Tropical Wetland Journal
Journal homepage: twj.ulm.ac.id | Published by Postgraduate Program - Lambung Mangkurat University | e-ISSN: 2654-279X

Original article
DOI 10.20527/twj.v7i2.95

Growth Response and Yield of Three Shallot Varieties on The Various Mixed of Urea + Za in Ultisol Soil

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Received: 13 January 2021; Accepted: 30 November 2021; Published: 17 December 2021

ABSTRACT

This study aimed to: (1) identify the interaction effect between varieties and mixed doses of urea + ZA on the growth and yield of shallots in Ultisol soil; (2) to identify the effect of each shallot varieties and the dosage mixture of urea + ZA which produce the highest yield in Ultisol soils. The research was conducted from April to June 2019 in Tungkaran Village, Martapura, with a split plot design. The main plot was shallot varieties (V) with three levels, namely Biru Lancor (v1), Bima Brebes (v2), and Super Philip (v3). Subplots were a mixture of urea + ZA (P) with four levels, namely 0 kg urea + 600 kg ZA (p1), 100 kg urea + ZA 400 kg (p2), 200 kg urea + 200 kg ZA (p3), and 300 urea kg + ZA 0 kg (p4). Each experiment was repeated three times. Therefore, there were 36 experimental units. Observation parameters included plant height, number of leaves per clump, number of bulbs per clump, fresh bulbs' weight per clump, and yield of stored dry bulbs. The results showed that the Bima Brebes variety (v2) had a significant effect on plant height, number of leaves, number of bulbs per clump, the weight of fresh bulbs per clump, and yield of stored dry bulbs. The mixture of 200 kg urea + 200 g ZA (p3) significantly affected plant height, number of leaves, number of tubers per clump, the weight of fresh tubers per clump, and yield of stored dry tubers.

Keywords: Bulb, Fertilizer, Nitrogen, Shallot, Ultisol

1. Introduction

Shallots (*Allium cepa* var. ascalonicum L.) are one of Indonesia's leading vegetable commodities that have long been cultivated by farmers intensively. The community's demand for shallots will continue to grow along with the population growth. This commodity is a source of income and job opportunities that can contribute significantly to regional economic development.

The demand for shallots in South Kalimantan province is around 16,000 tons per year, but the amount of production in South Kalimantan is only 10% of the demand (Denny, 2018). (Badan Pusat Statistik, 2018), the shallots' productivity in South Kalimantan is 2,846 tons. The demand for shallots in South Kalimantan is fulfilled by importing from outside the island, such as Java, Sulawesi, and West Nusa Tenggara.

The development of shallot plants in South Kalimantan is a top priority for local governments to reduce supply dependence outside Kalimantan. Minister of Agriculture, Andi Amran Sulaiman, targeted that Kalimantan can be self-sufficient on shallots by 2018 (Yulianus, 2016). However, Kalimantan has not been self-sufficient on shallot despite the support of government funds of Rp. 4 billion in 2017.

The low production of shallots in South Kalimantan is due to inferior quality seeds, poor planting media, less fertile land, and inadequate control of pests and diseases. Low productivity can be increased by improving the fertility of cultivated land.

Nitrogen is needed for the growth and development of shallots. Nitrogen functions to improve plants' vegetative growth (plants that grow on sufficient N elements will be greener) and facilitate protein formation (Hardjowigeno, 1987). N element can be obtained from urea and ZA fertilizers. The difference between the two is in their nutrient content and % N. Urea's N content is 42-46%, while in ZA is 21% and S is 24%. The application of ZA fertilizer to shallot plants containing N and S affects bulbs and bulb aroma formation. (Mitra & Pathak, 2016) stated that sulfur's function is to increase aroma, reduce shrinkage during storage, and enhance shallot and garlic cloves.

2. Materials and Methods

The research was conducted from April to June 2019 in Tungkaran Village, Martapura District, Banjar Regency. The materials used were shallot seeds, Ultisol soil, manure, urea, ZA, essential fertilizers in the form of SP-36 and KCl, water, and envelopes. The tools used were hoe, name tag, tape measure, watering can, analytical balance, oven, stationery, and camera.

This study used a split-plot design with shallot varieties (V) as the main plot and the mixture of urea + ZA (P) fertilizer as subplots. The main plot was the shallot variety (V), consisting of 3 levels, namely Biru Lancor (v1), Bima Brebes (v2), Super Philip (v3). Subplots were the mixture of urea + ZA (P), consisting of 4 levels, namely urea 0 kg + Za 600 kg (p1), urea 100 kg + Za 400 kg (p2), urea 200 kg + Za 200 kg (p3), and urea 300 kg + Za 0 kg (p4). Each experimental unit was repeated three times so that there were 36 experimental units.

The research consisted of several stages, namely land preparation, creating experimental plots with a size of 100 cm x 950 cm, fertilizing, maintaining, and harvesting. Each variety was planted on plots measuring 100 cm x 200 cm with a spacing of 15 cm x 15 cm. The parameters observed were plant height, number of leaves per clump, number of bulbs per clump, the weight of fresh bulbs per clump, and yield of stored dry bulbs.

