Preface

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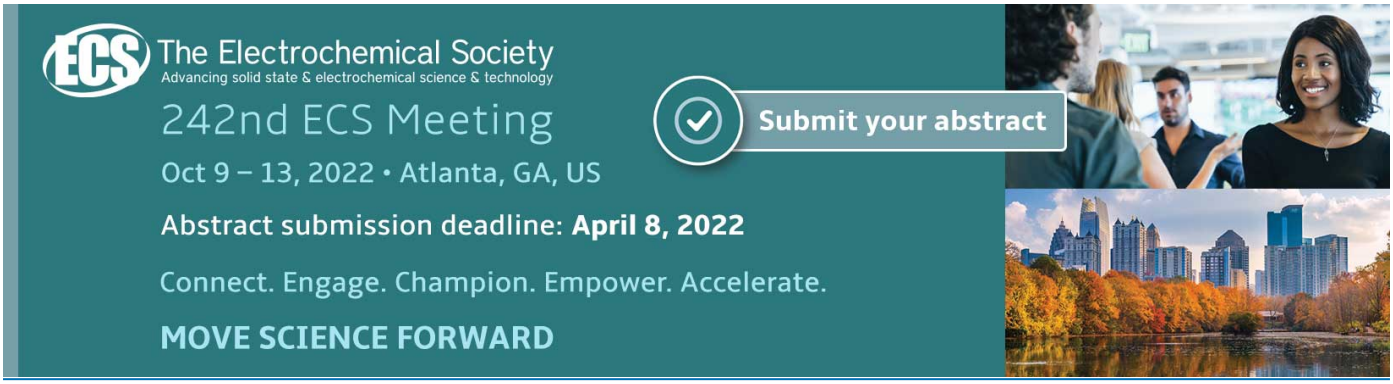

PREFACE

It is a great honor for us, Faculty of Forestry of Hasanuddin University, to host the 2nd Biennial Conference of Tropical Biodiversity 2021 (BCTB) 2021 on August 4th - 5th, 2021, in Makassar City of South Sulawesi Province, Indonesia. This conference is a series of international scientific seminars held by the Faculty of Agriculture, Universitas Hasanuddin, Makassar, Indonesia, held biennially since 2018. In addition, The proceedings of BCTB have been published in the IOP conference series: Earth and Environmental Science (EES).

Biodiversity is evenly distributed and varies widely across the world and within regions, the diversity of which is highly dependent on environmental factors such as temperature, rainfall, altitude, soil geography, and the presence of other species. Biodiversity is also essential in supporting ecosystem services, including air quality, climate, carbon dioxide absorption, water purification, pollination, and erosion prevention. Rapid environmental changes have led to many mass extinctions of species. Therefore, protecting its existence has become one of the most significant challenges humanity has to face.

The Biennial Conference of Tropical Biodiversity is a scientific forum to enhance science and technology, together with researchers, scientists, practitioners, and scholars to anticipate the impacts of climate change in biodiversity. This is also conducted to promote Sustainable Development Goals (SDGs). Hence, this conference chose an SDGs-related theme, namely **"Managing Challenges in Biodiversity Conservation During The Pandemic to Achieve Sustainable Development Goals for Better Environment"** with six sub-themes:

1. Assessment of global biodiversity: the impact of a pandemic to biodiversity.
2. The existence of genetic diversity to maintain biodiversity.
3. Community partnership for biodiversity conservation.
4. Biodiversity and utilization.
5. The conservation of tropical biodiversity: current challenges for the management.
6. Ecological risk and natural disaster.

The Biennial Conference of Tropical Biodiversity will be held every two years. The first was in 2018, and the second should be in 2019. Due to the Covid-19 outbreak, the conference was postponed to be this year (2021). Hence, the conference model has performed with a virtual conference instead of a live meeting.

