Effect of Arbuscular Mycorrhiza and Kokazolla Fertilizer on Physiological Parameters and Production Components of Purple Maize (*Zea mays* L.)

Elvira[1,*], *Feranita* Haring[2], and *Burhanuddin* Rasyid[3]

[1]Magister Agroteknologi, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia
[2] Department of Agriculture Cultivation, Hasanuddin University, Makassar, Indonesia
[3] Department of Soil Science, Hasanuddin University, Makassar, Indonesia

Abstract. The production of purple maize was essential to maintain the soil fertility development without environmental impact. The arbuscular mycorrhiza and kokazolla fertilizer are biological and organic material applications in the field. This study aims to determine the effect of arbuscular Mycorrhiza and Kokazolla fertilizer on purple maize production. This experiment used a group randomized design separate plot design. The main plot consists of 3 treatments (e0 = control, e1 = Mycorrhiza dose 7.5 g/plant, e2 = Mycorrhiza dose 15 g/plant), and the plot consists of 4 treatments (l0 = Control - NPK dose 0.3 Ton/Ha, 1 = Kokazolla dose 6.25 Ton/Ha, l2 = Kokazolla dose 12.5 Ton/Ha, and l3 = Kokazolla dose 18.75 Ton/Ha). The results showed that the application of Mycorrhizal biofertilizer 15 g/plant+Kokazolla fertilizer 18.75 Ton/Ha was higher for male flowering age, female flowering age, cob weight with petals per Ha, and cob weight without petals per Ha.

1 Introduction

Purple maize, which was initially produced and consumed in the United States, Mexico, and Argentina, has a high concentration of anthocyanins and is much greater than blueberries and red cabbage plants with an anthocyanin content of as much as 82.3 mg/g grains and has a dark purple color on the skin [1, 2]. Purple maize has considerable biological activity as an antioxidant and anti-mutagenetic with phenolic compounds, especially anthocyanins, phenolic acids, and tannins. Thus, the demand increased and popular, especially in the Americas, Europe, and Asia because of its benefits [2, 3].

The increasing demand for purple maize created dilemmatic conditions with the chemical application of purple maize planting. Chemical fertilizer application without the combination of biological fertilizer will impact of environment and soil degradation future. Therefore, we need to switch the use of chemical fertilizers to biological fertilizers such as mycorrhiza and

* Corresponding author: virafaranisaarda@gmail.com

kokazolla fertilizers which are saver The arbuscular Mycorrhiza and kokazolla fertilizers as biological fertilizers to prevent environmental impact.

Mycorrhiza is a symbiotic relationship between fungi and plant roots which has a role in increasing nutrient and water absorption and increasing plant resistance to biotic and abiotic stress [4]. Previously, Mycorrhizae have been used directly for soil fertility and plant growth and health through phosphate-dissolving activities and growth-promoting bioactives for plants [5, 6]. Previous research said that the application of arbuscular mycorrhiza as much as 10 g per plant had a real influence on the length and weight of corn plant cobs [7].

Kokazolla fertilizer is an organic fertilizer with ingredients from a combination of azolla plants, apu-apu, and goat manure. Azolla is a water fern that grows in wetlands and is reported as a green manure with a high cellulose content [8]. Meanwhile, apu-apu is a water weed that has the potential to be used as an organic fertilizer for plants. Previous research said that the addition of Azolla, apu-apu, and goat manure can increase the grain yield of rice plants because it increases total N, pH, and organic C, and reduces NH3 mortality. Increase the growth and productivity of maize plants through improving soil quality such as humus and pH [9-13] It can be concluded that the application of arbuscular mycorrhiza and kokazolla fertilizer is good for improving soil quality, plant growth, and productivity. Unfortunately, as far as the author knows, no one has ever reported the effect of giving a combination of arbuscular mycorrhiza with kokazolla fertilizer on the physiological characteristics and production of purple corn plants even though the results of this research will be able to contribute to increasing information on safe and environmentally friendly production technology that can be applied in society. Therefore, this experiment aims to determine the effect of the application of arbuscular Mycorrhiza and kokazolla fertilizer on the physiological properties and production of purple corn plants.

2 Material and Methods

2.1 Materials

Purple maize, NPK fertilizer, arbuscular mycorrhiza, goat manure, water cabbage, Azolla, EM4, molasses, bran, and water.

