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Application Cow Manure and Mychorriza to Physiological of Biduri (*Calotropis gigantea*)

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Abstract

Biduri (*Calotropis gigantea*) is a wild plant with many health and textile benefits. In the health sector, biduri is used as a herbal plant, while in the textile industry, used as the primary raw material. Biduri could be used as a substitute for kapok as the primary raw material. Therefore it is necessary to develop cultivation technology to meet the needs. This study aims to determine the effect of the application of Cow Manure and Mychorriza on the Physiology of Biduri (*C. gigantea*). The research was conducted in a laboratory at the UNS of Agriculture, Karanganyar using a factorial Randomized Complete Block Design (RCBD), which consisted of two factors: cow dung fertilizer and mycorrhizae. Cow dung fertilizer consists of 0 t/ha, 10 t/ha, and 20 t/ha. Mycorrhizae consisted of 0 grams/plant, 5 grams/plant, 10 grams/plant, and 15 grams/plant. Thirty-six unit combinations consisted of 12 treatment combinations repeated three times. The interaction between cow dung has no significant effect on all observed physiological variables. Results showed that applying 20 t/ha of cow dung fertilizer gave the best results on the width of stomata openings, the rate of photosynthesis, and the rate of transpiration. Inoculation with mycorrhizal fungi had no significant effect on all observations of physiological variables.

Keywords: *Calotropis gigantea*; cow manure; mycorrhiza; physiological

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Introduction

Biduri (*Calotropis gigantea*) is a weed that includes medicinal plants. All parts of this plant have benefits, including a wound-healing drug, dizziness, and asthma. Another use of biduri is the prime material in the industry of textile. (1) revealed that the biduri can produce fine fibers that can be processed into the prime material for the industry of textiles obtained from the bark. The fiber produced by biduri is sturdy and stiff. Biduri can be used as a substitute for kapok as the prime material for the industry of textile due to the low production of kapok. According to (2), based on 2018 BPS data, the national kapok production is only 500 tons/ha. Due to the lower output of the kapok that is considered unable to meet the needs of the national kapok, it is necessary to produce a substitute for the kapok. (3) added that biduri can produce 3.676 tons/ha/year of fiber, which can substitute the national demand for kapok.

Biduri has lots of potentials, but farmers need to cultivate it properly. The efforts to increase the availability of biduri are by applying sustainable and well technology or cultivation methods. This can be realized by not applying inorganic fertilizers to the growing media. Various studies have been conducted on the use of biduri in the pharmaceutical and textile fields. Still, these studies have yet to reveal many aspects of plant cultivation to increase growth. Thus it is necessary to know several factors that can be used to improve the development and availability of biduri.

Cow dung and mycorrhizae have potential in biduri cultivation technology. According to (4), using cow dung can increase microbial activity and improve the bacteria in the soil. Soil microbes or mycorrhizae have essential benefits for plants. According to (5), mycorrhizae can expand the system of the root. The addition of cow dung and mycorrhiza is expected to increase the growth of biduri. Therefore, this research has to be carried out with the aim is to determine the effect of the application of Cow Manure and Mychorriza on the Physiology of Biduri (*C. gigantea*).

Materials and Methods

The research was performed from March until October 2021 at the Jumantiono Field Laboratory of the Faculty of Agriculture UNS, Karanganyar. The design used was a factorial Randomized Complete Block Design (RCBD). There are two treatment factors, namely cow dung fertilizer and mycorrhizae. Cow dung fertilizer consists of 0 t/ha (control), 10 t/ha, and 20 t/ha. Mycorrhizae consisted of 0 grams/plant (control), 5 grams/plant, 10 grams/plant, and 15 grams/plant. 36 treatment combinations consisted of 12 treatment combinations repeated three times. Observations consisted of physiological observations, namely the number of stomata, the width of the stomata opening, the rate of photosynthesis, the rate of transpiration, the greenness of the leaves, and the light intensity.

The research includes seed seeding, land preparation, paranet installation, media preparation, transplanting, observation, and pest control. Data were analyzed by ANOVA and DMRT 5% degree.

Result and Discussion

Light intensity

Light intensity is the energy received by plants measured using a lux meter. The light intensity in this study was measured from the top and bottom of the plant. Based on the various test of cow dung, mycorrhizae, and their combinations have no significant effect on the light intensity.

Table 1. The effects of cow dung on light intensity (Lux) at 14 WAP

Fertilizer dose	Light Intensity (Lux)
0 ton/ha	0.84
10 ton/ha	0.87
20 ton/ha	0.92

Note: The number followed by the same letter indicates insignificant based on 5% DMRT analysis.

