The diversity and cultivation system of Saccharum edule L. and its role as an edible plant source in Papua, Indonesia

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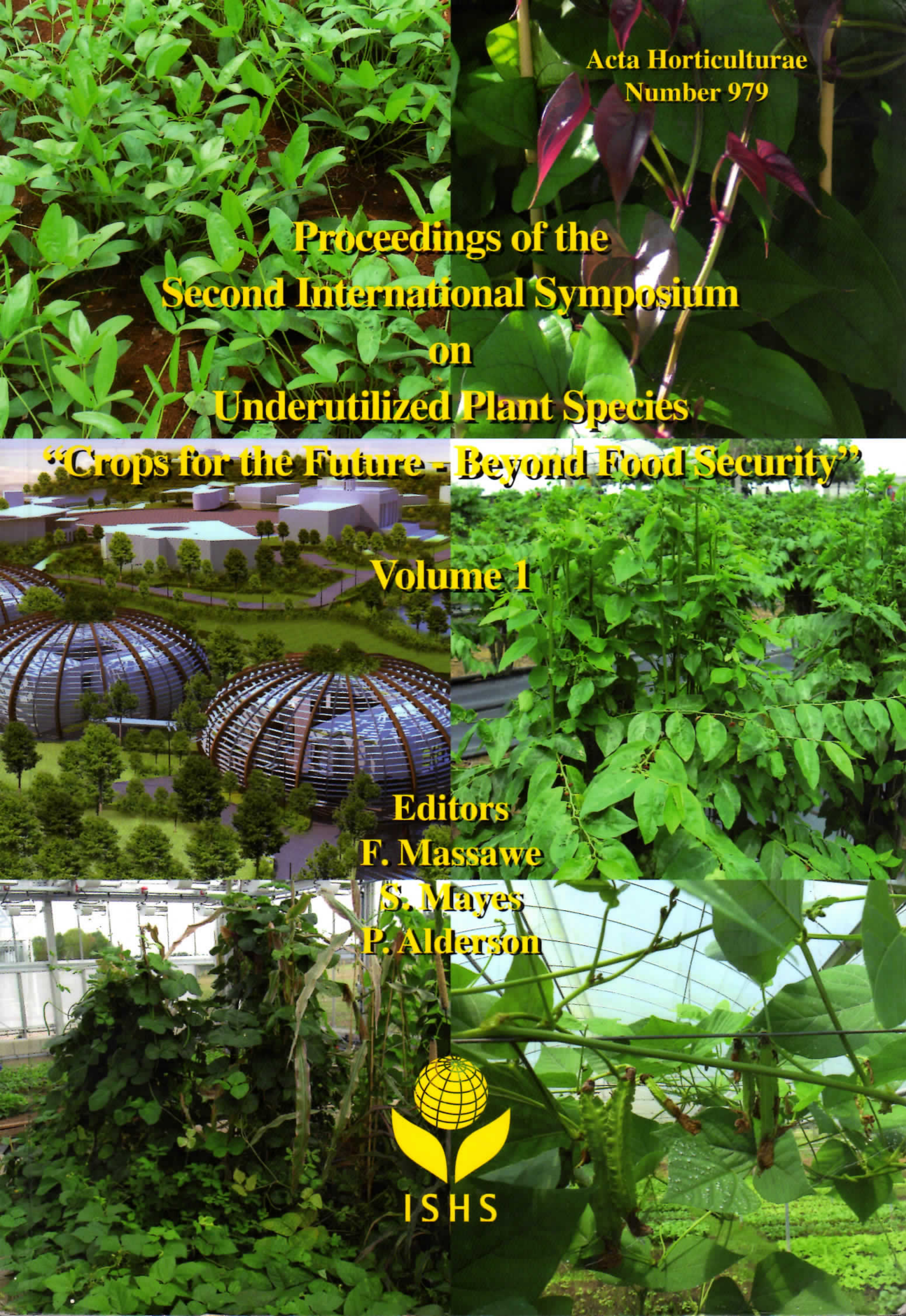

