Studies on Cultivation of Several Varieties of Onion (*Allium ascalonicum* L.) under Plastic Shade during Rainy Season in Jakarta

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Abstract. Onion (*Allium ascalonicum* L.) cultivation in Indonesia at the rainy season may affect the productivity which impacted on the price value fluctuation. Therefore, it was necessary to determine the best onion cultivation technology during the rainy season. This research was conducted to determine the effect of plastic shade on the growth and yield of several onion varieties during the rainy season in Jakarta. The study was conducted at Jakarta Assessment Institute for Agricultural Technology (Jakarta AIAT), from November 2018 to February 2019. The research arranged as a split plot design with two factors and four replications. The first factor was the plastic shade utilization, while the second factor was the onion varieties, namely Mentes, Bima and Trisula varieties. The results showed that the treatment without using a plastic shade provided the best effect on plant height parameters at 63 day after planting (42.57 cm). The number of tubers / plants with an average of 9.33 tubers. Wet weight / average plant 41.31g. Diameter / average tuber of 18.85 mm. The treatment of varieties showed that the best average height was obtained by Bima variety (40.55 cm) at 56 days. The mean number of leaves of Mentes and Bima varieties was 63 days after planting (26.75 and 25.37 pieces). The highest number of tubers / plants was found in the Mentes variety (9.87 tubers), the best compared to Bima and Trisula. Meanwhile, the mean wet weight of Bima variety (31.59 gr) was not significantly different from the wet weight of Mentes and Trisula varieties.

1. Introduction

Onion (*Allium ascalonicum* L.) is a horticultural commodity that is widely consumed by the public as a mixture of cooking spices after chilies [1]. Besides that, the onion commodity also contributes quite a lot to the regional economy, a source of income and opens up opportunities and jobs, [2]. The harvested area of onion was 122,126 ha in 2015 and has been increased into 149,635 ha in 2016. On the other hand, the onion productivity has been decreased from 10.07 tons / ha into 9.67 tons / ha [3].

The unstable productivity leads to fluctuating price of onion. Several factors that influenced the onion productivity were the use of superior varieties and offseason planting time. Each region has adaptive varieties to be developed in each region. Several varieties adaptable to developed in the lowlands, including Bima, Trisula and Mentes varieties [4]. Trisula variety has a potential yield of 23.21 tons / ha, the shelf life reached 5 months, and harvested at 55 days [5]. This onion variety can be
cultivated either in the dry season or the rainy season (20 tons/ha) [6]. Bima variety can be harvested at age of 60 days, with production may reach 10 tons/ha [7]. The Bima Brebes variety genetically appeared to be more competitive on utilizing nutrients, water and sunlight for bulbs development [8]. The harvesting time is approximately 58 days, with potential production ranging from 10 to 27.58 tons/ha, and the shelf life of 3 to 4 months [7]. Some factors that influence the growth and production were the interaction of genetic factors with supporting environmental factors. The height of the Mentes variety can reach 42.07 cm with 8-12 tillers per clump [9].

Besides varieties, microclimate management may affect the growth and yield of onion as well. According to [2], the use of tunnels during the rainy season was expected to prevent diseases, pests attack, and diminish rainwater intensity that can damage shallot plants. Adequate sun intensity was required for optimal growth of onion. Inadequate sun intensity during the rainy season related to the increase of pests attack which leads to lots of insecticides application. Furthermore, inadequate sun intensity affects on the decrease of onion production which lead to high price of onion.

Several studies on shallot cultivation during the rainy season have been carried out, including the tunnel system, as conducted by [10], that the tunnel system effectively prevented the rainwater and pests attack or reduced the use of pesticides and increase the temperature at night. Moreover, [11] stated that the usage of transparent plastic tunnel and plant density had a significant effect on the growth and yield of onion bulbs from seeds. [12] reported that the plastic tunnel system on Palu Valley variety can increase the number of leaves and the wet weight of bulbs. Similarly to [13], the plastic tunnel system was able to increase the number of leaves in Napu variety. Correspondingly to [14], the ways to improve the flowering system in onion, it is necessary to provide transparent plastic shading, reduce spacing, and bulbs selection. The tunnel system affects on relatively stable production among seasons and makes the selling price during off season better. [15] stated that the farmers who conducted the onion cultivation during off season, they can manage the microclimate by using plastic tunnel. Based on this information, research was conducted to determine the effect of plastic shade on the growth and yield of several onion varieties in the Jakarta area during the rainy season.

