RESULT OF SEVERAL CLONE OF SWEET POTATO (*Ipomoea batatas* L.) IN MIDDLE EAST ON THE INFLUENCE OF PHOSFOR FERTILIZER DOSAGE AND CLONE TYPES

Rita Hayati, Mardhiah Hayati, Dela Armanita

Agrotechnology Studies Program of Faculty of Agriculture, Syiah Kuala University of Darussalam Banda Aceh

email: ritanabila@yahoo.com

Abstract

Sweet potatoes include commodities as the main source of carbohydrates that occupy the fifth position after rice, cassava, wheat and corn. These plants can be cultivated at various altitude places in the lowlands, middle and highlands. Judging from the nutritional value of sweet potatoes have the privilege as an important source of carbohydrates so that this commodity becomes an alternative for food diversification program. The purpose of this study is to determine the effect of phosphorus fertilizer dosage and clone type and interaction between the two treatments on sweet potato yield in the middle plains. This research was conducted at Suka Makmur Village Farmer Kecamatan Lembah Selawah District of Aceh Besar Saree, at an altitude of 560 m above sea level from February to June 2016. This study used a Randomized Block 3 factorial factorial design with 3 replications consisting of 2 Factor, ie treatment of phosphorus fertilizer dosage and clone type. The phosphorus phosphorus treatment (SP 36) consisted of 3 levels, 100, 200 and 300 kg / ha and clone type factor ie CIP BDG, Local Saree Krem, and Antin 1. The variables observed in this study were wet bulb weight, Dry tuber weight, number of tubers, general evaluation of tubers and tuber production per hectare. The results showed that treatment of SP 36 fertilizer dosage was not significant on wet bulb weight, tuber weight, tuber amount, general evaluation of tubers and tuber production per hectare. The dose of SP 36 fertilizer tends to be better at a dose of 200 kg / ha. The clone type had a significant effect on the number of tubers and significantly affected the wet bulb weight, the weight of tubers and tuber yield per hectare and did not significantly affect the general evaluation of tubers. The best clone type is Local Creme Saree. There is no significant interaction between the treatment of SP 36 fertilizer dosage and the clone type on sweet potato crops.

Keywords: Clones, Sweet potatoes, Phosphorus.

BACKGROUND

Indonesia is a country that has the potential of food availability as a source of great carbohydrates in terms of the potential of its territory resources, one of which is the type of tubers such as sweet potato (*Ipomoea batatas* L.). Sweet potato is an alternative staple food that ranks fourth after rice, maize, and cassava (Suwarto *et al*., 2006). Meanwhile, according to Aris (2009) sweet potatoes including commodities as the main source of carbohydrates that occupy the fifth position after rice, cassava, wheat and corn.

Judging from the nutritional value of sweet potatoes have the privilege as an important source of carbohydrates so that this commodity becomes an alternative to food diversification program. Sweet potatoes have the main carbohydrate content of starch, which

consists of 30-40% amylose (Nintami and Rusanti, 2012). Sweet potatoes also contain calories, fiber, vitamins and minerals are quite good (Zuraida, 2009), in addition to sweet potatoes also contain high beta-carotene in the type of clones that are colored reddish orange tuber meat and yellow or white colored tubers (Dwi, 2008).

Production of sweet potatoes in Indonesia is experiencing the last 4 years, in 2011 the production of sweet potatoes is 2,196,033 tons and increased in 2012 to 2,483,460 tons, but in 2013 and 2014 returned to 2,386,729 tons and 2,382,025 tons respectively. In Aceh, the production of sweet potatoes in 2010 was 11,095 tons, an increase in 2011 and 2012 to 11,843 tons and 13,356 tons, but decreased again in 2013 and 2014 to 11,602 tons and 12,500 tons (Central Bureau of Statistics, 2014).

Many obstacles hamper the growth and production of sweet potatoes. The low production is the main problem faced in the cultivation system of sweet potato. Inadequate cultivation technology such as fertilizing and not yet spreading the superior variety is the cause of the low yield of sweet potato (Sukmasari *et al*., 2015). Harjadi (1996) states that the low production of sweet potatoes is also due to the growth that is dominated in the vegetative phase, namely when the formation of stems and leaves so that very little carbohydrate is left for the formation of tubers. The efforts that can be done to increase the production of sweet potato is through the use of superior seeds, improving the management of farming, the use of balanced fertilizer, dose, time and the right way (Aris, 2009). This is also reinforced by Sulistyaningsih's statement (2014), the increase of production can be done through fertilization because it ensures the optimal availability of nutrients to support the growth of crops so as to increase the yield of harvest, one of them is phosphorus fertilization (P).

