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Growth Response and Results of Two Sorgum Varieties With Different Dosage Application of Arbuscular Mycorrhizal

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Abstract. Sorghum is an adaptive plant, able to grow and develop on sub-optimal land such as dry land but the soil fertility level is still low. This study aims to determine the variety of sorghum and the appropriate dosage of arbuscular mycorrhizal fungi (AMF) for growing sorghum on dry land and to determine the best interaction effect. Research is carried out in the field and in the laboratory. The environmental design used was a complete randomized block design with two factorials and was repeated three times. The first factor was 2 varieties of sorghum namely Luzhouhong (V1) and Hongyingzi (V2). The second factor was the dose of AMF at a dose of 0 g/plant (D0), 2.5 g/plant (D1), of 5 g/plant (D2), 7.5 g/plant (D3). The results showed that the sorghum variety that had more potential to be developed on dry land based on growth and yield variables was the luzhouhong variety. The right dose of AMF for growth and yield on dry land is a dose of 2.5 g/plant (D1) compared to other AMF doses. The combination of Luzhouhong sorghum varieties with AMF dose of 2.5 g/plant is suitable for development in dry land as a result of seed production.

1 Introduction

Sorghum is one of the cereal commodities that has not been widely consumed by Indonesian people and has not been widely used. Sorghum is one of the potential products that can be developed to support food and energy diversification programs in Indonesia. Sorghum is a potential crop because its leaves and stems can be used as animal feed. Apart from being used as animal feed, sorghum can also be used as an alternative energy source, especially sweet sorghum because sweet sorghum has a high starch content [1].

Sorghum can be used as an alternative food besides rice because it has a nutritional content equivalent to rice, even with a higher protein content. Sorghum is a type of cereal with a high protein content compared to other cereals. Sorghum seeds contain 10.4% protein [2]. In addition, sorghum is also known as a multifunctional crop to meet the needs of feed, food, functional, industrial and energy. Sorghum plants are adaptive plants that can grow and

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develop on sub-optimal land, including dry land. Dry land problems include low rainfall, drought, salinity, nutrient leaching and intensive mineral weathering, low organic matter and low soil fertility [3].

Increased sorghum yield can be achieved by meeting nutritional needs through the use of chemical fertilizers.. However, continued use of chemical fertilizers can cause negative impacts on the environment, such as soil pollution, biodiversity changes,

eutrophication, water pollution and reduced use efficiency of fertilizer use. Furthermore, the inefficient use of chemical fertilizers can disrupt human health [4]. Appropriate and environmentally friendly management can be applied to increase the efficiency of chemical fertilizers applied to sorghum plants, one of which is by using arbuscular mycorrhizal fungi (FMA).

Evaluation of the performance of various sorghum varieties and the application of arbuscular mycorrhizal fungi to dry land to support biofuels needs to be carried out as an effort to optimize land, empower communities and reduce poverty. The specific objectives of the research were (1) to obtain adaptive sorghum varieties in dry land, (2) to obtain the most optimal dose of arbuscular mycorrhizal fungi to increase growth, yield of stem sap sugar and bioethanol to support renewable energy, optimize land and increase farmers' income in dry land.

2 Materials and Method

2.1 Materials and Method

The research was conducted in Gayam Village, Sukoharjo District, Sukoharjo Regency and the Laboratory of the Faculty of Agriculture, Sebelas Maret University Surakarta in January-April 2023. The study was arranged using a two-factor Completely Randomized Block Design (RAKL). The first factor was the varieties of sorghum plants which were different with 2 levels, namely the Luzhouhong and Hongyingzi varieties. The second factor was the dose of AMF (Arbuscular Mycorrhizal Fungi) given inoculant per each planting hole. 0 grams (without FMA), 2.5 grams, 5 grams and 7.5 grams. Based on this design, 8 treatment combinations were obtained and 3 repetitions were carried out to obtain 24 experimental units.

2.2 Data Analysis

Data analysis was carried out using the 5% and 1% F variance test, Duncan's multiple range test (DMRT) at the 5% level. Orthogonal polynomial test is used to find the optimum dose of AMF. Data analysis using SPSS version 26 software. Preparation begins with land preparation, planting, sampling, soil sampling before treatment, AMF application, maintenance, observation, harvesting, soil sampling after treatment. Observations made included number of leaves, leaf area, leaf area index, panicle length, panicle weight, weight of 1000 seeds.

3 Result and discussion

The analysis of variance application of Arbuscular Mycorrhizal Fungi (AMF) showed that there was an effect of two varieties sorghum used on plant height 8 weeks after planting.