2. Materials and Methods
The research was conducted at Jakarta AIAT, from November 2018 to February 2019. The materials used in this study were soil, chicken manure, NPK 16:16:16, TSP, Bima, Mentes and Trisula varieties of onion bulbs, Bioprotector, Antracol, Dithane, and Score. The study was designed as a separate plot consisting of two factors, namely 1). The plastic shade, utilization i.e. (S): without plastic shade (S1) and with plastic shade (S2). The second factor is varieties of onion (V), namely Mentes (V1), Bima (V2), and Trisula (V3). Each of the six treatments was repeated 4 times resulting in 24 experimental units. Parameters observed were plant height (cm), number of leaves (strands), number of bulbs per plant (tubers), bulbs wet weight per plant (g), diameter per bulbs (mm).

3. Results and Discussion
3.1. General Condition
The onion bulbs used in the study originally from the Indonesian Vegetables Research Institute (IVEGRI). In the first week after planting, the growth percentage of Bima and Trisula varieties reached 90%. At the age of 33 days, the growth of the Trisula variety seemed more compact and synchronous compared to Bima and Mentes varieties, and the plants had formed the bulbs. Harvesting time was conducted at 70 days. Weed control started at 7 days old. During the research period, rainfall intensity was between 203 and 229 mm / month, categorized on the moderate to high scale, which resulted in the plants easily collapsed and broken, and yellowing at the edge of the leaves (Phytophthora porent). The carrier of the disease was Conidium on the soil splashes that were exposed to rainwater and powdery mildew in the morning. Therefore, it is recommended to rinse the plants by spraying water either after the rain or in the morning, before the sun rises. The onion without plastic shade looked healthier and stronger, compared to the plants with use plastic shade use. Meanwhile, almost half of the plant under the plastic shade got yellowish part at the edge of their leaves.

3.2. The recapitulation results of variance
In Table 1, the results of the variance recapitulation of plastic shade utilization and onion variety treatments, toward plant height (cm), number of leaves (strands), number of tubers (tubers), tuber diameter (mm), wet weight (g), and dry weight (g) were presented. The tunnel affected significantly on the plant height at 14, 35, 42, 49, 56, and 63 day after planting. The onion varieties had a significant effect on plant height at the age of 35, 42, 49, and 56 day after planting, as well as on increasing the number of leaves at the age of 49, 56, and 63 day after planting. The onion varieties resulted in a significantly different number of bulbs at harvest time; even the plastic shade treatment resulted in highly significant different number of bulbs, as well as the bulb diameter and the wet weight of bulbs at harvest time.

| No | Parameters               | Day after planting | Treatments      | CD (%)         |
|----|--------------------------|--------------------|-----------------|----------------|
|    |                          |                    | S   | V  | (S*V) | S  | V   |
| 1  | Plant Height (cm)        | 14                | *   | NS | NS    | 6.91| 13.21|
|    |                          | 21                | NS  | NS | NS    | 12.42| 14.44|
|    |                          | 28                | NS  | NS | NS    | 6.04| 13.15|
|    |                          | 35                | *   | *  | NS    | 6.61| 8.71 |
|    |                          | 42                | *   | ** | NS    | 9.17| 7.39 |
|    |                          | 49                | *   | ** | NS    | 9.51| 7.29 |
|    |                          | 56                | *   | NS | NS    | 7.92| 6.88 |
|    |                          | 63                | **  | NS | NS    | 8.21| 7.16 |
| 2  | Number of Leaves (Strand)| 14                | NS  | NS | NS    | 10.18| 19.78|
|    |                          | 21                | NS  | NS | NS    | 11.29| 19.05|
|    |                          | 28                | NS  | NS | NS    | 8.52| 17.01|
|    |                          | 35                | NS  | NS | NS    | 9.06| 18.5 |
|    |                          | 42                | NS  | NS | NS    | 9.52| 14.87|
|    |                          | 49                | NS  | *  | NS    | 8.03| 12.16|
|    |                          | 56                | NS  | *  | NS    | 12.49| 15.66|
|    |                          | 63                | NS  | *  | NS    | 9.25| 17.04|
| 3  | Bulbs Number/Plant       | 70                | *   | ** | NS    | 11.75| 15.73|
| 4  | Wet Bulbs Weight/Plant (g)| 70              | **  | NS | NS    | 13.73| 13.58|
| 5  | Bulbs Diameter (mm)      | 70                | *   | *  | NS    | 13.75| 10.46|