Phosphorus is one of the macro nutrients that are essential for the growth and formation of sweet potato tubers. Phosphorus has functions in the process of photosynthesis, respiration, electron transfer and energy storage, cell division and enlargement in plants (Kuncoro, 2008). While Soenyoto (2014) states that P elements play a role in producing storage roots, sufficient phosphorus and potassium uptake by plants can increase tuber weight and also increase the starch content in tubers.

Plants that lack phosphorus nutrients, will disrupt the process of metabolism in plants and inhibit the process of formation and enlargement of tubers (Ispandi, 2003). In addition Karamoy (1998) stated that phosphorus deficiency causes plant growth will be hampered, leaf development and the number of branching a little so that dwarf plants, lean, and accumulated carbohydrates in leaves and branches.

The research that has been done by Sukmasari *et al.* (2015) that the use of a dose of 18 kg / ha P_2O_5 (50 kg / ha SP36) combined with bacterial phosphate solvent (BPF) to give effect to the plant dry weight, the length of the main stem, number of leaves, leaf area index, long yam, diameter potatoes , And the number of sweet potatoes. Meanwhile, according Ghulamahdi (2008) fertilizer phosphorus with a dose of 36 kg / ha P_2O_5 (100 kg / ha SP36) can increase the weight of the wet bulb and dry bulb increase the weight of sweet potatoes. Karamoy (1998) at dosages of 100 kg / ha P_2O_5 (280 kg / ha SP36) provides good leverage against berangkasan wet weight, wet weight of tuber and the production of sweet potato tubers.

In addition to successful fertilization in increasing the production of sweet potato tubers is also determined by the selection of the right clones and superior so that it can improve the sweet potato as desired. This is in accordance with the statement Sumarwoto (2008) low production of sweet potatoes in addition to poor fertilization is also caused by the use of local varieties or clones of low-power results. Therefore, the technological advances in the cultivation of sweet potato to produce high quality sweet potato is by providing sufficient and efficient fertilizer, improvement and application of appropriate farming techniques as well as the planting of superior clones.

This research was conducted in Saree middle plain with altitude 560 place from sea level (asl) on andisol soil type. Andisol soil is a suitable soil for sweet potato cultivation

because it has a high fertility rate and is loose. The middle plain is a plateau located at altitude 300-700 m above sea level (Sumartono, 2013). According to Elfia (2016) clones CIP BDG, CIP WHI-5, and CIP 204 are sweet potato clones that have the best growth and yield in the middle plains. Meanwhile, according to Noviyanti (2016) sweet potatoes that have growth and yield tend to be good in the middle plains is clones Local Saree, CIP B9 and CIP 204.

Based on the above doses of fertilizer phosphorus and clones are factors that can affect the outcome of yams, therefore, necessary to research on the effects of phosphorus fertilizers on the results of several clones of sweet potato in the middle plains.

The purpose of this study was to determine the effect of the correct dosage of SP 36 fertilizer and the best clone type and the interaction between the two treatments on sweet potato yield in the middle plain of Saree.

METHODS

This research was conducted in farmer's garden of Suka Makmur Village, Lembah Selawah District, Aceh Besar Saree District, at altitude of 560 meters from sea level and Horticulture Laboratory of Agriculture Faculty of Syiah Kuala University. The study was conducted from February to June 2016.

The material used in this research is the planting material of 3 types of sweet potato clones, namely CIP BDG from International Potato Center South East Asia (CIP-SEA), Local Saree Krem from Saree and Antin 1 varieties derived from Balai Penelitian Kacang Tubers (BALITKABI) Malang. Manure as basic fertilizer of 64.8 kg (20 tons / ha), fur and 30 g, Urea 810 g (200 kg / ha), KCl 810 g (200 kg / ha) as base fertilizer and SP36 fertilizer of 810 g Used according to treatment. Pesticides Curacron and Dithane M45. Tools used are machetes, hoes, rakes, gembor, ordinary scales, analytical scales, plastic bags, sacks, envelopes, and ovens.

The experimental design used in this study was Randomized Block Design (RAK) 3 x 3 factorial pattern with 3 replications. Two factors studied were the dosage of SP 36 (P) (3, 100, 200 and 300 kg / ha) and clone (K) (3 levels: CIP BDG, Local Crack and Antin Saree 1. Overall there were 9 combinations Treatment with 3 replications so as obtained by 27 units of experiment.If the F test results showed a real effect then tested continued by using the test of the Smallest Differences (BNT) at 5% level.

