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NPK FERTILIZER TEST AND PLANT POPULATION ON THE GROWTH AND YEARS OF SORGUM (SORGHUM BICOLOR (L.) MOENCH)

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ABSTRACT
This study aims to determine the effect of NPK fertilizer dose and plant population on the growth and yield of Sorghum (*Sorghum bicolor* (L.) Moench).The design that was carried out was a Complete Randomized Block Design (RAKL) Factorial consisting of NPK fertilizer dose treatment with four levels and the second-factor Spacing with two levels, so there are eight treatment combinations repeated four times. The data obtained were analyzed by analysis of variance and to find out significant differences continued with Duncan's Multiple Range Test with a significant level of 5%. The results showed that the fertilizer dose treatment had a significant effect on plant height and seed weight per panicle, the plant population treatment had no significant effect on all observed parameters, and the combination of fertilizer dose and population treatments had no significant effect on all observed parameters. The treatment with a fertilizer dose of 300 kg/ha produced the highest seed weight per panicle of 91.79 gr, and the lowest fertilizer dose of 150 kg/ha produced a seed weight per panicle of 71.95 gr.

Keywords: fertilizer, population, yield, sorghum.

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INTRODUCTION

Sorghum is a cereal crop that has the potential to be developed in Indonesia and has a high level of adaptation that can live in drought areas compared to other cereal crops (Rusae et al., 2018). Sorghum has many advantages; namely, it can be used as food and bioenergy (bioethanol), while the stem and leaf waste can be used as animal feed (Pabendon et al., 2016). Another advantage of sorghum lies in its broad agroecological adaptability, resistance to drought, high production, and more resistance to pests and diseases compared to other food crops (Pabendon et al., 2016).

Sorghum has a high nutritional content and even higher protein content than rice. Sorghum has a protein content of 11%, while rice only has 6.8%. Other micro-nutrient content possessed by sorghum is potassium, iron, phosphorus, and B vitamins (Subagio & Aqil, 2013). Sorghum seeds have a balanced nutritional value with corn seeds. Sorghum seeds have a high carbohydrate content, so they are often used as food and raw materials for the brewing industry, starch, liquid sugar (syrup), ethanol, glue, paint, paper, and other industries (AlamSyah & Nurhasanah, 2019). Sorghum seeds also have many benefits, namely as food and industry. Sorghum has become an alternative food ingredient in various regions of Indonesia, including Flores, Kupang, and its surroundings. Related to the high utilization of sorghum plants and seen from the low average national production, i.e., 2.68 tons ha-1 with production that should have reached 5-7 tons ha-1, an increase in production must be carried out (Yahfi et al., 2017). Fertilization is one effort that can be used to increase production and improve the quality of sorghum crops. The more nutrients that are given to plants through the

soil, the availability of nutrients for plants will increase. Mutiara NPK fertilizer is an inorganic fertilizer that contains more than one nutrient, so this fertilizer is also called compound fertilizer. NPK fertilizer contains nutrients, nitrogen, phosphorus, and potassium. This fertilizer is very good for supporting the growth period of plants. Pearl NPK Fertilizer (16:16:16) is a compound inorganic fertilizer that contains 16% of the macronutrients N, P, and K each (Fahmi et al., 2014).

In addition to fertilization, there are other ways to increase sorghum yields, namely by regulating the plant population per unit area through optimal spacing to obtain plant population density to increase sorghum yields (Puspitasari et al., 2012). Setting the plant population is one of the factors that must be considered to obtain optimal growth and production. If the population is too dense because the spacing is too close, it will cause the plants to compete in nutrients, sunlight, and water. In addition, at a high-density level, the plants will tend to shade each other (shading) so that photosynthesis does not occur optimally. Therefore, plant population by spacing is one of the efforts so that plants can absorb sunlight properly. Setting the spacing allows sunlight to enter freely around the plant (Harsono et al., 2021).