2.2 Methods

2.2.1 Research settings

This Study is from March 2023 to June 2023 in Bantaeng Regency, South Sulawesi Province, and Hasanuddin University Laboratory. The study design used a group randomized design (RAK) separate plot design (RPT) with the main plot consisting of 3 treatments (e0 = control, e1 = mycorrhiza dose 7.5 g/plant, e2 = mycorrhiza dose 15 g/plant), and subplot consists of 4 treatments (l0 = Control - NPK dose 0.3 Ton/Ha, l1 = Kokazolla dose 6.25 Ton/Ha, l2 = Kokazolla dose 12.5 Ton/Ha, and l3 = Kokazolla dose 18.75 Ton/Ha). Thus, 12 treatment combinations, 3 replicates 36 experimental plot units. The maize variety used Advanta. The area of each treatment experimental unit was 4 m^2. Mycorrhizal application is applied to the planting hole and planting seeds together based on treatments. Kokazolla fertilizer application and control (NPK 0.3 Ton/Ha) were applied 3 times with the first week before planting, the second week after planting, and the fourth week after planting with the dose according to treatment. Planting maize purple seeds was carried out with a planting distance of 25 x 50 cm, each experimental group consisted of 28 populations.

2.2.2 Preparation of Kokazolla Fertilizer

Hoes, fermentation plastics, gauges, stirrers, 90 kg of goat manure, 25 kg of water cabbage, 20 kg of Azolla, 0.54 L of EM4, 0.54 L of molasses, 27 kg of bran, and 54 L of water were prepared for the experiment It's manufacture started from first pouring goat feces manually, carrying out the process of mixing ingredients. make the layers for an easier and even mixing process. Apply EM4 and molasses and dissolve them in water, then pour them on the layer until the moisture content becomes around 40%. Make the next layer until all the material is gone, then create a new layer by hoeing from one side in the same direction to create a new pile. Then put in fermented plastic and tightly close. Let stand for two weeks, then open and stir once every 1 week for aeration in the composting process.

2.3 Statistical analysis

All statistical analysis used the Excel software program. The research data was analyzed with Sidik Ragam (ANOVA). If there is a real or very noticeable difference in treatment, further tests are carried out to distinguish the average between treatments using the Smallest Real Difference (BNT) test with significance at a probability level of <0.01.

3 Results and Discussion

3.1 Male Flowering Age

Observed data on parameters flowering age Males are presented in Table 1. Based on the results of fingerprint analysis, results were obtained that showed that there was an interaction between the dose treatment of arbuscular mycorrhiza and kokazolla fertilizer at the average flowering age of males. The BNT test results α 0.01 presented in Table 1 showed that the average flowering age of males was fastest in e2l3 treatment (Arbuscular Mycorrhiza 15 g/plant + Kokazolla 12.5 Tons/Ha) with an average flowering age of males 50 days and differed markedly with all treatments. The flowering age of males is longest in e0l0 treatment (Without Arbuscular Mycorrhiza + Control (NPK 0.3 Tons/Ha) with an average flowering age of 55 days. From Table 1 it can be concluded that arbuscular mycorrhiza and the highest dose of kokazolla fertilizer can accelerate the flowering time of males in purple corn plants. This is thought to be due to the presence of mycorrhiza which can make it easier for plants to absorb P elements and other nutrients supplied by soil and kokazolla fertilizer. The higher the dose of mycorrhiza, the more hyphae can form Likewise with kokazolla fertilizer, the higher the dose, the more nutrient supply. This follows the results of research by Jurhana, [14] who reported that the yield of sweet corn plants at various doses of organic fertilizer was highest at the highest dose of organic fertilizer, which was 25 tons/Ha.

Table 1. The effect of mycorrhizal application and kokazolla fertilizer on physiological parameters (flowering age of males and females) and parameters of production components (weight of cobs with petals and without cobs per Ha).

Treatment	Parameter			
	Flowering age of males (days)	Flowering age of females (days)	Cob Weight With Petals per Ha (Ton)	Cob Weight Without Petals per Ha (Ton)
e0l0	$55^{a}{}_{p}$	$58^{a}{}_{p}$	$6.06^{b}{}_{qr}$	$4.64^{c}{}_{r}$
e0l1	$54.67^{a}{}_{p}$	$57^{b}{}_{q}$	$6.53^{b}{}_{q}$	$4.59^{c}{}_{s}$
e0l2	$54.67^{a}{}_{p}$	$54.67^{a}{}_{p}$	$6.80^{c}{}_{q}$	$4.88^{b}{}_{p}$
e0l3	$53.67^{a}{}_{q}$	$57^{a}{}_{p}$	$8.03^{b}{}_{p}$	$5.84^{c}{}_{q}$
e1l0	$54^{b}{}_{p}$	$57.33^{a}{}_{p}$	$7.60^{b}{}_{q}$	$5.25^{b}{}_{q}$
e1l1	$53.67^{b}{}_{p}$	$57^{a}{}_{p}$	$6.72^{b}{}_{r}$	$4.93^{b}{}_{r}$
e1l2	$53^{b}{}_{q}$	$57^{b}{}_{q}$	$7.28^{b}{}_{q}$	$4.72^{c}{}_{s}$
e1l3	$52.67^{b}{}_{q}$	$56.67^{b}{}_{q}$	$8.24^{b}{}_{p}$	$6.35^{b}{}_{p}$
e2l0	$53^{c}{}_{p}$	$57^{a}{}_{p}$	$9.04^{a}{}_{q}$	$6.80^{a}{}_{q}$
e2l1	$53.33^{b}{}_{p}$	$57^{b}{}_{p}$	$7.17^{a}{}_{s}$	$5.09^{a}{}_{s}$
e2l2	$52.67^{b}{}_{q}$	$56^{c}{}_{q}$	$7.71^{a}{}_{r}$	$5.55^{a}{}_{r}$
e2l3	$50^{c}{}_{r}$	$54.67^{c}{}_{s}$	$11.79^{a}{}_{p}$	$8.96^{a}{}_{p}$

