Growth and yields performance of true shallot seed (TSS) in dry land of Sigi district

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Abstract. The alternative solution to the lack of availability of shallot tuber as planting material is TSS (True Seed of Shallot) technology. The purpose of the study is to determine the growth and yield of several seed shallots (TSS) varieties grown on dry land in Sigi, Central Sulawesi. The research was conducted on farmers' land in Kotarindau Village, Dolo subdistrict, Sigi from June to October 2018. The study used a Randomized Block Design (RBD) in 4 (four) varieties of Bima, Trisula, Lokananta and Sanren in 5 (five) replications. Observations included plant height, number of leaves, number of tubers per clump, tuber weight per clump, and productivity (t/ha). Data were analyzed using Analysis of Variance (ANOVA) and Duncan New Multiple Range Test (DMRT) at 5%. The results show that the Lokananta variety provide the best growth and yield on all parameters observed (plant height = 36.22 cm, number of leaves = 12.56, number of tubers per clump = 2.44 tubers, tuber weight per clump = 40.43 g and productivity 21.84 t/ha) compared to three other varieties.

1. Introduction
Shallot production contributes significantly to the total national vegetable production. However, the average productivity is relatively low at around 10 tons/ha from the potential productivity of shallots that can reach 20 tons/ha [1]. In Indonesia, there is a decrease in productivity and quality in the development of shallots. The low productivity and quality of shallots in the production area is due to the low quality of the seeds used [2]. Therefore, an increase in shallot productivity begins with using quality seeds available in each growing season and the amount of seed is sufficient. The use of quality seeds is an important factor for increasing productivity.

In Indonesia, farmers generally use tubers as planting material in shallot cultivation [3]. Planting using tubers is more practical and easier but has many obstacles in providing quality seed bulbs at planting time because the number of seed bulbs needed is very large and tends to be always lacking in each central area [4]. Seed tuber quality varies and low productivity due to the use of seeds derived from consumption tubers. Low quality tubers seed used by farmers is produced without quality certification and no selection process. Farmers use shallot tubers from the previous planting continuously causing transmission of systemic diseases that can occur through the seed bulbs used [5].

Development of True Seed of Shallot (TSS) is a technology for increasing availability of quality shallot seeds. The advantages of TSS technology are that shallot productivity increase, there is no dormancy, longer shelf life, cheaper seed supply costs, easier storage and distribution [3,5].

Generally, most shallot varieties can flower and produce seeds, except Sumenep variety which is unable to produce flowers in tropical climates [6]. Indonesian Agency for Agriculture Research and...
Development (IAARD) has released several superior varieties of shallots, including varieties Pancasona, Bima, Trident, Katumi, Maja, Violetta 1 Agrihorti, and Mentes. Information regarding the appropriate variety of shallots that can grow optimally in Sigi Regency, Central Sulawesi is not yet known. The purpose of this study was to determine the variety of shallot from seed that can adapt to specific location climatic conditions in Sigi Regency, Central Sulawesi.

2. Methodology
The research was conducted from June to October 2018. The research consists of preparation, plantation, cultivation; data collected, analyzed and write research reports. The location of the study was conducted in the Farmers' Land of Kotarindau Village (83 madpl), Dolo District, Sigi Regency, Central Sulawesi Province.

2.1. Materials
The materials used in this study were three shallot seed varieties (Bima, Trident Lokananta, and Sanren), husk charcoal, manure, lime/dolomite, NPK Phonska fertilizer, NPK mutiara fertilizer, NPK Grower, SP-36, KCl, ZA, insecticides, herbicides, and fungicides.

The tools used in this study were hoes, knives, spoons, gauges, hand sprayers, calipers, rulers, analytical scales, buckets, cameras, and stationery.

2.2. Experimental design
The study used a Randomized Block Design (RCBD) consisting of one factor of shallot varieties with 5 replications. The Kind of shallot varieties used were Bima, Trisula, Lokananta, and Sanren. The total number of experimental plot was 20 plots.

2.3. Research activities
Stages of research activities [8], namely:

2.3.1. Making nursery media. The nursery is made by clearing the land, clearing the area around the land from shrubs, weeds, then making beds and drainage channels so that when it rains, excess water will run off. The top layer of the beds is then mixed with manure and rice husk evenly.

2.3.2. Seedlings. TSS shallot seeds are soaked in warm water (50°C) for 3 hours before sowing, then they are drained and given a fungicide. The nursery is prepared in the form of beds by making a groove with a distance of +5 cm and a depth of 2 cm. Seeds are sown evenly and do not accumulate. Shredded shallot seeds are covered with a mixture of soil, manure and charcoal husks evenly. The seedbed is given water until it moist in the day before sowing.

