The effect of biocompost Trichoderma spp. tablet in stimulating shallot growth and yield for climate change adaptation

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Abstract. The use of fertilizers that are appropriate and right on target is necessary to assist plants in dealing with conditions of climate change to extreme climates that cause the soil to become dry and less fertile. To deal with climate change adaptation and increase the productivity of shallots, a study aimed to determine the effect of biocompost dosage Trichoderma spp. tablet in spurring growth and yield of several shallot varieties. The research used an experimental method which was conducted in Sembalun Bumbung Village, East Lombok Regency. This study used a Randomized Block Design with a factorial experiment. The main factor is the dosage of biocompost tablets, namely: 0 g/plant, 2.5 g/plant, 5 g/plant, 7.5 g/plant, and 10 g/plant. The simple factor is that the shallot varieties, namely: Bali Karet, Ampenan, Keta Monca, Super Philip and Super Cros. The results showed that the dosage of biocompost tablets starting at 5 g/plant can stimulate growth and can increase the weight of harvested dry tubers. Bali Karet varieties are very adaptive so that the growth and yield of dry tuber weight are the highest, Ampenan and Keta Monca are adaptive in the highlands, while Super Philip and Super Cross are less adaptive.

1. Introduction
Climate change is a phenomenon that cannot be avoided. Therefore, all sectors including the agricultural sector that are vulnerable to climate change must immediately increase their ability to adapt to the various changes that occur, in addition to various mitigation efforts to inhibit the rate of climate change. One example of a climate-smart agricultural system is the organic farming system. [1]

The Province of West Nusa Tenggara (NTB) is one of the centers for shallot production in Indonesia which is in third place. In 2017, there was a decrease in the productivity of shallots in NTB, reaching 10.92 tons/ha, previously reaching 11.03 tons/ha [2]. The productivity of shallots is still low when compared to the results of the study, reaching 15 tons/ha [3].

One of the causes of the low productivity of shallots in NTB is the conventional cultivation of shallots which rely too heavily on the use of inorganic fertilizers and the low quality of shallot seeds used, so that plant growth is less than optimal [4].

To be able to improve land quality in increasing the productivity of shallots, in the future it requires the application of technological innovation, especially the component that has the greatest influence on productivity, namely the biophysical aspect of land, where an important obstacle to the biophysical aspect of land is the low quality of soil fertility due to low organic matter [5].
One way that can be done to increase the soil organic matter content is by using biocompost. Biocompost is compost that is produced with the help of lignocellulolytic microbes which remain in the compost and act as biological agents to control plant disease and decomposition agents of organic matter [6]. The use of biocompost on soil and plants will increase the diversity of natural microorganisms that play a role in the soil nutrient recycling cycle, so that soil and plant fertility and productivity increase [7].

Biocompost is compost obtained from composting plant remains using decomposer microbes which have high ability in the composting process. Microbes as activators can shorten the time of making biocompost [8]. Biocompost is a useful and effective combination of microorganism inoculation technology with the concept of environmental management through nutrient enrichment [9].

Compost also provides micro nutrients for plants, facilitates plant root growth, prevents several root diseases, and can save on the use of chemical fertilizers and/or artificial fertilizers so as to increase fertilization efficiency. The role of compost when applied to the soil will result in changes, especially in the physical improvement of the soil. The addition of soil microbes can also speed up the process of compost breakdown [10].

The shallot seeds planted in planting centers in NTB are the Bali Karet variety (Highlands Sembalun Village, East Lombok), the Ampenan variety (Senteluk Village Lowlands, West Lombok), the Keta Monca variety, Super Philip and Super Cross (Rada Bima Village Lowlands). However, all these shallot varieties are less stable to climate change [11]. Preliminary research results showed that Bali Karet, Ampenan, Keta Monca, Super Philip and Super Cross varieties were induced by the biocompost of the fungus Trichoderma spp. gives growth and yields that are highly dependent on altitude [12].

To deal with climate change adaptation and increase the productivity of shallots, a study aimed to determine the effect of dosage biocompost Trichoderma spp. tablet in spurring growth and yield of several shallot varieties.

2. Methodology

2.1. Research materials

2.1.1 Biocompost Trichoderma spp. How to make a solution of T. harzianum and T. koningii, the procedure is following Sudantha [13]. The compost used is from cow shed waste, made by stacking the compost on a tarpaulin, then pouring it with a solution of saprophytic fungus T. harzianum isolate Sapro-07 and T. koningii isolate Endo-02 evenly. The procedure is following Sudantha [14].

