Growth Response and Yield of Shallots to *Trichoderma* Biostimulants and Growth Regulators Substance *Benzyl Amino Purine* (GRS BAP)

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ABSTRACT
Shallots are one of the vegetable commodities that have important meaning for the community, both in terms of their high economic value and nutritional content. The productivity of shallots in West Nusa Tenggara is still low compared to the production potential of shallots. One of the causes of the low productivity of shallots is that the conventional shallot cultivation technique relies too much on chemicals and is planted in the dry season on dry land. One of the efforts to increase the productivity of shallots is by administering the biostimulant *Trichoderma* and the Growth Regulatory Substance *Benzyl Amino Purine* (GRS BAP). This study aims to determine the growth response and yield of shallots to the biostimulant *Trichoderma* and GRS BAP. The study used an experimental method which was carried out on land owned by farmers in Sembalun Bumbung Village, Sembalun District, East Lombok Regency. The study used a Randomized Block Design with a factorial experiment consisting of 2 factors. The first factor was *Trichoderma* biostimulant which consisted of four levels, namely: without biostimulant, *Trichoderma harzianum* Sapro-07 fungus biostimulant, *T. koningii* Endo-02 fungus biostimulant, and mixed fungi biostimulant *T. harzianum* Sapro-07 and *T. koningii* Endo-02. The second factor is: GRS BAP which consists of two levels, namely without GRS BAP and with GRS BAP. The results showed that shallot plants treated with a mixture of biostimulant fungi *T. harzianum* Sapro-07 and *T. koningii* Endo-02 either with or without GRS BAP could increase plant height, number of leaves, root length, and increase the number of tillers and shallot weight dry harvest. In other words, the mixed biostimulant of *T. harzianum* Sapro-07 and *T. koningii* Endo-02 fungi had the same role as GRS BAP in stimulating the growth and yield of shallots.

Keywords: *Biostimulant, Shallot, Growth Regulatory Substance, Benzyl Amino Purin, Trichoderma.*

1. INTRODUCTION

Shallots (*Allium cepa*) are one of the most important horticultural crops for the community and the government. This is because the onion plant is an agricultural commodity that has high economic value and is used as a food flavoring and medicinal plant [1].

The province of West Nusa Tenggara (NTB) is one of the centers of shallot production in the third place in Indonesia. NTB shallot production in 2015 was 160,201 tons with a harvested area of 14,524 ha, in 2016 as many as 211,804 tons with a harvested area of 19,275 ha, in 2017 as many as 195,458 tons with a harvested area of 17,904 ha, in 2018 as many as 212,885 tons with a harvested area of 19,341 ha, and in 2019 as many as 188,255 tons with an area of 16,688 ha. The increase in shallot production was due to an increase in the expansion of the planting area, but in terms of yield productivity there was a decrease. In 2017 there was a decline in the productivity of shallots in NTB, which was 10.92 tons/ha, previously it reached 11.03 tons/ha [2]. The productivity of shallots is still relatively 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 traditional shallot cultivation which is more on the use of chemical fertilizers and chemical pesticides, so that plant growth is less than optimal. Fertilization with excessive chemical fertilizers can cause the soil to become hard, and excessive use of chemical pesticides causes the soil to be polluted and the ecological balance to be disturbed, the organic matter content in the soil is low and soil fertility decreases so that growth and crop yields also decrease [4].

To be able to improve the quality of land in increasing the productivity of shallots, it is necessary to apply technological innovations, especially the component that has the greatest influence on productivity, namely the biophysical aspect of the land, where an important obstacle to the biophysical aspect of the land is the low quality of soil fertility due to low organic matter. In this regard, soil management is needed that is oriented towards improving the physical, chemical and biological properties of the soil that support plant growth. This method needs to be done by applying cheap and easy technology. One way that can be done to increase the organic matter content of the soil is to use biostimulants. Biostimulants are formulations of plant bioactive compounds or microorganisms that can be applied to plants with the aim of increasing the efficiency of nutrient absorption, tolerance of abiotic stress and/or plant quality. Biostimulants are not nutrients or pesticides, but have a positive effect on plant growth and health and are environmentally friendly [5-6].

