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6th International Conference Sustainable Agriculture, Food, and Energy (SAFE2018). October 19-21, 2018 I'M Hotel, Makati. MANILA, PHILIPPINES

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Abstract

Preface

We are proud to inform you that the International Conference on Sustainable Agriculture, Food, and Energy (SAFE2018): Inclusive Agri-food Energy Production for Community Empowerment in a Changing Climate" was successfully conducted by SAFE-Network from October 19-21, 2018 in MANILA, Philippine. The host institution was Pampanga State Agricultural University (PSAU), Philippines Centre for Postharvest and Mechanization (PhilMech), and Central Bicol State University of Agriculture (CBSUA), Philippines This conference was the 6th conference after the 1st International Conference on Sustainable Agriculture, Food, and Energy (SAFE2013) in Padang, Indonesia (12-14 May 2014), the 2nd conference SAFE2014 in Bali, Indonesia (17-19 September

2014). The 3rd conference SAFE2015 in Ho Chi Minh City, VIETNAM (17-19 November 2015), The 4th conference SAFE2016, Colombo, Sri Lanka (October 20-22, 2016), and the 5th conference SAFE2017, Malaysia, August 22-24, 2017.

The objectives of the conference were:

1. To provide a forum for international researchers community to exchange and share the experiences, new ideas, sustainability concepts and research results on sustainable agriculture, food, and energy.

2. To promote collaboration in research on sustainable agriculture, foods, and energy production.

To establish a regional networking among participants on sustainable agriculture, food, and energy.

3. To increase awareness of the importance of living and working in the manner that enhances the economic, environmental and social well-being of our community through research, education, regional partnerships, and community engagement.

The committee accepted 150 papers of over 300 papers which were presented in SAFE2019 conference.

On behalf of SAFE-Network, we would like to convey our appreciation and thanks very much to the Pampanga State Agricultural University (PSAU), Central Bicol State University of Agriculture (CBSUA), and Philippines Centre for Postharvest and Mechanization (PhilMech) for co-hosting this conference.

We would like especially to thank Prof. Dr.Tafdil Husni, Rector of Andalas University for his strong support to this event, Dr. Norman de Jesus, local conference coordinator and the members of the local organizing committee who helped with all the preparations required to make the conference a success, as well as the session organizers who worked to ensure a high level of science presented at the meeting. Moreover, of course, we thank all honourable speakers and participants who have agreed to attend and discuss your work! Finally, please understand that while every effort was made to publish this proceeding, we know that unavoidable withdrawals and other changes will occur.

Looking forward to welcoming you to the SAFE2019 conference in Phuket, THAILAND!

Prof. Dr. Novizar Nazir

SAFE-Network Executive Chairman

SAFE NETWORK
Asia Pacific Network for Sustainable Agriculture Food and Energy

BECOMING BIGGER TOGETHER

Date : 18th SEPTEMBER 2018
Ref. No. : 511/SAFE-Network/SAFE2018/2018

Ir. Ni Made Yudi Astari, M.Si
Universitas Warmadewa
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INDONESIA

INVITATION TO PARTICIPATE IN THE CONFERENCE AND NETWORKING DISCUSSION

Dear Ms. Astari,

We are proud to inform you that the **International Conference on Sustainable Agriculture, Food, and Energy (SAFE2018): "Inclusive Agri-food Energy Production for Community Empowerment in a Changing Climate" (http://safe2018.safetainability.org)** which will be held from October 19-20, 2018 in MANILA, Philippines. The conference is an annual conference run by SAFE-Network, an Asia Pacific network for sustainable agriculture, food and sustainable. This organization member consists mainly of lecturers at universities and researchers at research institutes **(http://safe-network.org).**

The host institution are Pampanga State Agricultural University (PSAU), Philippines Centre for Postharvest and Mechanization (PhilMech), and Central Bicol State University of Agriculture (CBSUA), Philippines. This conference is the sixth conference after the 1st International Conference on Sustainable Agriculture, Food, and Energy (SAFE2013) in Padang, INDONESIA (12-14 May 2013) and the 2nd SAFE2014 in Bali, INDONESIA (17-19 September 2014), 3rd SAFE2015 in Nong Lam University HCMC, VIETNAM (17-20 November 2015), 4th SAFE2016 in Colombo, SRI LANKA and 5th Conference in Shah Alam, Malaysia August 22-24, 2017.

