ABSTRACT BOOK

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"Biodiversity Conservation for Sustainable Bioeconomy"

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FOREWORD

Welcome to the 10th International Conference on Global Resource Conservation (ICGRC 2019). The theme this year is Biodiversity Conservation for Sustainable Bioeconomy. The topic aligns bio-based economic activities that have strong innovation potential due to their use of a wide range of sciences, and enabling industrial technologies with biodiversity conservation so that a sustainable activity could be established.

In this event, around 130 authors will share their current experiments, knowledge, and experiences through five subtopics which are botany, zoology, conservation ecology, environmental science, and sustainable materials and resources. They are experts, lecturers, researchers, and students from various universities and research centers from Indonesia and abroad. Through this activity, it is expected to initiate collaborations, create innovation, and meet the demands for development of science and technology.

We would like to deliver a deep appreciation to the dedicated committee members, honorable speakers, and active participants, who have invested significant time to success this event. Additional thanks are given to Universitas Brawijaya and Indonesian Biology Consortium (KOBI) for their supports, and Center of Academic Proofreading Agency (CAPA) for sponsorship.

Finally, we welcome you to Malang, a city known for its cooler temperature, beautiful surrounding countryside, and attractive streets lined with historical buildings. We hope that you will take advantage of the many sights to see in the city, as well as the many natural and man-made wonders nearby, during your stay.

Malang, 04 September 2019

Irfan Mustafa
Chairperson of the 10th ICGRC
Universitas Brawijaya

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Morphology and Fruit Quality Characters of Pineapple (Ananas comosus L. Merr) cv. Quenn on Three Sites Planting: Freshwater Peat Swamp, Brackis Peat Swamp and Alluvial Soil

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ABSTRACT

The growth and fruit quality of crop is strongly influenced by the environment in which it grows. The purpose of this study was to observe the growth and fruit quality of pineapple (Ananas comusus L. Merr) cv. Queen that cultivated in the three different locations. Pineapple cv. Queen was planted in three different locations, namely in freshwater peatlands, brackish water peatlands and Alluvial soils in Riau province. Morphology and fruit quality characters of pineapple were evaluated at each location. The result of this study displayed that pineapple cultivated in freshwater peatland having fruit weight (1540.64 g), fruit length (19.80 cm), sucker number (4.94 pieces), slip number (3.16 pieces), total dissolve content (14.19oBrix), total acidifid acid (0.51%), and water content (85.94%) higher than others site. Morphology and fruit quality characters of pineapple that cultivated in brackish water peatlands and alluvial soils were not significantly different. Our finding of this study that pineapple grows well on three soil types and is adaptive in peatland so that pineapple can be selected as an alternative crop to be developed in the peatland in the future.
Keywords: pineapple, alluvial, peatland, fruit quality.

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October 29th, 2019

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Morphology and fruit quality characters of Pineapple (*Ananas comosus* L. Merr) cv. Queen on three sites planting: freshwater peat, brackish peat and alluvial soil

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Morphology and fruit quality characters of Pineapple (*Ananas comosus* L. Merr) cv. Queen on three sites planting: freshwater peat, brackish peat and alluvial soil

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Abstract. The growth and fruit quality of the crop is strongly influenced by the environment in which it grows. The purpose of this study was to observe the growth and fruit quality of pineapple (*Ananas comusus* L. Merr) cv. *Queen* that cultivated in the three different ecosystems. Pineapple cv. *Queen* was planted in three different ecosystems, namely in freshwater peatlands, brackish water peatlands and Alluvial soils in Riau province. Morphology and fruit quality characters of pineapple were evaluated at each ecosystem. The result of this study displayed that pineapple cultivated in freshwater peatland having fruit weight (1540.64 g), fruit length (19.80 cm), sucker number (4.94 pieces), slip number (3.16 pieces), total dissolve content (14.19ºBrix), titratable acidity (TA) (0.51%), and water content (85.94%) higher than others site. Morphology and fruit quality characters of pineapple that cultivated in brackish water peatlands and alluvial soils were not significantly different. Our finding of this study that pineapple grows well on three soil types and is adaptive in peatland so that pineapple can be selected as an alternative crop to be developed in the peatland in the future.