The data was first tested with the homogeneity test using the Bartlett homogeneity test. After the data was declared homogeneous, it was continued with the analysis of variance using the F test at the 5% and 1% levels to determine which treatment had an effect. If the analysis of variance shows a significant or very significant effect, then proceed with the DMRT (Duncan's Multiple Range Test) tests at the 5% level.

3. Results and Discussion

Analysis of variance for plant height, number of leaves, number of bulbs per clump, the weight of fresh bulbs per clump, and weight of stored dry bulbs showed that the interaction between shallot varieties and the urea + ZA mixture had no significant effect in all observations. Analysis of variance in the treatment of shallot varieties and fertilizer mixtures showed a significant and very significant effect on plant height observations. Analysis of variance on the treatment of shallot varieties and a mixture of urea + ZA fertilizer showed very significant results and a significant effect on the number of leaves. Analysis of variance on the treatment of shallot varieties and a mixture of urea + ZA fertilizer showed a very significant effect on the parameters of the number of bulbs per clump and the number of fresh bulbs per clump. Analysis of variance in the treatment of shallot varieties and fertilizer mixtures showed a significant and very significant effect on the yield of stored dry bulbs.

The results showed that for plant height parameters, Bima Brebes (v2) variety had the highest plant height at 7 WAS (Week After Sowing) and was significantly different from the Biru Lancor (v1) and Super Philip (v3) varieties. For leaf number parameters, Bima Brebes (v2) variety produced more leaves and was significantly different from the Biru Lancor (v1) and Super Philip (v3) varieties at 7 WAS. For the parameter of the number of bulbs per clump, the Bima Brebes variety (v2) produced more bulbs and was significantly different from the varieties of Biru Lancor (v1) and Super Philip (v3). For parameters of fresh bulbs weight per clump and yield of stored dry tubers (t. ha-1), the Bima Brebes variety (v2) produced higher weight and yield and was significantly different from the Biru Lancor (v1) and Super Philip (v3) varieties. The data are presented in Table 1.

Table 1. The effect of shallot varieties on plant height growth at 7 WAS, number of leaves at 7 WAS, number of bulbs per hill, weight of fresh bulbs per clump, and yield of stored dry bulbs.

Variety (V)	Plant Height (cm)	Number of Leaves (strands)	Number of Bulbs per clump (Bulbs)	Fresh Bulbs Weight per clump	The Yield of Stored Dry Bulbs (t. ha^{-1})
v_1	30.84 a	14.94a	5.06a	1.28a	3.31a
v_1	34.38 b	20.22b	5.62b	4.74b	4.85b
v_1	31.18 a	14.20a	5.01a	1.93a	4.09a

Table 1 shows that the Bima Brebes (v2) variety at the age of 7 WAS had a plant height of 34.38 cm, significantly different from the Biru Lancor (v1) and Super Philip (v3) varieties. It shows that the Bima Brebes (v2) variety has good growth ability to the environment and Ultisol soil conditions. It is consistent with (Koswara, Verity, Nugraha, & Lukman, 2015), which states that the Bima Brebes variety also adapts well to acid sulfate soils and has wide adaptability. The number of leaves of the Bima Brebes variety (v2) at the age of 7 WAP was 20.22, significantly different from the varieties of Biru Lancor (v1) and Super Philip (v3). It indicates that the Bima Brebes (v2) variety is one of the superior national varieties that can thrive and has good leaf growth. (Rahayu & Berlian, 2004) stated that shallots' growth is influenced by various factors such as soil fertility and cultivation techniques. Therefore, good growth will produce larger bulbs. Soil fertility can be improved by fertilizing using nitrogen, while good cultivation techniques can be performed using superior varieties. The Bima Brebes variety (v2) had the highest value for the number of bulbs per clump (5.62 bulbs), the weight of fresh bulbs per clump (4.74 g), and yield of stored dry bulbs (4.85 t. ha-1). Meanwhile, the lowest value was owned by the Biru Lancor variety (v1), which was not significantly different from the Super Philip variety (v3). Observation of the bulbs' size in the three varieties showed that the Bima Brebes (v2) variety had a larger bulb size. Hence, it affected bulb weight, bulb growth, and leaves. According to (Sutono, et al.,2007) a large seed bulb will grow better and produce longer leaves, larger leaf area, resulting in a higher number of bulbs per plant, and a higher total yield.

The administration of the mixture of urea + ZA (200: 200) produced the highest plant height and was significantly different from urea + ZA (0: 600), urea + ZA (100: 400), and urea + ZA (300: 0) at the age of 7 WAS. The administration of the mixture of urea + ZA (200: 200) produced more leaves and was significantly different from urea + ZA (0: 600), urea + ZA (100: 400), and urea + ZA (300: 0) at the age of 7 WAS. The independent fertilizer treatment showed that the fertilizer application with a mixture of 200 kg urea: 200 kg ZA produced the best response for the number of bulbs per clump, the weight of fresh bulbs per clump, and weight of dry bulbs stored per clump. The lowest response was generated by applying fertilizer with a mixture of 0 kg urea: 600 kg ZA, and it was not significantly different from a mixture of 100 kg urea: 400 kg ZA and 300 kg urea: 0 kg ZA. The data are presented in Table 2.