This conference presents keynote speakers from 5 countries, namely Prof. Enrico Bonello from Ohio State University, USA, Dr. Doan Nainggolan from Aarhus University-Denmark, Prof. Erin P. Riley from San Diego State University-USA, Dr. Ida Ayu Pradnya Resosudarmo from Australian National University-Australia, and Prof. Supratman from Hasanuddin University-Indonesia. The plenary session and discussion for all speakers were for 3 hours. Participant presentations (oral and video presentations) were held in 3 sessions, and each session was divided into ten rooms. The number of participants per room was 15-20 participants with an allocation of presentations for 5 minutes/participant conducted in parallel as many as three parallel sessions. Discussions sessions were held in parallel in each parallel session with an allocation of 3 minutes per participant. The Virtual BCTB conference implementation applied the zoom meeting application provided by the Faculty of Forestry, Universitas Hasanuddin.

This international conference is attended by around 250 participants from 6 countries (USA, Denmark, Australia, Italy, Finland, and Indonesia), including keynote speakers, oral presenters, and participants. The participant consists of 31 Universities and 13 forestry-related institutions. We received 202 abstracts in total, but after the review process, the committee accepted 187 abstracts and rejected 15 abstracts because they didn't fit the sub-themes. The conference will be held on August 4th - 5th, 2021.

We wish to convey my appreciation to the Rector of Hasanuddin University and the Dean of Forestry Faculty for their support to ensure the success of this conference.
Finally, we sincerely thank all committee members and a volunteer team of the Forestry Faculty, Hasanuddin University, who all have total commitment and work hard for this international conference. Our sincere thanks also to all parties, including session chairs, Publication Management Center (PMC) of Universitas Hasanuddin, all speakers, all authors, and participants that make this conference meaningful and happening. Sincerely thank you for your generous support, and we look forward to working with you in the future.

Warm Regards,

Mukrimin, S.Hut., MP., Ph.D

Chairman of 2nd BCTB 2021

Faculty of Forestry, Universitas Hasanuddin

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Peer review declaration

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Peer review declaration

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

- **Type of peer review:**
  Single-blind
- **Conference submission management system:**
  We conduct paper submission through open conference system (http://conference.unhas.ac.id/ocs/index.php/bctb/2021/login) and the manuscript from author has submitted before the conference through the conference website (https://bctb.unhas.ac.id/)
- **Number of submissions received:**
  Total received abstract = 251 titles
- **Number of submissions sent for review:**
  231 titles for abstract
- **Number of submissions accepted:**
  138 titles of fullpaper from 231 titles of fullpaper submitted
- **Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100):**
  59.7 %
- **Average number of reviews per paper:**
  7- 8 papers per reviewer
- **Total number of reviewers involved:**
  18 reviewers
- **Any additional info on review process:**
  There are some steps on review process
  1. Abstract review and acceptance
     At the begin, the abstract is submitted by the online system which is available on the conference page. The submitted abstracts are then collected by the committee for review one by one regarding the format, language and suitability of the conference scope. The abstract review was carried out by an internal reviewer. If there are any discrepancies, the abstract will be sent back to participants via email.
  2. Submission of Full Paper
     Secondly, uploading of full paper may only be done by participants who attend and present their research activities during the conference. This upload and revision activity was carried out on July 25 - September 15 2021
  3. Revision of Full Paper
     At the revision stage, participants will be requested to make revisions based on the input given by the reviewer, this input is generally in the form of format, language and continuity of each discussion.
  4. Peer review of Full Paper
     At the Fourth stage, full paper previously submitted through system were reviewed following a single blind peer review process. The papers were sent to

reviewer that consisted of 18 reviewers according to topic of the papers and reviewer's competency. Review was conducted on content, language, and format of the paper based on IOP Conference Series. At this stage, Reviewer submit a decision for the acceptance of the papers for publication in IOP Conference Series.

5. Revision of Reviewed Full Paper
   As the end, the submitted papers were then subjected to proofread stage and check for similarity using Turnitin program. Subsequently, papers were prepared for submission to IOP Conference Series.