The objectives of the conference are:

1. To provide a forum for international researchers community to exchange and share the experiences, new ideas, sustainability concepts and research results on sustainable agriculture, food and energy..
2. To promote collaboration in research on sustainable agriculture, foods and energy production.
3. To establish a regional networking among participants on sustainable agriculture, food and energy.
4. To increase awareness of the importance of living and working in manner that enhances the economic, environmental and social well being of our community through research, education, regional partnerships and community engagement.

We would like to invite you to participate in the Conference and join the Networking Discussion. We will discuss the programs, cooperation and join action of SAFE-Network in Networking discussion.

Some important points to note are listed below for your reference.

Program	Date
Pre-Conference Tour	October 19, 2018
Conference & Networking Discussion	October 20, 2018

Thank you very much for your kind cooperation. SAFE-Network will provide your accommodation during your participation in SAFE2018. Looking forward to welcoming you in Makati!

Regards,

Dr. Paul Kristiansen
Head of Advisory Board

Dr.Novizar Nazir
SAFE-Network Coordinator

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Peer review statement

All papers published in this volume of *IOP Conference Series: Earth and Environmental Science* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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Preface

Papers

Innovation on Sustainability related to Agriculture, Food, and Energy

The application of biochar in improving the nutrition quality and production of sorghum plant

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The application of biochar in improving the nutrition quality and production of sorghum plant

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Abstract. The current condition of agricultural land in Indonesia, both wetlands and highlands, have low organic matter. The role of biochar to increase crop productivity is influenced by the amount of biochar added. Sorghum is a plant that can be used from stems, leaves, and fruit as animal feed. The purpose of this study was to evaluate the productivity and nutritional content of sorghum given biochar with different doses. This research is a one-factor experiment with the simple randomized block design. The treatments tested were biochar doses with 6 dose levels, namely: P0 (without biochar), P1 (3 ton ha-1), P2 (6 ton ha-1), P3 (9 ton ha-1), P4 (12 ton ha-1) and P5 (15 ton ha-1). Plant variables observed were the number of leaves and plant height, fresh forage production, dry matter production, and seed production per hectare, as well as the nutritional quality of sorghum such as crude protein, crude fiber, ash content, and dry matter content. The results showed that there was no significant effect on the variable number of leaves and plant height, crude protein, crude fiber, ash content, and forage, but significantly affected the variables of fresh forage production, dry matter production and grain yield per hectare. From this study, it can be concluded that the application of biochar dosage 9 ton ha-1 provides the best results for the production of fresh forage, dry material production and seed production per hectare.

1. Introduction

One of the decisive factors in livestock raising is the availability of feed throughout the year, but the feed is available especially in the dry season not in accordance with the needs of livestock, both the amount and quality. Given the importance of forage for livestock, one of the forages of livestock that is feasible to be cultivated and developed is the sorghum plant.

The availability of feed, especially forage feed, is still an obstacle faced by farmers especially in the dry season. Utilization of less fertile land for feed crops is very important because there is no special land for cattle feed. The vast land of thousands of hectares in Indonesia is a very potential land if managed well. Feed crops are an important factor in the growth and increased the productivity of ruminant livestock since most ruminants feed originates from animal feed crops (grasses and legumes).

Sorghum plant has long been known in Indonesia and with the mention of different for each region. During this development sorghum less attention so rarely found in farmers' land. Even in the statistical data at the regional and central levels, commodities sorghum has not been found because the existence of this plant is already scarce in the field, the utilization of sorghum seeds in the community is still limited to traditional processed food. However, with the food diversification program from the Ministry of Agriculture, the development of sorghum is expected to get better attention, because this commodity has big potential to be used as various food products, processed and feed and industrial raw materials [1].

