THE EFFECT OF GIVING BIOCHAR UREA-BAMBOO GRANULAR FERTILIZER ON THE GROWTH OF SHALLOT PLANTS (Allium ascaloniucm L.)

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ABSTRACT

The use of urea-biochar granular fertilizer is intended to overcome the problem of inefficiency in the excessive use of urea fertilizer. The efficiency of urea is relatively low because 40-70% of N is lost from the soil. The purpose of this study was to determine the agronomic efficiency bamboo urea-biochar fertilizer on shallot plants. The research was conducted in the greenhouse of UPT Plant Pest and Disease Control Center in Celuk Sukawati Gianyar Village, in a Completely Randomized Design with a single factor consisting of 9 treatments and repeated 3 times. The treatments were U0B0 (control), U1B0 (with urea without biochar), U0B1 (with biochar without urea), S35 (35% biochar- coated granules), S30 (30% biochar-coated granules), S25 (25% biochar-coated granules), M35 (35% biochar matrix granules), M30 (30% biochar matrix granules), M25 (25% biochar matrix granules). Parameters observed were plant growth yields (height, weight of tubers and fresh litter, weight of tubers and oven-dried litter, number of tillers), fertilizer agronomic efficiency. The results showed that the S30 treatment significantly increased the shallot plant height by 43.67 cm, the weight of the oven-dried bulbs by 19.68 g and the RAE value by 362%, so that fertilization with the S30 treatment was the most efficient compared to other treatments and could be used by farmers in increasing the growth and yield of shallot plants.

Keywords: *Soil, biochar, granule, shallot plants, urea*

1. INTRODUCTION

Shallots (Allium ascalonicum L.) are one of the spice commodities with high economic value because they are widely used as a seasoning, raw material for the food industry, and traditional medicine (Dewi et al., 2016). As one of the commodities with high economic value, shallots have the potential for regional economic development. Increasing shallot production is needed to support regional and national income. The increasing demand for shallots has become a potential market that motivates farmers to increase shallot production. Various efforts have been made to increase production, especially through intensification through the application of fertilizer and fertilization technology. Fertilization is one of the important technologies to increase crop production. The type of fertilizer most needed by plants is Nitrogen (N) fertilizer, especially in the form of urea. The need for urea for shallot production is specific. In this study, the use of other natural materials as adhesives or carriers then became a special consideration, including bamboo charcoal (biochar) as an adsorbent and acrylic acid as an emulsifier and adhesive. The application of biochar can reduce the level of nitrogen loss in the soil, because biochar is a fertilizer companion that can hold water and nutrients in the soil to prevent fertilizer loss due to runoff and leaching (Ratna, 2016), and can improve

soil properties such as soil pH and soil CEC (Widowati et al., 2011). Airlangga et al. (2021) added that the addition of biochar to urea fertilizer causes the release of N to be slow release so that the intake of N requirements in plants can be met until harvest. According to Situmeang (2020), biochar with the addition of inorganic fertilizers can cover nutrient deficiencies from organic fertilizers, while biochar with the addition of organic materials is very helpful in improving degraded soil, because organic fertilizers can bind nutrients that are easily lost and help in providing soil nutrients so that fertilization efficiency becomes higher. From the problems above, it is necessary to conduct a study of the agronomic efficiency of acrylic acid-coated bamboo biochar urea fertilizer on shallot plants.

2. RESEARCH METODOLOGY

This research was conducted in the greenhouse of the UPT Plant Pest and Disease Control Center in Celuk Sukawati Village, Gianyar, from October to December 2024. The tools used in the study were pan granulator, sprayer, sieve (size 20 mesh, 2 mm and 5 mm), polybag, 3 kilogram plastic, bucket and a series of glassware in the laboratory for ammonium and nitrate analysis, spectrophotometer, Scanning Electron Microscope (SEM) Brand/Type Jeol JSM-IT200, and macro kjeldahl tool. The materials used in this study were bamboo biochar, urea fertilizer, tapioca flour, acrylic acid, distilled water, inceptisol soil taken from Plaga Village, and a series of chemicals for ammonium and nitrate analysis.
The study used a completely randomized design (CRD) with three replications. The treatment design used was a simple single factor design consisting of 9 levels. The treatments were U0B0 (control/without urea and biochar), U1B0 (with urea without biochar), U0B1 (with biochar without urea), S35 (35% biochar-coated granular urea), S30 (30% biochar-coated granular urea), S25 (25% biochar-coated granular urea), M35 (35% biochar matrix granular urea), M30 (30% biochar matrix granular urea), M25 (25% biochar matrix granular urea). Thus, there were 27 research units. In the agronomic testing of granular fertilizers, measurements were made on several plant parameters and several soil characteristic parameters after harvest. The observed plant parameters include: plant height (cm), fresh plant weight (g), total oven dry plant weight (g) and number of tillers (tillers per clump). Soil parameters after harvest include: soil ammonium and nitrate levels (%), soil N-total (%) and soil pH. Agronomic efficiency/effectiveness assessment is carried out by calculating the Agronomic Relativity value.