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The productivity and economic value of sweet potato (*Ipomea batatas*) planted intercropped with satoimo taro (*Colocasia esculenta* (L.) Schott *var. Antiquorum*) with various levels of compost

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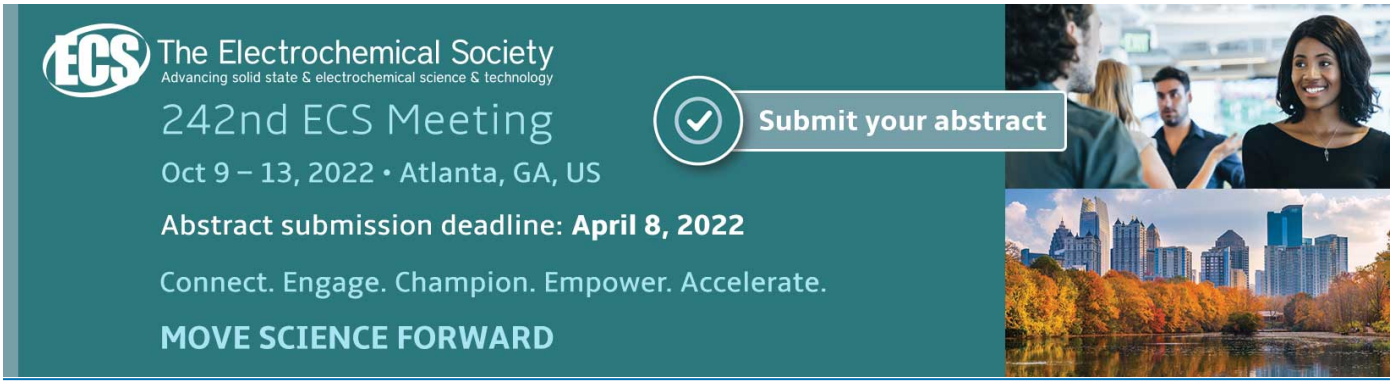

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The productivity and economic value of sweet potato (*Ipomea batatas*) planted intercropped with satoimo taro (*Colocasia esculenta* (L.) Schott *var. Antiquorum*) with various levels of compost

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Abstract. Sweetpotato (*Ipomea batatas*), as a well-known plant and widely cultivated by farmers in South Sulawesi, if it is intercropped with satoimo taro (*Colocasia esculenta* (L.) Schott var. Antiquorum) as a staple crop should be suspected of being able to be a 'safety' crop when there is a failure in taro plant—due to the relatively new and un-well-known plant. The study was aimed to know the productivity and economic value of sweet potato planted as an intercropped on the staple crop satoimo taro plantation with several levels of compost. The study used a randomized complete block design with four levels of manure compost, namely 400 grams, 800 grams, and 1200 grams per staple plant, which put into and mixed evenly in the plant hole, and 1200 grams per staple plant which mixed evenly in the beds, and three blocks. Sweet potatoes were planted between staple plants satoimo that arranged 20 plants in a bed of 500 cm x 110 cm in two rows. The parameters observed were yields of tuber per plant, size of tuber, number of tubers, and dry weight of tops. The results showed that there is no level of compost affected significantly. However, both of the levels of 1200 grams of compost which is filled into the plant hole, and 1200 grams of compost mixed in the beds tended to be higher than the others in tuber productivity. By economic valuations, the RC-ratio and RC-ratio indicated that planting intercropped sweet potato are beneficially in all levels and increased after the levels of compost. Cultivating sweet potato intercropped in the two kinds application of 1200 grams levels in the taro plantation is more recommended.

1. Introduction

1.1. Background

ITPC OSAKA reported, so far, imports of commodity HS 0714 (tubers group) in Japan were dominated by imports of taro, especially Japanese taro "satoimo" with a share of more than 60%, while imports of sweet potatoes reached 22.4%. In terms of taro imports, China currently controls the Japanese market with a 99.6% share, while Indonesia is the sixth-largest supplier (in 2019) with a 0.03% share behind Vietnam, Taipei, Myanmar, and the United States. Indonesia has great potential to develop the taro export market, considering that Indonesia's taro exports to the world show a significant growth of 25% in 2019 [1].

In South Sulawesi, the satoimo taro plant (hereinafter referred to as "satoimo" only), was designated by Gobernur as one of the important crops to increase exports to Japan. Because of that, socialization and even training and capital assistance have been carried out to farmers in all regions since 2019. However, the failure rate of production is still relatively high, causing economic losses for farmers who work on it. Finding plants that ecologically have characteristics that can be integrated with taro and are well known to farmers, and have high economic value to provide support is important. In general, the intercropping system is more profitable than the monoculture system because the land productivity is higher, the types of commodities produced are diverse, it is efficient in the use of production facilities, and the risk of failure can be minimized [2].