Some studies say the protein content of sorghum seeds is very high compared to other food sources such as rice, cassava, and corn. Sorghum has a high protein content, has mineral advantages such as Ca, Fe, P, and Vitamin B content. According to [2] the nutritional content of sorghum leaves is not much different or equivalent to elephant grass. This is certainly very well used to cope with the dearth of forages that the seasonal changes can afford. Similarly, the use of sorghum seed in feed ration is a supplement (substitution) for corn, because nutritional value is not different from corn, but because of high enough content (0.40-3.60%), the sorghum seeds are only used in a limited amount because it can affect the function of amino acids and proteins.

The current condition of agricultural land in Indonesia both wetland and dryland have low organic matter (<2%). The neglect of the return of organic matter has caused the physical and chemical conditions of the soil have decreased which layman called soil symptoms to become "sick" or land fatigue [3]. One effort that can be done to increase the productivity of the soil is to add organic materials into the soil. The usual organic ingredients added are usually manure. Utilization of livestock waste, especially cattle dung as organic fertilizer can be done. The use of manure can increase soil microbiology and improve soil structure. livestock manure also contains many nitrogen, phosphate, and potassium. However, due to the continuous degradation of natural resources such as decreased soil organic matter, due to decreased soil water, decreased soil pH, low earthworm population in the soil [4]. The use of inorganic fertilizer (chemical) that continuously and causing excessive soil becomes hard and production decline. Inorganic fertilizer is one of the nutrients that easily decompose so that the land will lack K elements that can reduce soil fertility [5].

Biochar is a stable form of charcoal made by burning / heating natural organic matter (plants, wood, sawdust, manure) with a high temperature ± 700 °C, with a low oxygen combustion process called pyrolysis. The role of biochar to increase crop productivity is influenced by the amount added. The amount of 4 to 8 ton ha-1 is reported to increase productivity significantly between 20 - 220%. Sources of natural soil enhancement materials that have been in use in recent years are biochar derived from residues or agricultural wastes such as timber, coconut shell, rice husks, and industrial wastes can also be used such as wood saws and wood waste and others. The biochar's effectiveness in improving soil quality depends largely on the physical and chemical properties of biochar determined by the types of raw materials (softwood, hardwood, rice husk, and others) and carbonization methods (type of combustion, temperature, and biochar), powders and activated carbon), wherever the use of soil raw materials from decomposing agricultural waste is one of the alternatives that can be used to accelerate the increase in the quality of soil physical properties [6]. Biochar acts as a bio-fertilizer provider of nitrogen fertilizers so as to increase the biomass of maize and nitrogen uptake in leaves [7]. From these circumstances then required a research to find out the exact dosage of biochar on sorghum planting.

2. Materials and Methods

2.1. Experimental design

This field trial was conducted using Random Block Design (RBD) with 6 treatments and three (3) replications. The applied treatment is 0 ton ha-1 (P0), 3 ton ha-1 (P1), 6 ton ha-1 (P2), 9 ton ha-1 (P3), 12 ton ha-1 (P4), and 15 ton ha-1 (P5).

2.2. Location and Time of Study

This experiment was conducted at the experimental station of the Faculty of Agriculture, the University of Warmadewa located in Tanjung Bungkak, Sumerta Village, Denpasar City. The experiment was conducted in July until October 2016.

2.3. Harvest

Harvesting is done when the plants are 15 weeks after planting at which time the seeds are ready for harvest

2.4. Variable observed

a. Sorghum growth includes plant height and number of leaves
b. Fresh feed production and dry feed production (tons ha-1)
c. Seed production (tons ha-1)
d. Quality of Nutrition Sorghum plants include crude protein, crude fiber, ash content, and dry matter

2.5. Data analysis

Data obtained from the results of the study were analyzed by the analysis of variance, if there were significantly different results (P<0.05) between treatments then the Duncan multiple-range test [8].

3. Results and Discussion

The summary of the results of research on the use of various doses of biochar on the production and quality of sorghum plant nutrition as presented in Table 1.

Table 1. The results of various biochar dosage studies on the production and quality of sorghum plant nutrition.