Notes: **: Highly significant at the 1% level
*: Significant at the 5% level
NS: Has no significant effect
CD: Coefficient of Diversity
S: Plastic shade utilization
V: Onion Variety

3.3. Plant height (cm)

Plant height is one of the components that affect the growth and yield of onion. The results of variance (Table 2) showed that there was no interaction between the plastic shade utilization on several shallot varieties. The plastic shade and onion variety treatment responded on the growth and yield in shallot plants. The plant without plastic shade yielded a better plant height and significantly different than using plastic shade, at the ages of 14, 35, 42, 49, 56, and 63 day after planting. The plant height without plastic shade at the age of 63 day after planting was 42.67 cm, resulted in the highest plant compared to the plant height with the plastic shade system (34.56 cm).
The results showed that there is no interaction between the plastic shade utilization and varieties of onion. The effect of plastic shade utilization on the average number of leaves of several onion varieties presented in Table 3. Each treatment has different effect on each type of variety. The number of leaves among onion varieties were significantly different at the age of 49, 56 and 63 day after planting, with the highest number of leaves obtained by Mentes variety (31.87) at the age of 49 week after planting, significantly different at the age of 49, 56 and 63 day after planting. All sunlight hitting the surface of the ground. Therefore, the intensity of the sunlight is greatly reduced. Photosynthesis activities occur during the day. The higher intensity of the light was absorbed by plants, which lead to restrain of photosynthesis process. If the plant experiences drought, the leaves' stomata will be closed, affecting improperly photosynthesis. The results of [17] showed that the sufficient rainfall and high humidity lead to the diseases development in onion, including anthracnose caused by Colletotrichum sp., Alternaria porri or purple spot disease/trotol, edge leaf rot, peronospora destructor (Indonesia: embun buluk), and rot leaf at the age of 6 week after planting [18].

3.4. Number of leaves (strands)

The results showed that there is no interaction between the plastic shade utilization and varieties of onion. The effect of plastic shade utilization on the average number of leaves of several onion varieties presented in Table 3.
compared to Bima and Trisula varieties. According to [19], the growth of shaded onion plants was not optimal, because the photosynthesis process was sub optimum. [20] reported that the number of leaves influenced on the number of bulbs produced. The optimum intensity of sunlight accelerates the rate of photosynthesis, which resulted in optimum plant growth and yields. Similarly, [21] stated that with high rainfall intensity and lack of sunlight, the moisture content of vegetation under the plastic shade can be increased, lead to the increased accumulation of dry matter and the leaves will experienced aging faster.