Sweetpotato plant (*Ipomea batatas*) with its character which efficiently utilizes light (C3), is one of the plants that is ecologically expected to be able to adapt and produce tubers normally when planted as an intercropping plant or intercropping in satoimo taro (*Colocasia esculenta* (L.)) which is also a C3 plant. Therefore, it is necessary to test whether the sweet potato plant—which is well known to farmers —can adapt and produce with normal productivity and be economically profitable when grown as an intercrop in taro plantation as a staple crop.

1.2. The objectives

The purpose of this study are to determine: (1) the productivity of the sweetpotato planted as an intercropping plant on taro plantation with four levels of manure compost; and (2) the economic benefits affected by the various levels of manure compost.

1.3. Sweet potato, taro and organic fertilizer

Sweet potato is economically important not only to fill export market demand but also to local market demand in line with increasing consumption and demand. Even in Papua, the farming practice of producing sweet potato for own consumption has shifted towards a commercial direction, so 83% of the production was for sale [3].

Sweet potatoes are usually planted on loosened soil and formed by raised beds about 80-120 cm wide. Taro too. Only slightly different in terms of how to grow them. If the taro is planted in a hole filled with compost first, the sweet potato will not. Only insert it into the loosened soil without being given compost, even if it is given compost, by mixing it with the soil at the time of final soil processing. Taro is composted at a high dose of about 20-30 t / ha, but sweet potato is only about 10 t / ha; even then, farmers rarely do. The density of taro ranges from 20-25 thousand plants per hectare, with a spacing of 100 cm x 50 cm to 100 cm x 40 cm or 80 cm x 50 cm. While sweet potato is about 30-40 thousand plants per hectare with a spacing of 75 cm x 50 cm or 100 cm x 25 cm. In China planting of sweet potato with a high density of 12 plants per square meter (120,000 plants per hectare) has been recommended [4].

Based on the genetic characteristics of the two plants, namely C3 plants that have a low light saturation level, so in terms of solar radiation, they are not worried about interfering with each other if combined in one planting area. What needs to be considered is the level of competition in using nutrients and water. Taro can even grow normally with a shade level of up to 70%; although, for satoimo taro or what in Bali is called salak taro, the tuber yield decreased up to 60.3% in 75% shade; 64.0% if it is covered by 50%, and 70.9% if it is covered by 25%. The decrease in yield occurred in proportion to the percent shade. With 25% shade, production becomes 70.9%, 50% shade production becomes 64.0%, and 75% shade production becomes 60.3% [5].

Fertilization with organic fertilizers can improve soil's physical, chemical, and biological properties. Even the amendments made to the organic fertilizer sand soil increased water holding, increased the microbial enzymatic activity, and the production of maize in China [6]. Through the application of organic materials, agricultural products have a sweeter taste, are more durable, are free from chemical residues so that they are safe and healthy for consumption. Giving organic material has a better effect on sweet potato plants if it is done 30 days before planting [7]. Various sources of organic fertilizers can be used, including chicken, cow, goat, and other manure for plants for taro and sweet potato plants. In

East Africa it was found that organic farming was effective in reducing parasitic nematodes (VAT) under control over a longer period of time (4 months) compared to conventional farming [8]. Another finding was also found in Africa, that the use of goat manure had a very good effect for intercropping sweet potato crops with maize because it was able to control nematodes [9]. However, in South Sulawesi, the compost that is most commonly found and applied to taro plants is chicken cuttings compost.

2. Material and method

The study was conducted at the Maros Regency, western of South Sulawesi; located on latitude 5 ° 7'S and longitude 119 ° 36'E, 25 m above sea level. The top soil (0 - 20 cm) texture of the experimental site is clayey loam. The soils are classified as alfisol-pluvisol (complex) with pH 5.25. The experimental field preparation was slashed, plowed, loosened, and made beds by using a cultivator between about end of June 2020. The beds are made to measure 500 cm x 110 cm with a trench width of 40 cm. Meanwhile, the main plant holes (taro) are arranged at a distance of 50 cm x 50 cm in the beds so that there are 2 rows with a total of 20 taro trees per bed.

