Productivity Analysis of Several Sorghum Varieties (*Sorghum bicolor* (L.) Moench) Flowering Phase In North Sulawesi

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Abstract

This examination plans to investigate the productivity of several flowering phase sorghum varieties as measured by fresh weight and dry matter weight. This research used a Completely Randomized Design (CRD) with 4 different varieties and 5 replications. The sorghum varieties analyzed were Super 1, Super 6, Super 2 and Numbu. The factors estimated were the fresh weight of leaves, stems and panicles and the dry matter weight of leaves, stems and panicles. The results of the analysis showed that the varieties gave very significant differences (P<0.01) in the fresh weight and dry weight of leaves, stems and panicles. The Super 6 variety had leaf fresh weight, panicle fresh weight, leaf dry weight and panicle dry weight which were very significantly (P<0.01) higher than the Super 1 and Numbu varieties. The Super 1 variety had a fresh stem weight that was very significantly (P<0.01) higher than the Super 2 variety and the Numbu variety, but was not significantly different (P>0.05) from the Super 6 variety. The Super 2 variety had a leaf dry weight. and stem dry weight was significantly (P<0.01) higher than Super 1 and Numbu varieties. It was reasoned that the various assortments of sorghum plants analyzed gave differences in productivity, where the Super 6 variety had the highest productivity.

Key words : *flowering phase, productivity, sorghum, varieties*

Introduction

Exploratory efforts to obtain animal feed plants that have high productivity and are able to survive the land and climate conditions in Indonesia. One type of forage for livestock is sorghum. Sorghum (*Sorghum bicolor* (L.) Moench) is a group of graminae or grasses. Sorghum plants are ruminant food. This plant is known as a type of forage that can survive dry stress and waterlogging, can produce on marginal land, and is relatively resistant to biotic pressure (Barcelos et al. 2016; Gibert 2009; Xie and Xu 2019).

The production and quality of local wheat and sorghum is still very low compared to imported products, so efforts are needed to improve plant varieties through plant breeding programs (Soeranto 2011). One of the efforts made is by introducing or introducing new varieties of sorghum plants. Blummel et al. (2003) stated that sorghum varieties or introductions as animal feed have great potential for increasing forage. The introduction of new sorghum varieties has several benefits, including increasing the diversity of sorghum varieties in Indonesia for feed, as cross-breeding material or directly releasing them as varieties after being tested for adaptation (Syukur et al. 2012). Genetic diversity is fundamental for improving crops (Sharma et al. 2014) Efforts to increase forage production require appropriate land resource management. Sorghum (Sorghum bicolor (L.) Moench) cultivation in Indonesia is still not intensively carried out by the Indonesian people, even though its potential is very good to meet food or animal feed needs which are still dominated by imported feed. The problem of sorghum grain productivity is that it tends to remain low, namely in the range of 2.0-3.5 tons per hectare, while the potential can reach more than 4.0 tons per hectare. One way to develop sorghum cultivation techniques that can be applied is to regulate the density or population of sorghum plants per unit area (Puspitasari et al., 2012). According to Atus'sadiyah (2004) determining plant density in a planting area is essentially one way to obtain maximum plant yields.

Materi dan Metode Penelitian

Waktu Dan Lokasi Penelitian

This research was carried out at the SM Paniki Bawah sorghum plantation, Mapanget District, Manado City, North Sulawesi (Figure 1). From April to August 2023, on an area of ±500 m2, the experimental garden in Paniki Subdistrict, Mapanget District, Manado City, North Sulawesi, Indonesia.

