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Agronomic Characters on Three Varieties of Sorgum with Differences of NPK Fertilizer Source and Harvest Time

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ABSTRACT
The research took place in the rainy season 2014-2015 which was held in Gowa regency of South Sulawesi. The objective of the study was to evaluate the agronomic character of three varieties of sorghum treated with different sources of NPK fertilizer and harvest time. Design The research used is Split-Split Plot Design, with Main Plot of Fertilization consisting of Conventional NPK (p1), NPK Slow Release (p2) and NPK Combination (p3). subplot were harvest time consisted above before physiological maturity (W1), the exact physiological maturity (W2) and passing physiological maturity (W3), and sub-sub plot were varieties consisted of numbu (V1), super-1 (V2) and super 2 (V3). The result data is processed by using variance analysis, further test using LSD test. The results showed that the treatment of P2 and P3 gave the best result to observed agronomic character, harvest time treatment in general was not significantly different but on the parameter of fresh biomass weight and fresh weight of stem, harvest time W1 gives the best results, while the best varieties are V1 and V2.
Keywords: *sweet sorghum, npk fertilizer sources, harvest time, sorgum variety, agronomic character.*

INTRODUCTION

Sorghum is a commodity that has various benefits. Sorghum seed is used as a source of food and is one of the world's main cereal crops. In addition, sorghum seeds can also be used as a source of ruminant animal feed. Forage of potential sorghum plants used as a source of large animal feed. Currently the sorghum juice that is extracted from the stem has also been widely used as a source of biofuels.

Application of NPK compound fertilizer can overcome the problem of low nutrient availability in sorghum plant. NPK compound increases efficiency. Application of fertilizer with macro nutrient content complete with the provision as well will save the cost of fertilization. The availability of NPK compound slow release can also be an alternative, the use of slow release is expected to optimize the availability of nutrients, given its loose nature is under control so it can reduce the

possibility of leaching off. Some studies with the use of slow release fertilizer to other commodities show an increase in plant growth and production. Harvest of sorghum crop depends on the purpose of the results to be achieved. Basically the physiologically proper harvest will optimize the seed maturity level which is the ideal harvest age especially for the availability of seeds in the next crop and also for food purposes. Harvesting before physiological maturity and after physiologic maturity can be considered if other plant parts will be utilized both the sorghum leaf for both feed and sap for biofuels.

Each variety represents different characters, different growths and productions so it is not easy to determine what type of variety to use. Each variety also provides different responses to the harvest, especially to the expected harvest end product. Each variety also has a responsive or varied response to the given nutrient source.

Problems that need to be formulated are closely related to the choice of cultivation technology applied especially in the case of the use of slow release or non slow release fertilizer. Another problem is precise harvest time whether before ripe physiologically, physiologically mature or physiologically viable. And the use of varieties that can optimize the overall end product sorghum to be obtained. This study aims to see the effect of the above on the agronomist character of the sorghum plant.

MATERIAL AND METHODS

Research conducted at experimental field of Cereal Crops Research Institute in rainy season 2014 - 2015. The study was conducted using the Split-Split Plot Design, with three factors. The main plot were nutrient release mechanism of fertilizer (P) comprises 3 levels ie NPK fast release or convensional (P1), NPK *slow release* (P2), a combination of conventional NPK + NPK slow release (P3), each the dose are 150–135–135 kg N-P-K/ha. As a subplot is the time of harvest to the level before physiological maturity (W1), the exact physiological maturity (W2) and passing physiological maturity (W3), sub subplot are varieties consisting of three varieties, namely Numbu (V1), Super 1 (V2) , super 2 (V3) with three replications, so that there are 81 plots.

Planting implemented after cultivated land, planting distance used is 75 cm x 25 cm, each plot measuring 3 m x 4 m so that in each plot contained 64 populations. Fertilization is carried out twice for P1 ie. 10 and 35 days after planting, whereas for P2 and P3 on 10 days after planting. Parameters measured results include plant height, stem diameter, fresh biomass weight, fresh weight of stem, leaf area and total chlorophyll.

RESULTS AND DISCUSSION

NPK combination (p3) earn the highest plant height i.e. 271,48cm, it was not significantly different with Slow Release NPK (p2) i.e. 266,24cm, that is significantly different and both higher against conventional NPK (p1) i.e. 212,96cm. NPK combination of higher average than the slow release NPK.

Table 1. Average plant height (cm) in various fertilization treatments, harvest time and sorghum plant varieties.

SOURCE OF NPK		HARVEST TIME		VARIETY	
p1	212.96[b]	w1	244.00	v1	277.70[a]
p2	266.24[a]	w2	250.11	v2	279.37[a]
p3	271.48[a]	w3	256.57	v3	193.61[b]
kk	*6.87*	*kk*	*17.03*	*Kk*	*16.14*
CVLS $D_{0,05}$	12.98	CVLSD $_{0,05}$	25.27	CVLSD $_{0,05}$	22.29

Both NPK Combinations and Slow Release NPKs are significantly different from Conventional NPKs. This is thought to be due to the controlled use of NPKs supporting the availability of N in the soil during the growing season, which is related to its loosely controlled nature. Matt Ruark (2012)[1] states that the efficiency of N administration depends on the amount of N trigger factor that is evaporation, nitrification, leaching and surface flow especially in the rainy season. Relatively tall plants could

potentially produce more sap (Almodares *et. Al.*, 2012)[2].