The results in table 1 show that the treatment of 20 t/ha of cow manure is insignificant from the treatment of 10 tons/ha of cow dung and without cow dung. One of the environmental factors that affect plant growth is light intensity. Nitrogen is one of the nutrients needed by plants whose availability is low. That is due to the high mobility of nitrogen in the soil. According to (6), nitrogen plays a role in overall plant growth, such as photosynthesis, leaf formation, and diameter enlargement.

Table 2. The effect of mycorrhizae on light intensity (Lux) at 14 WAP

Mycorrhizae dose	Light Intensity (Lux)
0 gram/plants	0.89
5 gram/plants	0.91
10 gram/plants	0.80
15 gram/plants	0.90

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The mycorrhizal treatment of 5 grams/plant is insignificant from the mycorrhizal treatment of 10 grams/plant, 15 grams/plant, and without mycorrhizae. It was presumed that the factors that affect the light intensity are not cow dung, mycorrhizae, or the interaction of the two. One of the factors that affect light intensity is shade. This study used a shelter in the form of a paranet installed from 1 WAP to 10 WAP. Paranet installation aims to regulate the intensity of incoming light and protect plants from unwanted weather. According to (7), providing shelter can maintain moisture and reduce evaporation from the soil and plants so that soil moisture is available and it can keep the plant's life.

The greenness of leaves

The greenness of the leaves is one of the parameters measured using a tool in the form of

SPAD (*Soil Plant Analysis Development*). This tool is used to determine the leaf chlorophyll content shown in units. The application of cow dung, mycorrhizae, and a combination of the two had no significant effect when analyzed using a 5% level of ANOVA.

Table 3. The effect of cow dung on green biduri (*C. gigantea*) leaves at 14 WAP

Fertilizer dose	Greenness of leaves (unit)
0 ton/ha	45.27
10 ton/ha	47.41
20 ton/ha	46.35

Note: The number followed by the same letter indicates insignificant based on 5% DMRT analysis.

The results in table 3 show that the treatment of cow manure at 10 t/ha is insignificant from the treatment of 20 tons of cow dung/ha and without treatment of cow dung. This is because cow dung is cold fertilizer, so the decomposition process runs slowly. The results of this study follow the research of (8); the use of cow manure at a dose of 10 tons/ha was not significantly different from the control treatment and an amount of 20 tons/ha on green bean plants; this was because the nutrients had not been absorbed optimally so that plants could not utilize them. Nitrogen nutrients play a role in the formation of leaves.

Table 4. The effect of mycorrhizae on the greenness of biduri (*C. gigantea*) leaves at 14 WAP

Mycorrhizae dose	Greenness of leaves (unit)
0 gram/plant	46.38
5 gram/plant	48.37
10 gram/plant	46.23
15 gram/plant	44.39

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

Table 4 shows that inoculation with mycorrhizal was not significantly different at all doses. Giving mycorrhizae at a dose of 15 grams/plant gave the least greenish value to the leaves. This is presumably because the number of inoculants is too much, so there is competition between inoculants. According to (9), doses of mycorrhizae that are too high will reduce infection due to the large number of inoculants competing for energy.

Number of stomata

Stomata are places for gas exchange located on the bottom and/or top of the leaf. Stomata on biduri are mostly found on the underside of the leaves. This type of stomata biduri is cylocitic. According to (10), the cylocitic stomata type has 1-2 layers of rings surrounding the guard cells. The number of stomata is the number of stomata calculated using a raster image application. Based on ANOVA of cow dung, mycorrhizae, and a combination of the two had no significant effect.

Tabel 5. The effect of cow dung on the number of biduri stomata (*C. gigantea*) at 14 WAP

Fertilizer dose	The number of stomata (amount/mm^2)
0 ton/ha	124.50
10 ton/ha	134.83
20 ton/ha	135.50

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The results in table 5 show that the application of cow manure at a dose of 20 tons/ha is insignificant from the control treatment and the treatment at a dose of 10 tons/ha. That is presumably because of the incomplete cow dung in the decomposition process, so there has not made any improvement in the nutrient. Stomata can help absorb CO2 from the atmosphere for photosynthesis. Photosynthesis requires water, carbon dioxide, light, and chlorophyll. According to (11), the formation of chlorophyll requires sufficient nutrients in the soil, so it is necessary to add manure containing nitrogen and phosphorus.