Before planting the staple crop, compost was given compost of each 400 grams (C1), 800 grams (C2), and 1200 grams (C3), each of which was inserted into the planting hole then mixed with the soil homogeneously in a row. Symbols (C1, C2, and C3), and 1200 grams are spread evenly over the beds, then mixed with soil as deep as 20 cm in layers throughout the beds (C4). After planting the main taro plant, immediately followed by planting the sweet potato between the two taro plants at a distance of 10 cm from the edge of the bed. The number of sweet potato plants is the same as the number of taro plants, each equivalent to 26.666 plants per hectare. The plant material used is one month old taro seedlings in the nursery and old sweet potato shoots. The taro seeds come from tubers harvested from the mother tree at the age of 5.5 months, while the sweet potato seeds from sweet potato varieties are maturing 3 months old.

The study was arranged using a Randomized Complete Block Design (RCBD) with 4 levels of compost and 3 groups. Thus there are 12 plots. Sample 3 plants each per plot. Parameters observed were tuber yield per plant, tuber size, number of tubers per plant, top dry weight; as well as the economic value consisting of farm profits and revenue cost ratio (RCR).

3. Results and discussion

After statistical tests were carried out, the compost level variation did not have a significant effect at the 0.05 level on all parameters. The yield of tubers per plant, the average size of tubers, and number of tubers per plant were not significantly different (Table 1). However, with the analysis using the histogram and trendline, it is seen that there is a trend of increasing linearly for all parameters (Figures 1, 2, 4, and 5).

Table 1. Statistical analysis of parameters

Parameters	Level of Compost				Statistical Analysis		
	400g	800g	1200g	1200gmix	F	First	Sig
Yields, g/plant	522.2	753.6	862.2	884.4	2.98	4.76	ns
Size of tubers, g/tuber	102.8	173.5	219.2	165.3	2.07	4.76	ns
Number of tubers	5.1	4.6	4.8	5.3	0.33	4.76	ns
Plant tops, g/plant	78	99	142	120	2.54	4.76	ns

ns = not significant at the 0.05 level

3.1. Number of tubers

The highest number of tubers per sweet potato plant (5.3 tubers) was achieved at the level of giving 1200 grams of compost per staple plant (taro) which was spread and mixed evenly in all parts of the bed, higher than the others, especially for giving the same amount but placed in a hole taro plant (Figure 1).

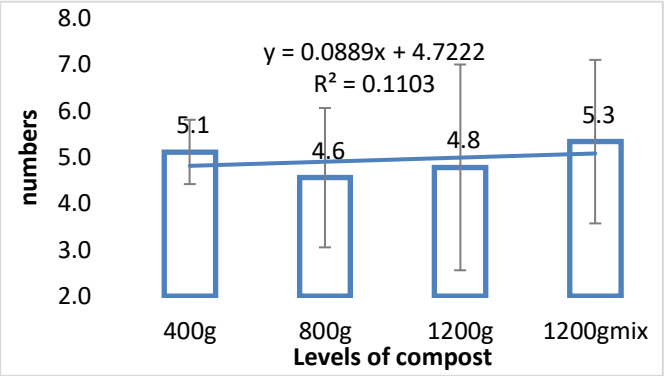

Figure 1. Number of tubers per plant

3.2. Tuber yields

From a quantitative perspective, tuber yields are the main parameters that determine productivity and production. The highest yield of tubers per plant was achieved (884.4 grams) in the treatment with 1200 grams of compost per staple plant, which was evenly mixed in all parts of the beds (C4) but was not significantly different from all other treatments at the level of 0.05 (Figure 2). However, the treatment of giving 1200 grams per staple plant inserted into the taro plant hole (C3) was significantly different from giving compost 400 grams and was not significantly different from the others.

