Available at: https://ejournal.unib.ac.id/index.php/JIPI
DOI: https://doi.org/10.31186/jipi.26.2.114-122

p-ISSN 1411-0067
e-ISSN 2684-9593

JIPI Jurnal Ilmu-Ilmu Pertanian Indonesia
INDONESIAN JOURNAL OF AGRICULTURE SCIENCES

THE GROWTH OF SORGHUM TYPES (*Sorghum bicolor* L. Moench) TREATED ORGANIC FERTILIZER IN DRYLAND

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ABSTRACT

Sumbawa Regency exhibits relatively dry soil characteristics due to limited water availability resulting from low rainfall levels. One of the plants suitable for cultivation in this area is sorghum. Sorghum is a viable alternative to rice and corn, as its seed market price is comparatively high. In addition to the limited rainfall in this region, farmers have faced challenges in optimizing crop yields to meet the nutritional needs of their plants. One approach is to optimize the utilization of inorganic and organic fertilizers as supplementary complex plant nutrients. The proposed approach involves using appropriately dosed organic fertilizers, which is anticipated to diminish reliance on excessive inorganic fertilizers. This study aimed to determine the effect of different doses of organic fertilizers on various varieties of sorghum in dryland plantations located in Sumbawa Regency. The experimental design used was Split Plot Design, with sorghum varieties (Bioguma, GBE Methane, and Sweetbetty) as the main-plot and organic fertilizer doses (0, 50, 100, and 200 g/plant) as sub-plots. The results of this study indicated that the interaction between varieties and organic fertilizers on plant growth promotes an increase in plant height, stem diameter, number of leaves, and leaf length. At the end of the plant height observation (42–49 days after sowing), the combination of treatments resulted in an increase in plant height. During the initial growth phases, certain variables showed responses in terms of leaf quantity (7 and 28 days after sowing) and leaf length (14–28 days after sowing). Sweetbetty and GBE Methane show enhanced plant growth; Sweetbetty shows higher plant height and leaf quantity, whereas GBE Methane demonstrates optimal stem diameter and leaf length, compared to Bioguma (a variety from Indonesia).

Keyword: *food safety, food security, organic fertilizer, sorghum, sustainable agriculture*

ABSTRAK

[PERTUMBUHAN SORGUM (*Sorghum bicolor* L. Moench) YANG DIBERI PUPUK ORGANIK DI LAHAN KERING]. Kabupaten Sumbawa memiliki karakteristik tanah yang relatif kering karena terbatasnya ketersediaan air akibat rendahnya curah hujan. Salah satu tanaman yang cocok untuk dibudidayakan di daerah ini adalah sorgum. Sorgum merupakan alternatif yang layak untuk menggantikan padi dan jagung, karena harga benihnya yang relatif tinggi. Selain curah hujan yang terbatas di wilayah ini, petani menghadapi tantangan dalam mengoptimalkan hasil panen untuk memenuhi kebutuhan nutrisi tanaman. Salah satu pendekatan adalah mengoptimalkan pemanfaatan pupuk anorganik dan organik sebagai suplemen nutrisi tanaman kompleks. Pendekatan yang diusulkan melibatkan penggunaan pupuk organik dengan dosis yang tepat, yang diharapkan dapat mengurangi ketergantungan pada pupuk anorganik yang berlebihan. Penelitian ini bertujuan untuk mengetahui pengaruh dosis pupuk organik yang berbeda terhadap berbagai varietas sorgum di perkebunan lahan kering yang terletak di Kabupaten Sumbawa. Rancangan percobaan yang digunakan adalah Rancangan Petak Terbagi, dengan varietas sorgum (Bioguma, GBE Methane, dan Sweetbetty) sebagai petak utama dan dosis pupuk organik (0, 50, 100, dan 200 g/tanaman) sebagai anak petak. Hasil penelitian ini menunjukkan bahwa interaksi antara varietas dan pupuk organik terhadap pertumbuhan tanaman mendorong peningkatan tinggi tanaman, diameter batang, jumlah daun, dan panjang daun. Pada akhir pengamatan tinggi tanaman (42–49 hari setelah tanam), kombinasi perlakuan menghasilkan peningkatan tinggi tanaman. Selama fase pertumbuhan awal, variabel tertentu menunjukkan respons jumlah daun (7 dan 28 hari setelah tanam) dan panjang daun (14–28 hari setelah tanam). Sweetbetty dan GBE Methane menunjukkan peningkatan pertumbuhan tanaman; Sweetbetty menunjukkan tinggi tanaman dan jumlah daun yang lebih tinggi, sedangkan GBE Methane menunjukkan diameter batang dan panjang daun yang optimal, dibandingkan dengan Bioguma (varietas dari Indonesia).

