Using bio-starter to increase growth and production of hortensia flower (Hydangea sp)

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Abstract: The purpose of this study was to increase the growth and production of horticultural flowers through the use of organic fertilizers without and with stater biotechnology. This study was a field study using a randomized block design (RBD) with 3 treatments and 5 replications. The data obtained were analyzed quantitatively using ANOVA, if there was a difference between the treatments followed by the Duncan Multiple Range Test (DMRT) at the level of 5%. The results showed that the bio-starter had an effect on the quality of organic fertilizer. Likewise, it has a significant effect on the growth and production of hortensia. This is probably due to the making of organic fertilizers with bio-starters, the decomposition of organic matter is perfect, does not cause odor, the availability of nutrients and the number of species becomes more abundant. With a lot of nutrients, it is easier to absorb by hortensia and the use of soil bio-starter becomes more loose, porosity increases.

1. Introduction
Hortensia flower plants (Hydrangea sp) are flowering plants originating from Asia (Japan, China, Himalaya and Indonesia), North and South America. This plant is a beautiful flowering plant that can be planted in pots and fields, cultivated as ornamental plants and cut flowers [1]. Hortensia flower plants in Bali better known as aspecah seribu, is one of the flowers that are widely cultivated by flower farmers in Bali, in contrast to outside Bali only as an ornamental plant. In Bali this interest has a high economic value, because it is needed by all Hindus as a complementary means of offerings for daily worship and in major religious holidays. The need for this flower from year to year has always increased along with population growth and the density of religious ceremonies of Hindus in Bali, causing this interest to continue to be needed by consumers in the short and long term. Besides being needed for traditional ceremonies, hortensia are also in demand among hotels, because they are used for flower arrangements for hotel florist purposes.

Hortensia is a shrub plant, can grow for years, always producing flowers throughout the year, regardless of season. Nurseries and flower maintenance are very easy, nurseries only with stem cuttings. From planting to producing flowers, it takes about 10 months. If the plants are in optimal growth conditions, harvesting flowers can be done every 2 weeks. The quality of a good flower has the size of a large flower shaped like a bright blue. Besides that the production and quality of flowers is strongly influenced by soil fertility and the availability of nutrients in the soil [2].

The mountainous area on the island of Bali which cultivates Hortensia as the center of production is a highland area located in Buleleng Regency, Sukasada District. In this Mountains Region large-scale acres of hortensia are cultivated, almost every village in this area has horticultural flower plantations,
including Amertasari and Wanagiri villages. This village is located approximately 7 km from Bedugul Tourism Object Area. Since the 1980s Hortensia has been cultivated in this village, which initially was only a garden plant, but because these flowers sell well at promising prices and are in demand in the market, local people are cultivated, from year to year the expansion of Hortensia always increasing and has become a daily livelihood in addition to pig and cattle farms. Observations in the production field and quality of horticultural flowers, especially in Amerta Sari Village, have been decreasing from year to year, even though demand is increasing. This decrease is due to land that has been used for years continuously planted with similar flowers (since the 1980s), so that soil fertility and nutrient availability decreases. This will cause the fertilizer needs, especially chemical fertilizers that are often used by local farmers, to increase, while the price of chemical fertilizers increases, so farmers object to buying fertilizers and sometimes farmers do not give fertilization to their crops.

Fertilization by using livestock manure is traditional, there is no touch of technology. Besides that there are also many pig farms in this village. From ancient times to the present, pig farms have been widely available in Bali, especially in mountainous areas, because they are supported by more abundant areas and feeds, in addition to meat for consumption as well as a means of making Hindu offerings. One farmer group can have up to 20 pigs. The waste produced is quite large and causes pollution problems in the environment because of the foul odor that is released, rarely used as organic fertilizer. If it is utilized and processed as organic fertilizer, the farmers will not lack fertilizer, besides the costs incurred are also cheap. But because the knowledge / technology about this matter is not yet well known by farmers, the farmers become objected to buying fertilizer. As a result the quality of the flowers produced is small and production decreases. Because the condition of the hortens is very thin because it is always fertilized with synthetic chemical fertilizers, which causes the soil to become poisoned and many soil microbes die [3].

