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PROCEEDING INTERNATIONAL CONFERENCE ON CASSAVA
(Sustainable Management of Renewable Resources in Tropics)
Bandar Lampung, November 23rd - 24th 2017

« Editors : »

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PREFACE

This proceeding consists of the papers presented in international seminar on cassava conducted by University of Lampung on November 23, 2017. As the university located in Lampung Province, University of Lampung realized that Lampung as the biggest producer of cassava in Indonesia has many problems concerning how to increase the poverty of farmers through cassava. There are two factors related to increasing poverty, namely upstream technology and downstream technology of cassava. Upstream technology is how to increase productivity per hectare and how to get the best quality of harvested tuber. While, downstream technology is the technology developed to fulfill people's need on cassava based products. Globally those products is demanded more as the increasing population. Therefore, Lampung needs many innovations about cassava since the development of cassava-based economics in Lampung is quite significant to influence the whole economics development. To get such important technologies, University of Lampung conducted an international seminar on cassava by inviting keynote speakers from the countries such as Thailand and Japan that have best experiences on upstream technology and downstream technology of cassava, beside some Indonesian scientists sharing their research.

After conducting such a seminar, hopefully this proceeding will be able to inspire all parties coming from government, scientists, industries, and practices. The proceeding of a seminar is very useful to bring the papers into the usage of technology. If the results actually need to be developed further, the scientists can carry out perfecting research in the next seminar. Therefore, the seminar on cassava nationally or internationally will strengthen the role of technology in fastening the growth of cassava-based economics.

University of Lampung would like to appreciate the dedication of the staffs in Research and Community Service Institution of University of Lampung working hard to finish the publication of this proceeding. We also would like to address our appreciation to Sungai Budi Group, the honorable Keynotes Speakers from Japan and Thailand for their support to the seminar.

Rector,

Prof. Dr. Ir. Hasriadi Mat Akin, M.P.

PREFACE

As the committee of The International Seminar on Cassava conducted in University of Lampung, we thanked you to all of the participants who has actively participated in that seminar. The participants consisted of researchers, students, staffs of cassava-based industries, and government officials of Lampung Province. The number of participants noted was 97 researchers and government officials and 33 students. The participants who submitted abstracts as the participants presenting their papers in the seminar were 35 people. After receiving the full papers, the committees reviewed all papers. As it was planned, if reviewers decided that the paper fulfilled the quality demanded by the journal, the paper would be forwarded to the international journal. Unfortunately, reviewers decided that there was no papers with proper in terms of subjects of research and grammar. Moreover, the committee faced the fact that not all participants sent their full papers, some of the participants chose to publish their papers in other journal. That was why this proceeding consisted of only 14 paper and took quite a long time to publish.

The committee would like to thank Rector of University of Lampung, the Head of Research and Community Service Institute of University of Lampung, Sungai Budi Group, and other institution that have support the publication of this proceeding.

Chairman,

Dr. Erwin Yuliadi, M.Sc.

PREFACE

University of Lampung is facing challenges to make cassava as potential commodity to increase the poverty of the people. As it is well known, cassava has beneficial use to fulfill daily needs of the people as food, feed, fiber, and pharmacy. The demand of cassava as raw material of those needs will increase as much as the increase of population. The problems appear related to productivity of cassava in Indonesia which is relatively low and low performance of downstream technology. As a research institution, LPPM (Institution of Research and Community Service) of the University of Lampung should do the action how to improve the upstream technology that can increase the productivity and quality of harvest of cassava and to improve and diversify downstream technology that can increase the demand of cassava as raw material of industry. Only then the income of farmers and cassava-based industry can be increased to improve the poverty.

One activity that can fasten to solve the problems is to conduct an international seminar on cassava. Hopefully through the seminar there will emerge some papers as results of researches on cassava that have great value to improve technologies on cassava. To make the seminar qualified, LPPM of University of Lampung invited keynote speakers from Thailand as greatest cassava exporter country in the world and from Japan as the country popularly with downstream technology.

After the seminar finished, the submitted papers were reviewed according to the quality demand of a paper that appropriate to be submitted to international journal. After working sometime, the papers finally can be arranged in form of proceeding. Beside the papers in this proceeding there are some papers that are not included because the authors chose to publish their papers in other journals.

LPPM of University of Lampung would like to thank to every party who had actively participated in the seminar and in the process of arranging this proceeding.