3.2 Female Flowering Age

Observed data on parameters The flowering age of females is presented in Table 1. Based on the results of fingerprint analysis, results were obtained that showed that there was an interaction between the dose treatment of arbuscular mycorrhiza and kokazolla fertilizer at the average flowering age of females. The BNT test results α 0.01 presented in Table 1 showed that the average flowering age of females was the fastest in e2l3 treatment (Arbuscular Mycorrhiza 15 g/plant + Kokazolla 12.5 Tons/Ha) with an average flowering age of females 54.67 days. The flowering age of females was the longest in the e0l0 treatment (Without Arbuscular Mycorrhiza + Control (NPK 0.3 Tons/Ha) with an average flowering age of 58 days. It is the same with the flowering speed of males the higher the dose of mycorrhiza, the more hyphae can form. Application of high doses of kokazolla fertilizer will cause the supply of nutrients to be greater so that the availability of nutrients for plants to use is more available. Following the research of [14], who reported that the highest dose of organic fertilizer, namely 25 tons/Ha gave the highest results in sweet corn production.

3.2.1 Cob Weight with Petals per Ha

Observed data on parameters the weight of cobs with petals per Ha is presented in Table 1. Based on the results of fingerprint analysis, results were obtained that showed that there was an interaction between the treatment of arbuscular mycorrhizal doses and kokazolla fertilizer on the average weight of cobs with petals per Ha. The BNT test results α 0.01 presented in Table 1 showed that the average weight of cobs with petals per Ha was highest in the e2l3 treatment (Arbuscular Mycorrhiza 15 g/plant + Kokazolla 12.5 Tons/Ha) with an average weight of cobs with petals per Ha of 11.79 Tons/Ha. While the weight of cobs with petals per Ha is lowest in treatment e0l0 (Without Arbuscular Mycorrhiza + Control (NPK 0.3 Tons/Ha) with an average weight of cobs with petals per Ha which is 6.06 Tons/Ha. This is thought to be because the dose of mycorrhiza and organic fertilizer affects the performance of nutrient absorption in plants. Following the statement Based on the results of research by [15] which states that the addition of FMA to the soil has a real effect on the cob weight of

semi-corn plants and the highest dose of mycorrhiza produces the highest cob weight as well. The higher the dose of kokazolla fertilizer, the more nutrient content so that the absorption of nutrients by plants will be greater.

3.2.2 Cob Weight without Petals per Ha

Observed data on parameters cob weights without lids per Ha are presented in Table 1. Based on the results of fingerprint analysis, results were obtained that showed that there was an interaction between the treatment of arbuscular mycorrhizal doses and kokazolla fertilizer on the average weight of cobs without petals per hectare. The BNT test results α 0.01 presented in Table 1 showed that the average weight of cobs without lids per Ha was highest in the e2l3 treatment (Arbuscular Mycorrhiza 15 g/plant + Kokazolla 12.5 Tons/Ha) with an average weight of cobs without lids per Ha of 8.96 Tons/Ha. While the weight of cobs without lids per Ha was lowest in the treatment e0l0 (Without Arbuscular Mycorrhiza + Control (NPK 0.3 Tons/Ha) with an average weight of cobs without lids per Ha of 4.64 Tons/Ha. This is thought to be because the difference in mycorrhizal doses will affect the number of spores and external hyphal tissue so it is assumed that the higher the dose of mycorrhiza, the more spores and external hyphal tissue will be able to expand the absorption field in the roots so that it will make it easier for plants to get sufficient nutrient supply. Sufficient nutrients will make plants produce well, including the parameters of cob weight without petals per Ha. According to [16], the highest dose of mycorrhizal treatment affects the growth and yield of sweet corn plants and provides the highest growth and yield on all parameters except the number of leaves. The higher dose of kokazolla fertilizer will make the absorption of nutrients by plants greater because the nutrient content will be higher.

4 Conclusions

Application arbuscular mycorrhiza dose 15 g/plant + kokazolla fertilizer dose 18.75 Tons/Ha produces the best results on plant physiological parameters of male and female flowering age, as well as on production component parameters of cob weights with and without petals per Ha.

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