Parameter	Treatment					
	P0	P1	P2	P3	P4	P5
Growth:						
Plant height	229.44 a	247.82 a	247.36 a	259.97 a	250.65 a	227.77 a
Leaf Amount	10.01 a	10.08 a	10.23 a	10.89 a	10.20 a	10.16 a
Quality of Nutrition:						
Crude Protein Content (%)	7.87 a	7.87 a	8.00 a	8.13 a	7.87 a	7.96 a
Rough fiber content (%)	30.66 a	30.91 a	30.58 a	30.61 a	31.17 a	30.85 a
Ash Content (%)	11.22 a	11.07 a	11.69 a	11.85 a	11.75 a	11.87 a
Dry matter content (%)	20.42 a	20.55 a	19.96 a	21.12 a	20.36 a	20.99 a
Production:						
Fresh Production Forage (ton ha^{-1})	9.11 a	9.87 a	12.75 b	13.56 b	13.36 b	12.77 b
Dried Green Production (ton ha^{-1})	1.86 a	2.05 a	2.54 ab	2.87 b	2.72 b	2.68 ab
Seed Production (ton ha^{-1})	2.58 a	2.82 a	2.97 b	3.31 b	3.09 b	3.07 b

Different letters towards the rows show significantly different (P<0.05)

3.1. Growth

From Table 1, it appears that for the growth of sorghum both for the number of leaves and for the height of the plant does not give a difference significant between each biochar treatment. The average number of leaves 10.26 strands with plant height 243.50 cm. Plant height is the most easily visible plant size. Different doses of biochar did not have a significant effect on the height of the 15 weeks after planting a crop of sorghum. The highest average plant height in treatment P3 (9 ton ha-1) that is equal to 259.97 cm. and the number of leaves showed P3 treatment (9 ton ha-1) also gives the number of leaves as much as 10.89 strands.

3.2. Quality of Nutrition

3.2.1. Rough Protein Content

The statistical test showed that there was no significant difference in the effect of administration of various doses of biochar on the production and quality of sorghum plant nutrition. The highest raw protein content was obtained at P3 treatment (9 ton ha-1) that was 8.15 %. The content of crude protein forage will be greatly influenced by the nutrients available in the soil. According to [9], the crude protein content of sorghum is equal to the nutritional quality of sorghum plant is by 7.7%, while it [10] stated the level of crude protein in the sorghum of 7.8%. Differences in protein content obtained are influenced by several factors such as different climatic conditions. The result of crop type analysis depends on the interaction between a genetic factor and environmental factor such as soil type, topography, climate pattern management and application of technology. The protein content of ruminant ingredients is not too problematic because, in the ruminant use of protein food more complex, there is microbial digestion and synthesis that runs in the rumen reticule so that the protein entering the small intestine is a mixture of protein food and protein microorganism [11].

3.2.2. The content of Rough Sorgum Fibers
The statistical test showed that the crude fiber content of the sorghum plant did not give a significantly different result. The lowest coarse fiber obtained at treatment P2 (6 ton ha-1) is 30.58 % while the highest in treatment P4 (12 ton ha-1) that is equal to 31.17%. There are several factors that influence the composition of forage include: 1) the effect of soil, ie the required physical fertility of the soil (the soil is expected to always loose and nest), chemical fertility (available nutrient elements needed planting) and fertility biological (where there are microorganisms in the soil; 2) the effect of the plant include the type of planting, age of the plant and plant parts for the different sections will provide different composition; and 3) The effects of climate include temperature, rainfall, and humidity all of which affect the quality of green.

3.2.3. Ash Content
The ash content of a forage reflects its mineral content. In this study, the average content of sorghum ash is 11.56 %. The highest ash content was obtained at the P5 treatment which was 11.87 % and the lowest in treatment P1 was 11.07%.

The ash content of a food ingredient is a rough idea of the mineral content of the feed. The mineral content of food depends on the mineral content in the soil where the forage grows, the genetic properties of forage, the soil pH and also the fertilization. Maximum nutrient availability for plants generally occurs at pH 5.5 to 6.5. At lower pH of the range, the solubility of some macronutrients tends to decrease, but some micronutrients tend to rise.

