

Towards sustainable agricultural production: Growth and production of three varieties of shallot with some various Nitrobacter bio-fertilizer concentrations

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Abstract. Organic production is important for health and eliminates the risk of chemical residues. Taking part on sustainable agriculture production, this research was conducted in January to March 2017. Located in Palajau Village, in Jeneponto Regency, altitude 120 m above sea level, South Sulawesi. The research was aimed to determine the growth and production of shallot varieties and their interaction with Nitrobacter bio-fertilizer. The study conducted in the form of a two-factor factorial experiment using Randomized Block Design as environmental design. The first factor was varieties (Bima, Bangkok and Tajuk), and the second factor was concentration of Nitrobacter bio-fertilizer; control-without fertilizer, 30 and 60 mL of fertilizer per 3000 mL of water. Results show that the varietal treatment of Tajuk gave a good response to the observed parameters, and the Nitrobacter bio-fertilizer treatment of 60 mL of fertilizer 3000 mL of water gave good results on the number of bulbs per cluster, bulbs and dried bulbs per plot (of tons per ha bulbs). Bangkok variety combined with Nitrobacter bio-fertilizer concentration of 60 mL of fertilizer per 3000 mL of water per plot showed the highest yield of bulb that is 9.13 tons per ha compared with Bima and Tajuk varieties.

1. Introduction

Shallot is one of important food commodities in Indonesia. Production centers have only concentrated on several places, such as Central Java province, East Java, West Java and East Nusa Tenggara. Consumption of shallot for household tends to increase from year over year. National shallot production in 2012 amounted to 964,195 tons, and in 2013 the production increased to 1,010,773 tons. In 2014 the production of shallots continues to increase to 1,233,984 tons. However, in 2015 production decreased to 1,229,184 tons, and in 2016 production increased by 1,427,885 tons [1].

Varieties of shallot that usually grown in the lowlands are Maja Cipanas, Medan, Sumenep, Bima, Bangkok, Headland and Ampenan varieties. Bima variety is very famous for its production, which is high enough to reach 10 ton ha⁻¹. Bima variety has wide and thick leaf shape. It also has Medium round bulb shape is dark red, resistant to rotten leaf disease. Harvest age could range from 55-60 days after planting [2]. Bangkok variety has a good quality and resistant to low temperatures. While Tajuk variety has a round bulb shape with the widest diameter close to the tip of the root [3].

Nitrobacter bio-organic fertilizer is a microorganism that can improve soil structure and restore the damaged soil structure as before. Plants will thrive on fertile soil and will increase crop yields. Biological fertilizers can also reduce fertilizer costs significantly because the application in the field does not



require any additional fertilizer. The results showed that Nitrobacter (some kind of liquid organic fertilizer) can improve plant growth better than chemical fertilizers [4].

Nitrobacter bio-organic fertilizer serves as an auto-immune system in plants. Research results from [4], on papaya plants that use biological fertilizer, showed that plants will grow healthier and larger fruit and sweeter taste, less disease resistance, and better and more durable stored fruit. Nitrobacteria as a natural pesticide is able to overcome plant diseases such as *Fusarium*, *phytophthora*, *pythium* and all kinds of microorganisms and pathogens in soil and water, causing root rot, wilted leaves, and dead plants [4].

Organic vegetable production is not only important for human health but also eliminates the risk of chemical residues from the environment. It is really important to take part in sustainable agriculture production. For that reason, this paper aims to determine the growth and production of several varieties of onion and the interaction of onion varieties with Nitrobacter biological fertilizers.

2. Material and Methods

This study was conducted in farmers' fields Palajau village, district Arungkeke, Jeneponto regency, with altitude 120 m above sea level, South Sulawesi, started from January to March 2017. The study was conducted in the form of a two-factor factorial experiment using Randomized Block Design arranged in factorial consisting of two factors. The first factor was varieties with 3 types, namely Bima variety (V1), Bangkok variety (V2), Tajuk variety (V3), and the second factor was the concentration of Nitrobacter bio-organic fertilizer (K) with 3 levels, namely control-without fertilizer (K0), 30 mL of fertilizer/3000 mL of water (K1), 60 mL of fertilizer/3000 mL of water (K2). Variable of shallots growth were observed was: plant height, number of tillers per cluster, number of leaves, weight of dried bulbs per plot and tuber production. The data were analyzed by using the analysis of variance (ANOVA) to see whether the application of various Nitrobacter bio-fertilizer concentration, profitable for some shallot variety. A further test was performed using Honestly Significance Difference Test (HSD) if one of the treatments showed significant effect.

3. Results

Factor of of bio-fertilizer giving significant effect on growth of the tuber number per cluster while varieties factor showed the opposite. The effect on the result of the interaction between the two factors shows a significant effect (table 1). In contrast, the total parameters of the number of bulb per cluster, the effect of both factors on the wet bulb weight per plot (kg), the weight of the dry bulb per plot, tuber yield per plot had significant effect on the growth and onion production but the interaction of the two factors on the three parameters observed (table 2, 3 and 4) have no significant effect.

Table 1. The average number of bulbs per cluster of various shallot varieties and Nitrobacter bio-organic fertilizer application

Concentration of Nitrobacter bio-organic fertilizer (mL/3 L water)	Varieties of shallot			Average	HSD
	V1	V2	V3		
K0 (0)	1.42	1.50	1.67	1.53 y	0.11
K1 (30)	1.52	1.66	1.71	1.63 y	
K2 (60)	1.68	1.83	1.80	1.77 x	
Average	1,60 b	1,66 ab	1,73 a		

Note: The numbers followed by the same letter are not significantly different at the 0.05 Honestly Significant Difference (HSD) Test level

Table 2. Average weight of fresh bulb per onion plot (kg) of various varieties of shallot and Nitrobacter bio-organic fertilizer application.