One of the microorganisms used as a biostimulant is the fungus *Trichoderma* spp consortium. According to Sudantha [7] the fungus *Trichoderma koningii* isolate Endo-02 can stimulate plant growth, including seed germination, shoot formation, stem elongation, and number of leaves; while the fungus *T. harzianum* isolate Sapro-07 can stimulate the formation of flowers and seeds. In addition, it acts as a decomposing agent of soil organic matter so that it can increase soil fertility. Thus, these two types of mushrooms can be used as a biostimulant consortium. Biostimulants are multifunctional for plants, on the other hand, they can also provide nutrients, increase nutrient availability, control plant-disturbing organisms, decompose organic matter and humus-forming, and break down chemical compounds [8-9].

The biostimulant formulation used is a consortium or a combination of saprophytic fungi and endophytic *Trichoderma* spp. which can function as biological control of plant diseases, promoter of plant growth and flowering. The use of these formulations has been successful in the growth and development of several plants. The use of fungi *T.koningii* isolates Endo-02 and *T. harzianum* isolates SAPRO-07 as biostimulants can stimulate plant growth, namely plant height, number of leaves and root length in vanilla plants [7]. Sudantha [10] reported that the use of the fungus *T. harzianum* can increase the growth and yield of soybean plants. Sudantha and Suwardji [11] reported that the use of the fungus *T. harzianum* could stimulate the growth and yield of maize. Sudantha *et al.* [12] reported that in a greenhouse experiment, the use of fungi *T. harzianum* isolates Sapro-07 and *T. koningii* isolates Endo-02 was 15 g/pot on shallot plants. Meanwhile, the use of bioactivator as much as 10 g/pot was able to increase plant growth and yield of shallots. Yusrinawati *et al*. [13] said that the use of *T. harzianum* bioactivator in combination with *Arbusclar Mycorrhizal Fungus* (AMF) can stimulate the growth and yield of shallots. Yudhiarti *et al.* [14] said that the use of bioactivator in tablet and liquid formulations in combination with AMF can increase soybean growth and yield. Pascual *et al.* [15] said that biostimulants in the form of compost enriched with *T. harzianum* T-78 (Th T-78) as a growing medium showed higher growth and yield of melons than without biostimulants. Colla *et al.* [16] (2014) said that the application of biostimulants containing the fungus *T. atroviride* can stimulate shoot and root formation and increase yields of lettuce, melon, pepper and tomato plants.

Meanwhile, to stimulate growth in shallot plants, it can be done by adding growth plant regulators (GRS) or phytohormones, either naturally or artificially. Efforts to increase flowering and seed formation can also be done with the application of GRS from the cytokinin group [17]. One class of cytokinins that actively affect plant physiological processes, such as cell division and enlargement, is benzyl amino purine (BAP). BAP at a concentration of 50 ppm can increase flowering and seed production of *Cajanus cajan* [18] and soybean plants [19].

To find out how big the effect of *Trichoderma* spp. and GRS BAP on the growth and yield of shallots under field conditions, a study was conducted on "Response of Growth and Yield of Shallots to *Trichoderma* Biostimulants and Growth Regulatory Substances Benzyl Amino Purine (GRS BAP)".

2. METHODOLOGY

2.1. Research Materials

The biostimulant used was a consortium of fungi *T. koningii* isolates Endo-02 and *T. harzianum* isolates Sapro-07 [7].

The onion seeds used are Bali Karet varieties which are purchased from seed growers. Onion seeds that are good to use are healthy and quality seeds with a shelf life of 2 months and there appear to be points growing at the roots. The day before planting the seeds are cut around ¼ part. [20].