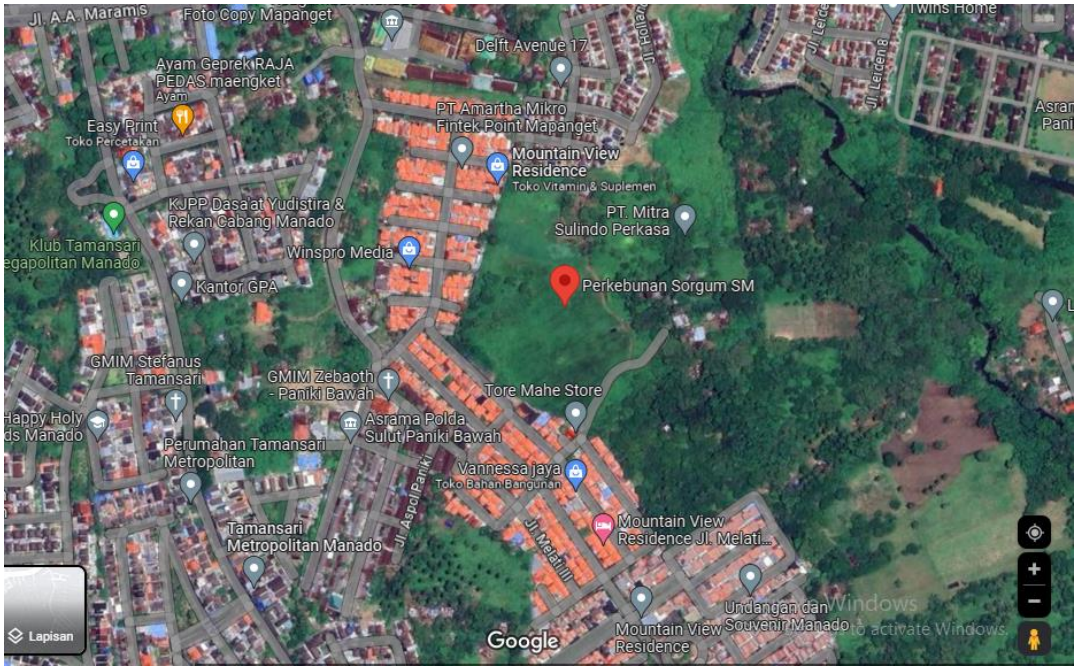

Figure 1. SM Sorghum Plantation, Manado City, North Sulawesi, Indonesia

Tools and materials

The tools used in this research were hoes, shovels, meters, nets, handsprayer, raffiah rope, bamboo stakes, twig scissors, digital scales, jugs, trays, sample paper bags and an oven. The materials used in this research were furadan, organic herbicide, organic fertilizer, sorghum seeds originating from the Maros Cereal Center, Makasar, South Sulawesi.

Research procedure

1. Land preparation
   The land used in this research was processed manually, cleaned using a handsprayer, machete and hoe, so that it was free from wild grass or weeds. Then turning the soil and hoeing aims to loosen the soil so that the land is ready for planting.
2. Penanaman
   Planting sorghum seeds is done using the tubing method. Seeds are planted in a plot measuring 3m x 3m with a spacing of 25cm x 25cm. In each hole, sorghum seeds are planted to a depth of 3 cm.
3. Pemeliharaan
   The first fertilization is carried out 14 days after planting (DAT), the fertilizer given is 180 ml of liquid organic fertilizer per planting hole. The second fertilization is given when the plants are 50 HST using liquid organic fertilizer of 150 ml per planting hole. Maintenance is carried out by watering twice a day during hot weather up to 30 HST and cleaning of weeds in the planting plot is carried out every day.
4. Pengamatan
   Observations were made every day until the flowering phase. The temperature was recorded every day, and once every two weeks, plant height was measured, stem diameter, number and width of leaves were recorded on each plant observed.
5. Harvesting is done when the plant enters the flowering phase. Plants were cut at a height of 10 cm from the ground then weighed, stems, leaves and panicles were separated. Each fresh stem, leaf and panicle is weighed using a digital scale and then placed in a coded paper sample bag.
6. The paper bag containing the sample is placed in the oven at 600^{C} for 1x24 hours, removed from the oven and weighed using a digital scale.
7. The sample is placed in the oven at 105^{0}C for 1 x 24 hours, taken out and then weighed again.

Experimental design

This research used a Completely Randomized Design (CRD) consisting of 4 treatments and 5 replications, so there were 20 experimental units. The treatment given was sorghum plant varieties:

V1 = Super 1
V2 = Super 6
V3 = Super 2
V4 = Numbu

Variables Measured

1. Fresh weight of leaves
   The fresh weight of the leaves was obtained after harvest, the leaves were separated from the stems and panicles, and the fresh weight was immediately weighed (g/plant).
2. Weight of dry leaf material
   The dry matter weight of the leaves was calculated based on multiplying the fresh weight of the leaves by the dry matter content of the leaves (g/plant).
3. Fresh weight of stem
   The fresh weight of the stems was obtained after harvest, the stems were separated from the leaves and the panicles were immediately weighed for fresh weight (g/plant).
4. Weight of dry stem material
   The dry matter weight of the stem is calculated based on multiplying the fresh weight of the stem by the dry matter content of the stem (g/plant).
5. Fresh weight of panicles
   The fresh weight of the panicles was obtained after harvest, the panicles were separated from the leaves and stems and their fresh weight was immediately weighed (g/plant)
6. Weight of panicle dry material
   Panicle dry matter weight was calculated based on multiplying the panicle fresh weight by the panicle dry matter content (g/plant).

Hasil dan Bahasan

The results of the analysis of productivity growth of sorghum varieties Super 1, Super 6, Super 2, and Numbu expressed through fresh weight and dry weight of leaves, stems and panicles can be seen in Table 1.

