Effect of drought stress and mycorrhizal dose on growth and yield of maize (*Zea mays* L.)

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Abstract. This study aims to determine the effect of drought stress and mycorrhizal dose on the growth and yield of maize (*Zea mays* L.). The research was done in the BPPT Banten Screen House and the Soil and Climate Laboratory of the Faculty of Agriculture, Sultan Ageng Tritayasa University starts from November 2020 until February 2021. This study used a factorial randomized block design (RBD) consisting of two factors. First factor was drought stress with four levels, namely k1 (100% FC), k2 (80% FC), k3 (60% FC), and k4 (40% FC) and second was the mycorrhizal dose with 3 levels, called m0 (0 g/pot), m1 (10 g/pot), and m2 (20 g/pot). There were 12 treatment combinations that were repeated 3 times in order to obtain 36 experimental units. The results showed that the drought stress treatment had a significant effect on maize plant height at 7 WAP of 174.22 cm, plant dry weight of 86.67 g, root dry weight of 21.67 g, and seed dry weight of 37 g. Drought stress of 40% FC can reduce the growth and yield of maize. The mycorrhizal dose treatment had no significant effect on the growth and yield of maize. The application of mycorrhizal dose of 20 g/pot tends to increase the growth and yield of maize. There was no interaction between drought stress treatment and mycorrhizal dose on growth and yield of maize.

1. Introduction
Maize is one of the agricultural commodities that has an important role in the agricultural sector because it is needed in the supply of food, animal feed and industrial needs [1]. Maize cropping conditions with low rainfall intensity can increase the risk of water shortages in maize plantations, so that it can cause a decrease in production.

Maize production in Banten is low due to the long and erratic dry season so that maize lack water supply which can inhibit growth and reduce crop yields. According [2] that drought stress has a complex effect on plant growth. Morphologically and physiologically the effect of water stress can be seen in the appearance of leaf area, leaf emergence speed, CO₂ assimilation activity, opening and closing of stomata, seed growth rate and seed filling. According [3] that the increasing level of water drought with water availability of 40% and 20% KL in maize shows a significant decrease in plant organs in vegetative organs (plant height, leaves, and roots) and reproductive organs (cobs and seeds).

One of the efforts to overcome drought stress in plants is the use of biological fertilizers such as mycorrhizae. These mycorrhizae are used as biofertilizers to increase plant growth and the availability of nutrients in the soil. Besides being able to help absorb water and nutrients, mycorrhizal fungi can also increase plant resistance to disease. According to the research results of [4] that application of
mycorrhizal fertilizer in marginal dry land can give the best effect on the weight of the cob (106.54 g/plant), the length of the cob (13.14 cm/plant) and the yield of up to 6.08 tons/hectare. This study aimed to determine the effect of drought stress and mycorrhizal dose on the growth and yield of maize (Zea mays L.).

2. Materials and methods
This research was conducted at the Green House BPTP Banten and Soil and Climatology Laboratory, Faculty of Agriculture, University of Sultan Ageng Tirtayasa. This research starts from November 2020 to February 2021.

The tools used in this study were pots, digital scales, Chlorophyll Meter SPAD-502, oven, microscope and meter measurement. The materials used in this research are water, maize seed of Bisi 2 variety, mycorrhizal fertilizer, soil, insecticide, Urea fertilizer, TSP and KCl. The environmental design used was a randomized block design consisting of two factors and three replications. The first factor is drought stress and the second factor is mycorrhizal dose. The grouping is based on the condition of the experimental land used, which is not homogeneous in sunlight.

This experiment consisted of two factors, namely the first factor was drought stress (K) consisting of 4 levels, namely: k1: 100% FC (Field Capacity); k2: 80% KL; k3: 60% KL; k4: 40% KL. The second factor is mycorrhizal dose (m) consisting of 3 levels, namely: m0: 0 g/pot; m1:10 g/pot; m2: 20 g/pot. Thus obtained 12 treatment combinations. Each treatment combination was repeated 3 times to obtain 36 experimental units. Parameters observed were plant height, number of leaves, leaf area, Leaf chlorophyll content, number of stomata, root length, plant dry weight, dry seed weight, and 100 seed weight.