2.2. Research Methods

The study used an experimental method which was carried out on land owned by farmers in Sembalun Bumbung Village, Sembalun District, East Lombok

Regency. The study used a randomized block design with a factorial experiment consisting of 2 factors. The first factor was *Trichoderma* biostimulant which consisted of four levels, namely: without biostimulant, *Trichoderma harzianum* Sapro-07 fungus biostimulant, *T. koningii* Endo-02 fungus biostimulant, and mixed fungi biostimulant *T. harzianum Sapro-07* and *T. koningii Endo-02*. The second factor is: RGS BAP which consists of two levels, namely without RGS BAP and with RGS BAP.

2.3. Trial Execution

Tillage was carried out using a hoe to level the soil and make plots with a size of 2 m × 4 m for each treatment plot. Furthermore, the experimental plots were covered with plastic mulch and planting holes were made with a distance of 20x20 cm.

Provision of basic fertilizer in the form of Phonska is done by immersing it next to the planting hole. The basic fertilizer used is 100 kg/ha (50% of the recommendation).

Fungal biostimulant *Trichoderma* spp. given at the same time as planting shallot bulbs by soaking shallot bulbs. Furthermore, the biostimulant was given back to the shallot plants three weeks after planting (wap). Planting is done by placing the onion seed bulbs into a hole with a depth of 2 cm and the hole is covered again with soil. Planting was done with a spacing of 20 × 20 cm.

Irrigation is carried out in the morning or evening and is carried out by dilebing the experimental land through the channel in the experimental plot until the soil is wet. Weeding is done by removing weeds that grow around the plant.

Follow-up fertilization is done when the plants are 5 wap. Subsequent fertilization using urea 165 kg/ha and KCl 50 kg/ha. Fertilization is done by placing fertilizer next to the base of the plant stem with a distance of ± 2 cm.

Pest control is carried out by spraying vegetable insecticides if there are signs of pest attack, while Fusarium wilt control is carried out by removing diseased plants. Shallots were harvested when the plants were 70 days after planting (dap).

2.4. Variable Observation

Observations of yield components were carried out at harvest, ie at the age of more than 70 days after the plants were dry at harvest. Observations were made by counting the tubers of each plant after the plants were harvested. Observation of harvested dry tuber weight was carried out by weighing all parts of the harvested dry plant when the plant was 75 dap. Observation of stored dry bulb weight was carried out by weighing the plant parts that had been stored or air-dried until the weight reached a constant.

2.5. Analysis Data

Data from observations were analyzed using Analysis of Variance (ANOVA) with a 5% level of significance using Minitab for Windows Rail. 13. If there are variations, further testing is carried out using the Honestly Significant Difference (HSD) at the 5% level.

3. RESULT AND DISCUSSION

3.1. The Effect of Biostimulant Trichoderma spp. and GRS BAP on the Growth of Shallots

The results of the analysis of variance showed that the biostimulant treatment of *Trichoderma* spp. and GRS BAP and their interactions showed significant differences in plant height, number of leaves and root length of shallot plants at 35 dap. The results of the further test of the interaction of *Trichoderma* spp. and GRS BAP using 5% HSD for plant height, number of leaves and root length of shallot plants at 35 dap observations are presented in Tables 1, 2 and 3.

Table 1 The Effect of Biostimulant *Trichoderma* spp. and GRS BAP on Plant Height of Shallots at 35 dap

Biostimulant *Trichoderma* spp.	Shallot Plant Height (cm) at 35 dap	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	17.40 a[1] A[2]	20.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	29.60 a B	30.65 a B
Fungus biostimulant *T. koningii* Endo-02	39.00 a C	39.67 a C
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	40.00 a D	40.67 a D

Notes: [1] The numbers in each column followed by the same letter are not significantly different.
[2] The numbers in each row followed by the same letter are not significantly different.