2. Materials and Methods

2.1. Experimental design
The research location is located in the village of Amertasari, Sukasada Buleleng. Research time is from January 2017 to October 2018. The design used was a randomized block design (RBD), with 3 treatments and 5 replications. The treatment was treatment without fertilizer (F0), treatment with organic fertilizer without bio-starter (F1), treatment with compost organic fertilizer with bio-starter and liquid organics (F3). Parameters observed were growth parameters (plant height, number of leaves), for production parameters (flower diameter, number of flowers / clumps, and weight of flowers / clumps). For fertilizer quality parameters (odor, colour, and appearance of fertilizer, nutrients (N, P, K), organic C, pH, and DHL. Data analysis using quantitative analysis using analysis of variance (ANOVA), if between different treatments is real then followed by multiple range test (DMRT) duncans at the level of 5% [4].

2.2. Making Compost Organic Fertilizer
Compost is made from chicken manure and agricultural waste. To make 100 kg of compost prepared 80 kg of chicken manure, 15 kg of agricultural waste that has been cut, 4.75 kg of sawdust, 0.25 kg of bio-starter. All ingredients are stirred and added with water until it is slightly crumbly. Then close tightly with a tarpaulin for 20 days, after which it is stirred and then closed again until the 40th day. After that the compost is ready for use.

2.3. Making Liquid Organic Fertilizers
Prepared 3 kg of fish waste and 3 kg of potatoes, each boiled with 50 liters of water for 30 minutes. Then drain and filter. After microbial cold is added and fermented for 1 month.

2.4. Hortensia Flower Planting Preparation

2.4.1 Seed preparation and planting
Hortensia seedlings are made by cutting, after 2 months the cuttings have grown and are ready to be planted. Media preparation in the field is 1 acre. Before planting media for F1 it was mixed with cow dung compost without bio-starter. For treatment F2 is mixed with compost 2 anyway / ha which is made by adding a bio-starter and added 1 L / ha of liquid organic fertilizer for all F2 media. Each treatment was repeated 5 times, and each replication consisted of 20 plant units. The total number is 300 plants.

2.4.2 Maintenance
Watering is done every day in the morning, weeding is done after the plants are 2 months old.

2.5. Observation
Fertilizer parameters consist of quality (texture, smell, colour, and maturity) and quantity (N, P, K, C organic, pH, DHL) of compost and liquid organic fertilizer, plant growth parameters consist of plant height and number of leaves, while for production parameters consist of the number of flowers, flower diameter and weight of flowers per clump

3. Results and Discussion

3.1. Results

3.1.1. Quality of organic fertilizer
The results showed that the quality of compost (colour, odor and appearance) between treatments showed differences (Table 1). Liquid organic fertilizer shows a normal pH of 6.35, a high P and K content is compared to N (Table 2).

| Table 1. Compost Quality Organic Fertilizers at Each Treatment |
|------------|----------------|----------------|
| No | Parameters | organic fertilizer without bio-starter | Organic fertilizer with bio-starter |
| 1 | Smell | Smelling pungent | |
| 2 | Colour | Brownish black | Brownish black |
| 3 | Texture | solid crumbs | crumbs |
| 4 | Maturity | Less mature | Maturity |

| Table 2. Quality of liquid organic fertilizer |
|------------|----------------|----------------|----------------|----------------|----------------|
| No | Replications | pH | DHL (mmhos/cm) | C. organic(%) | N (Total) | P (ppm) | K (ppm) |
| 1 | 6.2 | 7.50 | 0.97 | 0.04 | 46.80 | 484 |
| 2 | 6.2 | 7.51 | 0.99 | 0.06 | 46.80 | 485.2 |
| 3 | 6.4 | 7.50 | 1.00 | 0.04 | 46.82 | 485.1 |