3. RELATED RESEARCH/LITERATUR REVIEW

The shallot plant (Allium ascalonium L.) is an annual plant belonging to the genus Allium. Shallots are classified as follows:

Division : Spermatophyta

Subdivision : Angiospermae

Class : Monocotyledonae

Order : Liliales

Family : Liliaceae

Genus : Allium

Species : Allium ascalonium L.

Urea fertilizer is one type of chemical or inorganic fertilizer that is widely used in the agricultural sector. This type of fertilizer is hygroscopic or easily attracts water vapor. Urea is easily soluble and easily absorbed by plants because this fertilizer is able to attract water vapor and air at 73% humidity. In increasing shallot production, Nitrogen (N) fertilizer plays an important role, while the most widely used source of N fertilizer is urea, the nitrogen requirement for shallot plants is 92 kg/ha or equivalent to 200

kg urea/ha. The efficiency of N nutrient absorption by plants is one of the important indicators in achieving the expected harvest quality. The amount of N nutrient absorbed by plants can affect the amount of chlorophyll, as well as the height, number of leaves and plant production. Nitrogen deficiency causes plants to grow stunted, leaves become light green and tissues die. Urea contains 46% N (the highest compared to other N fertilizers), has hygroscopic properties and is easily soluble in water so that the use of urea is very wasteful and can pollute the environment.

Biochar is a porous charcoal made from organic waste (agricultural biomass) through incomplete combustion or with limited oxygen supply (pyrolysis). Biochar is used as a carrier for slow-release urea fertilizer and is very potential because in addition to being easy to obtain and easy to make, the use of biochar as a nutrient medium is very good for use as a substitute for slow-release fertilizer coatings. The potential for biochar raw materials is quite abundant, namely in the form of agricultural waste that is difficult to decompose or has a high C/N ratio. In Indonesia, the potential for using biochar is very large considering the raw materials such as coconut shells, rice husks, cocoa pods, palm shells, bamboo, corn cobs, and other similar materials.

4. RESULTS AND DISCUSSION

The results of statistical analysis showed that the provision of acrylic acid coated granular fertilizer had a very significant effect on the variables of plant height and number of tillers, a significant effect on the variables of fresh tuber weight and oven-dry tuber weight, and an insignificant effect on the variables of fresh litter weight and oven-dry litter weight.

Based on the results of the analysis, it was shown that the provision of acrylic acid coated granular fertilizer had a very significant effect on plant height, except for the S_{35} treatment, the provision of urea-biochar granular fertilizer increased the height of shallot plants compared to the three tested controls (U_0B_0, U_1B_0, and U_0B_1). However, the height of shallot plants between urea-biochar granular fertilizer treatments was not significantly different except compared to the S_{35} treatment. The U_0B_1 treatment was significantly different from all treatments. The M_{35}, M_{30}, M_{25}, S_{30}, and S_{25} treatments were not significantly different, but significantly different from U_0B_0, U_1B_0 and S_{35}, while the U_0B_0, U_1B_0 and S_{35} treatments were not significantly different.

Treatment S_{30} showed the highest plant height compared to other plants, which was 43.67 cm (Table 2). This was due to the nitrogen nutrient (N) from urea contained in the formulation of bamboo biochar urea granule fertilizer with acrylic acid adhesive. In the S_{30} treatment, the N content in the fertilizer was 30% which caused the nutrients needed by shallot plants to be available in optimum and balanced amounts, and the plants could absorb the nutrients contained in the fertilizer to carry out the metabolic process properly.

The provision of N fertilizer contained in urea has a major influence on the increase in plant height, this is because shallot plants in vegetative growth require high N fertilizer. In line with Riady's statement (2015) that the amount of N nutrients that can be absorbed by plants can affect the amount of chlorophyll, plant height, number of plant leaves and can affect plant production. In addition to the N content in urea, this is also influenced by the function of biochar, namely as a buffer that can store nutrients and release N elements according to plant needs (Sudjana, 2014). This study shows that the provision of granular fertilizer has a very significant effect on the number of shoots. The largest number of red onion shoots was found in the S_{25} treatment, namely 7 shoots per clump. Gutomo (2015) in his study stated that the formation of bulbs is greatly influenced by the photosynthesis capacity of the plant. Some of the results of photosynthesis will be sent to the roots to initiate tuberization. The greater the results of photosynthesis, the greater the sucrose that can be