Keywords: pineapple, alluvial, peatland, fruit quality.

1. Introduction

Pineapple (*Ananas comosus* L. Merr.) is one of the most economically important tropical fruits after banana and mango. Pineapple has high nutrient contents, specific flavor so that people like to consume it's freshly. Besides, pineapple is often processed in various forms product such as canned fruit, juice, bromelin extract [1,2,3] fiber production [4] animal feed [5,6], and pineapple wine. Indonesia is one of the biggest pineapple producing countries in the world [7], reflected in Indonesia's total pineapple exports of around 193,948 tons in 2015 which continued to rise to 210,025 tons in 2017. Pineapple exports contribute around 82% of Indonesia's fruit exports [8]. The destination countries for Indonesian pineapple exports are the United Arab Emirates, Japan, Korea, Hong Kong, Saudi Arabia, and Singapore. In pineapple global trade, Indonesia's competitors are Brazil, Thailand, Philippines, Costa Rica, and China.

Riau province is one of the center productions of pineapple in Indonesia. In this region, the pineapples are commonly cultivated in peatland. Riau province has the biggest peatland in Sumatra, which is about 4.044 million hectares or 56.1% out of total peat land in Sumatra [9]. Most of the peatland in Riau are utilized by the farmer to plantation, crops and horticulture. The productivity of crops and horticulture in peatland was low, but the contribution of peatland in the crops and horticulture production around 50-60% from the total of crop production on the peatland [10].

One of the problems cultivation in the peatland is low soil fertility, acid soil reactions, and nutrient deficiency, mainly Cu and Zn [11]. This caused only a few plants able to produce well in the

peatland, but instead, the pineapple is one of the crops that can grow and produce well in the peatland, not even using fertilizer until first harvesting. The utilization of peatland for pineapple cultivation is also reported in Malaysia, estimated about 90% of pineapple cultivation applied in the peatland [12],[13],[14]. According to [13] that the cultivation of pineapple in peatlands is more economically beneficial than cultivation in mineral soil, and is more environmental friendly [14] because the emissions of methane produced from peatland planted with pineapple are lower, which is 0.65% tons/ha/year compared to those on empty peat land which produces 0.75% tons/ha/year. Pineapple in Riau province has faster growth and harvesting age around 11-12 months. According to [15] and [16] stated that pineapple can flower at the age of six months after planting in tropical lowland areas and faster harvesting, but pineapple planted at an altitude of 750 m above sea level started to flower in the age of 11-12 months. Other reports stated that altitude, season, duration and intensity of sunlight radiation effect growth and fruit quality of pineapple [15,17,18].

Based on the ecosystem or physiographic characteristics, peatland in Riau province can be divided into three types of peat, namely coastal peat swamp that is peat formed from marine water, brackish peat that is peat formed from brackish water (river and sea) and freshwater peat swamp that is formed from rainwater or freshwater. Each type of peat has different physical, chemical and biological properties [19,20,11] so that it will produce differentiation vegetation that grows on it [21,22]. They are widely used for pineapple cultivation in Riau so pineapple might produce differences in fruit growth and quality, depending on genotype, environment, and interactions between genotype and environment. According to [23] that different pineapple genotypes and different growing environments require different fertilization to produce optimal fruit, in other words, different soil types will produce different fruit quality product. The purpose of this study was to observe the growth and fruit quality of pineapple (*Ananas comusus* L. Merr) cv. *Queen* that cultivated in the three different locations, namely in freshwater peatlands, brackish water peatlands and alluvial soils.