Chairman,

Warsono, Ph.D

CONTENTS

GROWTH AND YIELD OF CASSAVA *(Manihot esculenta* Crantz*)* UNDER INTERCROPPING WITH SEVERAL GENOTYPES OF SORGHUM (*Sorghum bicolor* [L.] Moench)

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ABSTRAK

The purpose of this experiment is to evaluate the growth and yield of cassava under intercropping with several genotypes of sorghum. This research was conducted in Sukanegara Village, Tanjung Bintang, South Lampung district in March 2017–March 2018, dry matter analysis conducted in the laboratory of Agronomy, Faculty of Agriculture, University of Lampung, Bandar Lampung. The experiment was set in RCBD (Randomized Completely Block Design) with three replications. Its homogeneity of variance was tested with Bartlett test and data's additivity of will be tested with Tukey's test. If these two assumptions are fulfilled then continued with analysis of variance (anova). Since factors in anova are significant then the comparison of treatment means were analyzed by LSD's test (Least Significant Difference) at the 5% level. The results showed that cassava under intercropping with sorghum genotypes of P/F-5-193-C and GH 5 tend to show a slower growth than the cassava planted in intercropping with other sorghum genotypes in this research. While, on the results of the component, the cassava plant in intercropping with P/F-5-193-C and GH 5 produce number of tuber fewer than when in the intercropping with other sorghum genotypes. Instead, the resulting starch content higher.
Keywords: cassava, intercropping, and sorghum

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of a tubers plant which have many uses, from tuber, stem, and the leaves can be utilized. Its tuber can be used as ingredients of food and industrial raw material such as tapioca, sugar, liquid cosmetics, toothpaste, paper, envelopes, etc. Cassava stems are usually used as a seed for cuttings, while the leaves are used as livestock feed.

The province of Lampung province is one of the major producers of cassava in Indonesia, in addition to plant palm plantations, rubber, and sugarcane. Cassava has been cultivated due to its important economic value. It is also supported by existing of tapioca industry in Lampung. In 2016, there are 295,550 hectares of harvest area for cassava producing a total of 7.74 million tons of tuber, so it makes the Lampung province the first rank in contributing cassava in Indonesia (BPS, 2017).

The use of cassava monoculture planting systems causes open space between plants that can be used when cassava plants are still in the vegetative phase, where the canopy between plants has not covered each other. Therefore, this condition can be used for intercropping. Sorghum (*Sorghum bicolor* [L.] Moench) is a crop that produces within three months, where in the three or four months at the beginning of the growth of cassava, the plant canopy still provides open space for soil under the plants so that it is suitable for intercropping with cassava.

As stated by Cong et al. (2014), intercropping, the simultaneous cultivation of multiple crop species in a single field, increases aboveground productivity due to species complementarity. Intercropping can allow the main crop, such as cassava, to be disturbed, due to competition to obtain nutrients, water, sunlight, and cause micro-climate changes under the canopy. This cropping system is believed to be most likely to affect the growth and yield of the main crop. Planting some different sorghum genotypes as intercropping

with cassava will affect cassava on its growth and yield due to genetic of sorghum plants. Therefore, this study aims to evaluate the growth and yield of cassava plants grown intercropping with several sorghum genotypes.

METHODS

The experiment was conducted in March 2017 - March 2018 in Sukanegara Village, Tanjung Bintang District, South Lampung Regency, dry matter analysis was conducted at the Agronomy Laboratory, Faculty of Agriculture, University of Lampung, Bandar Lampung. Equipment used in the field experiment are tractor, oven, starch content measuring instrument (Thai Sang Metric Co. Ltd.), and SPAD-500. Cassava clone of UJ5 was intercropped with eight sorghum genotypes (GH 3, GH 4, GH 5, GH 7, Mandau, P/F-5-193-C, Super 1, and Talaga Bodas), denoted as UB 1 (cassava + GH 3), UB 2 (cassava + GH 4), UB 3 (cassava + GH 5), UB 4 (cassava + GH 7), UB 5 (cassava + Mandau), UB 6 (cassava + P/F-5-193-C), UB 7 (cassava + Super 1), and UB 8 (cassava + Talaga Bodas). The experiment was set in RCBD (Randomized Completely Block Design) with three replications. Its homogeneity of variance was tested by using Bartlett's Test, and additivity by Tukey's Test. Analysis of variance continued with LSD's test (Least Significant Difference) at the 5% level, and all data were analyzed by Minitab (Version 17).

RESULTS AND DISCUSSION

The results showed that at the age of 6-21 WAP there was no difference in the height of cassava plants intercropped with sorghum genotype, but there was a tendency for plants to be shorter when intercropped with P/F-5-193-C. Plant height differences among intercropped genotypes are consistently seen at 26-51 WAP. The results showed that cassava under intercropping with P/F-5-193-C consistently tended to be shorter than other genotypes. Meanwhile, if cassava is grown in intercropping with the Talaga Bodas tended to increase (Figure 1).