Table 1. Analysis of growth and yield of sorghum with the application of Arbuscular Mycorrhizal Fungi at different doses and different varieties

Observation	F-count		
	Varieties	Dose	Interaction
Number of leaves	7.38 **	0.97 ^{n}	0.75 ^{n}
Leaf area	5.29*	2.50^{n}	1.19 ^{n}
Leaf area index	5.26*	2.50 ^{n}	1.19 ^{n}
Panicle length	0.61 ^{n}	3.17*	1.53 ^{n}
Panicle weight	0.36 ^{n}	3.85*	0.69 ^{n}
Weight of 1000 seeds	0.06 ^{n}	0.10 ^{n}	0.02 ^{n}

Description: n=no significant effect, *=significant effect, **=very significant effect, based on the F test.

3.1 Number of leaves

Based on the table varieties has very significant effect, but dose and interaction has not significant effect. Varieties can have an impact on the outcomes of the number of leaves depending on the findings of the analysis of various treatments. A crucial part of photosynthesis is played by leaves. In general, leaves are green because they contain chlorophyll; this hue serves the fundamental purpose of the leaves, which is to capture solar energy for photosynthesis. Assert that plants with the optimum plant height will produce more leaves since more leaves are produced as a plant grows taller [5]. The amount of leaves a plant has is related to the nutrients it contains and can take up through its roots [1].

3.2 Leaf area

The leaf area is larger because it is supported by the absorption of nutrients in the soil. By increasing the leaf area, it means that it will increase the absorption of light by the leaves, then the process of photosynthesis will increase and produce aimilate which will be used as a source of growth energy in forming vegetative organs in the growth phase, while in the generative phase assimilates stored in organ tissues will be transferred to the formation of reproductive organs, such as seed filling [6].

3.3 Leaf area index

The leaf area index value is affected by the administration of arbuscular mycorrhizal fungi because it has a high C-organic content which can increase production yields from plants, because plants are able to absorb high levels of nutrients for optimal growth processes [7]. The leaf area index results have optimum results so that the leaves are effective in absorbing solar radiation in the process of photosynthesis. the process of photosynthesis produces larger photosynthate, allowing for the formation of larger plant organs such as leaves and roots which then results in greater production of dry matter.

3.4 Panicle Length

The analysis of variance application of Arbuscular Mycorrhizal Fungi (AMF) showed that there was an effect of two varieties on panicle length.

Table 2. The results of the panicle length on 5% BNT test

Dose	Panicle Length
0	17.82 a
2.5	22.47b
5	18.25a
7.5	17.99a

Note: Numbers followed by the same letters show results that are not significantly different in the 5% BNT test

Based on the results of the BNT follow-up test, it was found that the panicle length results were significantly different with a dose of 2.5 grams with the highest yield being 22.47 cm. Panicle length is influenced by the genes of the plant. The panicle length of a crop is influenced by the genetic characteristics of the variety, the conditions or climate and environment in which the plant grows, and the cultural treatment [8].

3.5 Panicle Weight

Panicle weight has the highest correlation with seed/plant weight [9]. Panicle weight influenced by panicle length, so that the highest of panicle weight in dose 2.5 gr/plant. States that plant growth goes well and good plant growth is able to convert existing nutrients into plant results [10]. In this study the accumulation of panicle dry matter and seeds were related. The increase in dry panicle weight will be followed by an increase in dry seed weight.

3.6 Weight of 1000 seeds

Based on the analysis of the variety of differences in varieties give results that have a significant effect. The formation and filling of seeds is determined by the genetic capabilities of the plants in each plant related to assimilated energy sources and provision of nutrients to plants. The greater the weight of 1000 seeds, the larger the granules seed size can affect seed weight. Seeds that are formed are smaller due to aging and ripening occurs more quickly [11]. The results of the study by [12] pointed out that the amount of available nutrients that plants can absorb is one of the factors that can influence the yield level of plants. According to [10], the daily photosynthesis process in leaves is the basis for grain filling photosynthesis. Sorghum grain weight is important in determining grain yield per unit area and may represent accumulation during the reproductive period [13].

4 Conclusions

Based on the results of the experiment, dosage of Arbuscular Mycorrhizal Fungi has a significantly different effect on the number of leaves, leaf area of sorghum, leaf area index. Application of different doses of Arbuscular Mycorrhizal Fungi with different varieties of sorghum had a significant effect on panicle weight, panicle length, and seed weight.

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