2. Materials and Methods

The research conducted from March 2017 to February 2018. Plant materials that are used are pineapple cv. Queen. The research design used a randomized complete design (RCD) with land type as treatment. The plant sampled is taken from in three locations, e.g. freshwater peatland (101° 15’58” E and 0° 25’44” N), brackish peatland (102° 50’56.47” E and 0° 33’16.49” N) and alluvial soil (101°16’34.4” E and 0°24’53.7” N). Thirty plants sampled were randomly selected from each population and then carried out to the laboratory to be analysed.

The qualitative and quantitative characters of the sampled were observed. The measurement of quantitative characters of pineapple included plant height (cm), leaf length (cm), leaf width (cm), number of leaves, stem diameter (cm), number of slips, number of shoot, number of suckers, fruit weight with crown (g), fruit weight without crown (g), peduncle diameter (cm), fruit height (cm), fruit diameter (cm), eye (berry) depth (cm), core diameter (cm), crown height (cm), crown weight (g), total soluble solid (TTS °Brix), titratable acidity (TA), vitamin C content, TTS/TA ratio, and water content. Observations on qualitative characters were carried out on the character of plant habit, leaf color, bract color, petal colour, sepal color, fruit shape, fruit color when unripe, fruit color when ripe, fruit color homogeneity when ripe, eye profile, eye relative surface, flesh color, flesh aroma, and crown shape. The observation technique for all characters refers to the Descriptor for Pineapple guidelines, issued by the International Board for Plant Genetic Resources [24]. The analysis of variance was carried out to quantitative characters from three locations.

3. Results and Discussions

3.1. Qualitative Characters

The result observed the qualitative characters of pineapple at three sites planting are presented at Table 1. The results of this study showed that there is no difference in the qualitative character of pineapple cv. Queen on three types of cultivation land tested. This may be closely related to qualitative characters controlled by simple genes, so they are not influenced by environmental factors. It is

different from quantitative characters which are strongly influenced by many genes and are strongly influenced by genotype and environmental interaction [25],[26]

Table 1. Qualitative characters of pineapple cv. Queen planted in freshwater peatland, brackish peatland and alluvial soil in Riau Province.

Characters	Freshwater peatland	Brackish peatland	Alluvial soil
Plant habit	Erect	Erect	Erect
Leaf color	Greenish/green	Greenish/green	Greenish/green
Bract color,	Silver- white	Silver- white	Silver- white
Petal colour	White-purple	White-purple	White-purple
Sepal color,	Greenish-green		
Fruit shape,	Long-conical	Long-conical	Long-conical
Fruit color when unripe	Silvery green	Silvery green	Silvery green
Fruits color when ripe	Yellow with green mottling	Yellow with green mottling	Yellow with green mottling
Fruit color homogeneity when ripe	Good	Good	Good
Eyes profile	Prominent	Prominent	Prominent
Eyes relative surface	Medium	Medium	Medium
Flesh color	Golden yellow	Golden yellow	Golden yellow
Crown shape	Long conical	Long conical	Long conical

Based on the level of peat maturity, freshwater peatland and brackish peatland in this study were belong to hemic peat with a pH of 3.23-3.50 and 2.60-3.20, respectively, while alluvial mineral soils planted have a pH of 5.00-6.00. Pineapple grown on freshwater peatlands and brackish peatlands has a more vigorous initial growth than pineapple planted in alluvial soils. Pineapple has facultative photosynthetic pathways, namely C3/CAM [25,26,27,28,29,30]. At the beginning of growth (age 2 months), pineapple has a C3 photosynthetic pathway, but when plants experience abiotic stress such as low soil water content, high light intensity, and deficiency of soil nutrient cause changes and transitions of metabolism from C3 to CAM [25,27,28,30]. Changes in photosynthetic pathways from C3 to CAM cause pineapple to be efficient in water use due to stomata closure during the daylight [31]. Besides, pineapple also has a leaf anatomical structure that is capable of storing water and has a dense trichome and mushroom-shaped in the below leaves surface (usually silvery colored) thereby reducing evaporation [18].

