAP old.

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

3. Results and discussion

Data presented in Table 1 indicated that the stem length parameters had no significant effect on the three sweet potato clones. Sweet Potato accessions of Tanah Seribu had higher stem length compared to Sari Varieties and Sweet Potato accessions of Cengkeh Turi. This was because the ability of each genetic varies in adapting to the growth environment. Vegetative growth had a different genetic response to the environment. Sitompul and Guritno [7] stated that plant genetic factors are one of the causes of differences between one plant to another. In the treatment of the ridge size, the stem length had no significant effect. Treatment of 0 cm bed height resulted in a higher stem length compared to 15 cm and 30 cm bed height treatments. This was because at 0 cm height the root development was better hence the nutrient and water requirements for growth can be met. Taiz and Zeiger [8] stated that under sufficient water conditions, leaf area in all clones was significantly higher than water stress conditions.

| Treatment               | Stem length cm |
|-------------------------|----------------|
| Clone                   |                |
| Sari Variety            | 73.72          |
| Cengkeh Turi Accession  | 90.44          |
| Tanah Seribu Accession  | 104.63         |
| Ridge Size              |                |
| 0 cm                    | 97.81          |
| 15 cm                   | 82.44          |
| 30 cm                   | 88.54          |

Data in Table 2 indicated the parameters of the number of tubers per sample significantly affected the three sweet potato clones. Sweet Potato accessions of Cengkeh Turi produced the highest number of tubers per sample compared to Sari varieties and Tanah Seribu accessions. This was because the differences in sweet potato clones that affect tuber formation and land management need to be...
considered in cultivation techniques. Hahn and Hozyo [9] stated that tuber formation was strongly influenced by the environment in the first 20 days after planting. Hence, by giving the same conditions to the land, the differences that arise are thought to be due to differences in varieties. Whereas in the treatment of ridge size indicated that the parameter of the number of tubers per sample had no significant effect. The ridge size of 30 cm indicated the highest number of tubers when compared to 0 and 15 cm. This was because ridge size that are too high tend to cause long tuber forms. Prasetiaswati and Radjit [10] stated that usually, farmer plants sweet potatoes with a small bed/raised bed in the hope that the population will become high but have difficulty in caring for them.

| Treatment         | Number of tubers |
|-------------------|------------------|
| Clone             |                  |
| Sari Variety      | 1.07 a           |
| Cengkeh Turi Accession | 3.56 a       |
| Tanah Seribu Accession | 2.63 b       |
| Ridge size        |                  |
| 0 cm              | 2.22             |
| 15 cm             | 2.44             |
| 30 cm             | 2.59             |

Note: Numbers followed by the same letters indicated no significant difference in Duncan's Multiple Range Test at α = 5%

| Treatment         | Fresh shoot weight |
|-------------------|--------------------|
| Clone             |                    |
| Sari Variety      | 172.48 b           |
| Cengkeh Turi Accession | 971.70 a       |
| Tanah Seribu Accession | 420.67 a       |
| Ridge size        |                    |
| 0 cm              | 353.07            |
| 15 cm             | 833.85            |
| 30 cm             | 377.93            |

Note: Numbers followed by the same letters indicated no significant difference in Duncan's Multiple Range Test at α = 5%

Data in Table 3 indicated the parameters of fresh shoot weight per sample significantly affected the three sweet potato clones. Cengkeh Turi Accession produced the highest fresh shoot weight per sample compared to Sari Varieties and Tanah Seribu Accessions. This was because the optimal rate of photosynthesis that occurs in leaves allows more assimilates in plants to be collected hence more fresh shoot weight can be distributed to the tissues. Salisbury and Ross [11] stated that the capacity of photosynthesis increases with the increasing number of leaves in plants. However, in the treatment of the ridge size, the parameters of fresh shoot weight per sample had no significant effect. The ridge size of 15 cm produced the highest fresh shoot weight when compared to 0 cm and 30 cm. This was because land utilization patterns can affect soil moisture on soil quality and productivity. Kurnia et al
[12] stated that ridge size are mounds of soil that were deliberately made by farmers to grow food plants with a certain width and height to maintain soil moisture and drainage ditches.

Data in Table 4 indicated the tuber weights per sample significantly affected the three sweet potato clones. Sweet potato accessions of Cengkeh Turi and Tanah Seribu accessions produce higher tuber weights when compared to Sari Varieties. This was presumably because the sweet potato accession of Cengkeh Turi and Tanah Seribu accessions from lowland areas are more easily adapted to planting locations, while Sari Varieties come from highland areas were unable to adapt well. This condition causes the Sari varieties experienced changes in temperature which causes plant stress hence inhibit growth and decrease production. Ching [13] stated that aside from genetic factors, the environment in which it grows also influences the growth of sweet potato plants. However, in the treatment of the ridge size, tuber weight per sample had no significant effect. The ridge size of 15 cm produced higher tuber weights compared to 0 cm and 30 cm. This was because the shallow bed size can interfere with the growth and formation of tubers while the high ridge size can cause elongated tuber growth. Widodo et al. [14] stated that the method of cultivation by making large and tall beds is gradually more effective and efficient than traditional methods that require weeding and re-growing.

### Table 4. Tuber weights per sample of several sweet potato clones in various the ridge size

| Treatment | Tuber weight  |
|-----------|--------------|
| Clone     |              |
| Sari Variety | 40.22 b     |
| Cengkeh Turi Accession | 247.96 a    |
| Tanah Seribu Accession | 287.20 a     |
| Ridge size |              |
| 0 cm       | 144.30       |
| 15 cm      | 242.37       |
| 30 cm      | 188.72       |

Note: Numbers followed by the same letters indicated no significant difference in Duncan's Multiple Range Test at $\alpha = 5\%$

### Table 5. Harvest index of several sweet potato clones in various the ridge size

| Treatment | Harvest index |
|-----------|---------------|
| Clone     |               |
| Sari Variety | 0.22         |
| Cengkeh Turi Accession | 17.65         |
| Tanah Seribu Accession | 61.31         |
| Ridge size |               |
| 0 cm       | 0.25          |
| 15 cm      | 65.09         |
| 30 cm      | 13.83         |

Note: Numbers followed by the same letters indicated no significant difference in Duncan's Multiple Range Test at $\alpha = 5\%$
Data in Table 5 indicated that the observations of the three harvest indexes of sweet potato clones had no significant effect. Sweet Potato Accessions of Tanah Seribu produced the highest harvest index compared to Cengkeh Turi Accession and Sari Variety. This was presumably because the Tanah Seribu Accession had better adaptability than other clones. Fitter and Hay [15] stated that the high production of a variety is because the variety can adapt to the environment. The genetic potential of a variety is very supportive in the success of farming. In the ridge size treatments did not significantly affect the harvest index. The 15 cm treatment produced the highest harvest index when compared to 0 cm and 30 cm. This was because if the ridge size were too shallow or too high, tuber growth will be disrupted and tuber production is not optimal. Low production will also suppress the harvest index, which indicated the ratio between the weight of the economically valuable part of the plant and the overall weight of the plant.

4. Conclusion
The evaluation of growth and morphological production parameters on several sweet potato clones significantly affected the parameters of fresh shoot weight per sample and tuber weight per sample and had no significant effect on stem length parameters, the number of tubers per sample, and harvest index. Likewise, the ridge size treatments had a significant effect on the parameters of the number of tubers per sample and had no significant effect on stem length, fresh shoot weight per sample, tuber weight per sample and harvest index. Tanah Seribu Accessions were the best clones when compared to Sari Varieties and Cengkeh Turi Accessions and 15 cm was the best ridge size.

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