Implementation of Activities

Soil processing is done by hoeing, then made bed with size 150 cm x 100 cm with height of bed 40 cm and distance between beds 70 cm. After making beds continued with the provision of manure as much as 2.4 kg / bed. Planting of seedlings is done after 2 weeks of soil processing with spacing between seeds 40 cm x 25 cm with seed size 25 - 30 cm. Each bedeng planted 10 seeds and 5 plants used as sample plants. Provision of manure at the time of processing the soil with a dose of 2.4 kg / bed (20 tons / ha), while Urea, KCl, and SP36 fertilizer is given at 2 weeks after planting (MST). Urea was given two stages, namely 2 ml plant of 15 g / bed and 4 MST 15 g / bedeng, KCl fertilizer 30 g / bed and SP36 in accordance with the treatment dose of 15, 30 and 45 g / bed.

Maintenance

Watering is done in the morning or afternoon or in accordance with the conditions in the field and if the rain then do not do watering. Embroidering is done if there are dead seeds or poor growth. Stitching is done until the plant is 2 MST and done in the afternoon. Weed control is done manually by removing weeds directly by hand. The first weeding is done when the plants are 2 weeks old, the first weeding done together with weeding for weed control is done every week. While the control of insects and fungi was done by spraying using insecticide Curacron1 ml / liter of water and Dithane M-45 1g / liter of water fungicide carried out at the age of 6MST. Maintenance done at age 4 and 8 MST by hoisting and raising the soil. Withdrawal of tendrils in sweet potatoes is done at ages 3, 6, 9 and 12 MST by raising

tendrils to the top of the plant. Harvesting of sweet potatoes is done at 16 MST, or when the characteristics of sweet potato crops ready to harvest that is characteristic of the leaves have been much yellowing.

The variables observed

1. Wet and dry weighted weights (g) (70 ^{o}C for 48 hours)
2. Wet bulb weight and weight of dried bulb (g) (sample tuber weight after dried for 12 days)
3. Number of tubers
4. General evaluation of bulbs (using scale 1-3). Where the scale of 1 characteristic of the physical outer form is not smooth or flat, the scale of the two forms of physical outer a little not smooth or uneven and the scale of 3 physical outer shape is good. This can be seen in Figure 1.

Figure 1. Scale comparison evaluation of sweet potatoes 1, 2 and 3

Production of tubers per hectare of land can be calculated using the formula:
Tuber tubes = (Area of land per hectare) / (Area of plot) x (Wet bulb weight) / 1000/1000

RESULTS AND DISCUSSION

The effect of phosphorus fertilizer treatment on sweet potato crops in the middle plains

The result of variance analysis showed that phosphorus fertilizer dosage treatment had no significant effect on wet bulb weight and tuber weight of tuber, tuber and tubers per hectare. The average weight of wet bulb, dry bulb weight, tuber count, tuber yield per hectare and general evaluation of sweet potato tubes due to phosphorus fertilizer treatment can be seen in Table 1. Wet and dry bulb weight, production per hectare and general evaluation of tubers tend to be more High in the treatment of phosphorus fertilizer 200 kg / ha (P_2) and tuber tends to be higher in the treatment of phosphorus fertilizer dosage of 300 kg / ha (P_3) compared with other phosphorus fertilizer dose although statistically different was not significant.

Tuber yields tend to be higher in phosphorus fertilizer doses of 200 kg / ha (P_2). It is assumed that phosphorous fertilizer has no significant effect because the research location has acid soil with pH 4.51 and high Mg (Magnesium) content, so P is not available for plants because it is tied by Aluminum (Al) and iron (Fe). This is consistent with the statement of Helmi (2013) that the 36% superfosfat (SP 36) administered is strongly influenced by soil pH when the sour pH permits P to be bound by Al and Fe and when the pH of base P will be bound by Ca and Mg. P is available in the soil as a form of phosphate which is very easy to combine with iron (Fe) and aluminum (Al) so that P is less available to plants (Sutedjo, 2002). The fertilizer dosage of SP 36 200 kg / ha did not give the highest result supported by Karamoy (1998) where in the dosage of 100 kg / ha P_2O_5 (280 kg / ha SP 36) fertilizer gave good effect to wet weighted weight, wet bulb weight and production Sweet potato tubers.

The rate of phosphorus release is not proportional to the availability and uptake of P by plants, this is in line with Olusola's (2009) study, although the amount of phosphorus released is higher, then about 15-30% is absorbed by the plant, while about 60% P is

adsorbed by soil. Therefore, a certain amount of P is added annually to the ground. In this study, the sweet potato plant with the highest phosphorus dosage was also not maximally absorbed.

