EFFECT USE BIOFERTILIZER AND DIFFERENCES TYPE SOIL ON GROWTH AND YIELD ARROWROOT

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Submitted : 2017-03-07 Accepted : 2017-08-18

ABSTRACT

This research purposed to know the effect of biofertilizers, the effect of soil type, and the effect of interaction between biofertilizers and soil type on growth and yield arrowroot. This study uses a randomized block design with 2 factors, namely biofertilizers of biota max consisting of 2 levels and types of land consisting of 2 levels. Analysis of the data using Analysis of Variance and continued with Test of Least Significant Difference at the level 5%. The results of this study indicate: 1) application of biofertilizer is effect significantly against increased in the number of leaves, number of tillers total, relative growth rate and net assimilation rate, the number of tubers per hill, tuber diameter, tuber length and weight of tuber per hill than without the application of biofertilizers, 2) arrowroot planting in soil grumosol significant effect against increased crop height, number of tillers total, relative growth rate, leaf area index, and the number of tuber per hill than arrowroot planting in rendzina soil.

Key word: biofertilizer, soil type, arrowroot

Permalink/DOI: http://dx.doi.org/10.15608/stjssa.v14i1.600

INTRODUCTION

Existence land conversion of productive agricultural to non-agricultural purposes resulted main food crisis in Indonesia so that government has had to rice import. According to Dawe (2008), Indonesia has become rice importir country at least in last 100 years with rice imported segments for domestic consumption average 5%; only years certain, Indonesia not imported rice.

Rice imports practice conducted by the government has intended to solved rice production in limited domestic, but import can not be done continuously because it would produce a state budget deficit. In addition, the import will also affect rice price farmers because imports are cheaper than the prices of the products farmers themselves, or quality of imported products is better with price which the same relative.

Therefore, they need food sources diversification of carbohydrates in reduced rice consumption case.

Indonesia has carbohydrates local food variety such as cerealia (corn, sorghum, hotong, jali, jawawut, etc), bulb (cassava, sweet potato, taro, sago, ganyong, arrowroot, gembili, gadung, etc) and fruits (breadfruit, banana, pumpkin, mangroves fruit, etc). That the food sources of carbohydrates available and good growth in all around Indonesia, and traditionally, it consumed as a basic food as well as snacks.

Arrowroot has a high carbohydrate content as tubers crop. It can be a source of carbohydrates strategically to reduce carbohydrate source dependence on rice. Additionally, arrowroot plant is multifunctional crops, among others producer of starch and industrial raw materials arrowroot crispy, known as a healthy food. Waste of processing tuber arrowroot such as
leather and dregs can be used for animal feed. Arrowroot tuber is starch sources potentially with starch produced 1.92 - 2.56 t/ha (Djaafar et al. 2007; Anonim, 2009). Starch arrowroot can used material flour substitution (Djaafar dan Rahayu 2006) until 50-100%. Therefore, arrowroot starch has probability to reduced wheat import which have been reached 4.10 million t/year (Gusmaini et al. 2003).

Arrowroot have health benefits because low glicemic index than other root, such as gembili, kimpul, ganyong and sweet potato (Marsono, 2002). The glycemic index is measure that states increase of blood sugar levels person’s after eating food which concerned. More high glicemic index means that food was not good consumed at diabetics. Because of this, diabetics excellent eating arrowroot.

The advantages arrowroot plant among others able to grow up in the bottom of the stand or in shade trees with 30-70% shade intensity, grow on various types of soil, grown in different soil types both fertile and critical or nutrient-poor soil, grow both from waterfront to the mountainous region with an altitude of 900 m above sea level, and didn’t require specific treatment so that easily cultivated and preserved (Arimbi, 1998; Fillamajor dan. Jukema, 1996). According Nurhayati et al. (2003), arrowroot can be grown in a shaded place without lowering quality or tubers characteristics.