The interesting thing is that this fact contradicts the expectations of the research, which suspected that the C4 (mixed) treatment would give the best results because the compost provided was not only available for staple crops (taro) but also available for intercropping (sweet potato). Because it spreads throughout the bed. Research results in China. These results indicate that the addition of organic fertilizers will not only improve soil quality but also increase yields of radish and sweet potato compared to chemical fertilizers [6]. However, other researchers also found identical phenomena. Ginting et al. found the highest yield of sweet potato tubers per plot was not the one given the highest bokashi fertilizer (15 t / ha) but, on the contrary, the one has given bokashi between 5 to 10 t / ha. This phenomenon occurs in an average of the three varieties tested. In fact, one of them, the Antin 2 variety, achieved the highest yield at a level of around 5 t / ha [10] (Figure 3). The results of the study of Manohara variety of chicken manure gave the best response to stem length, number of leaves, fresh weight and tuber weight. Compost from household waste also has the best benefits if applied 30 days before planting sweet potatoes with a yield of 28 t / ha [11].

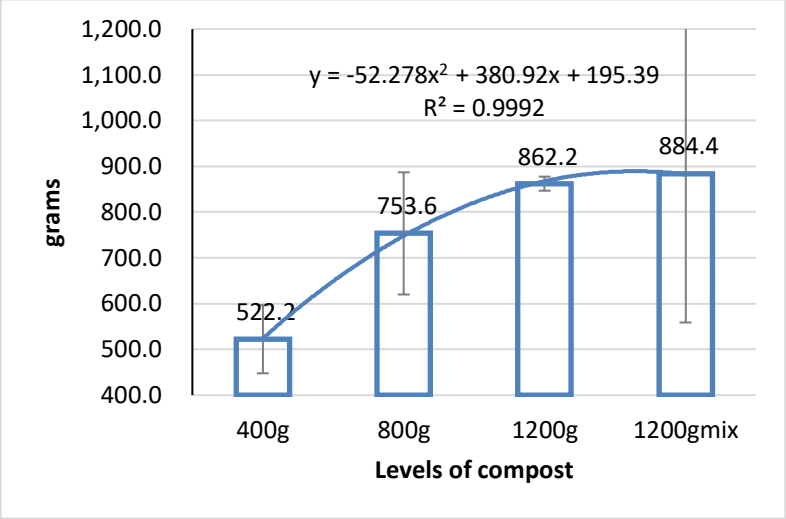

Figure 2. Tuber yields per plant

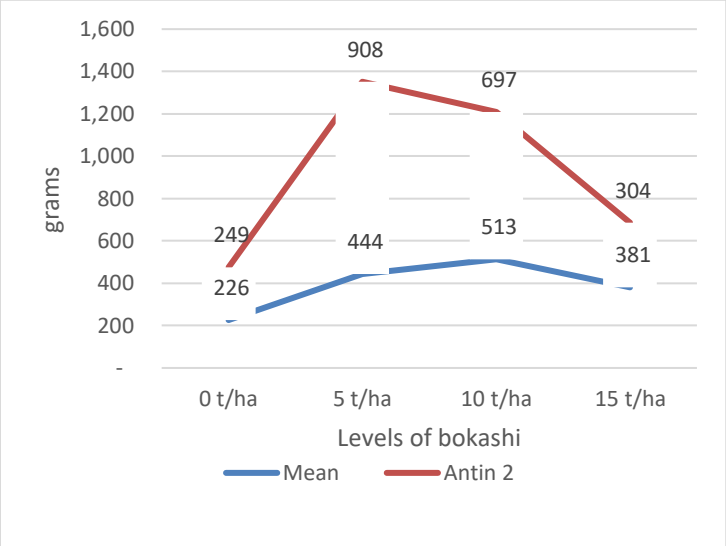

Figure 3. Tuber yields of three varieties of sweet potato [10]

3.3. Tuber size

Tuber size is one of the quality criteria for sweet potato tubers. If the tuber size is less than 30 grams, it cannot be sold (there is no market). The results showed the highest mean tuber weight (176.5 grams) in the treatment of giving compost 1200 grams per staple plant, which was evenly mixed in all parts of the beds (C4), but not significantly different from all other treatments at the level of 0.05. However, the treatment of giving 1200 grams per staple plant inserted into the taro plant hole (C3) was significantly different from giving compost 400 grams and was not significantly different from the others.