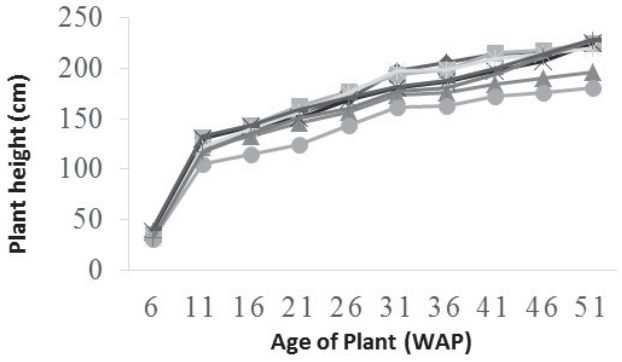


Figure 1. Plant height of cassava under intercropping with several genotypes of sorghum.

Description:

UB 1 UB 2 UB 3 UB 4
UB 5 UB 6 UB 7 UB 8

WAP: Weeks after planting

Cassava competition with sorghum plants occurred at the initial growth of sorghum. The results showed that in the range of 8-18 WAP, cassava had a disturbance due to light

competition with sorghum plants which were higher than cassava resulting the depressed growth of cassava. Cassava recovery due to this competition was happened after harvesting sorghum (18 WAP). Cassava growth and yield under intercropping with sorghum P/F-5-193-C consistently tend to be inhibited (Figure 2). This is presumably due to the high and the large number of leaves of the sorghum genotype, causing cassava to be shaded by a sorghum canopy. This experiment is supported by Herdiana *et al.* (2008), where shade density results in poor plant growth. Shade that is too tight causes disruption to growth. In addition, photosynthetic factors can affect the growth and yield of plants as Komariah (2017) stated that photosynthesis is the process of changing certain organic materials into food organic matter, where sunlight is an energy source for food crops. Sunlight is a source of energy for photosynthesis, so it can affect vegetative and generative growth.

Figure 2. Comparison of plant height of cassava and sorghum genotypes P/F-5-193-C

Description:

Cassava Sorghum

The number of cassava leaves showed a fluctuative increase every week (Figure 3). It is understandable because in August 2017 the rainfall was 38.6 mm, then increase to be 77.5 mm in the following month. Although cassava plants are classified as drought-resistant plants, it does not mean that cassava does not need water for its growth as stated by Craft et al., (1949) and Kramer (1969) that lack of water will disrupt the chemical balance in plants which results in reduced photosynthesis or all physiological processes run abnormally. Howeler (2014) states that during drought, cassava roots will grow deeper to absorb water and at the same time the stomata will be closed to reduce transpiration and stop producing new leaves and old leaves fall. However, after a period of drought ends cassava can return to its normal state in which new leaf buds appear.

Leaves greenness is only used to indicate the presence of chlorophyll content, but not real chlorophyll content. As Parry (2014) said that if chlorophyll is uniformly distributed, the SPAD value will be linearly related to the leaf chlorophyll concentration and the CCI (Chlorophyll Content Index) values will be related to chlorophyll concentration as a logarithmic function. However, chlorophyll is not evenly distributed in thez leaves and this causes the estimated concentration based on the transmission measurements to be deviant. The wood which is intercropped with sorghum genotype produces different leaf greenness. The results showed that when 51 WAP there was a tendency for leaf greenness to decrease in some intercropped genotypes.

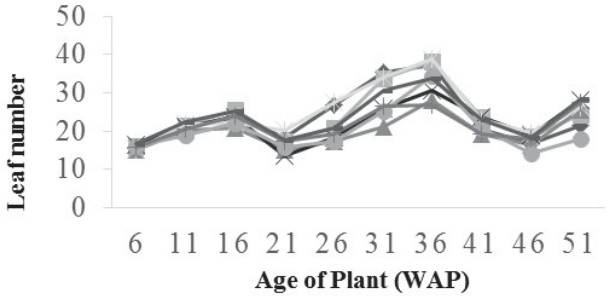


Figure 3. Leaf number of cassava under intercropping with several sorghum genotypes

Description:

UB 1 UB 2 UB 3 UB 4
UB 5 UB 6 UB 7 UB 8

WAP: Weeks after planting

Cassava intercropped with P/F-5-193-C has the lowest leaf greenness compared to cassava intercropped with other sorghum genotypes (Figure 4).

