Biotic resistance and rhizobacteria on the growth and yield of selected red onion (*Allium ascalonicum* L.) variety

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Abstract. Red onion has high nutrient and economic value. Onion can grow in both dry and wet season. Currently, we face climate drawbacks such as long rainy seasons and a short dry season due to climate change. This research aims to study the affects of rhizobacteria on the three red onion yield varieties. The research was conducted in Balecatur, Gamping, Sleman, Yogyakarta, Indonesia. The research used a Split Plot Design. The main factor was red onion variety, namely Bima, Biru and Thailand. The sub-factor was Rhizobacteria with a concentration of 0%, 0.75% and 1.5%. The data were analyzed using variance analysis with 5% significance level. The results showed that rhizobacteria increases the growth rate and tolerance index in red onion. Rhizobacteria does not increase yield and red onion yield index. Biru variety was as good as Thailand variety in terms of the number of bulb per plant, weight bulb per plant and yield. Thailand and Biru varieties are suitable in rainy season. Bima variety has the lowest number of bulb per plant, weight bulb per plant, growth rate, yield and yield index.

1. Introduction

Red onion is a horticultural commodity that has a high economic value. Indonesian people consume red onions 4.56 kg per capita per year with a consumption rate of 1.608 million tons per year [1]. This suggests that the demand for red onions rises as population increases. According to Sucipto [2], red onions as a horticultural commodity consumed by many Indonesian people have the potential to be developed in order to fulfill the needs of the country.

In order to improve production, one best way is by utilizing onion variety. Certain onion varieties developed in the special region of Yogyakarta are Bima, Biru and Thailand. The three varieties are grown in lowland area in Yogyakarta region. Bima Red onion variety is cultivated in Bantul district, Yogyakarta, Indonesia. Those varieties are suitable for lowland with a production potential reaching 9.9 tons per hectare [3]. Biru variety is a variety that many farmers cultivate at Kulon Progo district, Yogyakarta, Indonesia. It is a local variety harvested between 55-65 days. The production potential during dry season is 12.5-14.0 tons per hectare while during rainy reason it reaches 10.5-11.5 tons per hectare [4].

Thailand red onion variety was introduced from Thailand. It has been widely planted in Samas, Bantul regency, Yogyakarta Indonesia. Thailand variety is a selected plant type which is adaptable to dry and rainy season. It can live between 52-59 days with 5-15 bulbs number per clump and 5-12 gram
of weight per tuber. Moreover, it has a production potential of 12 -15 tons per hectare [5]. The research was carried out in 2018 at Sleman regency, Yogyakarta Indonesia. It occurred during the long rainy season as caused by climate change. Several red onion varieties cannot be planted in rainy season. So, a selected variety of red onion suitable to rainy season is needed.

Biofertilizer is a fertilizer that uses the basic material of microbial selection meant to help [6]. It was hoped that microbial selection can help red onion to live and yield well in rainy season. It is a biological agent like rhizobacteria. Rhizobacteria as a bacteria that lives in the plant root area [7]. It can be a beneficial for bacteria stimulant in plant growth. In addition, rhizobacteria is also able to provide nutrients and can be a biological controller [8]. According to Maryani [9], plant growth promotes regulator bacteria that includes nitrogen fixation such as Azospirillum, Azotobacter, phosphate-solvent bacteria like Pseudomonas.

### 2. Materials and method

The present research was conducted in Gamping, Sleman, Yogyakarta, Indonesia. The location has a altitude of 150 meter above sea level, with an average rainfall of 2000 to 3000 mm per year, soil pH 5.6-6.0 and inceptisol soil. The research is organized into split plot design [1]. Red onion varieties as the main plot are Bima, Biru and Thailand variety. Microbial concentration as sub-plot is 0.0%, 0.75%, and 1.5%. Microbial elements consist of *Pseudomonas fluorescen* with $10^6$ and *Bacillus polyxima* and $10^6$ in 100ml. Isolate microbial was from laboratory in university in downtown Yogyakarta. Variable observation of red onion includes the age of harvest, number of bulb per plant, weight of bulb per plant and yield. The observation result is used to calculate the sum of growth rate, harvest index and tolerance index. Analysis of variance (ANOVA) and Duncan’s advance test (DMRT) test at $p<0.05$ was performed to analyze the data [8].