Arrowroot have been developed in the Pranggong village of Andong subdistrict Boyolali district, Boyolali, Central Java Province ± 126 m altitude above sea level with dominant limestone soil and grumosol. According to Andong subdistrict Boyolali district, Boyolali, Central Java Province ± 126 m altitude above sea level with dominant limestone soil and grumosol. According to Andong subdistrict Boyolali district, Boyolali, Central Java Province ± 126 m altitude above sea level with dominant limestone soil and grumosol. According to Andong subdistrict Boyolali district, Boyolali, Central Java Province ± 126 m altitude above sea level with dominant limestone soil and grumosol.

N nutrient deficiencies can be corrected through the provision of biological fertilizers containing Paenibacillus polymyxa because it can served as a nitrogen-natural active (Anonim, 2010). Giving biological fertilizer containing microbes phosphate solvent, such as Bacillus, potentially high in phosphate dissolving phosphate is bound to become available in the soil (Alexander, 1977; Goenadi et al. 1993; Goenadi dan Saraswati, 1993) so that it can overcome nutrient deficiency P. Therefore, this study also aims to determined the effect of biological fertilizers on the growth and yield of arrowroot.

This research aimed to know the influenced of biological fertilizers, the effect of soil type, and the effect of the interaction between biological fertilizers and soil type on growth and yield arrowroot.

MATERIAL AND METHODS

This research was carried out in October 2015 until May 2016. Location of research in the Pranggong village, Andong District, Boyolali, Central Java Province ± 126 m altitude above sea level with dominant limestone soil and grumosol. Chemical and soil physics analysis conducted in chemical laboratory and soil fertility agricultural faculty University of March Surakarta. Proximate analysis and starch content conducted in Biology Laboratory and Soil-Biotechnology Laboratory March University Surakarta. Supporting analysis that scale and oven, conducted at the Laboratory Agriculture Faculty, Slamet Riyadi University, Surakarta.
Materials used in this research include a polybag 30 x 30 cm, paranet 65%, bamboo, scissors, knife, trowel, hoe, stationery, buckets, sprayer, cutting boards, oven, ropes, name boards, labels, and materials set of laboratory analysis. While the materials used, among others, end of the stem tuber cuttings, grumosol soil, rendzina soil, manure, and in this study biofertilizer used biota max solution, Orthocide fungicides, furadan 3G, urea fertilizer, SP-36, KCl, soil samples for analysis laboratory and chemikalia for analysis laboratory.

This research uses experimental research methods that factorial experiments are comprised of two factors with the basic design of a randomized block design (Gaspersz, 1991).

The first factor is a biofertilizer (B) with 2 levels, namely: P0 = without biofertilizers; P1 = with biofertilizer; The second factor is the type of soil (T) with two levels, namely: T1 = grumosol soil (original Pranggong village); T2 = rendzina soil (original Pranggong village).

Analysis Data used variance analysis to determine the effect of the treatment being tested. The effect of treatment is said to be apparent if F-counted value is greater than F-table 5%; and it can said to be highly significant if the F-counted value is greater than F-table 1% value, while said not the apparent if the F-counted value is smaller than F-table 5% (Gaspersz, 1991; Sugandi and Sugiarto, 1994).

RESULT AND DISCUSSIONS

Variety Analysis Result

Result of analysis variety (table 1) showed that biofertilizer treatment significantly influenced increase that the leaves of amount, total number of tillers, LPR (Relative Growth Rate) and LAB (Net Assimilation Rate); treatment types of soils significantly affected increase that plant heigh, totally amount of tillers, relative growth rate, leaf area index (ILD), and number of tubers per hill; (BT) interaction not significant affected in all observation parameters.

Biofertilizer application produced number of leaves highest at an average of 101,93 sheets than without biofertilizer application at an average 95,60 sheets; total number of tiller at average 9,3 stems is highest than without gave biofertilizer at average 8,2 stems; relative growth rate at average 0,0258 g/g/day is heaviest than without gave biofertilizer at average 0,0220 g/g/day; and at average 0,1295 g/dm²/week is heaviest net assimilation rate than without gave biofertilizer at average 0,0998 gram /dm²/week.