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Proceedings of the Second International Symposium on Underutilized Plant Species

"Crops for the Future - Beyond Food Security"

Volume 1

Editors
F. Massawe
S. Mayes
P. Alderson

ISHS

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Volume 1

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1. *Vigna subterranea* crop (by courtesy of the University of Nottingham).
2. Leaves of *Dioscorea* spp. (by courtesy of the University of Nottingham).
3. Artistic impression of Crops for the Future Research Centre (by courtesy of Crops for the Future Research Centre).
4. *Sauropus androgynous* (by courtesy of the University of Nottingham).
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FOREWORD

The 2nd International Symposium on Underutilised Plant Species entitled 'Crops for the Future – Beyond Food Security' was held on 27 June-1 July 2011 in Kuala Lumpur, Malaysia. The Symposium was organised by the University of Nottingham Malaysia Campus under the auspices of the International Society for Horticultural Science (ISHS) with support from the ISHS Working Group on Underutilised Plant Genetic Resources, the ISHS Commission on Plant Genetic Resources and the ISHS Section on Tropical and Sub-Ttropical Fruits. The event was co-convened and supported by The University of Nottingham, Crops for the Future (CFF), Crops for the Future Research Centre (CFFRC), Bioversity International, the Malaysian Agricultural Research and Development Institute (MARDI), Boustead Holdings Berhad, Food and Agriculture Organisation of the United Nations, Kirkhouse Trust, British Council and Forum for Agricultural Research in Africa.

Over 240 participants from over 45 countries attended the four-day event held in Kuala Lumpur to mark the hosting by Malaysia of the world 'Crops for the Future' (CFF) organisation with a global mandate to investigate promising underutilised food and non-food crops. Yang Amat Berhormat Dato' Sri Mohd Najib Bin Tun Haji Abdul Razak, the Prime Minister of Malaysia, officiated the opening ceremony of this symposium as well as the official launching of the Crops for the Future Research Centre (CFFRC). CFFRC is a joint venture between the Government of Malaysia and the University of Nottingham Malaysia Campus and from its global base in Malaysia CFFRC will establish world class research on promising underutilised crops.

This event provided a platform for delegates including high level keynote speakers to discuss the central symposium theme, Crops for the Future – Beyond Food Security. In particular delegates deliberated on the potential role of underutilised plant species to contribute to global food security and nutrition, provide a buffer against the consequences of climate change and enhance agricultural biodiversity. Their deliberations culminated into the identification of priorities for the future development of underutilised plant species and building of critical mass of researchers and end-users across food and non-food crops.

F. Massawe, S. Mayes and P. Alderson
Editors

PREFACE

The papers contained in this volume of *Acta Horticulturae* report the peer reviewed Proceedings of the Second International Symposium on Underutilized Plant Species – "Crops for the Future - Beyond Food Security". Keynote speakers and authors of selected contributed oral and poster presentations were given the opportunity to submit a manuscript for publication.

The manuscripts were reviewed by the Editors and members of the Editorial Board. Only those papers judged suitable for publication following the authors' consideration of reviewer suggestions appear in this volume of *Acta Horticulturae*.

The ISHS acknowledges and appreciates the contribution of all editors and reviewers. They have made a significant contribution to improving the quality of this publication.

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The Diversity and Cultivation System of *Saccharum edule* L. and Its Role as an Edible Plant Source in Papua, Indonesia

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Keywords: exploration, identification, intercropping, nutrient

Abstract

Papua is home to a diversity of plant species that have not been exploited and scientifically studied for their potential use. Papua is also considered the primary center of *Saccharum* diversity. Among the *Saccharum* species that grow widely in Papua is *Saccharum edule*, which is still considered an underutilized plant species. The inflorescence of *S. edule* is a delicacy for consumption for Papuan people. With the growing concerns about food production shortage, food security problems, limited supply, and the growing demand for *S. edule* in the local market, exploration and identification of this plant was conducted at the selected areas of Papua provinces, from June to September 2009. There were 77 accessions collected from selected areas in Papua provinces. Some accessions produced greater protein; while some others produced greater carbohydrate content than all other accessions. In the next trial, intercropping of *S. edule* and soybean, using a range of planting distances of *S. edule*, was carried out from June to December 2010. It showed that *S. edule* with the planting distance of 200×200 cm produced better growth and yield, as shown by greater plant height, number of suckers, flower number and flower weight, compared to 150×150 and 100×150 cm distances.