### 3. Results and discussions

#### Table 1. Age harvest, number of bulb, bulb weight per plant

| Variables       | Age harvest (day) | Number of bulb (piece) | Bulb weight per plant |
|-----------------|-------------------|------------------------|-----------------------|
| Variety         |                   |                        |                       |
| Bima            | 61.0 a             | 8.3 b                  | 61.1 b                |
| Biru            | 53.0 b             | 11.3 ab                | 67.1 ab               |
| Thailand        | 51.0 c             | 14.3 a                 | 78.3 a                |
| Rhizobacteria   |                   |                        |                       |
| 0%              | 55.0 p             | 9.0 q                  | 58.6 q                |
| 0.75%           | 55.0 p             | 12.0 p                 | 76.9 p                |
| 1.5%            | 55.0 p             | 13.0 p                 | 71.6 p                |
| Average         | 55.0 (-)           | 11.3 (-)               | 68.9 (-)              |

Mean followed by the same letters is not significantly different at $\alpha = 5\%$

Thailand Red onion variety has the shortest age in harvest. Its number of bulb per plant and bulb weight per plant was more than Bima variety (table 1) but having an equal number of bulb per plant and bulb weight per plant compared to Biru variety (table 1). Red onion of Thailand variety provides the sum of growth rate and the highest harvest index reaching 0.36 dan 0.70, followed by Biru variety reaching 0.33 and 0.64 and Bima variety reaches 0.32 and 0.61 (table 2). Variety is genetic [1]. Thailand variety is an introduced variety cultivated in Yogyakarta for it can grow in dry and rainy season [5]. In addition, Thailand red onion variety is too short. Red onion Biru and Bima variety are local varieties but
not suitable in rainy season. There is a dominant red onion variety in Bantul regency, Yogyakarta, Indonesia. In the 2018, it occurred during long rainy season. Due to climate change, Bima red onion variety reaches the lowest numbers of bulb per plant, weight bulb per plant, sum of growth rate, yield and yield index. Biru red onion variety is as good as Thailand variety in terms of the numbers of bulb per plant, weight bulb per plant and yield. Thailand red onion variety is very suitable in rainy season.

Table 2. Sum of growth rate, yield, yield index and tolerance index

| Variables             | Yield (ton ha\(^{-1}\)) | Sum of Growth Rate | Yield Index | Tolerance Index |
|-----------------------|--------------------------|--------------------|-------------|----------------|
| Variety               |                          |                    |             |                |
| Bima                  | 9.64 b                   | 0.3161             | 0.61        |                |
| Biru                  | 12.58 ab                 | 0.3292             | 0.64        |                |
| Thailand              | 13.77 a                  | 0.3547             | 0.70        |                |
| Rhizobacteria         |                          |                    |             |                |
| 0%                    | 11.81 p                  | 0.3161             | 0.64        | 1              |
| 0.75%                 | 11.59 p                  | 0.3292             | 0.65        | 1.19           |
| 1.5%                  | 12.59 p                  | 0.3547             | 0.66        | 1.25           |
| Average               | 12.00 (-)                |                    |             |                |

Mean followed by the same letters is not significantly different at \( \alpha = 5\% \).

The treatment of 1.5% and 0.75% rhizobacteria concentration can increase the number of bulb per plant and bulb weight per plant of red onion. The treatment of 0% rhizobacteria reaches the lowest number of bulb and weight bulb per plant red onion (table 1). Rhizobacteria treatment 1.5% concentration reaches the tolerance under 1.25. This suggests that rhizobacteria can increase plant growth of red onion. The treatment of 0.75% rhizobacteria concentration can increase growth rate of red onion. The treatment of 0.75% rhizobacteria reaches 19.18% and 1.5% rhizobacteria concentration reaches 25.29% (table 2). Rhizobacteria \textit{Pseudomonas fluorescens} and \textit{Bacillus polymixa} are bacteria for plant; so that it can increase plant growth with various mechanism [10]. Rhizobacteria mechanism can increase plant growth among others by producing indole acetic acid (IAA), solvent phosphate, sidefor and enzymes that can degrade cell wall such as cellulose, chitinase, protease [11]. According to Nasib [12], rhizobacteria \textit{Bacillus Sp}, \textit{Serratia sp}, and \textit{Pseudomonas fluorescens} are able to produce plant growth hormone such as indole acetic acid. Kumar et al. [13] state that \textit{Pseudomonas sp} can produce indole acetic acid of 44.40-95.60 µg ml\(^{-1}\). Egamberdieva [14] claims that \textit{Bacillus Subtilis} produces indole acetic acid. According to Shohri and Entiazi [15], some of bacteria in plant rhizosphere can produce indol acetic and indol acetic acid. Indole acetic acid may affect the cell wall width, cell extension and cell division [8].

4. Conclusion

This present research was carried out in 2018 during the long rainy season due to climate change. Biru red onion variety is as good as Thailand variety in terms of the numbers of bulb per plant, weight bulb per plant and yield. Thailand and Biru red onion varieties are suitable in rainy season. Bima red onion variety has the lowest numbers of bulb per plant, weight bulb per plant, growth rate, yield and yield index. Rhizobacteria increases growth rate and tolerance index of red onion to survive in rainy season due to climate change.

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Acknowledgement
The authors are indebted to the ministry of Sarjanawiyata Tamansiswa University, Yogyakarta, Indonesia.