3. Results and discussion
3.1. Plant height
Based on Table 1 shows that the drought stress treatment had a significant effect when the plants were 7 WAP (Weeks After Planting). Mycorrhizal dose treatment had no effect on plant age 7 WAP. There was no interaction between the two treatments. Drought stress level of 100% FC showed a better average plant height of 174.22 cm. [5] stated that that the drought stress condition in phase vegetative can reduce plant height. Giving a dose of mycorrhizal 20 g/pot was able to produce a better plant height than the other treatments, namely 163.42 cm. The treatment of drought stress and mycorrhizal dose did not show any interaction between the two treatments, this was presumably because the nutrients had been sufficient for the plant's need so that there was no visible difference between the level of drought stress and the mycorrhizal dose treatment. In addition, the positive fungi contained in mycorrhizal fertilizers have not been able to adapt well to the roots of maize.

| Plant Age (WAP) | Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------|-----------------------|--------------------------|---------|
|                 | 0                     | 10                       | 20      |
| 7               | 100                   | 183.33                   | 155.67  | 183.67 | 174.22 a |
| 80              | 159.00                | 167.33                   | 167.33  | 164.56 b |
| 60              | 141.33                | 146.33                   | 165.00  | 150.89 c |
| 40              | 129.67                | 121.00                   | 137.67  | 129.44 d |
| Average         | 153.33                | 147.58                   | 163.42  |

Note: Numbers followed by the same lowercase letter in the same column show no difference according to the DMRT test at the 5% level.
3.2. Number of leaves

Table 2 shows that the drought stress treatment had no effect when the plants were 7 WAP. The provision of 100% FC water showed that the number of leaves was more than the other treatments. Drought stress causes fewer leaves. According [6] stated that drought stress causes a small number of leaves due to growth disorders and plant mechanisms adapting to leaf loss to reduce large water losses. Mycorrhizal dose treatment and the interaction between the two had no significant effect. The mycorrhizal dose treatment had no effect, presumably because the positive fungi contained in mycorrhizal fertilizer had not been able to adapt to the roots of maize. Fungi are unable to adapt due to environmental factors such as unfavorable temperature and humidity. This is in accordance with the opinion of [7] which states that the application of biological fertilizers does not have a real effect due to environmental factors, such as high temperatures with low humidity making microorganisms unable to grow. [8] stated that microbial growth in the field can be influenced by several factors, namely nutrition, temperature, pH, oxygen and also competition between indigenous soils.

Table 2. Average number of leaves of maize with drought stress treatment and mycorrhizal dose.

| Plant Age (WAP) | Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------|-----------------------|--------------------------|---------|
|                 |                       | 0 | 10 | 20 |           |
| 7               | 100                   | 10.00 | 11.00 | 10.67 | 10.56 |
|                 | 80                    | 11.00 | 9.67  | 10.00 | 10.22 |
|                 | 60                    | 10.67 | 10.00 | 11.00 | 10.56 |
|                 | 40                    | 9.67  | 10.67 | 11.00 | 10.44 |
| Average         |                       | 10.33 | 10.33 | 10.67 |         |

3.3. Leaf area

Table 3 shows that the drought stress treatment had no significant effect on leaf area. Drought stress of 40% FC can reduce the leaf area of maize. Leaves can produce photosynthate products which are determined by productivity per unit leaf area and total leaf area. In the vegetative phase, water and nutrients are needed by plants to increase leaf area. According [9] which states that mineral nutrients and air availability affect the growth of leaf area, especially expanding cells. The treatment of mycorrhizal doses had no significant effect because the positive fungi contained in mycorrhizal fertilizers had not been able to adapt to the roots of maize. There was no interaction between drought stress treatment and mycorrhizal dose on leaf area of maize plant. This is presumably because the positive fungi have not been able to develop with environmental conditions in the screen house, because the temperature in the screen house is very hot and the fungus cannot reproduce at high temperatures. According [10] the presence of AMF (Arbuscular Mycorrhizal Fungi) spores is influenced by the temperature in the environment. The optimum temperature for good growth for forming mycorrhizal fungi in symbiosis with host plants in the soil is between 20°C - 30°C.