INTRODUCTON

Papua is home to a diversity of plant species that have not been exploited for their potential use. Among the food plant species that have not been scientifically studied is *Saccharum edule*, which is still classified as an underutilized plant species (Quartermain, 2006). *S. edule* is among the *Saccharum* species, which belong to the same family as sugarcane (*Saccharum officinarum*). As it grows widely in the land of Papua including Papua New Guinea, Pacific islands, and Fiji, these areas are considered the center of *Saccharum* diversity (Daniels and Roach, 1987). The genus *Saccharum* consists of six species: *S. officinarum* L., *S. sinense* Roxb., *S. barberi* Jesw., *S. edule* Hassk., *S. robustum* Brandes and Jesw. *ex* Grassl and *S. spontaneum* L., of which the former four species are cultivated and the latter two species are wild (D'Hont et al., 1998).

The local name for *Saccharum edule* in Papua is *sayur lilin*. It is also called *tebu terubuk* or *tebu terubus* in Indonesia, whereas it is called *duruka* or *Fijian asparagus* in Fiji and *pitpit* in Papua New Guinea. *S. edule* has an aborted inflorescence enclosed inside the leaf sheaths that serves as an edible part for consumption (Glyn, 2004), and can be prepared in many ways (Mudaliar, 2007). In the highland areas of Papua, the leaves are used for thatching the traditional houses and floor base, while stem is used to make a traditional music instrument.

Saccharum edule had also been domesticated; however, the production is generally in the hands of small subsistence farmers with no appropriate cultivation techniques. With future concerns over food production shortages, food security problems, and limited supply and growing demand in the local market, coupled with the increase of population and the decrease of cultivated land, evaluation of underutilized crop such as *S. edule* is necessary. Added to the fact that food price has been continually increasing, the emphasis on food promotion and consumption should be based on traditional food crops.

The first exploration of *S. edule* was carried out by Karafir and Vokames (2003), however, this only covered limited areas of Nimboran and Kemtuk districts of Papua. Widiastuti (2000) found 7 and 8 accessions of this plant in Kemtuk and Nimboran districts, respectively. It is believed that *S. edule* grows widely in Papua and its diversity needs to be preserved in order to support food security and the sustainability of biodiversity. Hence, maintaining the traditional food crop is important as many of them are coming under threat nowadays. Positive initiatives should be revived to evaluate this crop, not only as a promising food, but also for cash income for the community.

Intercropping is a traditional farming method, practiced by Papuans from generation to generation. *S. edule* is commonly planted with root crops and various vegetables. However, the productivity is variable and low due to several factors, including inappropriate cultural practices. Farmers use inappropriate population density or irregular planting distances. As a consequence, the plants usually suffer from poor growth and development and finally low yield.

The objective of the research was to identify *S. edule* based on morphological characters, analyze the nutrient contents of its edible inflorescence and conserve the collected plants. Research also aimed to identify the appropriate planting distance of *S. edule* which would produce high inflorescence yield in an intercropping system with soybean.

MATERIALS AND METHODS

Plant Collection, Identification and Analysis

Exploration was conducted in selected regencies of Papua, Indonesia, namely Manokwari, Yapen, Jayapura, Wamena, Fak-fak and Kaimana regencies, representing lowland and highland areas. Study was carried out from June to September 2009. Sampling strategy in plant collection was based on the information of native people and village tribal chiefs. Data were also supported by direct interview with the local people, the village chiefs, and staff of the agricultural extension services. Interview was also conducted to obtain information on *Saccharum*'s local name and the local knowledge related to the use of *S. edule*, by using the descriptive method.