Tabel 6. The effect of mycorrhizae on the number of biduri stomata (*C. gigantea*) at 14 WAP

Mycorrhizae dose	The number of stomata (amount/mm^2)
0 gram/plant	130.44
5 gram/ plant	134.33
10 gram/plant	132.44
15 gram/plant	129.22

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The results of table 6 show that the application of mycorrhizae has an insignificant effect. The mycorrhizal dose of 15 grams/plant was not significantly different from the doses of 5 grams/plant, 10 grams/plant, and the control treatment. This happened presumably because the environmental conditions in the growing media were less supportive of mycorrhizal propagation. According to (12), environmental factors that influence the proliferation of mycorrhizae are soil pH, organic matter, and light intensity.

The width of the stomata opening

Stomata are slits in the epidermis of the leaf. These stomata will open in the morning from 9:00 to 12:00. The opening-closing of stomata is one of the plant movements often called nastic motion. Based on ANOVA of cow dung, mycorrhizae, and the combination of the two had no significant effect.

Tabel 7. The effect of cow dung on stomata opening width of biduri (*C. gigantea*) at 14 WAP

Fertilizer dose	The width of the stomata opening (µm)
0 ton/ha	4.5625 a
10 ton/ha	5.2692 a
20 ton/ha	6.2692 b

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The DMRT results in table 6 show that cow manure treatment at a dose of 20 tons/ha gave the largest stomata opening width. Also, it is significantly different from the control treatment and the treatment of 10 tons/ha. This is presumably because plants have stimulated cow dung so that organic matter can improve the nutrients plants need. According to (13), the opening of stomata can be affected by potassium because the potassium pump controlled by abscisic acid (ABA) can enter the guard cells. Hence, the turgor pressure increases, and the stomata opens. Potassium ions move by active transport through channels on the surface of guard cells.

Rate of Photosynthesis

Photosynthesis is the molecular breakdown process of water with the help of sunlight, with the reaction equation CO_2+H_2O $C_6H_{12}O_6$+O_2. Based on the analysis of the variety, cow dung had a significant effect on the rate of photosynthesis biduri.

Tabel 8. The effect of cow manure on the rate of photosynthesis of biduri (*C. gigantea*) at 14 WAP

Fertilizer dose	The rate of photosynthesis (µmol/m^2/s)
0 ton/ha	3.5363 a
10 ton/ha	4.7908 ab
20 ton/ha	5.4325 b

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The results of table 8 show that the application of cow dung significantly affects the rate of photosynthesis. The application of cow dung at 20 tons/ha gave the highest rate of photosynthesis, significantly different from the application of 10 tons/ha of cow manure and without cow manure. This is because the addition of N (nitrogen) elements from cow dung can play a role in forming chlorophyll, which plants need for photosynthesis. (14) added that nitrogen fertilizer applied to a plant will stimulate leaf growth, which plays a role in photosynthesis.

Transpiration rate

Transpiration is the process of water loss in the form of water vapor from living plant tissues above the soil surface through the stomata, lenticels, and cuticles. The results of ANOVA showed that the application of cow dung fertilizer had a significant effect on the rate of transpiration of biduri (*C. gigantea*), then continued with the DMRT follow-up test at a 5% level

Tabel 9. The effect of cow manure on the rate of transpiration of biduri (*C. gigantea*) at 14 WAP

Fertilizer dose	Transpiration rate (mmol/m^2/s)
0 ton/ha	0.1483 a
10 ton/ha	0.2017 a
20 ton/ha	0.3992 b

Note: The number followed by the same letter indicates insignificant based on a 5% DMRT analysis

The results in table 9 show that the 20 ton/ha cow manure treatment gave the highest transpiration rate and was significantly different from other treatments. This is presumably due to the maximum addition of nutrients that have been absorbed to fulfill the plant's needs. (15) say a high transpiration rate will increase nutrient absorption. This is because the plant loses more water due to the large size of the stomata. Several factors, including temperature, light, water, and chemical, influence the width of the stomata opening.

Conclusion

The conclusion that can be drawn based on the research that has been done it follows:

1. The interaction between cow dung and mycorrhiza not increasing the physiology of biduri (*C. gigantea*).
2. The application of cow dung fertilizer at 20 tons/ha increases the width of stomata openings, the rate of photosynthesis, and the rate of transpiration.
3. The application of mycorrhizae not increasing the physiology of biduri (*C. gigantea*).

Conflict of Interest

All authors declare no conflicts of interest in this section.

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