Table 2 The Effect of Biostimulant *Trichoderma* spp. and GRS BAP on Plant Height of Shallots at 35 dap

Biostimulant *Trichoderma* spp.	Number of Shallot Plant Leaves (strands) at the Age of 35 dap	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	16.60 a[1] A[2]	45.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	26.60 a B	28.65 a B
Fungus biostimulant *T. koningii* Endo-02	37.00 a C	38.67 a C
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	44.00 a D	45.67 a D

Notes: [1] The numbers in each column followed by the same letter are not significantly different.
[2] The numbers in each row followed by the same letter are not significantly different.

In Tables 1 and 2 it can be seen that the biostimulant treatment of *Trichoderma* spp. can increase plant height and number of leaves of shallot both with RGS BAP and without RGS BAP. The best increase in height and number of leaves in the treatment of fungal biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02 accompanied by RGS BAP was the average plant height was 40.67 cm and the number of leaves was 45.67 strands. Poor plant growth was shown in the treatment without the biostimulant *Trichoderma* spp. and without RGS BAP, the average plant height was 17.40 cm and the average number of leaves was 16.60. The biostimulant containing the fungus *T. koningii* Endo-02 was more dominant in stimulating the growth of shallot plants compared to the fungus *T. harzianum* Sapro-07.

There were differences in plant height and number of shallots after treatment with biostimulant Trichoderma spp. presumably due to the first role of the fungus *T. harzianum* isolates Sapro-07 and *T. koningii* isolates Endo-02 contained in biostimulants that were able to stimulate the growth of shallots, the second difference in growth was due to the influence of PGR. The role of the fungal biostimulant *Trichoderma* spp. in spurring plant growth caused by the fungus *Trichoderma* spp. In the rhizosphere or plant root areas, ethylene is released which is diffused into the plant body through the xylem which plays a role in promoting vegetative growth. According to Sudantha [7] that *T. koningii* isolate Endo-02 contained in the biostimulant has a role in stimulating ethylene in plant tissue so as to stimulate growth in height and number of plant leaves compared to *T. harzianum* isolate Sapro-07. According to Windham *et al.* [21] Ethylene is a hormone produced by the fungi *Trichoderma* spp. which dominantly stimulated plant growth compared to the hormones gibberellins, cytokinins and abscisic acid. Sudantha [22] said that the application of *T. harzianum* fungus to soybean plants acts as a biological agent and stimulator to increase yield components compared to treatment without *Trichoderma* fungi. Latifah *et al.* [23] argued that the fungi *Trichoderma* spp. able to stimulate plants to produce the hormones gibberellin acid (GA3), Indoleacetic acid (IAA), and benzylaminopurine (BAP) so that plant growth is more optimum, fertile, healthy, sturdy, and ultimately affects plant resistance. Gibberellins and auxin hormones play a role in root and stem elongation, and fruit (tuber) growth and increase plant growth. Sudantha *et al.* [20] said that the use of *Trichoderma* spp. as much as at least 5 ml/plant can increase plant height and number of leaves. This is presumably because this fungus produces gibberellic acid (GA3), indoleacetic acid (IAA), and benzylaminopurine (BAP) which can stimulate plant height and number of leaves. Furthermore, Sudantha [24] said that the fungus *T. harzianum* can increase seed germination and plant growth. According to Salisbury and Ross [25] that ethylene is a hormone produced by the fungus *Trichoderma* spp. can stimulate plant growth and flowering. Similar results were reported by Soliah *et al.* [26] that the application of *T. harzianum* in the formulation of biomol and compost tea on soybean plants acts as a biological agent and stimulator of plant growth so as to increase the growth components and yield components compared to biomol and compost tea.