3.1.2 Hortensia Plant Growth
High parameters and number of plant leaves for each treatment were measured every month for 10 months (Tables 3 and 4). It was shown that the application of organic fertilizer to plants significantly affected the height and number of leaves of hortesia plants (P <0.05).
### Table 3. Hortensia Plant Height

| Treatment | Height (cm) | Month |
|-----------|-------------|-------|
|           |             | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| F0        | 30          | 35    | 40    | 44    | 49    | 54    | 60    | 63    | 69    | 75a*  |       |
| F1        | 30          | 35    | 40    | 45    | 49    | 56    | 61    | 66    | 71    | 78b   |       |
| F2        | 30          | 41    | 45    | 46    | 552   | 58    | 62    | 69    | 73    | 80c   |       |

* Numbers followed by the same letters show no significant difference based on Duncan's Multiple range Test at the level of 5%.

### Table 4. Amount of Leaves Hortensia Plants

| Treatment | Number of leaves | Month |
|-----------|------------------|-------|
|           |                 | 10    | 11    | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    |
| F0        |                 | 10    | 14    | 19    | 24    | 27    | 33    | 40    | 46    | 53    | 59a*  |
| F1        |                 | 10    | 14    | 19    | 25    | 28    | 33    | 41    | 47    | 55    | 63b   |
| F2        |                 | 10    | 14    | 06    | 26    | 30    | 36    | 43    | 49    | 57    | 69c   |

* Numbers followed by the same letters show no significant difference based on Duncan's Multiple range Test at the level of 5%.

### 3.2. Hortensia Flower Production

The results of the study of the number of flowers, flower diameter and flower weight are shown in tables 5 and 6. The relationship between fertilizer and flower weight is shown in Figure 1. The flower colour is shown in figure 2.

### Table 5. Amount of flowers per clump

| Treatment | Amount of flowers | Month |
|-----------|-------------------|-------|
|           |                   | 10    | 11    | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    |
| F0        |                   | 1     | 1     | 1     | 2     | 2a*   | 2     | 3     | 3     | 3a*   |       |
| F1        |                   | 1     | 1     | 2     | 2     | 3b    | 3     | 3     | 4     | 5b    |       |
| F2        |                   | 1     | 2     | 2     | 3     | 3b    | 3     | 4     | 4     | 4b    |       |

* Numbers followed by the same letters show no significant difference based on Duncan's Multiple range Test at the level of 5%.

### Table 6. Diameter of hortensia flower

| Treatment | Diameter (cm) | Month |
|-----------|---------------|-------|
|           |               | 10    | 11    | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    |
| F0        | 18            | 18.5a | 18.9  | 19    | 19.2  | 19.5  | 20    | 20    | 20.1  | 20.3  | 20.3a*|
| F1        | 18            | 18.5a | 19    | 19    | 19.2  | 19.6  | 20.2  | 20.3  | 20.3  | 21    | 21.1b |
| F2        | 18            | 19b   | 19.2  | 19.2  | 19.9  | 20    | 20.3  | 21    | 21    | 22.2  | 22.2c |

* Numbers followed by the same letters show no significant difference based on Duncan's Multiple range Test at the level of 5%.
Table 7. Weight of flowers / clumps

| Treatment | Weight (gram) | Month | | | | | | |
|-----------|--------------|-------|---|---|---|---|---|---|---|
|           | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| F0        | 300 a* | 310 | 315 | 325 | 325 | 327 | 330 | 332 | 334 | 350 |
| F1        | 350b | 352 | 355 | 351 | 560 | 362 | 365 | 356 | 367 | 370 |
| F2        | 397c | 399 | 400 | 410 | 415 | 415 | 430 | 432 | 435 | 435 |

* Numbers followed by the same letters show no significant difference based on Duncan's Multiple range Test at the level of 5%.