As with tuber yields, the interesting thing is that this fact contradicts research expectations which suspect that the C4 (mixed) treatment will give the best results because the compost provided is not only available for the staple crop (taro), but is also available for intercropping (sweet potato) because it spreads to all parts of the bed. But other researchers also found identic things [10].

3.4. Plant tops

One indicator of plant fertility is the level of vegetative development, which is marked by the dry weight of the plant top. The results showed that the highest plant top (142 grams) was treatment with 1200 grams of compost per staple plant inserted into the plant hole, but it was not significantly different from other treatments (Figure 5). When observed carefully, vegetative growth or in other words, the highest producer of biomass is the treatment (C3). This treatment is also close to (almost) significantly different from the other two treatments.

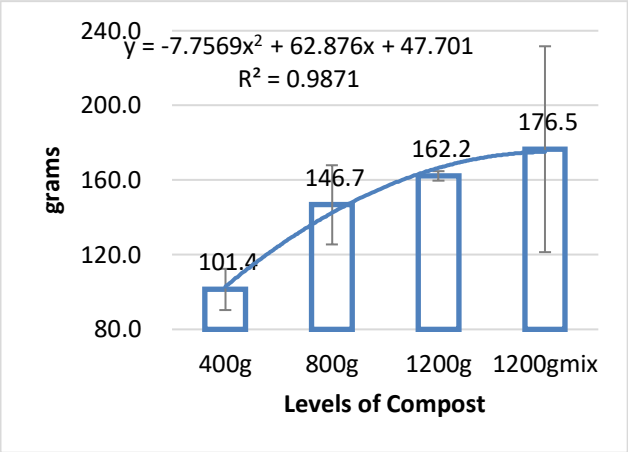

Figure 4. Tuber size

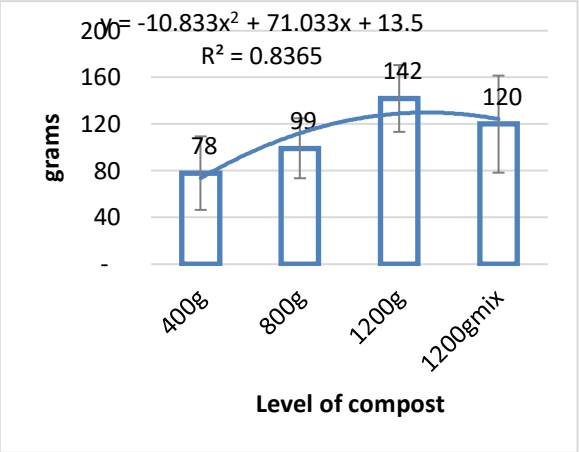

Figure 5. The dry weight of plant tops

3.5. Productivty

The productivity of sweet potatoes is mainly assessed by the yield of the tubers both in quantity and quality. In this study an approach was used to measure the yield of tubers per plant — which can be converted into tons per hectare — and tuber size. Based on this perspective, although the treatment of 1200 grams of compost into the main plant hole is not the highest, it is more advisable because it has a different significance level (level of confidence) from other treatments. The productivity of the tested plants was relatively higher individually than the average productivity of the "extract" varieties tested. The results of the research from treatments C1, C2, C3, and C4 were 522.22, 753.56, 862.22, 884.44 grams per plant compared to the average productivity in the field, generally around 700 grams per plant (14-40 or an average of 27.67 t / ha for a population of 40 thousand plants per hectare). In fact, other studies have found that the average production is only 22.5 t / ha [12].

3.6. Economic benefits

The indicator used is the profit and benefit cost ratio (BCR). In this analysis, according to the concepts and facts, several assumptions are referred to according to: (a) production costs consist of sweet potato seeds, planting costs and weed maintenance/control, and harvest costs; (b) does not cover land leases, costs for processing land, irrigation, pesticides because they have been borne by the cost of staple crops; (c) with early varieties (var. Sari) harvested at the age of 90 days does not cause harm to the staple crop (taro); (d) labor for planting and special planting in the 1200 compost treatment which is mixed evenly throughout the beds (C4) is less than the other three treatments because the soil is looser (light) because additional processing has been carried out when mixing the compost just before planting ; and (e) the number of productive plants is the total population as much as the taro population multiplied by 90% survival rate, namely 26,667 plants per hectare multiplied by 90% or 24,000 population.