Table 1. Effect of Different Varieties on Sorghum Productivity

Variety	Variable					
	Berat Segar (g/tanaman)			Berat Bahan Kering (g/tanaman)		
	Leaf	Stem	Panicle	Leaf	Stem	Panicle
Super 1	62,47^{c}	327,9^{a}	42,60^{c}	15,80^{b}	79,60^{b}	23,47^{c}
Super 6	88,33^{a}	297,9^{ab}	81,47^{a}	20,40^{a}	56,87^{c}	45,20^{a}
Super 2	73,80^{b}	266,6^{bc}	71,60^{ab}	22,73^{a}	97,33^{a}	35,20^{b}
Numbu	52,53^{d}	264,6^{c}	62,93^{b}	12,27^{c}	68,40^{bc}	36,00^{b}

Note: different letters in the same column indicate very significant differences (P<0,01)

Effect of Variety on Fresh Weight of Leaves, Stems and Panicles

The effect of different varieties on the fresh weight of leaves, stems and panicles of sorghum plants can be seen in Table 1. The fresh weight of sorghum plant leaves ranges from 52.53 grams/plant obtained from the Numbu variety to 88.33 grams/plant obtained from the Super 6 variety The fresh weight of sorghum stalks ranges from 264.6 grams/plant obtained from the Numbu variety to 327.9 grams/plant obtained from the Super 1 variety. The fresh weight of the sorghum plant panicles ranges from 42.60 grams/plant obtained from the Super variety 1 to 81.47 grams/plant obtained from the Super 6 variety.

The results of the diversity analysis showed that different varieties had a very significantly different effect ($P<0.01$) on the fresh weight of leaves, stems and panicles of sorghum plants. The BNJ test showed that the fresh leaf weight of the Super 6 variety was very significantly ($P<0.01$) higher than the Numbu, Super 1 and Super 2 varieties; the fresh stem weight of the Super 1 variety was very significantly ($P<0.01$) higher than the Numbu and Super 2 varieties, but not significantly different ($P>0.05$) from the Super 6 variety; The fresh panicle weight of the Super 6 variety was significantly higher than the Numbu variety and the Super 1 variety, but was not significantly different ($P>0.05$) from the Super 2 variety. This shows that varieties that have high adaptability will produce a higher fresh weight of leaves so that the number of leaves tends to be greater than other varieties. According to Isaac et al. (2013) the number of leaves influences plant photosynthesis, the more leaves the higher the photosynthesis that occurs. Leaves function as the main organ of photosynthesis in plants, they are effective in absorbing light and fast in taking up CO_2.

Effect of Treatment on Dry Weight of Leaves, Stems and Panicles

The effect of different varieties on the dry weight of leaves, stems and panicles of sorghum plants can be seen in Table 1. The dry weight of sorghum plant leaves ranges from 12.27 grams/plant obtained from the Numbu variety to 22.73 grams/plant obtained from the Super 2 variety The dry weight of sorghum stems ranges from 56.87 grams/plant obtained from the Super 6 variety to 97.33 grams/plant obtained from the Super 2 variety. The dry weight of sorghum plant panicles ranges from 23.47 grams/plant obtained from the variety Super 1 up to 45.20 grams/plant obtained from the Super 6 variety.

The results of the diversity analysis showed that different varieties had a very significantly different effect ($P<0.01$) on the dry weight of leaves, stems and panicles of sorghum plants. The BNJ test showed that the dry leaf weight of the Super 2 variety was very significantly ($P<0.01$) higher than the Numbu and Super 1 varieties, but was not significantly different ($P>0.05$) from the Super 6 variety; the stem dry weight of the Super 2 variety was very significantly ($P<0.01$) higher than the Numbu, Super 6 and Super 1 varieties; The dry weight of the panicles of the Super 6 variety was significantly higher than the Numbu, Super 2 and Super 1 varieties.

According to Lakitan (2010), the lack of availability of macro nutrients (N, P, K) can inhibit vegetative growth, so that it will affect the photosynthesis process of plants and if the nutrient content in the soil is sufficient, the area of a plant will be higher, where some Most of the results of photosynthesis are channeled into leaf formation which results in increased leaf area.

Conclusion

The different varieties of sorghum plants analyzed, namely the Super 1, Super 2, Super 6 and Numbu flowering phase varieties, provide varying productivity; where the highest fresh weight of leaves and panicles and dry weight of leaves and panicles were obtained from the Super 6 variety; for fresh weight of stems obtained from the Super 1 variety and for dry weight of stems obtained from the Super 2 variety.

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