Figure 1. Effect of Bio-starter on the weight of flowers / clumps on month 10

Figure 2. The flower of hortensia
The appearance of odour in the treatment of making organic fertilizers without bio-starter due to the lack of decomposer microbes, so that there is an imperfect overhaul [5,6]. The treatment of making organic fertilizer using bio-starter, organic fertilizer that is produced is odourless, with crumb texture and mature maturity level [7]. This is due to the presence of enough microbial decomposers. Organic matter is decomposed by microbes perfectly, considering that the bio-starter added are *Trichoderma* sp, *Aspergillus niger* which is a decomposing microbial cellulose, hemicellulase, lignin etc. [8]. Compost organic fertilizers can also improve the physical, chemical and biological quality of soil [9,10]. Liquid organic fertilizer shows a normal pH of 6.35, a high P and K content is compared to N (Table 2) because the raw material used is from fish waste. The high parameters of P and K are very suitable for plants that produce flowers. While many elements of N are obtained from compost which is made from raw livestock and agricultural waste [11].

The impact of using organic fertilizers on new plants is seen after several months of treatment, this is different from the treatment using synthetic fertilizers, where the results can be seen immediately after several days of fertilization. Data in the field show that plant height was significantly different between controls with organic fertilizer treatment without and with bio-starter at 10 months, as well as the number of leaves significantly different between the two treatments namely organic fertilizer without and with bio-starter (Tables 3 and 4). This is supported by the research of Suriani et al [11; 12], that organic fertilizers with biostats can increase the height and number of local anthurium and rice leaves. Organic fertilizers can also increase the production of anthurium waves of love [13]. Santi [14] showed that compost at a concentration of 30% had a significant effect on the height of tomato plants. Ref. [15,16] stated that liquid organic fertilizer R11 had a significant effect on the number of flower cabbage leaves at a concentration of 2 ml / 0.5 L. Organic fertilizers here were to restore soil fertility, maintain porosity and maintain soil moisture. Another impact is the use of organic fertilizer is safe for the environment because there are no chemical residues left in the environment [17]. According to the high element N can increase the growth of vegetative plants.

The results showed that the hortens flower only produced at month 10 (Table 5). The amount of interest between treatments and controls was not significantly different (P> 0.05%). In the 14th month, the control with F2 treatment showed significantly different (P <0.05%), and in the 19th month between control and treatment showed significantly different (P <0.05%), this is probably due to learning to flower in the 10th month, and in the month of 14 the effect of organic fertilizer has begun to be seen especially for F2 using bio-starter. The influence of organic fertilizer in the relatively long period of time has only seen its influence. While the flower / clump weight among all treatments was significantly different at 10th month (Figure 1; Table 7), while the flower diameter between organic fertilizer treatment and bio-starter with control was significantly different (P <0.05%) in the 11th month, and between control and all treatments were significantly different (P <0.05%) seen in the 19th month (Table 6). Flower colour parameters indicate that between the control and the treatment there is a difference in flower colour. For the treatment of organic fertilizer with a bio-starter, it shows a bright blue green flower colour, the treatment with organic fertilizer without a bio-starter is a rather bright blue green colour, while the control of the green flower colour is pale blue (Figure 2).

This is caused by the influence of organic fertilizer on hortensia plants. Suriani et al [18] states that organic fertilizers with bio-starters can increase the number and diameter of anthurium flowers and provide brighter colours, and can increase grain production in local rice. Hartatik and Widowati [3] stated that organic fertilizers with basic ingredients of manure contain important nutrients, hormones that can stimulate plant growth.

4. Conclusion
The conclusion from the research is that the bio-starter has an effect on the quality of organic fertilizer, and has a significant effect on the growth and production of hortensia (*Hydrangea* sp) flowers.
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