Concentration of Nitrobacter bio-organic fertilizer (mL/3 L water)	Varieties of shallot			Average	HSD
	V1	V2	V3		
K0 (0)	1.42	1.50	1.67	1.53 y	0.11
K1 (30)	1.52	1.66	1.71	1.63 y	
K2 (60)	1.68	1.83	1.80	1.77 x	
Average	1,60 b	1,66 ab	1,73 a		

Note: The numbers followed by the same letter are not significantly different at the 0.05 HSD Test level

Table 3. Average weight of dried bulbs per plot (ton plot⁻¹) on various shallot varieties and Nitrobacter bio-organic fertilizer application.

Concentration of Nitrobacter bio-organic fertilizer (mL/3 L water)	Varieties of shallot			Average	HSD
	V1	V2	V3		
K0 (0)	1.33	1.45	1.58	1.45 y	0.13
K1 (30)	1.46	1.54	1.62	1.54 y	
K2 (60)	1.62	1.75	1.74	1.70 x	
Average	1.47 b	1.58 ab	1.65 a		

Note: The numbers followed by the same letter are not significantly different at the 0.05 HSD Test level

Table 4. Average yield of tuber production (ton ha⁻¹) on various varieties of shallot and Nitrobacter bio-organic fertilizer application.

Concentration of Nitrobacter bio-organic fertilizer (mL/3 L water)	Varieties of shallot			Average	HSD
	V1	V2	V3		
K0 (0)	7.12	7.48	8.37	7.66 y	0.53
K1(30)	7.60	8.28	8.55	8.14 y	
K2 (60)	8.40	9.13	9.02	8.85 x	
Average	7.71 b	8.30 a	8.64 a		

Note: The numbers followed by the same letter are not significantly different at the 0.05 HSD Test level

4. Discussion

4.1. Interaction of Shallot Varieties and Nitrobacter bio-organic fertilizer

The result of statistical analysis showed that the interaction between onion varieties and nitrobacter biological fertilizer had a significant effect on bulbs bulk parameter per cluster. The varieties of Bima onion (V1) combined with nitrobacter bio-fertilizer concentration of 60 mL per 3 L water per plot (K1) produced the highest number of tubers per cluster from treatment (V1K2) by 21.80 tubers per cluster, and the lowest is found in the control treatment that produced 12.70 bulbs number of tubers per cluster. It is suspected that the varietal response is very helpful to the number of tubers and tillers. The results of the research conducted by Kartapradja and Putrasamedja [5] in Sukamandi showed that the number of tillers that can be formed by this interactions are 6-8 tillers, the magnitude of these variations is made possible by the genetic influence of the cultivars being tested. In certain cases, the number of tubers

produced by a variety is closely related to the number of leaves because more number of leaves will experience more photosynthesis [6].

4.2. Varieties of Shallot

The experimental results showed that shallot varieties have a real impact on wet tuber weight per plot, weight of dried tuber per plot and tuber yield per ha of shallot, but no significant effect on the number of tubers per cluster. The result of statistical analysis on the growth and production of shallot crops showed that the Tajuk variety gave a significant effect of the increase of wet weight per plot and the weight of the tuber of ton per ha, while Bangkok variety showed the highest number of dry bulb weight per plot. This was presumably because these three varieties have different growth responses. This is in accordance with Gardner et al. [7], that plant growing power and the plant growth rate are strongly influenced by external and internal factors.

Bangkok variety that applied with Nitrobacter bio-fertilizer concentration of 60 mL per 3 L water gave good effect to onion bulb production for 9.13 ton per ha and has reached productivity potency of Bangkok variety in general which is 9.4 ton per ha. Biological fertilizers can improve yields, improve the quality, increase efficiency and reduce the dosage of artificial fertilizer, improve the physical structure, chemistry, and biology of the soil, suppress pest and disease attacks, make the balance of flora and fauna in the soil and created good environment on agricultural cultivation [8].

4.3. Nitrobacter Bio-organic Fertilizer

The result of statistical analysis showed that the application of bio-organic fertilizer had no significant effect on the parameters of plant height, number of leaves, tuber diameter, fresh bulb weight per sample, and weight of dried tuber per sample. Presumably, the Nitrobacter bio-organic fertilizer given was slowly available to the plant, therefore the plant has not given a significant response. As well as the existing bacteria in the nitrobacter bio-organic fertilizer can not symbiosis well on the soil causing the lack of biological fertilizer influence on plant growth. This is in accordance with Damanik *et al.*, [9] which found that the difference of biological fertilizer with chemical fertilizer is slowly response of the plants, the supply of indirect nutrients, the environmental impact is absent so that the biological fertilizer is slowly available for the plant, therefore the plant has not responded have a real impact. As well as existing bacteria in the biological fertilizer, had lack of influence on plant growth because the application of biological fertilizer in the soil can be washed out due to the occurrence of extreme weather.

5. Conclusions

- Varieties of shallot that had good effect on growth and production on observed parameters which were wet bulbs weight per plot, weight of dried bulb per plot and production of ton per ha.
- Nitrobacter bio-organic fertilizer with concentration of 60 mL per 3 L water gave good influence on observed parameters which were bulbs per cluster, the weight of wet bulb per plot, weight of dried bulbs per plot and production of ton per ha.
- Interaction between Bangkok variety and application of Nitrobacter bio-organic fertilizer with concentration of 60 mL per 3 L water per plot produced the highest production by 9.13 tons per ha.

6. Suggestion

Based on the results of the research, it is necessary to develop the planting of Bangkok varieties with concentration of 60 mL 3 litre water per plot.

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