Table 1: Mean weight of wet and dry bulb, tuber number, tuber yield per hectare and general evaluation of sweet potato tuber due to treatment of fertilizer dosage SP 36.

Parameter	Dosage of SP 36 fertilizer		
	100 kg/ha (K_1)	200 kg/ha (K_2)	300 kg/ha (K_3)
Wet bulb weights (g)	152,56 (11,75)	199,78 (13,52)	175,78 (12,58)
The weight of the dry bulb (g)	128,22 (10,71)	169,33 (12,45)	140,51 (11,29)
Number of tuber crops	2,09	2,40	2,42
General evaluation of tubers	1,42	1,62	1,53
Production of tubers per hectare	9,15 (2,88)	11,99 (3,31)	10,55 (3,08)

Description: The number followed by the same letter on the same line is not significant at the 5% probability level (BNT test 0.05).

The influence of clones on sweet potato crops in the middle plains

The result of variance analysis showed that the clone significantly affected the number of tubers, significantly affected the wet bulb weight and the weight of tubers and tuber yield per hectare and had no significant effect on the general evaluation of sweet potato tubers. The average weight of wet bulb, dry bulb weight, tuber count, tuber yield per hectare and general evaluation of sweet potato tubers due to clone type can be seen in Table 2.

Table 2 shows that wet bulb weight and weight of tubers and highest yield of tuber per hectare were found in local clone saree Krem (K_2) clones significantly different from Antin 1 (K_3) varieties and not significantly different from CIP BDG (K_1). The highest number of tubers was found in local clone saree Krem (K_2) clones significantly different from CIP BDG (K_1) and Antin 1 (K_3) varieties. General evaluation of tubers tends to be better encountered in different clones of Local Crack Saree (K_2) clones not significantly different with BDG (K_1) CIP clones and Antin 1 (K_3) varieties. Local clones The best Krem Saree is allegedly because local clones Saree Creme (K_2) is a clone derived from a research site that has been able to adapt well to its original environment so as to produce growth and yields that tend to be higher than the type of clone CIP BDG (K_1) and varieties Antin-1 (K_3). In addition, genetic and environmental factors of each type of clone are different so there is a variety of diversity for both the growth and the yield of sweet potatoes.

Table 2: Mean of wet and dry bulb weight, number of tubers, tuber production per hectare and general evaluation of sweet potato tuber due to treatment of clone type.

Paramter	Clone Type		
	CIP BDG (K_1)	Local Creme Saree (K_2)	Antin 1(K_3)
Wet bulb weights (g)	12,51 ab (169,44)	15,81 b (258,67)	9,53 a (100,00)
The weight of the dry bulb (g)	11,55 ab (145,11)	14,20 b (209,00)	8,70 a (83,96)
Number of tuber crops	2,04 a	3,36 b	1,51 a
General evaluation of tubers	1,60	1,38	1,60
Production of tubers per hectare	10,17 (3,06) ab	15,52 (3,87) b	6,00 (2,34) A

Description: The number followed by the same letter on the same line is not significant at the 5% probability level (BNT test 0.05).

This is in accordance with Paada (2006) where one of the causes of low production of sweet potato clones is clones that are not suitable with the location of planting, where the location of planting is a limiting factor of growth and production of sweet potato associated with soil conditions, humidity temperature and other environmental factors . In addition, a sweet potato clone has a variety of responses when tested with unequal environments this is due to the interaction between varieties and the environment (Jusuf et al., 2002).

Interaction between doses of phosphate fertilizer and clone type

There was no interaction between the dosage of SP 36 fertilizer and the clone type, indicating that the different doses of SP 36 fertilizers were not influenced by different types of clones and vice versa. Each potato varieties have different capabilities to absorb P (Trehan and Singh, 2013; Balemi and Schenk, 2009; George et al., 2008). The difference may be significant and some varieties may require twice as much P fertilizer to achieve the same concentration (Trehan and Sharma, 2005). Each part of the plant absorbs P in different concentrations. The difference in efficiency of P utilization can be explained to be influenced by several factors, such as the size of the root system, the efficiency of the root system and the needs of the plant (Shenoy and Kalagudi, 2005; Dechassa et al., 2003).

CONCLUSION

1. The dose of phosphorus fertilizer has no significant effect on sweet potato crops. Plant yields tend to be higher in treatment of phosphorus fertilizer 200kg / ha.
2. Type of clone effect very real number of tuber and have real effect to, wet bulb weight, dry bulb weight and not significant effect of general evaluation of tuber. The highest yield of sweet potato plant is found in local clone saree Krem.
3. There is no significant interaction between the treatment of SP 36 fertilizer dosage and the clone type to sweet potato crops.

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