For the role of RGS BAP in promoting plant growth as reported by Werner *et al.* [27] that to stimulate the growth process in shallot plants can be done with the addition of PGR or phytohormones. RGS is a group of organic compounds that are formed naturally or artificially. One example of PGR is the cytokinin group. Barclay and McDavid [28] said that one class of cytokinins that actively affect plant physiological processes, such as cell division and enlargement, is BAP. BAP at a concentration of 50 ppm can increase growth, flowering and seed production of *Cajanus cajan*. [29] said that the use of BAP can stimulate growth in soybean plants. Cho *et al.* [30] said that the administration of BAP can increase the mobilization of minerals contained in the leaves and roots such as phosphorus, potassium, calcium, magnesium, nitrogen and sodium, so it can be concluded that the administration of BAP has an effect on the roots of shallot. RGS cytokinins function to stimulate cell division and mitotic differentiation, are synthesized at root tips and translocated through xylem vessels.

From the results of the study, the administration of *Trichoderma* spp. and RGS BAP have the same role in terms of spurring the vegetative growth of shallots. In other words, shallots have the same response to the administration of the biostimulant *Trichoderma* spp. and RGS BAP.

As an illustration of the growth of shallot treated with the fungal biostimulant *Trichoderma* spp. and RGS BAP as shown in Figure 1. In Figure 1 it can be seen that the shallot plants treated with the fungal biostimulant *Trichoderma* spp. and RGS BAP had an average plant height of 38.60 cm and the number of leaves was an average of 31.90 strands, meanwhile shallot plants treated without biostimulants and RGS BAP had a plant height of 38.60 cm and an average number of leaves an average of 31.90 pieces.

Figure 1 The average height of the Shallots was 38 cm and the number of leaves was 35 that were treated with the biostimulant fungus *Trichoderma* spp. and RGS BAP

(A). The average height of Shallots was 28 cm and the number of leaves was 23 without biostimulant treatment and without RGS BAP (B).

Table 3 Effect of Biostimulant *Trichoderma* spp. and RGS BAP on Root Length of Shallots at 35 dap

Biostimulant *Trichoderma* spp.	Shallot Root Length (cm) at 35 dap	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	4.40 a[1)]A[2)]	5.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	6.60 a B	6.65 b B
Fungus biostimulant *T. koningii* Endo-02	7.00 a C	7.60 b C
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	9.00 a D	9.60 b D

Notes: [1)] The numbers in each column followed by the same letter are not significantly different.
[2)] The numbers in each row followed by the same letter are not significantly different.

In Table 3 it can be seen that the biostimulant treatment of *Trichoderma* spp. and RGS BAP showed a significant difference in the root length of shallot plants compared to those without biostimulants (control). The fungal biostimulant *T. koningii* Endo-02 stimulated plant root length more than the fungal biostimulant *T. harzianum* Sapro-07, but when these two fungi were mixed, it stimulated root elongation of the shallot plant. This means that there is a synergism between the use of *T. koningii* Endo-02 and *T. harzianum* Sapro-07 biostimulants.

There is a difference in the length of the roots of shallot plants in the treatment of biostimulant Trichoderma spp. allegedly due to the adaptability of the fungus *T. harzianum* isolates Sapro-07 and *T. koningii* isolates Endo-02 after being treated in the soil, so that they are able to reproduce both under normal conditions and drought stress so as to stimulate the growth of shallot root length. When compared with no biostimulant, there was an increase in the population of *Trichoderma* spp. in all biostimulant treatments, the average was 10.00 x 105 propagule/g soil, while in the control there was no *Trichoderma* spp. in the ground. The content of nutrients in biostimulants that can stimulate plant root growth. According to Sudantha et al. [31] that the nutrient content in biostimulants 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/ml biostimulant; free from soil borne pathogens. According to Mona *et al.* [32], tomato plants inoculated with *Trichoderma* showed an increase in root and shoot growth and chlorophyll pigment compared to uninoculated control and drought stress plants. Proline and total protein content According to Elham *et al.* [33] *Trichoderma* fungi should be considered as a biofungicide/biostimulant because it can control disease and increase stem and root length and yield weight. Shentu *et al.* [34] said that the endophytic fungus *T. koningii* should be considered as a biofertilizer or biofungicide/biostimulant because of its ability to suppress pathogenic fungi and increase plant height, chlorophyll, and yield. Thanapat *et al.* [35] said that the *Trichoderma* fungi has a high adaptability to several ecological environments including drought. According to Colla *et al.* [36] that the fungal biostimulant *Trichoderma* spp. can increase plant organ growth and morphogenesis as well as increase tolerance to abiotic stress and nutrient absorption efficiency. Qostal *et al.* [37] said that inoculation with *Trichoderma* sp. as a biostimulant has a significant effect on seed germination, growth and yield of wheat and barley.