Kata kunci: *keamanan pangan, ketahanan pangan, pertanian berkelanjutan, pupuk organik, sorgum*

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is a member of the worldwide family Graminae (Poaceae) (Khan *et al*., 2022). On a world production basis, sorghum ranked fourth among the major cereals after wheat, rice, and maize (Sharif *et al*., 2014). As a seasonal plant of the C4 type, which includes corn, sugar cane, and others, sorghum is resistant to high temperatures and water shortages. C4 plants get their name from the first thing that comes out of fixing CO2: oxaloacetate, a C4 organic acid. This acid is made when PEP is carboxylated by PEP carboxylase (Christin & Osborn, 2014). Sorghum serves as an alternate dietary source to substitute rice, corn, and cassava, which are relatively high in carbohydrates. Sorghum is a cereal commodity that has not been widely consumed by the Indonesian people in the years between 2010, but in the years between 1990, it became an important source of nutrition. The nutritional value of sorghum seeds is not inferior to rice. In fact, sorghum contains carbohydrates (70–80%), protein (8–18%), dietary fiber (19%), fiber (3%), and other minerals (Tanwar *et al*., 2023). Sorghum productivity in Indonesia is moderate (2.00 ton/ha), and according to Kurniasari *et al*. (2023), the average productivity of dry sorghum seeds in the world is 1.41 ton/ha. The highest productivity is in America, which is 3.71 ton/ha and the lowest in Africa, which is 1.00 ton/ha. Productivity in Asia is 1.11 ton/ha. This plant can grow on marginal land in Indonesia (Sari *et al*., 2022). Marginal land can serve as a site for agricultural production due to its expanse and ability to enhance agricultural productivity, exemplified by the drylands in Sumbawa Regency, West Nusa Tenggara Province (WNT). An appropriate environment is essential for the growth and development of sorghum, leading to increased plant productivity. Plant productivity is a combination of the influence of plant genetics, plant growing environment, and genetic × environment interactions (Badriyah *et al*., 2015).

Farmers in Sumbawa Regency face several challenges or problems concerning fertilizers, which are crucial for enhancing crop yields and ensuring food security. Farmers apply fertilizers without considering the specific nutritional needs of plants and soil. This can result in nutritional imbalances and decrease the effectiveness of fertilizer application (Sher *et al*., 2022), especially when farmers combine both organic and inorganic fertilizers concurrently. Organic fertilizers play a crucial role in supplying nutrients, maintaining soil fertility, enhancing soil characteristics and health, and boosting crop yield (Irmansyah *et al*., 2020; Al-Zayadi & Hussein, 2024). The application of organic fertilizers to the soil results in the gradual release of nutrients, particularly nitrogen and phosphorus (Kareem & Hamed, 2024). Organic fertilizers consist of natural ingredients and provide a comprehensive array of macro- and micronutrients in sufficient amounts for plants, whereas inorganic fertilizers are synthesized through artificial chemical processes involving human intervention, offering elevated levels of macro- and micronutrients in only a limited number of elements. Inorganic fertilizers have high concentrations of some of their elements, which effectively stimulate plant growth and fruit development. In addition, excessive application of in-organic fertilizers or those that exceed specified limits can adversely affect the environment, such as water pollution and soil degradation (Muhammad *et al*., 2018; Kamaei *et al*., 2019; Hassanen & Abotaleb, 2020).