Based on the description above, to increase the yield of sorghum plants in the future, it is necessary to give the right dose of NPK Mutiara fertilizer and regulate the right planting population. Therefore, it is necessary to conduct research by applying NPK Mutiara fertilizer with a variety of different doses and different planting population arrangements.

METHODS

The research was conducted on Pebruary – Mei, 2023, in Dayu Village, Distric Gondangrejo, Karanganyar Regency, at an altitude of 200 m above sea level with latosol soil type. The materials used were sorghum seeds of the Numbu variety pearl NPK fertilizer. The tools used are hoes, scythes, roller meter scales, members, ropes, spray tools, and ovens.

This study is an experimental study using a factorial Complete Group Randomized Design (RCBD) consisting of two factors, namely the dose of NPK fertilizer with 4 levels, namely 0, 150, 300 and 450 kg / ha and plant population factors of 35 and 20 plant populations per plot. So there are 8 treatment combinations that will be repeated 4 times so that there are 32 trial plots. The data obtained were analyzed by variety analysis and continued with the Duncan Multiple Range Test (DMRT) with a significant level 5%.

RESULTS AND DISCUSSION

Plant Height

Analysis of variance showed that the dose of NPK fertilizer had a significant effect on plant height. In contrast, plant population had no significant effect, as did the interaction between the two. Providing a high resolution of the figure is important to ensure the quality of the manuscript, and the caption must support the figure and tablet. Refer to and cite figures and tables in-text by their full, spelled-out forms. For example: Table 1. Duncan's multiple range test 5% treatment of planting population and doses of NPK fertilizer on plant height variable (cm) In Table 1 the effect of plant population is not significantly different on plant height at all plant ages. However, in general, it is known that in the treatment of high populations (dense), higher plant heights are obtained. This proves that in high populations, there will be competition in the use of light. Which also affects the

uptake of nutrients and water. If a plant covers another plant, the process of taking light from the shaded plant will be hampered and there will be competition for light (Nizan, 2021).

From Table 1 above, it is known that until 42 days after planting, the effect of fertilization was not significantly different on plant height. However, at 56 days after planting (dap), there was a significant difference where the 150 kg/ha fertilizer treatment had the highest plant height of 240.19 cm and was significantly different from other fertilizer dose treatments; this shows that a fertilizer dose of 150 kg/ha is sufficient to provide the best growth when compared to other doses. (Godang, 2018) states that the treatment by giving adequate doses of fertilizer can increase plant height in sorghum plants.

Number of leaves, wet stover, and dry stover

From the analysis of variance, it was found that the population treatment and NPK fertilizer doses had no significant effect on the number of leaves wet and dry stover.

Table 2. Duncan's Multiple Range Test 5% Treatment of Plant Population and Dosage NPK Fertilizer on Sorghum Plant Growth Variables

Treatment	Number of leaves	Wet stove	Dry bran
Plant population 35 (P1)	15,43 a	726,068 a	233,841 a
Plant population 20 (P2)	15,25 a	747,984 a	239,701 a
Control(N0)	15,25 a	735,686 a	240,475 a
Dose of 150 kg/ha (N1)	15,38 a	665,416 a	207,671 a
Dose of 300 kg/ha(N2)	15,50 a	784,188 a	254,930 a
Dose of 450 kg/ha (N3)	15,25 a	762,313 a	244,009 a

Note: Numbers followed by the same letter in the same column show no significant difference in Duncan's 5% Multiple Range Test

From Table 2 above, it is known that the treatment of plant populations was not significantly different between the two populations in terms of the number of leaves and wet and dry stover. However, let us look closely at these parameters. It can be seen that in a low population (plant population 20/plot) it has a high value. This shows that in low/sparse populations, there is less competition for factors that support growth, such as water, nutrients, and light. In dense/high populations, there will be competition for water, nutrients, and light (Nizan, 2021). With this competition, there will be plants that lose the competition, resulting in poor growth, which is indicated by the parameters of the number of leaves wet and dry stover, which are lower. (Indrayanti, 2010) stated that plant population regulation affects plant growth, such as leaf area and dry weight. The amount of sunlight received and nutrients absorbed in the soil. Setting the plant population is a factor that must be considered to achieve good plant growth; there is a tendency for unfavorable growth caused by a high population due to increased competition between the plants in obtaining nutrients, water, and sunlight (Silalahi et al., 2018).