2.3.3 Land preparation. Initial tillage is carried out by cleaning weeds, and then tillage process with tools in dry soil conditions (field capacity). Then the planting beds are made with widths (1.0-1.2 m) and the length is adjusted to the land conditions.

2.3.4. Planting. Planting beds are made rather high so that drainage is maintained properly. The day before planting, water was put into the land. In the lowlands drainage ditches used are well arranged, so that saturated water conditions can be controlled more on beds. The planting beds that are ready and neat are then planted with 6-week old shallots. Spacing is 8 x 10cm with 1-2 seedlings per clump. Furthermore, the TSS shallots need to be maintained in soil moisture conditions (especially if there is no rain) until they grow upright in the field.

2.3.5. Fertilizing.
- Shallot fertilizing for production using seed TSS was carried out in 3 (three) stages, namely basic fertilizer, supplementary fertilizer 1 and 2. Basic fertilization is used in the final land preparation
phase, which is given manure at 4-5 tons/ha, stocked evenly distributed on bed and additional Phonska 400-500 kg/ha, 200 kg SP-36 and KCl 100-150kg/ha.

- Supplementary fertilizer is given in 2 times, which is 3-4 weeks after planting (WAP) used NPK Mutiara 400 kg/ha and 150-200 kg ZA / ha. The fertilizer is sown in beds or between rows of shallot plants evenly and followed by watering. The second supplementary fertilizer is carried out at the age of 6-7 WAP using NPK (15-9-20) Hydro complex (Grower) 400 kg/ha beside shallot plants, then followed by watering.

2.3.6. Watering. Until the plants grow upright (0-7 day after planting, DAP), watering was 2 times/day (morning and evening). Another irrigation was carried out according to the conditions of planting in the field (for example, by washing plants from splashes of soil after rain in the morning) once a day until the plants reach 60 DAP. After the plants reach physiological maturities in the lowlands in dry weather conditions in age 60-70 DAP, they can be watered one time during the day with sufficient water volume.

2.3.7. Control of weeds and pests (OPT). Weed in shallot is removed manually (hand-weeding) according to crop conditions. The Control of plant pests (OPT) principal was based on the concept of Integrated Pest Management (IPM), namely: (a) Preventive; before OPT attack, plant rotating and fungicides/insecticides spraying periodically according to the action mechanism of active ingredients, and (b) Curative: insecticides spraying if the population or intensity of the pest attack has reached the threshold of control.

2.3.8. Harvest. Ready-to-harvest shallot characteristics are: leaves begin to turn yellow, the upper part of the plant starts to fall, the base of the leaf is deflated and most of the tubers protrude above the surface of the soil and the formation of red/ deep red/ purplish-red pigments on the tubers (depending on variety). TSS shallot harvest time is longer than shallot which seedling from the tuber, which is 60 - 70 days after planting in the lowlands; 70- 75 days in the medium plains and >80 days in the highlands. Leaf thickness reaches 80-90%. The best time for harvesting is sunny air by pulling the plants carefully, then collecting 10-15 clumps and tied. Then they are sun-dried.

2.4 Data collection and analysis
Data collection of plant growth and yield: (1) plant height at harvest time (cm); (2) number of leaves at harvest (strands); (3) number of tillers at harvest; (4) number of tubers/clumps; (5) tuber diameter (cm); and (6) fresh tuber weight/clump (g). To find out the effect of varieties on growth and yield, it was tested by analysis of variance. If the results of the analysis of variance are significantly different, then to compare the treatment averages, test is performed with the Duncan's Multiple Range Test (DMRT) method at 5% level.

3. Results and discussion

3.1. Shallot growth
Plant growth is an important process in the life cycle of a plant which depends on the availability of water, nutrients, and other growth substances and the supporting environment. The results of observations of the growth and development of shallot plants including plant height, number of leaves, and number of tillers are presented in Table 1.
Table 1. Average of plant height, number of leaves in various shallot varieties (TSS) in Kotarindau Village, Dolo, Sigi 2018.

| Treatment | Plant Height (cm) | Number of Leaves (strands) | Amount of Tiller |
|-----------|-------------------|-----------------------------|------------------|
| Bima      | 30.11 b           | 11.33 a                     | 2.45 a           |
| Trisula   | 29.55 b           | 10.78 a                     | 2.22 a           |
| Lokananta | 36.22 a           | 12.56 a                     | 2.22 a           |
| Sanren    | 33.67 a           | 11.66 a                     | 2.55 a           |

Note: The numbers followed by the same letters in the same column are not significantly different according to DNMRT advanced tests of 5%.