Table 3. Average leaf area of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|--------------------------|---------|
|                       | 0 | 10 | 20 |           |
|                       | 100 | 7699.00 | 7248.67 | 8167.67 | 7705.11 |
|                       | 80  | 7755.33 | 9385.33 | 8013.00 | 8384.56 |
|                       | 60  | 8080.33 | 7377.67 | 8741.33 | 8066.44 |
|                       | 40  | 5765.33 | 5401.33 | 8840.67 | 6669.11 |
| Average               | 7325.00 | 7353.25 | 8440.67 |         |
3.4. Leaf chlorophyll content
Table 4 shows that drought stress treatment had no significant effect on leaf chlorophyll content. The provision of 100% FC water showed a higher leaf chlorophyll content of 22.29 mg cm\(^{-2}\) compared to other treatments. The mycorrhizal dose had no effect on the chlorophyll content of the leaves. There was no interaction between drought stress treatment and mycorrhizal dose on leaf chlorophyll parameters. This is presumably because at the time of leaf sampling in the generative phase, maize were attacked by red mites (\textit{T.urticae}). According [11] that the large population of \textit{T.urticae} mites on leaves is caused by the presence of liquid that the mites prefer as food. In addition, the large population of \textit{T.urticae} on leaves is caused by mites that can take shelter under the broad leaf surface during extreme weather. Mites are more susceptible to hot and dry environmental conditions. Red mite attacks cause spots on the leaves and the leaves turn yellow to brown.

Table 4. Average leaf chlorophyll content of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|----------------------|--------------------------|---------|
|                      | 0                        | 10      | 20      |
|                      | mg cm\(^{-2}\)           |         |         |
| 100                  | 27.30                    | 19.17   | 20.40   | 22.29   |
| 80                   | 15.67                    | 19.83   | 20.47   | 18.66   |
| 60                   | 19.60                    | 18.83   | 13.93   | 17.39   |
| 40                   | 20.47                    | 21.47   | 17.30   | 19.74   |
| Average              | 20.71                    | 19.83   | 18.03   |

3.5. Number of stomata
Table 5 shows that the drought stress treatment had no significant effect on the number of stomata. Water is important in plant physiological processes. Water plays an important role in the processes of photosynthesis and in hydraulic processes. According [12] the availability of water at a normal level will ensure turgor pressure in the guard cell which is related to the process of opening stomata. Mycorrhizal treatment had no significant effect on the number of stomata. The mycorrhizal dose of 10 g/pot showed the number of stomata tended to be better, namely 82.33. Giving mycorrhizae can help in the absorption of nutrients and water so that the rate of photosynthesis of plants increases and plants grow well. there was no interaction between drought stress treatment and mycorrhizal dose on the number of stomata. It is suspected that the attack of red mites during the generative phase made the plants not give a positive response to the treatment given.

Table 5. Average number of stomata of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|----------------------|--------------------------|---------|
|                      | 0                        | 10      | 20      |
|                      |                          |         |         |
| 100                  | 69.67                    | 74.00   | 75.33   | 73.00   |
| 80                   | 71.67                    | 78.00   | 75.00   | 74.89   |
| 60                   | 75.33                    | 82.67   | 92.67   | 83.56   |
| 40                   | 86.00                    | 94.67   | 79.33   | 86.67   |
| Average              | 75.67                    | 82.33   | 80.58   |

3.6. Root length
Table 6 shows that the drought stress treatment did not have a significant effect on root length. The application of 40% FC water showed better root length than the application of 100% FC water. According [13] stated that the root growth of maize that experience drought stress will experience
long root growth and one of the mechanisms of root resistance in response to drought stress conditions. Mycorrhizal dose treatment had no effect on root length. There was no interaction between drought stress and mycorrhizal dose on root length. This is also suspected because the roots of maize are not able to adapt perfectly to mycorrhizal fungi because the microorganisms are not able to work optimally. The combination of drought stress treatment of 40% FC with a mycorrhizal dose of 20 g/pot had a longer root length of 62.00 cm. The role of mycorrhizal fertilizers can help maize plant roots in maintaining plants in drought-stressed conditions. According [14] the development of plant roots with arbuscular mycorrhizae can increase root interception in the absorption of nutrients and water.