2.1.2 Shallot seeds. The shallot seeds used are Bali Karet, Ampenan, Keta Monca, Super Philip, and Super Cross varieties purchased from seed breeders. Preparation of shallot seedlings for this study was according to procedures by Sudantha et al. [15].

2.2. Research methods

The research used an experimental method which was conducted in Sembalun Bumbung Village, East Lombok Regency. This study used a Randomized Block Design with a factorial experiment. The first factor is the dosage biocompost tablets, namely: 0 g/plant, 2.5 g/plant, 5 g/plant, 7.5 g/plant, and 10 g/plant. The second factor is that the shallot varieties, namely: Bali Karet, Ampenan, Keta Monca, Super Philip and Super Cros.

2.3. Ways of working

Processing was carried out by using a hoe to level the soil and make experimental plots measuring 2x4 m for each treatment plot. Furthermore, the experimental plots were covered with plastic mulch and the planting holes were made 20x20 cm apart. Basic fertilizer is given by immersing it next to the planting hole. The basic fertilizer used is Phonska fertilizer as much as 100 kg/ha or 50% of the recommendation.
Biocompost of *Trichoderma* spp. given according to the treatment, namely: immersed next to the planting hole. Planting is done by placing the shallot seed tubers into a hole with a depth of 2 cm and the hole is closed again with soil. Planting is done with a spacing of 20×20 cm. When the plant is 5 weeks after planting, the follow-up fertilization is carried out using urea fertilizer 165 kg/ha and KCl 50 kg/ha, done by placing the fertilizer next to the base of the plant stem with a distance of ± 2 cm. Harvesting of shallots is carried out when the plants are 62 days after planting (dap).

2.4. Observation of variables
Plant height was measured to the maximum vegetative growth, namely the age of 35 dap. The number of leaves was observed by counting all leaves up to the maximum vegetative growth at 35 dap. Observation of the number of tillers was done by counting all the tubers of each plant, for the dry tuber weight of the harvest was done by weighing all parts of the harvested dry plants when the plants were 75 dap.

2.5. Data analysis
Data were analyzed using Analysis of Variance at 5% level and Honestly Significant Different (HSD) Test at 5% level.

3. Results and discussion

3.1. The effect of biocompost dosage for *trichoderma* spp. on the growth of shallots and yield
The results of further tests on the dosage of *Trichoderma* spp. using HSD 5% on plant height, number of leaves and number of tillers and are presented in Tables 1.

| No | Biocompost Tablet Dose Treatment | The Growth of Shallots | Shallot Crop Yield |
|----|---------------------------------|------------------------|-------------------|
|    |                                 | Plant Height of Shallots (cm) | Number of Shallot Leaves (sheet) | Number of Tillers (tuber) | Weight of Harvested Dry Shallots (tons/ha) |
| 1. | 0.0 g/plant                     | 23.40 a<sup>1)</sup>         | 23.30 a<sup>1)</sup>         | 6.50 a<sup>1)</sup>       | 5.80 a<sup>1)</sup>          |
| 2. | 5.0 g/plant                     | 38.10 b                   | 35.20 b             | 11.60 b                  | 13.90 b                     |
| 3. | 10.0 g/plant                    | 38.20 b                   | 35.30 b             | 11.80 b                  | 14.80 b                     |
| 4. | 15.0 g/plant                    | 38.30 b                   | 35.50 b             | 12.20 b                  | 14.90 b                     |
| 5. | 20.0 g/plant                    | 38.50 b                   | 35.60 b             | 12.30 b                  | 14.90 b                     |

Information: 1) The numbers in each column followed by the same letter are not significantly different.

Tables 1 show that the dosage treatment of *Trichoderma* spp. showed significant differences in plant height and number of shallot leaves, and number of tillers and weight of harvested dry shallot compared to without biocompost. Between doses of biocompost tablets Biocompost tablets from a dose of 5.0 g/plant to 20 g/plant were not significantly different, meaning that with the use of biocompost at a minimum dose of 5.0 g/plant, it was able to spur plant growth, both plant height and number of shallots.

As an illustration of the growth of shallot plants treated with *Trichoderma* spp. as seen in Figure 1. In Figure 1, it can be seen that the shallot treated with biocompost up to the age of 35 dap have an average plant height of 38 cm and an average number of leaves that is an average of 35 sheet, meanwhile the shallot without biocompost treatment *Trichoderma* spp. has a plant height of 28 cm and an average number of plant leaves 23 sheets.