The adverse effects of agricultural environmental degradation are positively associated with the diminished quantity and activity of beneficial bacteria in the soil and cover crops capable of nitrogen fixation (Yadav & Sarkar, 2019; Khairi *et al*., 2023). In the long term (>3 years) the use of fertilizers will reduce crop production. Damage to the agricultural environment will pollute irrigation water and rivers around the agricultural environment that flow into large rivers and result in a reduction or death of fish and other living creatures native to the river. Long-term application of inorganic fertilizers has been criticized for posing various threats to human health and the environment, including the contamination of groundwater and environmental detriment (Kakar *et al*., 2020). Continuous use of inorganic fertilizers causes plant tissues to absorb and accumulate heavy metals, thereby reducing the nutritional quality and yield of crops (Maqbool *et al*., 2020). Therefore, excessive use of inorganic fertilizers has resulted in contamination of soil, air, and water due to nutrient leaching, degradation of soil physical qualities, and the accumulation of toxic chemical compounds in aquatic environments, among other effects (Abdiani *et al*., 2019; Maqbool *et al*., 2020). Chemical compounds in agriculture are one of the major and dominant waste/pollution factors in developing countries and play a harmful role in human health in agriculture livestock (Sharma & Singhvi, 2017). In addition, excessive use of inorganic fertilizers results in decreased soil quality and toxicity to living things, such as soil microbes (*Rhizobium* sp., *Azotobacter* sp., and others). This study identified two primary issues: the limited availability of alternative food sources beyond rice and the inadequate growth support capacity for cultivated plants in Sumbawa Regency. Multiple solutions were identified for these issues, specifically the cultivation of sorghum plants and the application of organic fertilizers on agricultural land to enhance plant growth. This research is essential due to the limited demand for alternative food sources and the suitability of the growing environment for sorghum cultivation in Sumbawa Regency. Different sorghum genetics or varieties need to be studied with a combination of organic fertilizer doses needed to determine the quality of safe and high-quality sorghum seeds, ensuring their safety for public consumption. The purpose of this study was to determine the effect of different doses of organic fertilizers on various sorghum varieties in dryland plantations located in Sumbawa Regency.

MATERIALS AND METHODS

This research was conducted from March to August 2024 at Pernek Village, Moyo Hulu Subdistrict, Sumbawa Regency, WNT Province, Indonesia, at an altitude of 40 m asl. The location had a temperature of 30.58 ± 0.97 °C, RH of 76.04 ± 0.51%, sunlight intensity of 39,751.20 ± 10.15 lx, and wind speed of 2.50 ± 0.08 m/s. This research used a Split Plot Design consisting of two plots. The main plot used various varieties of sorghum: V_1 = Bioguma (originated from Indonesia), V_2 = GBE Methane (brand of Seminart Selected Seeds, Italy), and V_3 = Sweetbetty (brand of AGT Foods Africa, South Africa). The subplot is the application of solid organic fertilizer: T_0 = 0 g/plant (control), T_1 = 50 g/plant, T_2 = 100 g/plant, and T_3 = 200 g/plant. Solid organic fertilizer has been made according to guidelines from Khairi *et al*. (2024). Inorganic fertilizers (NPK Phonska and Urea) were given at 5 g/plant at 10, 20, and 30 DAS. The watering was given every three days of 250 mL/polybag and depending on rain. The planting distance was 70 cm × 20 cm. Chemicals with a concentration of 1,000 ppm were used to control pests and plant diseases. The fungicide used was Amistar Top and the insecticide used was Curacron. The planting media consists solely of soil from the farm, weighing 10 kg per polybag. The soil used is free from weeds or organic/non-organic waste, then the soil is filtered (1×1 cm) to separate stones and other waste. Soil analysis was carried out before planting on experimental land, and there were three samples for each soil observation variable. The soil contained N of 0.08 ± 0.05%, P of 185.72 ± 3.58 ppm, and K of 0.58 ± 0.01 cmol(+)/kg. N was analyzed by following the Kjeldahl method. P was analyzed by following Bray I. Finally, K was analyzed by NH_4OAc pH 7.0. Then an analysis of organic fertilizer was carried out before planting on experimental land and before being given to plants. The fertilizer contained water content of 13.24% (Loss on Ignition method), N of 1.35 ± 0.38% (Kjeldahl method), P_2O_5 of 1.60 ± 0.50% (HNO_3:$HClO_4$, Spectrophotometer), and K_2O of 3.80 ± 0.55% (HNO_3:$HClO_4$, Atomic Absorption Spectrometer). The variables observed in this research were plant height, stem diameter, number of leaves, and leaf length. The observation data were analyzed using Analysis of Variance (ANOVA) 5%. The result of the ANOVA, which showed a significant difference, was tested with post-hoc analysis using Tukey's Honest Significant Difference (HSD) 5%. Software used for data analysis was SAS® OnDemand for Academics.