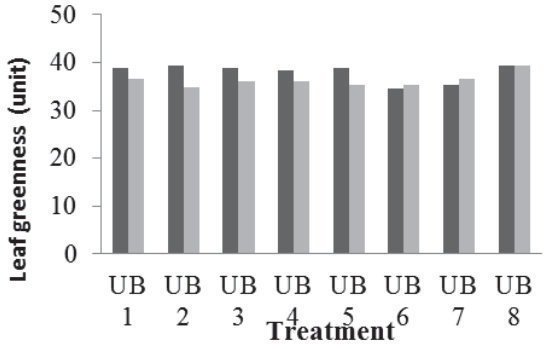


Figure 4. Leaf greenness of cassava under intercropping with several sorghum genotypes

26 WAP 51 WAP

WAP: Weeks after planting

The results of the experiment (Table 1) showed that cassava plants intercropped with P/F-5-193-C or GH 5 caused lesser number of tubers. Conversely, if it is intercropped with Talaga Bodas or Super 1 there is an indication that it can increase production because the number of tubers produced is more than the others. Although the weight is small but this can be improved by means of fertilization and a good environment. In tuber formation, cassava plants need sufficient P and K nutrients (Howeler, 2014). Although potassium is not a basic component of protein, carbohydrates, or fat, it plays an important role in their metabolism. Potassium stimulates clean photosynthetic activity from the given leaf area and increases photosynthetic translocation to tuberous roots. This results in low carbohydrates in the leaves, thus increasing photosynthetic activity (Kasele, 1980). Blin (1905), Obigbesan (1973), and Howeler (1998) reported that the application of K not only increases the weight of tubers but also the starch content. Obigbesan (1973) and Kabeerathumma et al. (1990) reported that K application also decreases HCN content from roots.

Table 1. Tuber number under intercropping with several sorghum genotypes

Treatment	Tuber number
UB 1	4,33 bc
UB 2	5,22 abc
UB 3	4,00 c
UB 4	4,67 abc
UB 5	5,22 abc
UB 6	3,56 c
UB 7	6,22 ab
UB 8	6,44 a
BNT 5%	1,92

Description: The number followed a similar letter on the same column shows no different of LSD's test at 5% level.

The diameter of the tuber is closely related to the number and length of tuber. The size of the tuber that extends is usually not followed by a large diameter. This is in accordance with Widodo (1990) which states those long tubers are generally not large in diameter while tuber with large diameter do not elongate. The results showed that cassava under intercropping with Talaga Bodas and Super 1 genotypes tended to produce more fresh weight per tuber (Figure 5) and lower tuber length (Figure 6), while the diameter of the tubers was medium (Figure 7). On the other hand, cassava intercropped with P/F-5-193-C produces fewer tubers and their weight.

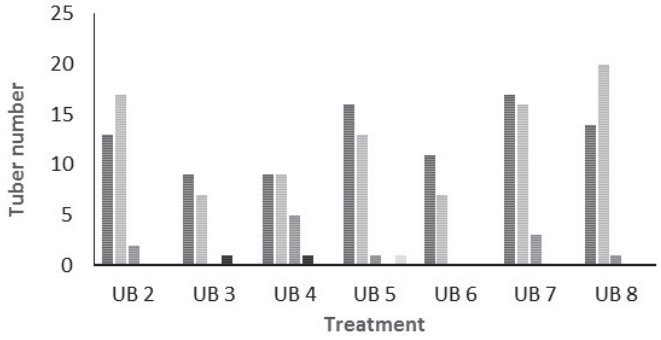


Figure 5. Category fresh weight per tuber of cassava under intercropping with several sorghum genotypes

Description:

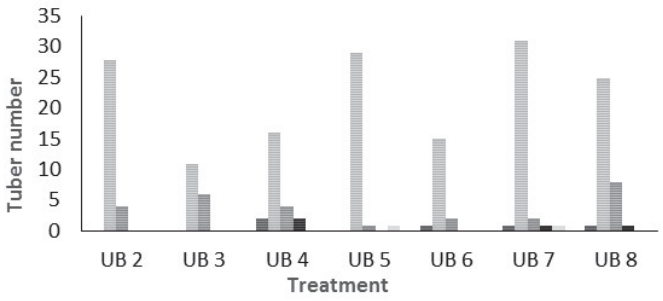


Figure 6. Category tuber length of cassava under intercropping with several sorghum genotypes