As an illustration of the root growth of shallot plants treated with the fungal biostimulant *Trichoderma* spp. as shown in Figure 2. In Figure 2 it can be seen that the root length of shallot plants treated with biostimulants up to 35 days after planting was 8 cm, while the root length of shallot plants without biostimulant treatment of *Trichoderma* spp. an average of 4 cm.

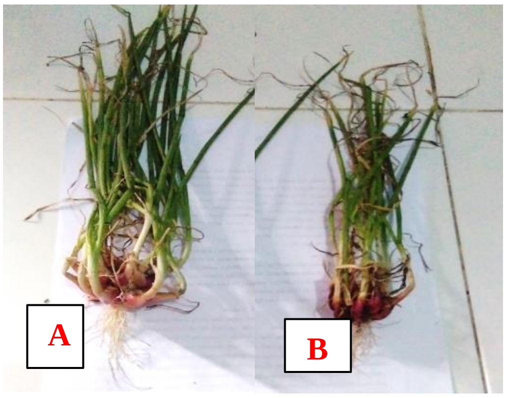

Figure 2 The average root length of Shallots was 8 cm which was treated with the biostimulant *Trichoderma* spp. (A). Shallot root length on average 4 cm without biostimulant treatment (B)

3.2. The Effect of Biostimulant Trichoderma spp. on Shallots Yield

The results of the analysis of variance showed that the biostimulant treatment of *Trichoderma* spp. and RGS BAP and their interactions showed significant differences in the number of tillers, the weight of harvested dried shallots and the weight of stored dry shallots. The results of the further test of the interaction of the biostimulant *Trichoderma* spp. and RGS BAP using HSD 5% for the number of tillers, the weight of harvested dried shallot bulbs and the weight of stored dried shallots bulbs are presented in Tables 4, 5 and 6.

Table 4 The Effect of Biostimulant *Trichoderma* spp. and RGS BAP on the Number of Tubers of Shallots

Biostimulant *Trichoderma* spp.	Number of Tubers of Shallots (bulbs)	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	6.40 a[1)] A[2)]	7.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	11.60 a C	11.65 b C
Fungus biostimulant *T. koningii* Endo-02	8.00 a B	8.67 b B
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	13.00 a D	13.60 b D

Notes: [1)] The numbers in each column followed by the same letter are not significantly different.
[2)] The numbers in each row followed by the same letter are not significantly different.

Table 5 The Effect of Biostimulant *Trichoderma* spp. andRGS BAP on the Weight of Harvested Dried Shallot Bulbs

Biostimulant *Trichoderma* spp.	Weight of Harvested Dried Shallot Bulbs (tons)	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	5.40 a[1)] A[2)]	8.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	13.60 a C	13.65 b C
Fungus biostimulant *T. koningii* Endo-02	11.00 a B	11.67 b B
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	15.90 a D	16.30 b D

Notes: [1)] The numbers in each column followed by the same letter are not significantly different.
[2)] The numbers in each row followed by the same letter are not significantly different.