Arrawroot cultivation in grumosol soil produced plant height highest at average 105,35 cm than rendzina soil 100,65 cm; leaf area index in grumosol soil 6,29 g/g/day average is heaviest than rendzina soil at average 5,47 g/g/day; relative growth rate at average 0,0260 g/g/day is heaviest than at average 0,0218 g/g/day in rendzina soil; the most amount of tubers per hill at average 9,6 pieces in grumosol soil than in rendzina soil at average 8,1 pieces.

Effect of Biofertilizer on Growth and Yield Arrawroot

Occurrence increased growth of arrawroot indicated that the biofertilizer can worked function as nutrients contribution in the soil (Simanungkalit et.al., 2006). This nutrient was then well utilized for number of leaves growth, tillers total, relative growth rate, net assimilation rate. The availability of nutrients in the soil is very likely due to the biofertilizer used in this study contains five most prolific species from Bacillus genus bacteria and 4 fungi, genus Trichoderma also Paenibacillus polymyxa as nitrogen fixing natural (Anonymous, 2010). The presence of
Paenibacillus polymyxa, was causing nitrogen in the soil which are more soluble, also caught nitrogen in the air and processed it into elements that can be used by plants (Anonymous, 2011). N element much needed of the plant, especially to supported plant vegetative growth.

The increasing availability of N (Nitrogen) in soil will stimulated a new formation leafs. According Yudianto et al. (2015) the number of leafs on a plant will affected the growth and development of plants, where crops have much leafs will more available energy for photosynthesis than rather leafs. This means that formation of new leafs will increased the number of leafs of the plant and increased light absorption by leafs. Light obtained will utilized plants for photosynthesis activity that more fotosintat generated that it can supported the growth of leafs and other organs (Bilman 2001).

Besides that nitrogen to increased the number of leafs acts also stimulated growth of tillers acts (Setyamidjaja, 1986). In the process tillers formatted crop need nitrogen nutrients in fotosintat rate and increased synthesis protein. This protein is used for the formation of plant cells (Anisyah et. al., 2014).

Occurrence of increased LPR (Relative Growth Rate) would not be loosed from the biofertilizer presence which capable role as a nutrient provider required plant especially elements N (Nitrogen) and K (Kalium). According Setyamidjaja (1986), N is required to make plants become more green because it contains a grain of green leafs that are important in photosynthesis. Whereas K element is needed in the opening and closing process of stomata, affect translocation of fotosintat, and increased photosynthetic activity that will ultimately affect the weight of the plant.

The decrease and increase in LAB values associated with the development of leaf area and assimilate distribution to all parts of the plant. (Paul, 2011). The results of this study indicated that at first LAB is high (age 30 HST) then decreased (age 60 HST) and consistent decline continuously with increasing the age of the plant until harvest time (180 HST). Decreased in the LAB values accordance with the Gardner et. al. (1985) opinion that the LAB values are not constant, but tends to decrease with increasing age of the plant.

Effect of Soil Types on the Growth and Yield Arrowroot

Planting arrowroot in the grumosol soil will obtained crop height which higher than planting arrowroot in rendzina soil. This

| Parameter of Observation | Biofertilizer | Types of Soil |
|--------------------------|--------------|---------------|
|                         | P0           | P1            | T1            | T2            |
| 1. plant height (cm)     | 100,7 a      | 105,3 a       | 105,35 b      | 100,65 a      |
| 2. amount of leaf (sheets)| 95,60 a      | 101,93 b      | 100,3 a       | 97,23 a       |
| 3. ILD                   | 5,6 a        | 6,2 a         | 6,29 b        | 5,47 a        |
| 4. total number of tillers (stem) | 8,2 a | 9,3 b | 9,2 b | 8,3 a |
| 5. LPR (g/g/days)        | 0,0220 a     | 0,0258 b      | 0,0260 b      | 0,0218 a      |
| 6. LAB (g/dm³/weeks)     | 0,0998 a     | 0,1295 b      | 1,00 a        | 1,08 a        |
| 7. amount of per hill (pieces) | 8,73 a | 9,03 a | 9,6 b | 8,1 a |
| 8. diameter of tuber (cm)| 24,43 a      | 25,1 a        | 25,13 a       | 24,35 a       |
| 9. tuber weight per hill (g) | 550,63 a | 569,38 a | 583,75 a | 536,25 a |