The dose of NPK fertilizer also showed no significant effect on the parameters number of leaves weight of wet stover and dry stover. , this shows that with sufficient doses, it will provide good growth. The correct dosage of NPK fertilizer is an important factor. Nitrogen, Phosphorus, and Potassium play a role in the metabolic and biochemical processes of plant cells; nitrogen is a builder of nucleic acids, proteins, enzymes, and chlorophyll (Seminar & Purnamawati, 2017). Phosphorus is a builder of nucleic acids, phospholipids, bioenzyme and an important part of ATP in energy transfer. Potassium regulates the balance of ions in cells, which functions in regulating various metabolic

mechanisms such as photosynthesis, carbohydrate metabolism, translocation, and protein synthesis and increases plant resistance to pests and diseases.

Number of panicles and seed weight per panicle

The results of the analysis of variance showed that the population treatment and NPK fertilizer dose had no significant effect on the number of panicles as well as the interaction, while the NPK fertilizer doses had a significant effect on seed weight per panicle, but the population treatments were not significantly different, and so was the interaction.

Table 3. Duncan's Multiple Range Test 5% Treatment Plant Population and Dosage NPK Fertilizer on Sorghum Crop Yield Variables

Treatment	Number of panicles	Seed weight per panicle (gr)
Plant population 35 (P1)	50,22 a	79,55 a
Plant population 20 (P2)	49,92 a	84,84 a
Control(N0)	49,91 a	78,15 b
Dose of 150 kg/ha (N1)	49,53 a	71,95 a
Dose of 300 kg/ha(N2)	48,47 a	91,79 c
Dose of 450 kg/ha (N3)	52,37 a	86,89 c

Note: Numbers followed by the same letter in the same column show no significant difference in Duncan's 5% Multiple Range Test

From Table 3 above, the treatment of plant population per plot had no significant effect on the number of panicles per plant and the weight of seeds per panicle. Plant population 20 (P2) obtained a higher seed weight per panicle (84.84 gr). In comparison, plant population 35 (P1) obtained a seed weight per panicle of 79.55 gr. Low plant populations produce higher seed per panicle weight than high (dense) populations. As (Maspeke et al., 2009), at low plant populations, plants are more free to use water, nutrients, and sunlight for photosynthesis so that more assimilated results from photosynthesis can accumulate. The seeds formed will be stored in fruit or seeds so that the size, weight, and number of seeds produced by plant production will increase, whereas, in high plant populations, there will be a decrease in seed yield due to intense competition. The number of per panicle seeds was influenced by seed filling, which was controlled by genetic and environmental factors, especially in growth and photosynthetic results (Rahman et al., 2022). Genetic factors are related to the plant's ability to optimize production in the regulation of seed filling by allocating photosynthetic results appropriately (Sitinjak & Idwar, 2015).

In contrast, environmental factors are related to the photosynthetic process, namely the absorption of nutrients, water, and light. The NPK fertilization treatment had no significant effect on the number of panicles. However, from Table 3, it is known that the 450 kg/ha fertilizer dose obtained the highest number of panicles, 52.37. Fertilizer dose treatment showed a significant difference in seed weight per panicle. Treatment with a fertilizer dose of 300 kg/ha produced seed weight per panicle of 91.79 gr, and the lowest fertilizer dose treatment of 150 kg/ha produced seed weight per panicle of 71.95 gr.

CONCLUSION

This study concludes that plant population does not have a significant effect on all observed parameters. The dose of NPK fertilizer independently has a significant impact on plant height at 56 days after planting and seed weight per panicle, while other parameters do not differ significantly.

The interaction between plant populations and NPK fertilizer doses does not show significant differences in all observed parameters.

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