RESULTS AND DISCUSSION

Assessment of plant height

The plant height data from 7–35 days after sowing (DAS) (Table 1 and Table 2) shows that is not significantly different. This is because the varieties with organic fertilizer doses does not provide a response at the beginning of growth until the middle of the observation, then the results are the same. Furthermore, at the end of the observation (56 DAS) there was no different response between treatments. Table 2 shows

Table 1. Plant height 7–28 DAS with different treatment combinations

Interaction	Plant height (cm)			
V × T	7 DAS	14 DAS	21 DAS	28 DAS
V_1T_0	11.00±0.50	22.93±0.83	37.89±0.43	67.44±0.38
V_1T_1	10.94±0.50	21.63±0.26	38.52±0.32	68.14±0.32
V_1T_2	12.36±0.28	22.57±0.31	41.54±0.50	68.33±0.36
V_1T_3	12.50±0.34	22.09±0.47	44.45±0.27	68.78±0.43
V_2T_0	12.69±0.22	26.51±0.25	39.43±0.24	64.59±0.44
V_2T_1	12.20±0.30	26.87±0.33	40.66±0.21	66.04±0.34
V_2T_2	12.06±0.20	26.94±0.17	43.08±0.77	67.18±0.46
V_2T_3	11.99±0.21	26.78±0.46	46.77±0.38	66.96±0.44
V_3T_0	13.84±0.20	28.06±0.25	64.06±0.46	94.30±0.65
V_3T_1	12.77±0.22	26.41±0.83	66.46±0.27	96.58±0.50
V_3T_2	13.28±0.29	27.92±0.49	67.68±0.54	96.84±0.49
V_3T_3	11.71±0.48	28.32±0.37	68.01±0.87	97.11±0.61

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; mean ± standard error (n = 3) significantly different data at 42–49 DAS. The plant height is of great morphophysiological importance, by directly reflecting on plant growth and differentiation (Oliveira *et al*., 2017). Based on research conducted by Novitasari *et al*. (2016) reported that plant height of various sorghum varieties (Numbu, CTY, and Manis) planted in dryland in Gunung Kidul Regency, Special Region of Yogyakarta Province, Indonesia produced a value from Numbu of 165.93 cm, CTY of 162.00 cm, and Manis of 142.47 cm. The three varieties, the values are still lower compared to Sweetbetty (233 cm –241 cm) with control or treatment with organic fertilizer at 49 DAS. This study is in conform with the results of Muhammad *et al*. (2018), that the provision of higher organic fertilizers has a significant impact on increasing plant height.