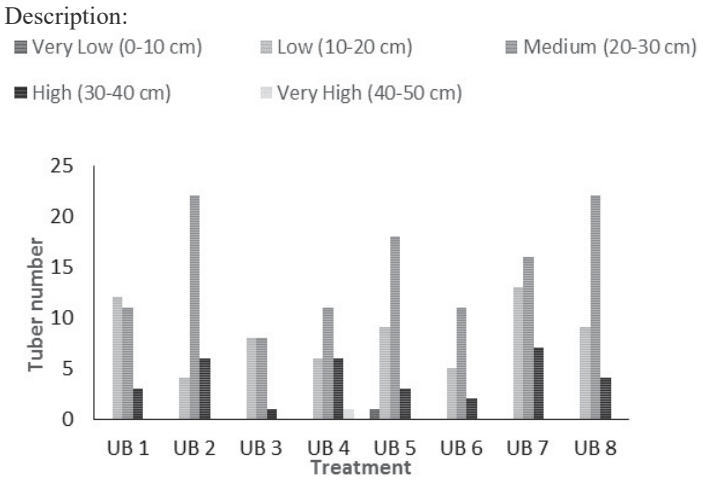
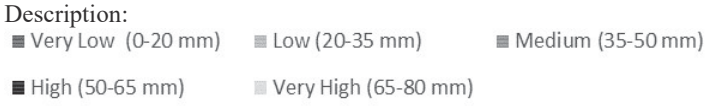


Figure 7. Category tuber diameter of cassava under intercropping with several sorghum genotypes



Although the fresh weight of the tuber produced is not different when planted in intercropping with any sorghum genotype (Figure 8), the starch content is different (Figures 9 and 10). Based on the experiment it was found that cassava planted in intercropping with GH 3, P/F-5-193-C and Super 1 genotypes produced more starch than others. If viewed from the aspect of starch content processing efficiency, it turns out that tubers with low weight and high starch content can reduce the cost of production when processing tubers into starch.

The longer the cassava harvest (to a certain extent) the higher the cassava starch content produced, up to 51 WAP still shows an increase in starch content. In cassava aged 36 MST, the highest starch content was 25.5%, while at the age of 51 WAP it reached 29.17%. Susilawati *et al.* (2008) stated that the longer cassava harvest, the more starch granules formed in the tuber. This is in accordance with the report of Abbot and Harker (2001) which states that with increasing age in the tubers the texture will be harder due to the increasing starch content but if the fiber is too old the fiber content increases while the starch content decreases.

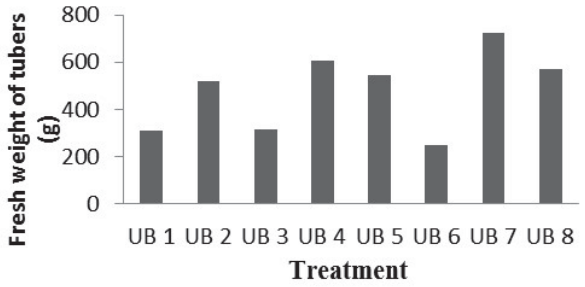


Figure 8. Fresh weight of cassava tubers under intercropping with several sorghum genotypes

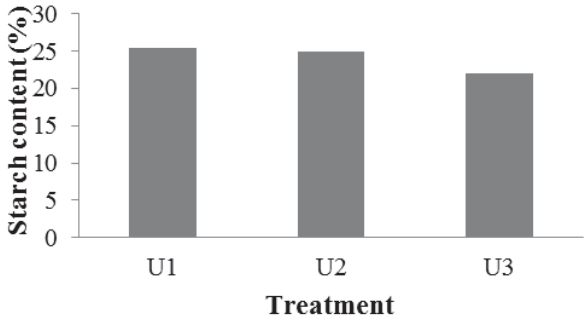


Figure 9. Starch content of cassava under intercropping with several sorghum genotypes at the time aged 36 WAP

Description: U1: Replication 1, U2: Replication 2, U3: Replication 3

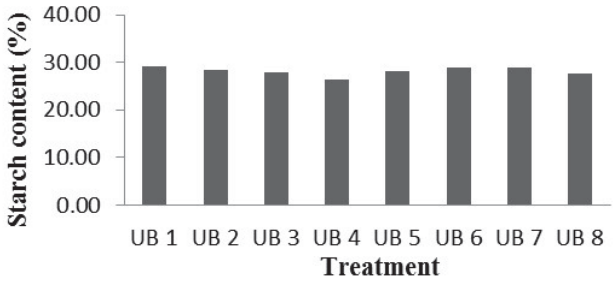


Figure 10. Starch content of cassava under intercropping with several sorghum genotypes at 51 WAP

CONCLUSION

This experiment showed cassava under intercropping with sorghum genotypes of P/F-5-193-C and GH 5 tended to show slower growth and produced lesser tuber number compared to intercropping with other sorghum genotypes in this experiment. Conversely, the starch content produced was higher.

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