Identification of *S. edule* covered the characters of morphology and the nutrient content of inflorescence. Morphological and agronomical characters were recorded at the exploration sites, whereas analysis of the proximate and mineral contents was done for selected accessions according to methods from the Association of Analytical Chemists (AOAC, 1990) and Vadanat-Molibdat method at the Agriculture Technology Laboratory, Papua State University.

Data of proximate and mineral elements were analyzed using the tabulation method, whereas the diversity and genetic proximity of all accessions was examined using cluster analysis with the UPGMA method, using NTSYS programs.

The collection of *S. edule* was conserved ex situ, by growing the plants (or keeping the seeds) at the Agriculture Faculty, Papua State University.

Intercropping Field Trial

A field trial was planted, where *S. edule* was intercropped with soybean at different *S. edule* planting distances (P1=100×100 cm; P2=150×150 cm; P3=200×200 cm). The experimental design was Randomized Complete Block Design with 4 replications. Data were collected on plant height, fresh weight, sucker number per plant and the number and weight of *S. edule* inflorescences. Data of seed weight per plant and per plot for soybean were also collected. The data were analyzed using analysis of variance. The Duncan's Multiple Range Test (DMRT) was used as the mean comparison among treatment means.

RESULTS AND DISCUSSION

The Diversity of *Saccharum edule*

S. edule grows widely from the lowland to highland, with approximate height of 0-1750 m above sea level. The optimum growth temperature is between 25-30°C, with minimum and maximum temperature of 12 and 35°C, respectively. The plants grow profusely under intense sunlight.

Based on the identification, there was diversity of morphological characters both within and between populations. The cluster of 77 individuals of *S. edule* from 11 different locations is presented in the dendogram (Fig. 1). Based on the similarity analysis, the lowest similarity of morphological characters accounted for 45% and appeared in two distinct clusters: (1) Regions of Jayapura, Yapen and Manokwari, and part of Amban Pantai, and (2) regions of Wamena, Fak-fak, Kaimana, and Manokwari (Prafi, Mandopi, Saukori, Pami and a part of Amban Pantai). Each cluster generated sub-clusters of population from the same growth location. Individuals from the same origin normally clustered in proximity or at a close distance. This cluster pattern suggests a closer genetic relatedness among populations from similar areas, compared to those from distant locations. Each location had unique plant characters, and therefore the 11 populations of *S. edule* were indigenous to each original location. This phenomenon supports the theory that the closer the geographical area between two individuals or two populations, the shorter the genetic distance between those two individuals or populations.

The different characters of *S. edule* among regions were due most likely to the ecological and geographical isolation (ecogeographic). Ecogeographic isolation is induced by external factors such us climate, water, soil and topography. These factors function as catalyst in inducing barriers to gene exchange between populations, and hence each population in a particular ecosystem provides unique characters in each region. Hence, individuals or populations which have evolved under these conditions of ecological isolation will be adapted to a specific habitat and a specific environment.

According to Paterson (1978), it is difficult to explain the relation between character diversity due to geographical factors with different ecology. However, because of the geographical isolation, many of the characters are well adapted and can be clearly described. Characters that cannot adapt well will be lost and perhaps are altered or modified with other relevant characters. When the characters are stable, they will be transferred to the offspring, thus creating a new plant population in the region (Mawikere, 2005).