Table 2. The effect of the urea + ZA fertilizer mixture on plant height growth at 7 WAS, number of leaves at 7 WAS, number of bulbs per clump, the weight of fresh bulbs per clump, and yield of stored dry bulbs.

Urea Fertilizer+ZA (kg)	Plant Height (cm)	Number of Leaves (strands)	Number of Bulbs per clump (Bulbs)	Fresh Bulbs Weight per clump	The Yield of Stored Dry Bulbs (t. ha^{-1})
p1	28.57 a	15.37a	9.96a	10.91a	3.59a
P2	32.72 b	16.65ab	11.67bc	12.85b	4.18b
P3	34.91 c	17.62b	12.56c	13.90c	4.62c
P4	32.27 b	16.18ab	10.83ab	12.03b	3.94b

Table 2 shows that the fertilizer administration of the mixture of 200 kg urea: 200 kg ZA resulted in a significantly different response to the application of the mixture of 100 kg urea: 400 kg ZA and 300 kg urea: 0 kg ZA for the entire response tested. It shows that the application of 200 kg/ha urea produces the best height of shallot plants. The administration of the right dose of urea + ZA fertilizer affects the height growth of shallots. (Napitupulu & Winarto, 2010) state that nitrogen application can increase plant growth, stimulate chlorophyll formation, and cause leaf color to be greener to increase the root shoot ratio. Therefore, nitrogen application can increase the plant growth rate. According to (Masnanto, 2006) urea fertilization on shallots in paddy fields up to 200 kg/ha has a significant effect on the number of leaves, leaf area, wet and dry bulbs weight, plant height, harvest index, number of bulbs per clump, weight loss, diameter, height, hardness, N plants, and specific gravity. Plant growth and development are strongly influenced by fertilizers' application and the nutrient's availability in the soil. Nutrient uptake is limited by nutrient elements in a minimum state (Leibig's Minimum Law). Consequently, the lowest nutrient status will control the plant growth process. Optimal growth can be achieved if all nutrients are in balance, meaning that no single nutrient becomes a limiting factor (Pahan, 2012). The application of urea to shallot is significantly affecting its vegetative growth. Therefore, the correct dosage of fertilizer will provide optimal growth. According to (Rauf, Syamsuddin, & Sri, 2000)nitrogen's primary role is to stimulate vegetative growth (stems and leaves).

The leaves number response from the application of urea + ZA (200: 200) on several shallot varieties indicates that nitrogen fertilizer is a vital nutrient for shallot plants. It is suspected that the application of nitrogen fertilizer at a specific limit can meet the shallot's need for nitrogen to increase leaf numbers. It is in line with the conclusion of (Sigit, 2001), which states that nitrogen plays a role in spurring plant growth in general, especially in the vegetative phase. It plays a role in the formation of chlorophyll, which is very useful in the photosynthesis process.

The influence of urea + ZA fertilizer on shallot bulb growth is caused by plants' response to land with minimal nutrients. Genetically, plants need nutrients to grow and develop so that each shallot plant variety has different growth pattern. (Sumarni,et al., 2012) and (Edi, 2019) stated that the number of shallot cloves (tillers) was determined more by plant genetic factors than fertilization factors. The production of shallots between varieties shows differences. It indicates that each variety has different growth and adaptability in lowland agroecosystems. (Putrasamedja, 2010) states that in addition to external factors, shallot production is also influenced by internal factors, namely the genetics of each plant.

Treatment is carried out before the seeds are planted, namely cutting the top of the shallot, which aims to accelerate new shoots' growth. It is confirmed by (Wibowo, 1994) who stated that cutting seed bulbs could accelerate plant growth and the number of tillers and could encourage the growth of side bulbs.

The application of urea + ZA fertilizer on ultisol soils significantly affects the three shallot varieties to respond to fresh and dry bulbs' production. Therefore, it can be seen that the use of different varieties affects different conditions. (Koswara et al., 2015) stated that shallot productivity in the lowlands has not been able to match production in the highlands. The main problem is the unavailability of varieties that can adapt to the lowlands, which encourages farmers to use seeds derived from shallots for consumption, and the lack of farmers' knowledge about cultivation technology.

The higher the plant and the more leaves, the higher the yield of the shallot plant. It is in line with the opinion of (Rahayu & Berlian, 2004), which states that good growth of shallot plants, which are characterized by higher and more leaves, can produce larger bulbs and higher yield. (Minardi,et al., 2011) find that element N played the most significant role in increasing plant height and growth of fresh plant weight and dry weight.

4. Conclusions

The interaction between shallot varieties and the mixture of urea + ZA did not significantly affect all growth parameters and crop yields. The single factor of each type of shallot variety and various urea + ZA mixtures significantly affected all growth and yield parameters.

Acknowledgments

The authors would like to acknowledge the Head of the Food Crops and Horticulture Office of Banjar Regency, South Kalimantan Province, who has facilitated the author.

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