### Table 6. Average root length of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|---------------------------|---------|
| 100                   | 0                         | 45.44   |
|                       | 10                        |         |
|                       | 20                        |         |
| 80                    | 49.33                     |         |
|                       | 48.00                     |         |
| 60                    | 42.00                     |         |
|                       | 50.33                     |         |
| 40                    | 54.33                     |         |
|                       | 62.00                     |         |
| Average               | 46.58                     |         |
|                       | 50.92                     |         |
|                       | 51.92                     |         |

3.7. **Plant dry weight**

Drought stress affects the dry weight of maize. The application of 100% FC water showed that the dry weight of the plant was greater than the application of 40% FC water. The higher the drought stress, the lower the dry weight of the plant. Plants that experience drought will cause water stress so that their physiological processes are disrupted because the photosynthesis process is reduced which will reduce plant anabolic reactions. If it occurs continuously, it will affect the dry weight of the plant. In the treatment, the mycorrhizal dose did not significantly affect the dry weight of the plant. There was no interaction between drought stress treatment and mycorrhizal dose. However, giving a dose of 20 g/pot can increase plant dry weight. [15] stated that in drought stress conditions the allocation of photosynthate was greater for the roots than the canopy. An increase in the allocation to the root causes faster root growth thereby increasing the absorption of water and nutrients by expanding the absorption area. Meanwhile, the decrease in the allocation of the canopy causes the growth of the crown to be inhibited, thereby preventing excess water loss from the transpiration process.

### Table 7. Average plant dry weight of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|---------------------------|---------|
| 100                   | 76.67                     | 86.67 a |
|                       | 83.33                     |         |
| 80                    | 65.00                     | 65.56 b |
|                       | 65.00                     |         |
| 60                    | 51.67                     | 52.22 c |
|                       | 41.67                     |         |
| 40                    | 60.00                     | 47.78 c |
|                       | 43.33                     |         |
| Average               | 63.33                     | 67.50   |
|                       | 58.33                     |         |

Note: Numbers followed by the same lowercase letter in the same column show no difference according to the DMRT test at the 5% level.
3.8. Maize cob length
Table 8 shows that drought stress treatment and mycorrhizal dose had no significant effect on ear length. There was no interaction between drought stress and mycorrhizal dose. The treatment with 40% FC water showed that the lowest cob length was 9.94 cm compared to other treatments. According to [3], the drought stress treatment of 40% FC had the shortest cob length yield compared to the 100% FC treatment. Drought stress with a high level of drought can cause damage to generative organ tissue in maize. Drought stress will reduce plant size and reduce the expression of genes related to cell development and division as well as smaller maize cob growth. In addition, the attack of red mites during the generative phase caused the inhibition of the development of maize cobs. This red mite pest in addition to attacking the leaves can also attack the young maize cob hair which causes the maize cob hair to change color to dry brown and the development of the cob stops. According to [16], these red mites appear in dry and hot conditions that can support the survival of red mites. In this study, it has a high temperature of up to 34°C and a low humidity of 60.09%.

Table 8. Average cob length of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|--------------------------|---------|
| 100                   | 0                        | 11.67   |
|                       | 10                       | 13.33   |
|                       | 20                       | 13.17   |
|                       | Average                  | 12.72   |
| 80                    | 0                        | 11.67   |
|                       | 10                       | 11.83   |
|                       | 20                       | 13.00   |
|                       | Average                  | 12.17   |
| 60                    | 0                        | 10.67   |
|                       | 10                       | 10.50   |
|                       | 20                       | 12.67   |
|                       | Average                  | 11.28   |
| 40                    | 0                        | 10.50   |
|                       | 10                       | 9.17    |
|                       | 20                       | 10.17   |
|                       | Average                  | 9.94    |
| Average               |                          | 11.13   |
|                       |                          | 11.21   |
|                       |                          | 12.25   |

3.9. Cob diameter
Based on Table 9, it can be seen that the drought stress treatment and the mycorrhizal dose did not significantly affect the diameter of the cob. There was no interaction between dryness stress and mycorrhizal dose on ear diameter. However, the 100% FC treatment showed a larger cob diameter than the other treatments. The higher the drought stress, the lower the diameter of the maize cobs. Mycorrhizal treatment with a dose of 20 g/pot can increase the diameter of maize cobs was 30.43 mm.