transferred to the bulb. Increasing the provision of N for plants will cause an increase in the formation of new cells which will affect the process of leaf elongation and widening, increasing the height and encouraging the growth process of leaves and plant shoots. In the S_{30} (fresh tuber weight) and M_{30} (fresh litter weight) treatments, the N content in each fertilizer was 30% due to the addition of biochar to urea fertilizer which caused the release of N to be slow release so that the intake of N requirements in plants could be met until harvest (Airlangga *et al*., 2021). Providing sufficient nitrogen can help the cytokinin hormone to be more responsive in plants. The cytokinin hormone plays an important role in the growth of new shoots, the number of shoots and the number of leaves. Dry weight is an indication of successful plant growth, because dry weight is an indication of the presence of net photosynthesis results that can be precipitated after the water content is dried. The greater the dry weight indicates the more efficient the photosynthesis process that occurs and the productivity and development of tissue cells are higher and faster, so that plant growth is better (Sarif *et al*., 2015). In the S_{30} (oven dry tuber weight) and M_{30} (oven dry litter weight) treatments, the N content in each fertilizer was 30% due to the addition of biochar to urea fertilizer which caused the release of N to be slow release so that the intake of N requirements in plants could be met until harvest (Airlangga *et al*., 2021). Agronomic efficiency testing was conducted by calculating the Relative Agronomic Effectiveness (RAE) value. RAE is a comparison between the increase in yield due to the use of the tested fertilizer with the increase in yield on standard fertilizer multiplied by 100% (Machay *et al*., 1984). This study showed that the largest RAE value was in the S_{30} treatment, which was 362% or increased the RAE value by 262% higher compared to the recommended standard fertilizer treatment (U_1B_0), so that the composition of the S_{30} treatment fertilizer was the most efficient compared to other treatments. Meanwhile, the treatments S_{25}, M_{30}, U_0B_1 gave RAE values of 284%, 188%, and 143% respectively, this indicates that the tested fertilizer is effective compared to the standard treatment (U_1B_0), while the treatments M_{35}, M_{25} and S_{35} had RAE values of 33%, 41, and 32% respectively lower than the standard fertilizer treatment (U_1B_0), this indicates that the treatments M_{35}, M_{25} and S_{35} are not effective compared to U_1B_0.

Table 1. Significance of the effect of acrylic acid coated granule fertilizer on shallot growth

No	Observation Variable	Significance
1	Plant Height (cm)	**
2	Fresh Bulb Weight (g)	*
3	Fresh Litter Weight (g)	ns
4	Number of Offshoots (offshoots/clump)	**
5	Oven-Dried Bulb Weight (g)	*
6	Oven-Dried Litter Weight (g)	ns

Source: Obtained from primary data, 2025

Description:

** : Very significant effect

* : Significant effect

ns : Not significant effect

Table 2. Effect of applying granular fertilizer coated with acrylic acid on the growth and yield of shallot plants

Treatment	Observation Variables						
	Plant height (cm)	Number of tillers (tillers per clump)	Fresh tuber weight (g)	Oven-dry tuber weight (g)	Fresh litter weight (g)	Oven-dry litter weight (g)	RAE value (%)
U_0B_0	34,00 c	5,33 a	12,78 c	6,28 c	2,99 a	0,59 a	0
U_1B_0	34,67 c	5,33 a	21,86 a	9,98 a	2,28 a	0,79 a	100
U_0B_1	35,67 b	3,00 d	22,56 a	11,58 a	1,28 a	0,43 a	143
M_{35}	40,00 a	4,33 b	15,24 b	7,51 b	1,82 a	0,54 a	33
M_{30}	42,33 a	4,33 b	23,41 a	13,23 a	4,26 a	0,81 a	188
M_{25}	40,67 a	3,67 c	15,24 b	7,81 b	2,63 a	0,63 a	41
S_{35}	34,67 c	5,00 a	14,18 b	7,48 b	0,56 a	0,27 a	32
S_{30}	43,67 a	6,00 a	30,37 a	19,68 a	2,11 a	0,74 a	362
S_{25}	42,00 a	7,00 a	26,10 a	16,80 a	1,72 a	0,51 a	284

5. CONCLUSION

There are differences in agronomic efficiency produced by several formulations of bamboo biochar urea granule fertilizer coated with acrylic acid, so the recommended proportion of fertilizer for commercialization is S30, because it significantly increases the height of shallot plants by 42 cm, fresh bulb weight by 26.10 g, oven-dry bulb weight by 16.80 g and RAE value by 284%, so fertilization with S30 treatment is the most efficient treatment and can be used by farmers.

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