3.2. Quantitative Characters

The average values of pineapple quantitative characters in three different soil types are presented in Table 2. There are differences in the character of growth and quality of pineapple at different locations, except for the character of leaf width, fruit diameter, and heart diameter. Pineapple that grows on brackish peatlands and mineral soils has a higher plant height and leaf length than pineapple which grows on freshwater peatlands. The highest number of leaves is found in mineral soil which is 61.90 leaves/plants. The plant height of pineapple in brackish peatland and alluvial soil is higher than the pineapple in freshwater peatland. The plant height of pineapple in this study is higher than pineapple of Mahkota Bogor and Palembang pineapple which has an average plant height of 60.30 cm [33]. The stem diameter of pineapple in brackish peatland and freshwater is higher than pineapple in alluvial soil, and this character is also higher than the stem diameter of pineapple of Makhota Bogor (4.46 cm), and Palembang pineapple (4.04 cm) [33,34]. Differences in plant morphology are strongly influenced by the environment and genotype. According to [35] that plant height of pineapple ranged from 39.00 cm to 171.00 cm with an average of 91.09 cm. Furthermore, [36] explained that plant

height and the number of leave correlated to fruit size. Pineapple planted on peatlands has a higher plant height and number of leaf in which resulted in the larger fruit size. The positive correlation between the number of leaves and the stem diameter with fruit size is closely related to the efficiency of light absorption so that photosynthates are produced more [37].

Table 2. The Average value of morphological characters of pineapple cv. Queen planted in freshwater peatland, brackish peatland and alluvial soil in Riau Province.

Characters	Freshwater peatland	Brackish peatland	Alluvial soil
Plant height	82.48[b]	106[a]	110[a]
Leaf length	66.00[b]	83.10[a]	87.50[a]
Leaf width	4.99[a]	5.27[a]	4.84[a]
Leaf number	36.00[b]	30.84[b]	61.90[a]
Stem diameter	9.97[a]	8.97[a]	4.92[b]
Fruit weight with crown	1540.64[a]	1091.05[b]	999.00[b]
Fruit weight without crown	1380.32[a]	926.84[b]	865.00[b]
Fruit height	19.80[a]	17.52[b]	16.30[b]
Fruit diameter	9.97[a]	8.97[a]	8.95[a]
Eye (berry) width	1.08[b]	1.58[a]	1.58[a]
Core diameter	2.37[a]	2.20[a]	2.14[a]
Crown height	15.33[b]	19.89[a]	16.20[b]
Leaf number of crown	126.06[b]	139.15[a]	107.10[c]
Crown weight	129.97[b]	162.21[a]	128.00[b]
Number of suckers	4.93[a]	1.21[b]	0.80[b]
Number of shoots	0.96a[b]	1.21[a]	0.40[b]
Number of slips	3.16[a]	0.10[b]	0.55[b]

The average value of fruit weight with crown, fruit weight without crown, fruit height, number of sucker, and number of slip of the pineapple planted on freshwater peatlands is higher and significantly different than pineapple grown on brackish peatland and alluvial soil, while the character of crown as crown height, leaf number of crown, crown weight, and number of shoot on brackish peatlands is higher and significantly different compared to freshwater and alluvial soil (Table 1). The weight of pineapple fruit in alluvial soils in this study was higher than the fruit weight reported by [38] in Bogor pineapple, [39] in Palembang pineapple and Blitar pineapple, and by [26] in many pineapple accessions cv. Queen. This showed that even though there was a decrease in the fruit size of pineapple grown in mineral soil but fruit size was not lower than another pineapple cv. queen that has been reported, even fruit size (as fruit weight, fruit diameter, and fruit length) and growth characters of the pineapple planted in alluvial soil higher compared to various accession of Bangka pineapple reported by [40].

