Effort to increase shallot productivity using true shallot seed (TSS) from the superior varieties supporting Proliga

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Abstract. Lack of high quality/certified seed is an important constraint in shallots farming. One potential alternative technologies to be developed is the use of botanical seeds (TSS = True Shallot Seed). Stated that the cultivation of shallots using TSS is expected to cut the shallots production chain so that shallots production is stable and available throughout the year. So that the seed planted TSS can be directly used as tuber production. The assessment was done using split plot design. The main plot is two shallot varieties namely Trisula and Bima Brebes. The sub plot is four cropping systems that direct planting of seeds TSS, transplanting, planting mini bulbs, and large bulbs as a control. Parameters measured were plant growth and bulbs production, as well as input-output data. Data collected from some of the observed variables then tabulated and analyzed using SAS 9.1. software. Variety Test between treatment effect was done by using Duncan Multiple Range Test (DMRT) at the level of 95%. The results showed that the treatment by using mini tuber seeds gave the highest productivity on Trisula varieties (12.87 t / ha), followed by TSS treatment of Bima Brebes varieties with transplanting (6.78 t / ha). The results of this studied were the four applied shallot cultivation systems, the use of mini tubers as one of shallot cropping system with seeds from TSS gives the highest productivity (12.87 t / ha).

1. Introduction

Shallots are propagated using vegetative seeds. Farmers usually use vegetative seeds derived from consumption tubers obtained from their own crops, from other farmers and or imported from abroad. This causes the low quality of seeds which results in low production potential. TSS (True Shallot Seed) seed technology is the Grand Design of the Ministry of Agriculture to maintain the availability of shallots both in quantity, quality and continuity in 2016-2045 [1]. Proliga (multiple production) of shallot is a cultivation technology that combines several components such as the use of TSS, tight spacing, fertilizer dosage, fertilization techniques and integrated pest and disease management. Proliga can reduce yield losses up to 10 % and produce tubers up to 40 t/ha [2]. The opportunity to use TSS as shallot seeds is very prospective and will be able to overcome the supply system of shallot production with efficiently.

The development of shallots seeds as planting material has a strategic position to increase production. The use of shallot seeds has long been introduced, but has not been widely adopted or applied by farmers because of the limited availability of shallot seeds. The difficulty of providing shallot seeds is caused by: 1) still difficult to flower and produce shallot, 2) flowering shallots not in unison, 3) the percentage of seeds produced have low growth power, 4) nursery technology has not
been found, and 5) shallot cultivation technology [3]. Mini tubers are small shallot tuber with a volume of 3-4 g which are deliberately produced as seed products from TSS multiplication [4].

At present, the cultivation of shallots from TSS has not yet developed in Indonesia. This is due to the limited availability of TSS, and farmers find it difficult to grow shallots from seeds, so that the development of TSS is currently only carried out by the private sector. The success of cultivation of TSS for the production of seed tubers or consumption tubers depends on the handling of technical cultures, such as seedling seed planting methods, seedling age, plant population, fertilization, and other maintenance in the field [5]. Therefore, this study was conducted to determine the ability of TSS in increasing the productivity of shallots through appropriate technical culture.

2. Materials and Methods

This research was carried out in May - December 2017 in the Bontotangnga, Tamalatea District, Jeneponto Regency, South Sulawesi. The study used a split plot design with three replications. The main plot is two varieties of shallot namely Trisula and Bima Brebes. The subplot is four planting systems namely direct planting True Shallot Seed, Proliga Package (transplanting seedlings), mini tuber, and large tuber as a control. Each treatment consisted of 6 beds in an area of 5 m x 10 m. On the beds spread 2 kg / m² of mature manure, NPK (16:16:16) 50 g / m² and Furadan evenly, then stir with the soil. For direct seed planting treatment, transplanting, and mini tuber planting use 10 cm x 10 cm spacing, whereas for large tuber using 15 cm x 15 cm spacing. Before planting, seeds were treated with 80% Mankozeb fungicide at a dose of 2 g / kg of seed. For transplanting treatment, the nursery is first carried out in a special nursery and will be moved at the age of 6 weeks or have 3-4 leaves. Seedlings removed and planted 2 seedling hole. Supplementary fertilization is done twice, namely at the age of 30 days after planting (DAP) and 60 DAP with NPK (16:16:16) each 25 g / m². Harvesting shallot at age of 60 DAP from the tubers and 80-85 days from TSS.

3. Result and Discussion

3.1 Plant Growth

Table 1. Agronomic performance of shallots at 4 and 5 WAP

| Treatment       | Height 4 WAP (cm) | Height 5 WAP (cm) | Clumps 4 WAP | Clumps 5 WAP |
|-----------------|-------------------|-------------------|--------------|--------------|
| **Trisula**     |                   |                   |              |              |
| Direct planting | 11.07 ns          | 17.57 ns          | 0.00 a       | 0.00 a       |
| Transplanting   | 23.33 ns          | 25.82 ns          | 0.00 a       | 0.00 a       |
| Mini tuber      | 29.3 ns           | 30.13 ns          | 4.85 b       | 5.72 b       |
| Large tuber     | 23.03 ns          | 24.87 ns          | 5.57 b       | 5.62 b       |
| **Bima**        |                   |                   |              |              |
| Direct planting | 10.27 ns          | 16.87 ns          | 0.00 a       | 0.00 a       |
| Transplanting   | 27.42 ns          | 29.9 ns           | 0.12 a       | 0.12 a       |
| Mini tuber      | 14.95 ns          | 18.45 ns          | 5.10 b       | 5.28 b       |
| Large tuber     | 24.32 ns          | 26.93 ns          | 5.33 b       | 5.53 b       |

Description: The numbers followed by the same letter are not significantly different based on the DMRT test of 5%. WAP = Week after planting.