The results of the benfit analysis are shown in Table 2. It appears that sweet potato farming, which is planted by intercropping with the main taro crop is very profitable with varying levels of profit according to the compost level treatment of the staple plant (taro). The RC-ratios were 2.31, 3.23, 3.66, and 4.01 for C1, C2, C3, and C4 treatments, respectively. This value is relatively higher than in general

sweet potato farming; range 2.0. A study in Teluk Dalam Subdistrict, Asahan Regency, shows the R / C Ratio value of 2.35 [13], in North Sumatra, the value is 1.8, and in Bogor, it is 2.1 [14] because it has been financed by the main planting business. However, it should be reminded that this analysis is partial, because it does not take into account the (negative) impact of sweet potato cultivation on taro as its main crop.

Table 2. Cost analysis of sweet potato intercropped with taro based on the effect of treatments

Item	Velume	Unit Price	Levels of Compost			
			400g	800g	1200g	1200gmix
FIXED COST						
Management cost (MM)	4	2,000,000	8,000,000	8,000,000	8,000,000	8,000,000
Equipment amortization and maintain	4	500,000	2,000,000	2,000,000	2,000,000	2,000,000
Total FC			10,000,000	10,000,000	10,000,000	10,000,000
VARIABLE COST						
Seeds	30,000	75	2,250,000	2,250,000	2,250,000	2,250,000
Planting cost (MD)	10	70,000	700,000	700,000	700,000	700,000
Weeding & filling cost (MD)	25	70,000	1,750,000	1,750,000	1,750,000	1,400,000
Harvesting cost	30	70,000	2,100,000	2,100,000	2,100,000	2,100,000
Bag/sacks, 'second'		1,500	470,000	678,200	776,000	796,000
sub total VC			7,270,000	7,478,200	7,576,000	6,450,000
Total Cost:			**17,270,000**	**17,478,200**	**17,576,000**	**16,450,000**
REVENUE						
Tuber yields (depend on tretment, grams per plant)			522.22	753.56	862.22	884.44
Tubers yields, from 24000 plants/ha (kg)			12,533	18,085	20,693	21,227
Price		3,000	37,600,000	54,256,000	62,080,000	63,680,000
Seeds	30,000	75	2,250,000	2,250,000	2,250,000	2,250,000
Total Revenue:			**39,850,000**	**56,506,000**	**64,330,000**	**65,930,000**
Profit			22,580,000	39,027,800	46,754,000	49,480,000
Revenue Cost Ratio (RCR)			2.3	3.2	3.7	4.0
Benefit Cost Ratio (BCR)			**1.3**	**2.2**	**2.7**	**3.0**

4. Conclusions

The productivity of the sweet potato planted as intercropping plant on taro plantation is within the normal range, namely 522.22, 753.56, 862.22, 884.44 grams per plant, and tends to vary but does not differ significantly according to the level of compost application, respectively 400 grams, 800 grams, and 1200 grams of compost that is put into the hole of the satoimo staple plant, and 1200 grams per plant are mixed evenly as deep as the processing layer throughout the beds. The highest yield of tubers was treated with 1200 grams of compost which was evenly mixed into the processing layer in all parts of the bed.

The total profit and revenue-cost ratio of IDR 22,580,000 (RCR 2.31), IDR 39,027,800 (RCR 3.23), IDR 46,754,000 (RCR 3.66), and 49,480,000 (RCR 4.01), respectively, varies by level. compost, respectively 400 grams, 800 grams, and 1200 grams of compost that is put into the hole of the satoimo staple plant, and 1200 grams per plant are mixed evenly as deep as the processing layer in all parts of the bed. The highest yield of tubers was treated with 1200 grams of compost which was evenly mixed into the processing layer in all parts of the bed.

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