### Table 3. The effect of plastic shade on the leaves number of several onion varieties (strands)

| Day after planting | Treatment       | Variety | Average |
|-------------------|-----------------|---------|---------|
|                   |                 | V1 (Mentes) | V2 (Bima) | V3 (Trisula) |       |
| 14                | S0 (Without Plastic Shade) | 11.5 | 10.75 | 10 | 10.75 |
|                   | S1 (With Plastic Shade)  | 11.5 | 11 | 8.5 | 10.33 |
| Average           |                 | 11.5 | 10.87 | 9.25 |       |
| 21                | S0 (Without Plastic Shade) | 17.5 | 17.25 | 15 | 16.58 |
|                   | S1 (With Plastic Shade)  | 19 | 18 | 14.25 | 17.08 |
| Average           |                 | 18.25 | 17.62 | 14.62 |       |
| 28                | S0 (Without Plastic Shade) | 22.5 | 22 | 20 | 21.5 |
|                   | S1 (With Plastic Shade)  | 23 | 21.25 | 18.75 | 21 |
| Average           |                 | 22.75 | 21.62 | 19.37 |       |
| 35                | S0 (Without Plastic Shade) | 29.75 | 28.5 | 25 | 27.75 |
|                   | S1 (With Plastic Shade)  | 30.25 | 26.75 | 24 | 27 |
| Average           |                 | 30 | 27.62 | 24.5 |       |
| 42                | S0 (Without Plastic Shade) | 32.5 | 28 | 27.5 | 29.33 |
|                   | S1 (With Plastic Shade)  | 30 | 28.5 | 25.5 | 28 |
| Average           |                 | 31.25 | 28.25 | 26.5 |       |
| 49                | S0 (Without Plastic Shade) | 30.25 | 29.75 | 27.50 | 29.17 |
|                   | S1 (With Plastic Shade)  | 33.50 | 29.00 | 26.00 | 29.50 |
| Average           |                 | 31.8 a | 29.37 b | 26.75 c |       |
| 56                | S0 (Without Plastic Shade) | 28.25 | 26.25 | 19.50 | 2.67 |
|                   | S1 (With Plastic Shade)  | 25.25 | 25.75 | 21.25 | 24.08 |
| Average           |                 | 26.75 a | 26.00 a | 30.37 b |       |
| 63                | S0 (Without Plastic Shade) | 28.50 | 25.00 | 19.50 | 24.33 |
|                   | S1 (With Plastic Shade)  | 25.00 | 25.5 | 21.25 | 24.00 |
| Average           |                 | 26.75 a | 25.37 a | 20.37 b |       |

Notes: Numbers followed by different letter at each row were significantly different at P=0.05

### 3.5. Number of bulbs / plant (bulbs)

The results showed no interaction between the plastic shade utilization on the 3 varieties of onion with the number of bulbs. Without plastic shade, the number of bulbs was 9.33, much more than with plastic shade (7.01). Of the three varieties, Mentes variety produced more bulbs (9.87) than Bima and Trisula varieties (Table 4).

### Table 4. The effect of using plastic shade on the bulbs number of several onion varieties (bulbs)

| Tunnel Treatment       | Variety | Average |
|------------------------|---------|---------|
|                        | V1 (Mentes) | V2 (Bima) | V3 (Trisula) |       |
| S0 (Without Plastic Shade) | 11.25 | 9.50 | 7.25 | 9.33 a |
| S1 (With Plastic Shade)  | 8.50 | 6.00 | 6.75 | 7.01 b |
| Average                | 9.87 a | 7.75 b | 7.00 b |       |

Notes: Numbers followed by different letter at each row were significantly different at P=0.05
[22], states that shallot bulbs are formed from a layer of leaves that develop into one bulb. In the tuber production process, sufficient sunlight is needed. According to [20], the onion was a plant that has long days, particularly on the process of bulbs production. Onion bulbs were continued to develop and enlarge and then formed the tillers. If the length of the day is sub optimum, then only a few numbers of bulbs will be produced and small in size.

### 3.6. Wet weight of bulbs / plant (g)

Based on the results of the variance, it shows that there was no interaction between the use of plastic shade and varieties on the wet weight of bulbs. In Table 5, it shows that the onion plants without plastic shade produced a higher wet / plant weight (41.31 g) compared to the onion plants using plastic shade (17.55 g).

Table 5. The Effect of plastic shade on wet weight of several onion varieties

| Tunnel Treatment   | Variety | Average |
|--------------------|---------|---------|
|                    | V1 (Mentes) | V2 (Bima) | V3 (Trisula) |
| S0 (Without Plastic Shade) | 50.56 | 46.55 | 36.83 | 41.31a |
| S1 (With Plastic Shade) | 19.39 | 16.64 | 16.62 | 17.55b |
| Average            | 29.98 | 31.59 | 26.73 |

Notes: Numbers followed by different letter at each row were significantly different at \( P=0.05 \)

The low weight of wet tubers is caused by the need for sunlight when the growth is very lacking, so that plant growth is disrupted and the wet weight obtained is also less than optimal. According to [19], onion required high intensity of radiation, since vegetative growth until flower formation and harvest time. In addition, [23] described that the water availability, air humidity, CO2, light and temperature greatly influenced on the formation of onion bulbs. Also, [24], the formation of shallot bulbs is strongly influenced by genetic, environmental and technical factors of cultivation.