Slow Release NPK (p2) obtaind the highest biomass weights which averaged 55.89 t/ha, NPK combination (p3) which averaged 52.56 tonnes / ha and significantly different both heavier than the conventional NPK (p1) Ie 41.28 tons / hectare. The low fresh biomass in Conventional NPK treatment is thought to be due to N inefficiency compared to NPK Slow Release (p2) and Combination NPK (p3).

Table 2. Average fresh biomass (ton / ha) at various fertilizer treatments, harvest time and varieties of sorghum plant

SOURCE OF NPK		HARVEST TIME		VARIETY	
p1	41.28[b]	w1	54.12	v1	53.96[a]
p2	55.89[a]	w2	52.20	v2	52.63[a]
p3	52.56[a]	w3	43.42	v3	43.15[b]
Kk	*19.31*	*Kk*	*32.65*	*Kk*	*18.98*
CVLS $D_{0,05}$	7.2	CVLS $D_{0,05}$	9.7	CVLS $D_{0,05}$	5.2

Research results Zhao *et al.*, (2005[3] showed that the deficiency of N in the sorghum was observed 58 DAT showed significantly reduced leaf area, leaf chlorophyll content, photosynthetic value and low biomass yield. N, P and K constitute the cyberspace structure of plant tissue from macro nutrients reaching 2.7 bpj in plant tissue (Taiz and Zeiger, 2002)[4], as well as controlling the major biochemical functions in plants. With sufficient nutrients the growth of plant biomass is much better.

Table 3. Average fresh weight of stems (ton.hektar $^{-1)}$ at different fertilization treatment, time of harvest and varieties of sorghum.

SOURCE OF NPK		HARVEST TIME		VARIETY	
p1	31.35[b]	w1	39.61	v1	38.99[a]
p2	39.96[a]	w2	36.76	v2	39.56[a]
p3	38.37[a]	w3	33.02	v3	31.13[b]
Kk	*13,69*	*kk*	*29.83*	*Kk*	*18.44*
CVLS $D_{0,05}$	3.78	CVLS $D_{0,05}$	6.47	CVLS $D_{0,05}$	3.72

The NPK Slow Release (p2) treatment resulted in the highest fresh weight of the stem, which averaged 39.96 tons / hectare, was heavier than the combined NPK treatment (p3) of 38.37 tons / hectare and both were significantly different in weight With treatment of Conventional NPK (p1) ie 31.35 ton / hectare. According to Taiz and Zeiger (2002), nitrogen is a plant nutrient that plays a role in preparing carbon compounds. N of which are found in amino acids, amides, proteins, nucleic acids and nucleotides. This is thought to be the cause of the low weight of fresh stems.

Table 4. Average leaf area (cm $^{2)}$ in the treatment of various fertilization, time of harvest and varieties of sorghum

SOURCE OF NPK		HARVEST TIME		VARIETY	
p1	396.99[b]	w1	411.08	v1	426.73
p2	427.51[a]	w2	433.27	v2	436.55
p3	437.53[a]	w3	417.68	v3	398.75
Kk	*9.23*	*kk*	*13.52*	*kk*	*12.69*
CVLS $D_{0,05}$	29.34	CVLS $D_{0,05}$	33.73	CVLS $D_{0,05}$	29.47

NPK combination (p3) generate the highest leaf area at an average 437,53cm ^{2} compared with Slow Release NPK (p2) at an average 427.51 cm ^{2} and both are significantly different wider than the conventional NPK (p1), which 396,99cm $^{2.}$ The leaf area of p2 and p3 is significantly different from p1, as the previous morphological parameters are presumed to be due to the availability of sufficient N at p2 and p3. The release of nutrients with good hydrolysis on p3 system (combination) and p2 *(slow release)* preferably plant, which is characterized by a more optimum leaf area. Nitrogen will be synthesized into organic materials such as nucleotides, whose constituent elements are Sugars, nitrogen and phosphate bases, and lipids and other organic materials.

Observations of agronomic parameters show that they are generally significantly different except in bar diameter. This can be seen in the parameters of plant height, fresh biomass weight, fresh weight of stem and leaf area, each of which is significantly different from the fertilizer treatment given. It is predicted that the increase of production, among

others, the indicator in the form of fresh weight of stem and volume of sap will be supported by the increase of plant height and the volume of sap in the stem, while the stem diamater in the field condition can not give a significant response to the given input. Thus more attention to the process of increasing the height of the plant is expected to obtain fresh weight of stems and volume of sap better.

Several studies related to improving the genetic properties of the sorghum plant show that the diameter of the stem can not give a significantly different response to the treatment given. Gamma ray radiation 40, 50, 60, and 70 gy (Endang and Dewi, 2015)[5] on the sorghum of numbu varieties did not give a significant difference in stem diameter between the parent plant and the resulting mutant. Gamma-ray radiation between 0-1000 (Surya, 2009)[6] gives a high genetic diversity to plant height, weight of 1000 seeds and panicle length, but in diameter the character does not provide high genetic diversity. This study shows that there is difficulty in obtaining varying diameter of stem against genetic improvement performed compared to other characters.