Table 9. Average cob diameter of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|--------------------------|---------|
| 100                   | 0                        | 30.13   |
|                       | 10                       | 31.93   |
|                       | 20                       | 31.27   |
|                       | Average                  | 31.11   |
| 80                    | 0                        | 28.87   |
|                       | 10                       | 29.57   |
|                       | 20                       | 31.20   |
|                       | Average                  | 29.88   |
| 60                    | 0                        | 26.40   |
|                       | 10                       | 29.00   |
|                       | 20                       | 30.13   |
|                       | Average                  | 28.51   |
| 40                    | 0                        | 28.07   |
|                       | 10                       | 25.97   |
|                       | 20                       | 29.10   |
|                       | Average                  | 27.71   |
| Average               |                          | 28.37   |
|                       |                          | 29.12   |
|                       |                          | 30.43   |

3.10. Dry seed weight
Table 10 shows that the drought stress treatment had a significant effect on dry seed weight. Stress treatment of 100% FC and 80% FC showed higher dry weight compared to drought stress of 60% FC and 40% FC. Mycorrhizal dose treatment had no significant effect on dry seed weight. There was no interaction between drought stress treatment and mycorrhizal dose on dry seed weight. According to [17], the decreasing availability of ground water causes a decrease in dry seed weight or the lower
ground water availability decreases dry seed weight. Dry seed weight decreased due to disruption of the filling and seed maturation process during drought stress in the reproductive phase. The mycorrhizal dose of 20 g/pot showed a higher seed dry weight of 31.02 g than without mycorrhizal treatment. The increasing mycorrhizal dose will increase the dry seed weight of maize.

Table 10. Average dry seed weight of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|--------------------------|---------|
| 100                   | 29.60                    | 34.86   | 37.00 a |
| 80                    | 35.13                    | 37.67   | 35.26 a |
| 60                    | 21.98                    | 24.93   | 21.76 b |
| 40                    | 22.49                    | 26.64   | 22.37 b |

Note: Numbers followed by the same lowercase letter in the same column show no difference according to the DMRT test at the 5% level.

3.11. Weight of 100 seeds
Table 11 shows that the drought stress treatment and mycorrhizal dose did not have a significant effect on the weight of 100 seeds. There was no interaction between drought stress treatment and mycorrhizal dose at 100 grain weight. The drought stress treatment of 40% FC tends to show the lowest weight of 100 grains, which is 19.40 g compared other treatments. According [3] that the decrease in biomass of 100 seeds occurred due to the lack of water and mineral nutrients. During the generative phase, the seed filling phase becomes faster, causing the seeds to not be completely filled. Plants that experience drought stress will accelerate their generative phase, including filling the seeds which causes the formation of seeds that are not completely filled. Cob development will stop early so that the seed filling phase is very short and the size of the seeds becomes smaller. The combination of treatment between the drought stress level of 100% FC with a mycorrhizal dose of 20 g/pot showed the best results of 23.78 g. The combination of treatment between drought stress and mycorrhizal doses had no interaction due to the attack of red mites which disrupted plant development.

Table 11. Average weight of 100 seeds of maize with drought stress treatment and mycorrhizal dose.

| Drought stress (% FC) | Mycorrhizal dose (g/pot) | Average |
|-----------------------|--------------------------|---------|
| 100                   | 22.97                    | 23.19   | 23.78   | 23.31   |
| 80                    | 19.71                    | 22.23   | 20.84   | 20.93   |
| 60                    | 19.27                    | 22.49   | 18.30   | 20.02   |
| 40                    | 21.19                    | 20.02   | 16.98   | 19.40   |

Average 20.78 21.98 19.98 4. Conclusions
Drought stress treatment had a significant effect on maize plant height at 7 WAP of 174.22 cm, plant dry weight of 86.67 g, root dry weight of 21.67 g, and seed dry weight of 37 g. Drought stress of 40% FC can reduce the growth and yield of maize. Mycorrhizal dose treatment had no significant effect on the growth and yield of maize. The application of mycorrhizal dose of 20 g/pot tends to increase the growth and yield of maize. There was no interaction between drought stress treatment and mycorrhizal dose on growth and yield of maize.
References