Remarks:
Number are followed by the same letter means not different significantly
T1 = grumosol soil
T2 = rendzina soil
P0 = without biofertilizer
P1 = used biofertilizer

STJSSA, ISSN p-ISSN 1412-3606 e-ISSN 2356-1424, parent DOI : 10.15608/ stjssa.v14i1.600
means that grumosol soil have better capacity strength to arrowroot growth than rendzina soil. This fact is supported by the results analyzes soil which showed that grumosol soil has pH 6.75 (neutral) whereas rendzina soil has pH 8.23 (little alkaline). The soil pH conditions will certainly affect the availability of nutrients in the soil.

According Setyamidjaja (1986) and Blair (1979) in Agustina (2004), at soil pH which high (alkaline, pH above 8.0) nitrogen (N) are available in relatively little quantities, whereas at pH 6.5 - 7.5 nutrients (including N) are available in the optimal amounts. This N availability is suspected of causing arrowroot is planted in the soil grumosol produced plant height which significant higher compared to rendzina soil. This is accordance Haefele et. al. (2008) opinion that the N elements important played at crop vegetative growth. Availability of N element which sufficient will gave better plants vegetative growth.

Availability of N is suspected of causing arrowroot is planted in the soil grumosol soil produced more total numbers of tillers significantly than rendzina soil. It is appropriate Setyamidjaja opinion (1986) that N (Nitrogen) besides important played in increasing plant height also plays a role in stimulated the growth of tillers.

Arrowroot cultivated in grumosol soil will produced higher relative growth rate than arrowroot cultivated in rendzina soil. This is presumably because grumosol soil are many contains nutrient and available for crop compared rendzina soil which has limited nutrient content due to fixation so that the plants can not utilize according to their need.

Setyamidjaja (1986) explains that at high soil pH (alkaline, pH above 8.0) the element of potassium (K) are available in relatively little quantities, whereas at pH 6.5 - 7.5 nutrients (including K) are available in optimal amounts. Nyakpa et. al. (1988) also explained that the K fixation occurred at high soil pH so that their at soil pH, K may be exchanged to be low. Availability K is apparently to be the limiting factor in produced larger leaf area, in which the leaf area determine the leaf area index (ILD) generate by arrowroot (Mualim et. al., 2009).

According Yin et al. (2003), ILD (Leaf Area Index) is one of important variable to predicted yield and growth crop. The highest achieved ILD when the plants age of 30 HST and will decline until it reaches lowest when the plant was 180 HST. Edmond and Ammerman (1971) in Paul (2011), stated that the Leaf Area Index (ILD) rise sharply in the early phase of growth and then gradually declined until harvest.

The Interaction Effect

The results of this study indicate that there is no interaction between biofertilizer factor with soil type factor on all parameters observed. This means that effect from various of biofertilizers level are not affected by various soil types level, and opposite. In the other words, both factors worked independently so there is no contribution mutual support which each other in increasing growth and yield of arrowroot.

CONCLUSION

1. Granting biofertilizers on arrowroot crops was significant effect that more increased in number of leafs, total number of tillers, relative growth rate, net assimilation rate, number of tubers per hill, tuber diameter, tuber length, and weight of tuber per hill than without used biofertilizers.
2. Arrowroot planting in grumosol soil was significant effect that more increased in plant height, total number of tillers, relative growth rate, leaf area index, and the number of tuber per hill than arrowroot planting in rendzina soil.
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