Table 2. Plant height 35–56 DAS with different treatment combinations

Inter-action (VxT)	Plant height (cm)			
	35 DAS	42 DAS	49 DAS	56 DAS
V_1T_0	81.42±0.36	126.48±0.28 h	151.49±0.48 b	174.30±0.49
V_1T_1	81.53±0.36	127.24±0.53 gh	154.45±0.24 b	176.49±0.24
V_1T_2	84.86±0.38	128.44±0.28 fg	157.48±0.95 b	176.07±0.58
V_1T_3	86.53±0.32	127.77±0.55 f	159.39±0.29 b	177.61±0.57
V_2T_0	87.20±0.37	113.87±0.49 e	178.36±0.40 d	191.38±0.33
V_2T_1	88.38±0.31	114.71±1.26 e	178.35±0.43 d	194.10±0.20
V_2T_2	88.64±0.37	119.84±0.31 d	187.84±0.29 c	195.05±0.45
V_2T_3	91.92±1.47	120.69±0.33 d	188.72±0.22 c	197.80±0.29
V_3T_0	121.78±0.58	182.61±0.27 c	233.97±0.66 a	252.28±0.71
V_3T_1	124.84±0.37	185.22±0.39 bc	236.88±0.36 a	252.09±0.53
V_3T_2	125.53±0.22	186.66±0.24 ab	238.78±0.20 a	255.51±0.37
V_3T_3	126.44±0.32	187.28±0.43 a	241.32±0.45 a	257.44±0.55

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; mean ± standard error (n = 3)

Assessment of number of leaves

The number of leaves was significantly different at 7 and 28 DAS (Table 3), but not significantly different at 14–21 DAS and 35–56 DAS (Table 3 and Table 4). The combination of treatments given to sorghum responded at the beginning of observation (7 DAS) and the middle (28 DAS), with a pause process of 14 days (from 7 DAS). This indicates that the organic , effect on sorghum varieties. Organic fertilizer supports high efficiency in fertilizer use due to the slow release of nutrients during plant growth (Hazra, 2016; Oliveira *et al*., 2017).

Table 3. Number of leaves 7–28 DAS with different treatment combinations

Interac-tion	Number of Leaves			
V × T	7 DAS	14 DAS	21 DAS	28 DAS
V_1T_0	2.53±0.08 c	4.03±0.23	6.03±0.46	7.53±0.33 a
V_1T_1	2.40±0.03 c	3.60±0.03	6.13±0.49	7.67±0.34 a
V_1T_2	2.80±0.07 bc	3.77±0.05	5.03±0.05	7.43±0.21 ab
V_1T_3	2.80±0.03 bc	3.80±0.03	5.17±0.05	6.97±0.05 abc
V_2T_0	2.47±0.05 c	3.27±0.08	5.17±0.05	6.43±0.07 c
V_2T_1	2.27±0.08 c	3.53±0.07	5.60±0.03	6.40±0.09 c
V_2T_2	2.53±0.02 c	3.60±0.03	5.60±0.03	6.40±0.06 c
V_2T_3	2.43±0.11 c	3.50±0.10	5.60±0.03	6.40±0.06 c
V_3T_0	3.70±0.03 a	5.37±0.04	6.13±0.11	6.57±0.08 bc
V_3T_1	3.67±0.05 a	5.23±0.10	6.23±0.08	7.60±0.09 a
V_3T_2	3.43±0.04 a	5.30±0.12	6.30±0.07	7.77±0.05 a
V_3T_3	3.33±0.10 ab	5.50±0.07	6.40±0.09	7.80±0.06 a

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; mean ± standard error (n = 3)