Table 6. The Effect of Biostimulant *Trichoderma* spp. and RGS BAP on the Weight of Dried Shallots Store

Biostimulant *Trichoderma* spp.	Weight of Dried Shallots Store (tons)	
	Without RGS BAP	With RGS BAP
Without Biostimulant *Trichoderma* spp.	4.40 a[1)] A[2)]	7.60 b A
Fungus biostimulant *T. harzianum* Sapro-07	12.60 a C	12.65 b C
Fungus biostimulant *T. koningii* Endo-02	10.00 a B	10.67 b B
Fungi biostimulant *T. harzianum* Sapro-07+ *T. koningii* Endo-02	14.0 0 a B	15.67 b D

Notes: [1)] The numbers in each column followed by the same letter are not significantly different.
[2)] The numbers in each row followed by the same letter are not significantly different.

In Tables 4, 5 and 6 it can be seen that the biostimulant treatment of *Trichoderma* spp. and RGS BAP showed significant differences in the number of tillers, weight of harvested dried shallot bulbs, and weight of stored dried shallot bulbs compared with no *Trichoderma* spp. and without RGS BAP. The fungal biostimulant *T. koningii* Endo-02 stimulated plant root length more than the fungal biostimulant *T. harzianum* Sapro-07, but when these two fungi were mixed, it stimulated root elongation of the shallot plant. This means that there is a synergism between the use of *T. koningii* Endo-02 and *T. harzianum* Sapro-07 biostimulants. According to Sudantha [7] that the fungus contained in the biostimulant *T. harzianum* Sapro-07 isolate had a role in stimulating ethylene in plant tissue so as to stimulate plant growth and generative development compared to *T. koningii* isolate Endo-02. Saptarini *et al.* [38] said that PGR can affect tissue activity in various organs or plant organ systems. RGS does not provide additional nutrients because it is not a fertilizer. The function of RGS in plant tissue is to regulate the physiological processes of cell division and elongation, and to regulate the growth of roots, stems, leaves, flowers, and fruit.

The saprophytic fungus *T. harzianum* in the rhizosphere or plant root areas releases ethylene which is diffused into the plant body through the xylem which plays a role in promoting generative growth [39]. Another report stated that spraying conidia of the fungi *T. viride* and *T. koningii* to protect strawberry plants from rot disease was found to promote early flowering [40]. The success of the use of *Trichoderma* fungi which is formulated in various forms has been reported by several previous researchers, namely the use of *Trichoderma* spp. and AMF can increase the growth and yield of shallots in dry land [13]. The effect of *Trichoderma*-based biostimulant and nitrogen (N) fertilization rate on agronomic performance and functional quality can increase the weight of lettuce and rocket vegetables [41]. The use of tablet and liquid bio activators with the use of AMF can increase the induced resistance of soybean plants to wilt disease and increase soybean growth and yield [14]. The use of bio activators and biocompost fermented with **Trichoderma** spp. can increase the growth and yield of shallots [42]. The use of *Trichoderma* spp. which is formulated in the form of a stimulator bio compost can increase the growth and yield of maize in dry land [43]. *Trichoderma* spp. biofungicide treatment in liquid, powder and solid formulations that act as biostimulants can increase the weight of harvested dried shallot bulbs and inhibit the occurrence of Fusarium wilt disease [44]. Biostimulant treatment in the form of *Trichoderma* spp bio compost tablets as much as 5 g/plant can stimulate the growth of shallot plants and increase the weight of harvested dried shallot bulbs [45]

From the results of the study, the administration of *Trichoderma* spp. and RGS BAP have the same role in terms of increasing the yield of shallots. In other words, shallots have the same response to the administration of the biostimulant *Trichoderma* spp. and RGS BAP.

4. CONCLUSION

The results showed that shallot plants treated with a mixture of biostimulant fungi *T. harzianum* Sapro-07 and *T. koningii* Endo-02 either with or without RGS BAP could increase plant height, number of leaves, root length, and increase the number of tillers and shallot weight dry shallot harvest. In other words, the mixed biostimulant of *T. harzianum* Sapro-07 and *T. koningii* Endo-02 fungi had the same role as RGS BAP in stimulating the growth and yield of shallots.

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