According to [14] environmental conditions greatly affect the growth and weight of fresh bulbs. In the highlands, the treatment of providing plastic shade from planting to harvest can increase plant growth and ultimately increase bulbs weight, compared to without using plastic shade. The plant's response was very positive to plastic shade treatment, as it protects from heavy rainfall and strong winds. Providing shade provides a better microclimate environment for the growth of seed-derived bulbs, because the environment becomes warmer, the air temperature increases, the photosynthesis rate and the growth rate also increase.

### 3.7. Diameter /bulbs (mm)

There was no interaction between the use of plastic shade and onion varieties on bulbs diameter. In Table 6, it can be seen that the use of the plastic shade resulted in a smaller bulb diameter (15.06 mm) than without the plastic shade (18.85 mm). The diameter of the bulb of the Bima variety (18.45 mm) was higher than Trisulla (16.50 mm) and Mentes (15.90 mm) varieties. Besides the number and weight of onion bulbs, the diameter of bulbs / plants was also influenced by the intensity of sunlight. Not only the quality of planting media and maintenance factors, the requirement of sunlight was essential for plant growth and development. In the onion plantation with plastic shade, the requirement of sunlight intensity was fulfilled insufficiently, lead to the yellowish leaves and affected greatly on the diameter of onion bulbs.

Table 6. The effect of using plastic shade on bulbs diameter (mm) of several onion plant varieties

| Tunnel Treatment | Variety | Average |
|------------------|---------|---------|
|                  | V1 (Mentes) | V2 (Bima) | V3 (Trisula) |
| S0 (Without Plastic Shade) | 17.80 | 20.34 | 18.40 | 18.85a |
| S1 (With Plastic Shade) | 14.00 | 16.56 | 14.61 | 15.06b |
| Average          | 15.90c | 18.45a | 16.50b |

Notes: Numbers followed by different letter at each row were significantly different at \( P=0.05 \)
[16] stated that fruit formation in plants requires full light intensity. Thus, the covered plants will get less light intensity, because the percentage of light that enters the plastic cover will be reflected back into the atmosphere, the light intensity absorbed by the plants was partial, and inhibit the photosynthesis process. In addition, according to [25], besides sunlight intensity, bulb diameter was also greatly influenced by genetic factors of onion varieties. [1] said that the bulbs which formed from each variety certainly had different number of bulbs, because each variety was a combination results of genetic and environmental factors. Thus, the appearance of each variety varied greatly. [25] added that the weight loss among varieties will certainly different. There were large, medium and small bulbs, as well as the color and aroma of each variety will be different. It was probably because plant genotype was determined by interactions between genetic varieties and the environment.

![Image of onion varieties with and without plastic shade]

**Figure 1.** Performance of three onion varieties with plastic shade (sungkup) and without plastic shade system (tanpa sungkup) (Documentation by Oktanurviani, 2019)

### 4. Conclusion

The results showed that the treatment without using a plastic shade provided the best effect on plant height parameters at 63 day after planting (42.57 cm). The number of tubers / plants with an average of 9.33 tubers. Wet weight / average plant 41.31g. Diameter / average tuber of 18.85 mm.

The treatment of varieties showed that the best average height was obtained by Bima variety (40.55 cm) at 56 days. The mean number of leaves of Mentes and Bima varieties was 63 days after planting (26.75 and 25.37 pieces). The highest number of tubers / plants was found in the Mentes variety (9.87 pieces).
tubers), the best compared to Bima and Trisula. Meanwhile, the mean wet weight of Bima variety (31.59 gr) was not significantly different from the wet weight of Mentes and Trisula varieties.

During the rainy season, the utilization of tunnel was not required; otherwise the plant management including providing additional air holes, rinse the plants after the rain, application of bioprotector, making space among polybags, and improving the planting media. The utilization of chemical fungicides was the last option.

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