[1] Suwarti R, Efendi, M Azrai, N Tahir 2013 Growth, yield and sensitivity index of maize to waterlogging stress Prosiding Seminar Nasional Serealia pp 169-180

[2] Sinclair R R, Russell C M 2001 System Analysis of Plant Traits to Increase Grain Yield on Limited Water Supplies Agronomy Journal 93 263-270

[3] Sukma K P W, Rachmawati D, Daryono B S 2016 Growth and Production of Maize Crops of Guluk-Guluk Varieties in Drought Jurnal Agrosains 3 297-300

[4] Moelyohadi Y, Harun M U, Munandar M, Hayati R, Gofar N. 2012 Effect of Combination of Organic and Biological Fertilizers on Growth and Production of Maize (Zea mays L.) Lines Results of Nutrient Efficient Selection in Marginal Dry Land Jurnal Lahan Suboptimal 2 100-110

[5] Purwanto, Agustomo T 2010 Study of Physiology of Soybean Plants in Drought Stress Conditions and Various Density of Teki Weeds Agrosains 12 24-28

[6] Saidah L, Nurhati S, Muhibuddin A 2018 The Role of VAM (Vesicular Arbuscular Mycorrhiza) on Photosynthetic Activity and Production of Osmoprotectants in Soybean (Glycine max L.) Plants in Dry Soil Jurnal Sains dan Seni ITS 7 47-52

[7] Septiawan A 2020 Effect of Biofertilizer on Growth and Yield of Soybean (Glycine max L. Merr.) Plants in Drought Stress Skripsi Department of Agroecotechnology Faculty of Agriculture University of Sultan Ageng Tirtayasa

[8] Rifka A 2018 Addition of Various Types of Organic Fertilizers and Biological Fertilizers on Productivity and Quality of Soybean Seed (Glycine max L.) Skripsi IPB

[9] Wulansari H R, Widaryanto E 2017 Response of Sweet Maize (Zea mays saccharata Sturt L.) Plants on Various Types of Mulch Towards Water Supply Levels Jurnal Produksi Tanaman 5 1389-1398

[10] Sianturi R P, Delvian D, Elfiati D 2015 Arbuscular Mycorrhizal Diversity (AMF) in Several Stands in the Arboretum Area, University of North Sumatra Peronema Forestry Science Journal 4 128-138

[11] Pebriani N N, Widaningsih D, Darmiati N N 2018 Population Density and Percentage of Attack of Red Mite Tetranychus urticae Koch (Acarina: Tetranychidae) on Siamese Citrus (Citrus nobilis Lour) Treated with Piridaben Acaricide 135 g/l Jurnal Agroekoteknologi Tropika 7 585-592

[12] Nurshanti D F, Astuti Y, Diana S 2019 The Effect of Water Supply on the Growth and Production of Sweet Maize (Zea mays) Lansium 1 35-43

[13] Ilmawan E, Subaehad S T, Takdir A 2018 Analysis of Genetic Performance of Maize Tolerant to Drought Stress in Rainfed Rice Fields Jurnal Ilmiah Ilmu Pertanian 2 39-47

[14] Valentine K, Herlina N, Aini N 2017 Effect of Giving Mycorrhizae and Trichoderma sp. on the Growth and Yield of Hybrid Melon Seed Production (Cucumis melo L.) Jurnal Produksi Tanaman 5 1085-1092

[15] Medina V, Laliberte B 2017 A Review of Research on The Effects of Drought and Temperature Stress and Increased CO₂ on Theobroma Cacao L., and The Role of Genetic Diversity to Address Climate Change. San Jose (CR): Biodiversity International

[16] Sari K, Pramudianto 2016 Red Mite (Tetranychus urticae Koch) on Cassava and how to control it Bulletin Palawija 14 36-48

[17] Rusmana, Rohmawati I, Ritawati, S 2019 The Response of Three Soy Varieties to Drought During the Reproductive Phase Prosiding Seminar Nasional Agroteknologi Universitas Islam Negeri Sunan Gunung Djati Bandung