The character of fruit weight is not only influenced by genetic factor but also is strongly influenced by the size of population/ha, plant spacing, in which the closer of spacing used is the smaller the size of fruit produced [41,42], but production/ha will increase with increasing plant population [41,43]. Furthermore, [44] also stated that giving organic matter can increase fruit size. Other studies also reported that the addition of nitrogen (N), phosphate (P) and potassium (K) increased plant growth, fruit weight, fruit size, and productivity [45,46,47]. Other factors that caused differences in fruit size included fertilization, uneven seedling size, and plant size when induction of flowering is carried out.

The character of fruit weight, fruit length, number of shoots, and the number of the slip of pineapple growing on freshwater peatland have higher compared to another, this was probably closely

correlated to the nutrient content of freshwater peatlands that supported to pineapple growth well. The same has been reported by [48] that the pineapple growth in peatland is better than alluvial soil. The author explained that it closely related nutrient uptake in pineapple plant tissue that grows in peatlands in which higher N, P, and K contents, ie 1.01%, 0.22 %, and 0.71% compared to alluvial soils with N, P, and K contents of 0.85%, 0.13%, and 0.69%, respectively. Furthermore, [49] reported the results of microscopic studies on peatland containing very high N, P, K, Ca, and Mg elements. This nutrient content is estimated to increase more vigorous the growth of pineapple in peatland, both in the character of growth in vegetative phase and in yield characters such as fruit weight, fruit diameter, and fruit length. In another study, [50] reported that the macronutrient content of N, P, K, Ca, and Mg on peatland planted with pineapple was higher than that of empty peat soil. This is related to changes in organic matter in peatland, besides the increase of temperature will also accelerate the decomposition in peatland [51]. Macro-nutrient deficiencies cause a decrease in fruit size and fruit weight [52].

One of peat soil characteristic is high organic matter content. According to [53] reported that the addition of organic matter to pineapple crops significantly increased the growth and number of leaves. It is also lined with reported by [54]. The same has been reported by [55] and [56] also found that the growth of *Brassica oleracea* was significant differences when planted in two different soil types, it occurred due to differences in the symbiosis of soil microorganisms against *Brassica oleracea* plants. According to [53] reported that differences in the growing environment and soil nutrient content caused differences in plant height, number of leaves, root length, plant dry weight in two pineapple genotypes.

Soil water content, nutrient content, and carbon assimilation have also influenced the growth of pineapple [52,57]. Nutrient content in peatlands is strongly influenced by the water that forms the peat (freshwater, brackish and seawater) [19,11], the type of organic matter forming, peat maturity, and peat acidity level [49]. Peat that is formed from tidal runoff/flooding of water river and seawater contained a lot of minerals, so it was relatively more fertile [58]. The differences in growing environments, techniques cultivation and genotypes caused differences in phenotypes in pineapple [53,1].

3.3. Fruit Quality

The quality of fruit is not only observed from the size of the fruit, but also the total soluble solid contents (TSS), titratable acidity (TA), Vitamin C content, TSS/TA ratio, and water content. Total dissolved solids (TSS) are an important component in determining the quality of pineapple. The TSS of pineapple in the freshwater and brackish peatlands is higher and significantly different compared to pineapple planted in alluvial soil (Table 3). the value of TA on brackish peatland is higher (0.78%) and is significantly different from pineapple which grows in freshwater peatlands (0.51%) and mineral soils (0.50%), while TSS/TA ratio is 25.86 in alluvial soil and 27.82 in freshwater peatland, and that values are higher and significantly different than TSS/TA ratio in brackish peatland (19.92) (Table 1). The ratio of TSS/TA is one of the indicators that are widely used in flavor evaluation because it describes the balancing between sugar levels and acid levels in the fruit. The higher the TSS/TA ratio usually the sweeter the fruit tastes. TSS/TA ratio in this study was higher than that reported by [59] 16) in smooth cayenne pineapple (23.78-25.58), [60] in Vitória pineapple (17.50-21.29), Maeda et al. (2011) in Smooth Cayenne Pineapple (15.35-18.01), but it was lower than the TSS/TA ratio (30.47-34.82) that reported by [41]. The value of TSS, TA, and TSS/TA ratio of pineapple in this study have met market standards for fresh fruit which requires TSS, TA, and TSS/TA ratio were 13, 0.5-0.7, 20-40, respectively.