*T. harzianum* and *T. koningii* fungi contained in the tablet biocompost have a role to stimulate ethylene in plant tissue so as to stimulate plant vegetative growth. *T. harzianum* fungus can increase seed germination and plant growth [16]. Of the four types of auxins, namely geberelin, cytokinins, abscisic acid and ethylene, it is thought that ethylene is a hormone produced by the fungus *Trichoderma* spp. which can promote plant growth and flowering [17]. Application of *T. harzianum* on soybean plants
acts as a biological agent and stimulator of plant growth so that it can increase yield components compared to treatment without *Trichoderma* [18]. The fungus *Trichoderma* spp. able to stimulate plants to produce the hormones gibberellin acid (GA3), Indolasetic acid (IAA), and benzylaminopurin (BAP) so that plant growth is more optimal, fertile, healthy, robust, and ultimately affects plant resistance. The hormones gibberellin and auxin play a role in root and stem elongation, and fruit (tuber) growth and increase plant growth [19]. The use of *Trichoderma* spp. biofungicide as much as at least 5 ml/plant can increase plant height and number of leaves [20].

![Figure 1](image1.png)

*Figure 1.* The average Shallot height is 38 cm and the number of leaves is 35 sheets which is treated with *Trichoderma* spp. Biocompost Tablets. (A). The average height of Shallot is 28 cm and the number of leaves is 23 sheets without the treatment of Biocompost Tablets (B).

Sudantha *et al.* [21] said that the nutrient content in the biocompost tablet is able to stimulate the growth of height and number of shallots. The nutrient content in tablet biocompost includes: pH 6.0; C-organic 1.54; CEC 17.92 cmol kg⁻¹; C/N ratio 12.6; population of *Trichoderma* spp. 30 x 10⁶ propagules/g of biocompost; free from soil borne pathogens. Mona *et al.* [22] said that tomato plants inoculated with *T. harzianum* showed increased root and shoot growth and chlorophyll pigment compared to non-inoculated controls and drought stressed plants. A clear increase in the phenol and flavonoid content was observed due to *T. harzianum*. Plants inoculated with *T. harzianum* maintained higher levels of the growth regulator indole acetic acid, indole butyric acid, and gibberellic acid under drought stress. Elham *et al.* [23] said that *Trichoderma* fungus should be considered as a biofungicide because it can control disease and increase stem and root length and yield weight.

3.2 The effect of shallot variety treatment on plant growth and shallot crop yield

The results of further tests on the effect of shallot varieties on plant growth and shallot crop yield at the age 35 dap using HSD 5% are presented in Table 2.

From Tables 2 it is known that shallot varieties show different effects on plant height, number of shallots on plants aged 35 dap, and number of tillers and weight of harvested dry shallots. The Bali Karet variety showed higher plants than the Ampenan and Keta Monca varieties, while the Ampenan and Keta Monca varieties did not show any significant differences.
Table 2. The effect of shallot variety treatment on plant growth at the age of 35 dap and yield.

| No. | Treatment of Shallot Varieties | The Growth of Shallots | Shallot Crop Yield |
|-----|--------------------------------|------------------------|-------------------|
|     |                                | Shallot Plant Height (cm) | Number of Shallot Plant Leaves (sheet) | Number of Tillers (tuber) | Weight of Harvested Dry Shallots (tons/ha) |
| 1.  | Bali Karet                     | 38.80 a¹               | 47.10 a²           | 12.40 a¹               | 14.90 a¹          |
| 2.  | Ampenan                        | 37.40 b               | 41.60 b           | 10.10 b               | 10.50 b          |
| 3.  | Keta Monca                      | 37.10 b               | 41.90 b           | 10.20 b               | 10.10 b          |
| 4.  | Super Philip                    | 28.30 c               | 35.10 c           | 8.30 c                | 8.20 c           |
| 5.  | Super Cross                     | 28.40 c               | 35.20 c           | 8.20 c                | 8.30 c           |

Information: ¹ The numbers in each column followed by the same letter are not significantly different.

Referring to Tables 2 that shallot varieties affect the plant height and number of shallots, and number of tillers and weight of harvested dry shallots. According to stating that the difference in plant growth is the morphological adaptability, which in turn will affect the growth and yield of a plant. [24]. The occurrence of variations in a plant can be caused by environmental influences and genetic factors. Different environmental conditions lead to variations that can determine the final appearance of a plant [25].

4 Conclusion

The results showed that the dosage biocompost tablets starting at 5 g/plant can stimulate the growth and can increase the weight of harvested dry tubers. Bali Karet varieties are very adaptive, so that the growth and yield of dry tuber weight is the highest. Ampenan and Keta Monca are adaptive in the highlands, while Super Philip and Super Cross are less adaptive.

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