Table 4. Number of leaves 35–56 DAS with different treatment combinations

Interaction	Number of leaves			
V × T	35 DAS	42 DAS	49 DAS	56 DAS
V_1T_0	8.90±0.12	10.80±0.23	13.80±0.20	14.43±0.27
V_1T_1	9.20±0.17	11.50±0.27	13.90±0.03	14.23±0.18
V_1T_2	9.27±0.11	11.57±0.38	14.03±0.13	15.27±0.22
V_1T_3	9.17±0.05	11.40±0.09	14.13±0.24	16.07±0.21
V_2T_0	7.33±0.05	8.40±0.07	10.87±0.21	11.30±0.49
V_2T_1	7.30±0.09	8.40±0.07	10.97±0.24	11.63±0.20
V_2T_2	7.33±0.08	8.57±0.04	10.83±0.32	11.00±0.41
V_2T_3	7.43±0.05	8.40±0.09	11.00±0.44	11.17±0.29
V_3T_0	8.40±0.10	9.37±0.11	10.30±0.03	11.83±0.20
V_3T_1	8.83±0.05	9.33±0.07	10.50±0.15	11.60±0.29
V_3T_2	8.40±0.06	9.17±0.05	10.50±0.15	12.37±0.12
V_3T_3	8.30±0.09	9.60±0.03	10.43±0.15	12.60±0.24

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; mean ± standard error (n = 3)

Based on research conducted by Akhtar *et al.* (2020), the number of leaves of various sorghum varieties (Johar and SS-2) planted in dryland in Rawalpindi, Pakistan, produced a value of 11.5 for Johar and 10.6 for SS-2. Compared to Bioguma or Sweetbetty, both varieties yielded lower leaf counts when treated with organic fertilizer (50 g/plant) at 28 days after sowing. This study is in conformity with the results of Muhammad *et al.* (2018) found that the provision of higher organic fertilizers has a significant impact on the increasing number of leaves

Assessment of stem diameter

The stem diameter shows significant differences at 7–14, 28, and 42–56 DAS (Table 5), but does not significantly differ at 21 and 35 DAS (Table 5 and Table 6). The development of stem diameter is seen at the beginning of observation (7–14 DAS); after that, it begins to be seen again at 28 and 42–56 DAS. The development pause process necessitates a period of 7 days to identify any significant differences in response. Based on research conducted by Anggraini *et al.* (2021), it was reported that sorghum planted in dryland in North Lombok Regency, West Nusa Tenggara Province, Indonesia, with 20 ton/ha of organic fertilizer (converted to 280 g/plant) produced a value of stem diameter of 2.46 cm, significantly different compared to 10 ton/ha of organic fertilizer (converted to 140 g/plant). The content of soil organic matter, which can strengthen the ability of the soil to maintain and supply fertilizer as well as change the structure of soil aggregates and enhance soil fertility, can effectively be improved by increasing the use of organic fertilizer (Li *et al.*, 2021; Wan *et al.*, 2021). Additionally, several studies show that organic fertilizer can improve soil physico-chemical properties, such as soil organic matter, total porosity, and available N, P, and K of soils (Tabaxi *et al.*, 2020; Kuziemska *et al.*, 2020). Increasing these components supports increased plant growth.

Table 5. Stem diameter 7–28 DAS with different treatment combinations

Interaction	Stem Diameter (cm)			
V × T	7 DAS	14 DAS	21 DAS	28 DAS
V_1T_0	0.43±0.02 bc	1.20±0.03 ab	1.60±0.03	1.90±0.03 e
V_1T_1	0.50±0.03 bc	1.17±0.05 abc	1.63±0.02	2.20±0.03 cd
V_1T_2	0.50±0.03 bc	1.23±0.02 ab	1.80±0.03	2.50±0.03 ab
V_1T_3	0.53±0.02 bc	1.30±0.03 a	1.80±0.03	2.70±0.03 a
V_2T_0	0.33±0.02 c	0.93±0.05 bc	1.23±0.02	1.63±0.05 f
V_2T_1	0.37±0.02 c	1.10±0.03 abc	1.53±0.05	1.90±0.03 e
V_2T_2	0.60±0.03 ab	1.30±0.03 a	1.70±0.03	2.03±0.02 de
V_2T_3	0.77±0.02 a	1.30±0.03 a	1.83±0.04	2.17±0.05 d
V_3T_0	0.33±0.02 c	0.87±0.02 c	1.40±0.03	1.87±0.02 e
V_3T_1	0.43±0.02 bc	0.87±0.02 c	1.47±0.02	2.07±0.04 de
V_3T_2	0.47±0.02 bc	1.07±0.05 abc	1.60±0.03	2.13±0.02 d
V_3T_3	0.53±0.02 bc	1.30±0.03 a	1.73±0.02	2.40±0.03 bc