3.2.4. Dry Ingredients
The results showed that the dry matter content of sorghum plants was not significantly different. The highest dry ingredient of sorghum was obtained at P3 treatment 21.13%, while the lowest was P4 treatment 20.36% but statistically was not significantly different. The maturity level of plants is an important factor affecting the production and value of forage utilities. During the vegetative period, crop production will outweigh the need. The excess assimilation results will be stored in the vegetative section as a reserve compound. The reserve compounds are mostly composed of carbohydrates but also contain enough lipids and proteins. As the age of the plant increases, total carbohydrates in the grass will be higher [12]. Furthermore, [13] stated that with the increasing age of the plant especially when entering the generative phase, the ratio of stems and leaves increases the value of the food decreases. Plants will decrease the content of P, K, fats, minerals, and carbohydrates easily dissolve with increasing plant life, while the content of crude fiber and lignin increases.

3.3. Crop Production

3.3.1. Fresh Production Forage
The statistical test showed a significantly different effect on the use of various doses of biochar on the production of fresh crops of sorghum plants at the age harvest of 15 weeks after planting. The highest yield was obtained in treatment P3 (9 tons ha-1) which is equal to 13.56 tons ha-1, but lowest yield was obtained in treatment P0 (0 ton ha-1) that is equal to 9.11 ton ha-1 and statistically showed significantly different results.

The utilization of waste biochar 10 tons ha-1 gave a significant effect on plant height and total wet weight [14], further research [15, 16] showed that the best plant growth response was obtained at biochar treatment 10 tons ha- 1 and compost fertilizer 20 tons ha-1. In this study 20% ha-1 treatment also given biochar treatment also given manure as 9 tons ha-1 was obtained on biochar.

3.3.2. Production of Dried Green Forage

The production of dry matter forage in this study gives a significant effect. The treatment of P3 (9 ton ha-1) gave the highest yield of 2.87 ton ha-1 significantly higher than the treatment of P0, P1, and P2. Benefits of adding biochar into the soil between others: to increase plant growth, reduce emissions of methane, reducing emissions of NO (approximate 50%), reducing the need for fertilizers (approximate 10%), reducing the leaching of nutrients, storing carbon role in long-term stable, increase soil pH, increase soil aggregate, increase soil water level, increase soil ability to provide Ca, Mg, P and K, increase soil microbial respiration, increase soil microbial biomass, increase arbuscular mycorrhizal fungi, increase CEC of soil, increase crop yield and the quality of plant products [17].

3.3.3. Seed Production

The highest seed yield obtained at treatment P3 (9 ton ha-1) that is equal to 3.31 ton ha-1, significantly different than the treatment of P0, P1, and P2. Sorghum has the potential to produce dry beans of 4.0 - 5.0 tons ha-1. This is presumably because biochar is concentrated in the soil causing water retention and increasing nutrients so the soil becomes fertile. Nutrient retention effects on the addition of nutrients to the plants. In addition, it is suspected that the biochar effect causes increased porosity of the soil, water holding capacity, C-inorganic, and microbial activity in the soil. Soil analysis results showed that P3 treatment of C-organic content became moderate and phosphor content was available to be very high. The soil condition with moderate C-organic and phosphor is very high allegedly can increase the content of soil organic material and available nutrients used by plants for the growth process.

4. Conclusions

The treatment of biochar doses of 9 tons ha-1 resulted in the highest plant height and number of leaves, but not statistically significantly different. The maximum plant height obtained in the biochar treatment of 9 tons ha-1 was 259.97 cm and the most number of leaves was also in the biochar treatment of 9 tons ha-1 which was 10.89 strands.

The quality of feed produced did not show a significant effect by giving various doses of biochar. The highest content of crude sorghum green protein was obtained in biochar treatment 9 tons ha-1 which was 8.13%, the highest crude fiber content in biochar 3 tons ha-1 was 30.91%, the highest ash content was 11.87% in biochar 15 tons ha-1 and dry matter 21.12% highest in biochar 9 tons ha-1. The provision of biochar 9 tons ha-1 provides the best for fresh forage production, namely 13.56 tons ha-1, the production of dry matter feed is 2.87 tons ha-1 and the production of sorghum seed seed 3.31 tons ha-1.

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