Table 1 shows that plant height was not significantly different, this is thought to be due to interactions between genetic factors and supporting environmental factors, able to influence the growth of plants of each variety. Genetic factors are factors that cause the appearance of crop performance, genetic traits that will be expressed in a variety of plant traits include the shapes and functions that produce plant diversity. External factors also affect the growth of plants, including pH
and climate. The pH of soil needed for the growth of shallots is 5.5 - 6.5. Based on the results of testing groundwater content, it was found that the watering water used contained pH 8.20 for water from the first well and 8.59 for the second well water (Appendix Table 1). The soil that is too alkaline (pH> 7) causes plants to not be able to absorb manganese salt (Mn) so that plants lack manganese nutrients, resulting in small tubers resulting in low production both quality and quantity [6]. On alkaline soils (pH> 7) shallot plants often exhibit symptoms of chlorosis plants, ie plants become stunted, turn yellow and small tubers result from lack of iron (Fe) and Manganese (Mn) [7]. In the treatment of seeds and transplanting of the Bima Brebes variety, only 0.12% formed tillers, while the Trisula variety did not form tillers, so that in the transplanting treatment the tubers that formed on average a single tuber did not undergo cell breakdown and formed tillers. Shallot cultivation using seeds as planting material in the dry lowland climate will produce a single tuber.

The measurement of plant growth when compared with the description of varieties released by Indonesian Vegetables Research Institute (IVEGRI), is very different from the results in the field. The height of the Trisula variety until the age of 5 MST, the highest only reached 30 cm with an average of 5.62 tillers per clump. In the Bima variety, the highest plant height was 29.9 cm with an average number of tillers of 5.53 tillers. The Trisula variety had a plant height of 39.92 cm and had 5-8 tillers per clump [8]. Whereas in the Bima variety, plant height is 25 - 44 cm with the number of tillers 7-12 tubers per clumps [9]. The less productive growth of shallot plants in this activity is likely due to the lack of soil's ability to bind nutrients and water, in addition to climatic conditions, especially air temperatures during vegetative growth is very high. The temperature in Jeneponto districts during September is estimated to reach 31.8°C and September is the driest month during the year, where there are only 6 mm of precipitation in September [10]. This year even the peak of heat occurred in October-November and the temperature recorded at the location of the activity averaged 32°C.

3.2 Productivity

| Treatment     | Amount tuber/clumps | Tuber weight/clumps (g) | Weight/plot (g) | Productivity (t/ha) |
|---------------|----------------------|-------------------------|-----------------|--------------------|
| Trisula       |                      |                         |                 |                    |
| Direct planting | 1.0 b                | 6.30 c                  | 5.700 b         | 4.99 b             |
| Transplanting | 1.0 b                | 5.27 c                  | 5.267 b         | 3.83 b             |
| Mini tuber    | 5.5 a                | 24.22 a                 | 17.700 a        | 12.87 a            |
| Large tuber   | 5.1 a                | 13.10 b                 | 5.500 b         | 3.99 b             |
| Bima Brebes   |                      |                         |                 |                    |
| Direct planting | 1.0 b                | 4.54 c                  | 4.500 b         | 3.27 b             |
| Transplanting | 1.05 b               | 9.30 b                  | 9.333 a         | 6.78 b             |
| Mini tuber    | 5.2 a                | 10.28 b                 | 5.500 b         | 4.00 b             |
| Large tuber   | 6.5 a                | 21.00 a                 | 4.967 b         | 3.61 b             |

Description: The numbers followed by the same letter are not significantly different based on the DMRT test of 5%
From the results obtained, shallots tuber weights per plot and productivity are presented in Table 2. In Table 2 it can be seen that the highest weight per plot in the treatment using mini tubers of Trisula varieties was followed by transplanting of Bima Brebes varieties. Although the tuber weight in the treatment using mini tubers is greater than that of the transplanting treatment, however, farmers are more interested in developing the use of TSS seeds with a transplanting system on the grounds that seed costs are less and do not carry disease. Farmers will try to use TSS seeds with a transplanting system and plant them at the end of the rainy season.

The low productivity is due to the ability of plants to bind nutrients from the soil less, such as manganese, one of the micro nutrients needed by plants, which is caused by the pH of the water and soil around the plants is very alkaline, specifically in the treatment of Bima Brebes varieties using large tubers, disease attacks Fusarium wilt is quite high. Direct seed planting systems are not suitable to be developed in dry climate low-lying areas such as Jeneponto district, because plant growth is very slow due to the temperature being too high, so the soil dries quickly. Planting TSS using the direct seed planting system is vulnerable to biotic (weed) and abiotic (environmental) stresses [11]. The Increase in air temperature that is too high (30 °C) usually leaves the stomata closed. This closure will inhibit the entry of CO$_2$, so the rate of photosynthesis will decrease [12]. Meanwhile, respiration increases with increasing air temperature. So, this can reduce the dry weight of plants and the shallot tubers.

4. Conclusion
Shallot productivity using TSS with a mini tuber planting system provides higher production. Planting systems with direct planting and transplanting less correspond to dry land agro-ecosystem as Jeneponto. South Sulawesi

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