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; the number followed by the same letter on the same days after sowing (DAS) has no significant difference based on Tukey's HSD test with significant with α 0.05; mean ± standard error (n = 3)

Table 6. Stem diameter 35–56 DAS with different treatment combinations

Interaction	Stem diameter (cm)			
V × T	35 DAS	42 DAS	49 DAS	56 DAS
V_1T_0	2.30±0.03	2.73±0.02 de	3.70±0.03 de	4.10±0.03 h
V_1T_1	2.47±0.02	2.80±0.03 de	3.70±0.03 de	4.23±0.02 fgh
V_1T_2	2.57±0.07	2.80±0.03 de	3.83±0.02 cd	4.20±0.03 gh
V_1T_3	2.77±0.05	2.90±0.03 cd	3.83±0.02 cd	4.43±0.02 def
V_2T_0	2.10±0.03	2.60±0.03 e	3.83±0.02 cd	4.80±0.03 abc
V_2T_1	2.40±0.03	2.90±0.03 cd	4.00±0.03 bc	4.83±0.02 ab
V_2T_2	2.50±0.09	3.20±0.03 ab	4.13±0.02 ab	4.83±0.02 ab
V_2T_3	2.77±0.02	3.27±0.05 a	4.20±0.03 a	4.97±0.02 a
V_3T_0	2.30±0.03	2.83±0.02 cde	3.40±0.03 f	4.10±0.03 h
V_3T_1	2.47±0.02	2.83±0.02 cde	3.60±0.03 e	4.40±0.03 efg
V_3T_2	2.53±0.02	2.97±0.05 bcd	3.83±0.02 cd	4.63±0.02 bcd
V_3T_3	2.77±0.02	3.10±0.03 abc	3.83±0.02 cd	4.60±0.03 cde

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; the number followed by the same letter on the same days after sowing (DAS) has no significant difference based on Tukey's HSD test with significant with α 0.05; mean ± standard error (n = 3)

Assessment of leaf length

Variety responses with different fertilizer doses caused significant differences in leaf length 14 –28 DAS (Table 7). At 14–21 DAS, Sweetbetty +

200 g/plant of organic fertilizer ($V_3.T_3$) produced the most significant results, while at 28 DAS, GBE Methane + organic fertilizer (100 or 200 g/plant) yielded the best results. Table 8 showed no significant differences at 35–56 DAS. Application of organic fertilizer doses to sorghum varieties will affect leaf length. The results of this study coincide with those of Silalahi *et al*. (2018) reported that the application of organic fertilizer of 6.5 ton/ha (converted to 163 g/plant) produced a value of 102.38 cm, significantly different compared to the control (0 g/plant) of 85.78 cm in leaf length. Different plant varieties and fertilizer doses did not cause significant differences between treatments. This may be caused by the dose of organic fertilizer not being able to be made available in the long term by soil particles for plant use in the period 35–56 DAS, which only sustains its efficacy during the interval of 14–28 DAS.