The character of TSS, and TA, the ratio of TSS/TA, and the content of Vitamin C are influenced by several factors including fertilization [61,44,46,47,52], induction flowering [62,63] in which carbide use at high doses increases the TA level of fruit [64], fruit maturity [65,66], and the harvesting season [67], while the spacing, size of the population/ha, source of planting material, and size of seedling used did not affect the value of TSS and TA of the fruit [41,68,62]

Table 3. The Average value of fruits quality of pineapple cv. Queen planted in freshwater peatland, brackish peatland and alluvial soil in Riau Province.

Characters	Freshwater peatland	Brackish peatland	Alluvial soil
Total soluble solids (TSS)	14.19[a]	14.10a	12.93[b]
Titratable acidity (TA)	0.51[b]	0.78[a]	0.50[b]
Vitamin C content	17.92[a]	11.14[b]	8.56[c]
TSS/TA Ratio	27.82a	19.92[b]	27.51[a]
Water content	85.94[a]	77.59[b]	80.20[b]

Some researchers stated that addition of organic matter has been reported able to increase TSS content and TSS/TA ratio and significantly different from pineapple plants that are given chemical fertilization, while TA and Vitamin C content increases with giving of chemical fertilizers [61,44,69]. According to [47] that the addition of Nitrogen fertilizer caused a decrease in TSS, TA, and Vitamin C. It was inlined with reports [52] that explained lack of Nitrogen caused an increase in the TA, TSS, and vitamin C content, but TSS/TA ratio decreased. The results of this study indicated that TTS and TSS/TA ratio of the pineapple in peatland is higher than that in mineral soils, this is presumably because peat is very rich in organic matter, compared to mineral soils. The content of vitamin C and moisture content of pineapple which grows in freshwater peat is higher and significantly different from brackish peatland and alluvial soil. The vitamin C content of pineapple in this study was almost similar to vitamin C content in pineapple (9.44-16.86%) that is reported by [59], but lower than reported [61] that is 31.15% -32.81%.

4. Conclusion

The results of this study indicated that pineapple which grows in peatlands has a higher plant vigor and fruit size, but no difference in the qualitative character of pineapple plants both those grown on peatlands and mineral soils.

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July 8, 2019

LETTER OF ACCEPTANCE

Dear **Dr. Rosmaina**,

On behalf of the committee, we are pleased to confirm that your abstract,

Morphology and Fruit Quality Characters of Pineapple (Ananas comosus L. Merr) cv. Quenn on Three Sites Planting: Freshwater Peat Swamp, Brackis Peat Swamp and Alluvial Soil

has been accepted, with editorial decision:

Accepted for Oral Presentation

at *The 10th International Conference on Global Resource Conservation*.

Please note that, in order for the abstract to be included in the conference program, presenters are required to complete the registration fee.

Your presentation is an important part of the conference, and we are looking forward to meet you at the conference.

Sincerely,

ICGRC

Irfan Mustafa, Ph.D.
Conference chairperson

CERTIFICATE

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Morphology and Fruit Quality Characters of Pineapple (*Ananas comosus* L. Merr) cv. Quenn on Three Sites Planting: Freshwater Peat Swamp, Brackis Peat Swamp and Alluvial Soil

Malang, September 4 - 5, 2019

Prof. Dr. Ir. Nuhfil Hanani A.R., M.S
Rector of Universitas Brawijaya

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Conference Chairperson