The results show that the treatment of varieties does not significantly affect the growth component of the shallot seeds, except plant height. The analysis of variance result show that the highest plant height is found in the shallot varieties of Lokananta, but not significantly different from the Sanren variety and significantly different from the Bima variety and the Trident variety. Trident variety has the lowest plant height. This indicates that the Lokananta variety is able to adapt well to the environment when compared to the Sanren, Bima and Trident varieties.

Generally, shallot has a type of plant height/leaf length of 30 cm. Short plant height is caused by environmental factors such as high rainfall and genetic factors [7]. Each variety responds differently because each variety has different root and leaf growth even if planted in the same soil [8]. The potential of genes from a plant will be maximized if it is supported by local environmental factors [9]. Adaptive varieties which have superior genetic traits are able to live in the local environment so that they produce according to their genetic potential.

The results of the highest number of leaves is found in the Lokananta variety and the highest number of tillers is found in the Sanren variety, although not significantly different from other varieties. There were fluctuations in yield as a result of environmental factors related to the stability mechanism of plant appearance [10]. The number of tillers depends on each characteristic of plant varieties [11]. Shallot development is directed at the optimal suitability of environmental physical factors that directly affect the yield and adaptability of varieties.

3.2. Plant yield

The characteristics of planting shallots are: ready to harvest, the leaves begin to turn yellow, the top of the plant begins to fall, the base of the leaf is deflated. The observations of the mean components of shallot yields including the number of tubers/clumps, tuber diameters, and fresh weight of tubers/clumps are presented in Table 2.

Table 2. Average of tubers/clumps, a diameter of tubers, and fresh weight of tubers/clumps in various varieties from shallot (TSS) in Kotarindau Village, Dolo, Sigi 2018.

| Treatment | Number of Bulbs/Clumps (Bulbs) | Diameter of Bulbs (cm) | Fresh Weight of Bulbs/Clumps (g) |
|-----------|---------------------------------|------------------------|----------------------------------|
| Bima      | 2.33 a                          | 3.09 a                 | 37.69 a                          |
| Trisula   | 2.11 a                          | 3.02 a                 | 31.35 a                          |
| Lokananta | 2.45 a                          | 3.36 a                 | 40.43 a                          |
| Sanren    | 2.67 a                          | 3.25 a                 | 38.96 a                          |
Note: The numbers followed by the same letters in the same column are not significantly different according to DNMRT advanced tests of 5%.

The results show that the treatment of varieties does not significantly affect the components of the observations of the shallot from seeds. The average number of tubers found in the treatment of Sanren varieties is higher than that of Trisula varieties which are thought to be due to the response of the variety which is strongly related to the number of tubers and saplings formed. In certain cases, the number of tubers produced by a variety is closely related to the number of leaves, because a large number of leaves will produce more photosynthates [12].

Based on Table 2, the diameter of the tubers and the fresh weight of the tubers/clumps show that the treatment of the varieties is not significantly different. The treatment of Lokananta shallot varieties tends to produce the best tuber diameter with an average tuber wet weight of 40.43 g per clump. The size and weight of tubers are indirectly influenced by the number of tubers formed [13]. Each average planting only forms 2.11-2.67 tubers so that the use of photosynthesis produced is only focused on an average of two tubers, so it can be said that the tubers that are formed have weight and diameter that are relatively not different.

This shows that the growth of plant weights, besides being determined by genetic factors of each plant variety, is also influenced by environmental factors, especially soil moisture and temperature. The water content of leaf cells is one of the factors that have an important role in the process of plant metabolism [14]. Each variety has a difference in terms of its ability to sustain life and growth of individuals from different climates. Plant genetic factors and their adaptation to the environment produce different growths. It can be seen that varieties have a significant influence on the growth and yield of shallots. The shallots produced from this study are dominantly round and large. The characteristics of shallots that are preferred by farmers are large, round tubers with a diameter of more than 2 cm and dark red [15].

4. Conclusion
The treatment of several shallot varieties from seed in the dry land of Sigi regency does not show any significant effect on the components of growth parameters and yields observed, except for the observation of plant height parameters. Lokananta variety shallots provide the best growth and yield of shallot plants on plant height, a number of leaves, tuber diameter and fresh tuber weight /clump compared other shallot varieties.

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