Table 7. Leaf length 7–28 DAS with different treatment combinations

Interaction	Leaf length (cm)			
V × T	7 DAS	14 DAS	21 DAS	28 DAS
V_1T_0	7.80±0.72	14.69±1.31 d	21.10±1.27 c	39.54±0.68 e
V_1T_1	8.68±0.59	13.54±0.67 d	18.74±0.38 c	39.47±0.30 e
V_1T_2	8.48±0.07	13.56±0.13 d	17.76±0.80 c	39.21±0.19 e
V_1T_3	8.67±0.04	16.43±0.23 cd	19.73±0.05 c	40.01±0.11 e
V_2T_0	9.73±0.08	20.19±0.19 bc	31.16±0.28 ab	53.65±0.52 cd
V_2T_1	10.40±0.17	24.29±0.98 ab	35.83±0.64 ab	58.05±0.52 b
V_2T_2	9.86±0.41	23.22±0.72 ab	32.71±0.91 ab	62.37±0.98 a
V_2T_3	9.30±0.17	22.95±0.89 ab	33.44±0.82 ab	64.20±0.51 a
V_3T_0	8.42±0.23	23.59±0.87 ab	30.04±0.17 b	51.70±0.41 d
V_3T_1	8.80±0.06	22.16±0.21 ab	33.09±0.93 ab	54.39±0.42 cd
V_3T_2	8.75±0.05	27.02±0.57 a	34.59±1.50 ab	56.70±0.38 bc
V_3T_3	8.55±0.21	26.84±1.28 a	36.62±0.34 a	58.38±0.17 b

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; the number followed by the same letter on the same days after sowing (DAS) has no significant difference based on Tukey's HSD test with significant with α 0.05; mean ± standard error (n = 3)

Table 8. Leaf length 35–56 DAS with different treatment combinations

Interaction	Leaf length (cm)			
V × T	35 DAS	42 DAS	49 DAS	56 DAS
V_1T_0	67.10±1.41	86.10±0.99	95.94±0.89	108.79±0.45
V_1T_1	65.66±1.57	87.40±0.76	96.72±0.57	107.73±0.68
V_1T_2	66.66±0.67	88.74±0.34	98.64±0.66	109.88±0.39
V_1T_3	68.89±0.37	90.01±0.13	100.31±0.47	111.65±1.57
V_2T_0	66.44±1.35	83.38±1.55	96.45±0.45	111.61±1.32
V_2T_1	64.59±1.58	87.99±0.87	96.88±1.22	107.01±0.53
V_2T_2	69.30±0.25	88.29±0.37	92.84±1.00	102.93±0.97
V_2T_3	69.20±0.37	88.28±0.72	94.79±0.83	106.34±1.68
V_3T_0	62.44±0.14	74.49±0.63	96.59±0.81	110.31±1.67
V_3T_1	66.60±0.53	76.93±0.68	97.33±0.82	106.05±1.05
V_3T_2	67.54±0.71	74.39±1.64	98.45±0.43	106.44±1.33
V_3T_3	71.33±0.20	77.04±0.58	96.78±0.73	114.98±1.41

Note : DAS = Days After Sowing; V = sorghum varieties; V_1 = Bioguma; V_2 = GBE Methane; V_3 = Sweetbetty; T = organic fertilizer doses; T_0 = 0 g/plant; T_1 = 50 g/plant; T_2 = 100 g/plant; T_3 = 200 g/plant; mean ± standard error (n = 3)

CONCLUSION

The interaction between varieties and organic fertilizers on plant growth supports an increase in plant height, stem diameter, number of leaves, and leaf length. The combined response to plant height increased at the end of plant height observation (42–49 DAS). While some variables were seen reacting at the beginning of the growth of number of leaves (7 and 28 DAS) and leaf length (14–28 DAS). A different thing was shown in stem diameter, which resulted in a difference in increase over time. The results and implementation of this study can be recommended using Sweetbetty and GBE Methane with 200 g/plant of organic fertilizer.

Sweetbetty and GBE Methane are sorghum varieties from abroad that can be recom-mended for planting in dryland in Sumbawa Regency combined with organic fertilizers to increase plant growth.

ACKNOWLEDGEMENT

Thanks to Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (KEMENRISTEKDIKTI) for the grant funds that have been provided through to Penelitian Dosen Pemula Afirmasi.

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