Table 5. Total Chlorophyll on various fertilization treatments, harvest time and varieties of sorghum plants (age 50 HST)

SOURCE OF NPK	VARIETY			HARVEST TIME	
	v1	v2	v3		
p1	$43,88^{a}_{y}$	$33,47^{c}_{z}$	$38,06^{b}_{y}$	w1	44.75
p2	$53,46^{a}_{x}$	$44,12^{b}_{y}$	$38,66^{c}_{y}$	w2	44.68
p3	$52,63^{a}_{x}$	$49,67^{b}_{x}$	$48,53^{b}_{x}$	w3	44.73
$CVLSD_{0,05}$	2,44			2,58	

The highest chlorophyll parameters were obtained in the main plot interaction with p2v1 plot children with an average of 53.46 units, averagely higher than p3v1 of 52.63, and both significantly different from p1v1 which is an average of 43.88 units . Leaf Is an organ in which chlorophyll is present as the center of photosynthesis of plants (Taiz and Zeiger, 2002). As an autotrophic organism, the agronomic indicator for the plant is determined by the amount of asymilat produced by the plant, this process takes place on the leaf part, where chlorophyll plays an important role in selecting the light to be used in preparing the chemical energy. Chlorophyll formation itself is one of them is determined by the availability of macro and micro nutrients are enough of which include nitrogen, magnesium and iron, and manganese, copper and zenk. One of the causes of low N chlorophyll is the non-optimal availability of N in the soil (Zhao, 2005).

The highest diameter rod parameters were obtained at p2 with an average of 14.51mm, greater than p3 with an average of 14.46mm, and with a p1 with an average of 13.52mm, with an average total of 14.16mm, though no different real.

1.2. Response of plant Sorghum to time harvest treatment

Treatment time of harvest was not significantly different to plant height, stem diameter, fresh biomass weight, fresh weight of stem, leaf area, flowering age and chlorophyll. However, fresh biomass weight and fresh weight of stems at w1 harvest average higher than other treatments.

The observation of growth parameters shows that from all parameters observed there is no significant difference between w1 (before physiological maturity) with w2 (exact physiological mature) and w3 (after physiological maturity), in w1 there has been a phase of seed formation and ripening which means has entered The final stage of growth of sorghum, Vanderlip (1993)[7] states that the age of 70-95 HST is the final stage of growth of sorghum.

1.3. Response plant Sorghum Based on Varieties

The results showed that varieties gave significantly different results in plant height, fresh biomass weight, fresh weight of stem, leaf area, flowering age, and total chlorophyll. Parameter of stem diameter was not significantly different to variety.

Super 1 (v2) is the highest plant, its height of 279,37 cm, not significantly different from numbu (v1) which is 277,70 cm and significantly different than super 2 (v3) with average 193,61cm. Based on the description of varieties recorded that high plant of

numbu 187 cm, height of super 1 is 216.5 cm and super 2 height is 229,71. Varieties of numbu (v1) obtaind the highest fresh biomass weight of 53.96 ton/hectare not significantly different from the super 1 (v2) varieties of 52.63 ton/hectare and both were significantly different compared to the super 2 (v3) of 43.15 ton/hectare.

Super 1 (v2) varieties obtain the highest fresh weight of the highest stem 39.56 tons/hectare not significantly different from the numbu (v1) varieties of 38.99 tons/hectare, both significantly different from the super 2 varieties ie 31.13 tons /hectare. Measurements of fresh biomass parameters show that Numbu and Super 1 give better results than the super-2 varieties. The contribution of weight to numbu is obtained from leaves and panicles larger, in super 1 obtained from the weight of stems larger than numbu.

Super 1 varieties obtain the fastest flowering age of 61.56 days significantly different faster than numbu ie 65.93 days and super varieties ie 68.70 days. The highest chlorophyll parameters were obtained from p2v1 interaction with mean value 53,46unit, significantly different with p3v2 with mean value 49,67unit and to p3v3 with mean value chlorophyll 48,53unit.

Correlation coefficient analysis showed a strong correlation between plant height to fresh biomass. The correlation coefficient indicates a strong relationship between plant height and fresh biomass of the plant. The higher the plant the greater the fresh biomass of the plant, the shorter the plant the lower the fresh biomass of the plant. The correlation coefficient analysis shows that there is a very strong relationship between fresh biomass and fresh weight of stem.

CONCLUSION

Sources of Fertilizater which obtain sorghum with the best morphological characters is Slow Release NPK (p2) and NPK combination (p3) compared with conventional NPK (p1), include plant height, weight of biomass fresh and stem fresh weight.

Treatment of harvest time did not give significant results on average difference, however the highest mean of fresh weight biomass weight parameter and fresh weight of stem was harvest time before physiological maturity.

The best varieties of agronomic character are the numbu and super 1 varieties compared to the super 2 variety.

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