Based on *S. edule* identification, the greatest amount of morphological character diversity among regions or among populations within a region in Papua and West Papua is plant number per cluster, plant height, stem color, internode length and flower color. Based on the geographical location, the pattern of population clustering could not isolate *S. edule* populations collected from Papua and West Papua. This was indicated by the morphological character similarity among regions (45%); some *S. edule* accessions (GAM, GAKCM, GAH) were collected from Amban Pantai in Manokwari regency (West Papua province) which is close to the populations collected from Jayapura and Yapen regencies (Papua province). On the other hand, population of *S. edule* collected from Fak-fak, Kaimana and Manokwari regencies (Saukori, Mandopi, Pami, Prafi) of West Papua province were close to populations from Wamena regency (Papua province). Papua and West Papua provinces, together with Papua New Guinea (PNG) is an island of New Guinea, and classified in the demarcation zone of East Melanesia. Plants in the similar demarcation zone tend to have similar characters (Mawikere et al., 2007).

The greatest similarity between characters accounted for 88%, which appeared in 2 individuals of *S. edule*, collected from the same regions of LN-1 (Lismau Ngu-1) and LN-2 (Lismau-Ngu-2). Both individuals originated from Kali Tembakau, Prafi district of Manokwari regency (West Papua province). The characters between both individuals showed similarity in nearly all observed morphological characters, and only 18% of the characters were different between individuals. The morphological characters that varied between those 2 individuals are stem color (yellowish brown and yellowish red), stem circumference (6.5 and 8 cm), number of internodes per plant (27 and 40), and internode length per plant (7 and 5 cm).

The proximate and mineral composition of *S. edule* inflorescence varied among the accessions (Tables 2 and 3). The values for moisture content ranged from 86.42-89.41%, with 'Yu Kefye' having the highest value (89.41%). Food with high moisture content is more prone to deterioration and the high moisture values observed in all accessions suggests susceptibility to spoiling. Values of moisture of *S. edule* inflorescences confirm those observed by Mudaliar (1997) for water content of *S. edule* (89.3%). The high ash content is a reflection of the mineral content preserved in the food materials. Of all the inflorescence samples, accession of 'Yu Nggang' had relatively highest ash content (1.91%), followed by 'Yu Mencang' (1.71%). Crude fat ranged from 1.03-1.91%, while crude protein and carbohydrate contents ranged from 4.50-7.23% and 1.41-6.06%, respectively. 'Yu Kwam' accession had the highest protein content (7.23%) despite producing the lowest carbohydrate content (1.41%). On the other hand, 'Yu Mencang' had the highest carbohydrate content (6.06%) followed by 'Yu Ming' (5.39%).

Comparing with sweet potato tubers, as the main staple food for the indigenous Papuan, the edible part of *S. edule* produced greater protein and fat contents. Sweet potato fresh tubers normally contain 0.38-1.09% protein (Nuraeni, 2008) or 2.15% and 0.77-0.9% fat content. On the other hand, *S. edule* had a lower carbohydrate content (Table 1) than sweet potato (11.67-13.99%) (Nuraeni, 2008).

Table 1 shows the mineral contents of *Saccharum edule*. The results of nutritionally valuable minerals shows that 'Yu Nggang' produced the highest Mg content (97.10 ppm) and P content (0.34%), whereas the lowest Mg and P content were produced by 'Yu Ming' (84.56 ppm) and 'Yu Mencang' (0.19 %), however, 'Yu Ming' produced the greatest Fe content (20.29%). 'Yu Brop' followed by 'Yu Nggang' produced the highest Zn content (16.91 and 16.34 ppm, respectively). All accessions produced similar values of K content (0.03%).

S. edule produced greater amounts of the minerals Mg, Fe and Zn than do sweet potato tubers based on the sweet potato nutrient fact reference (33, 0.81, 0.40 mg, respectively). Therefore, this plant could be considered a healthy source of nutrients.

Intercropping *S. edule* with Soybean

Significant reduction in plant height was observed when plant spacing was reduced (Table 3). P3 produced taller plants, followed by P2 and P1, respectively. P3 also significantly produced greater biomass and number of plant suckers than P2 and P1. It is likely that with increasing number of plants per unit area, interplant competition for soil and other resources and light increased. As a result, under closer planting distances (higher population density) mutual shading increased, reducing biomass and restricting the growth of *S. edule* suckers.

Planting distance did not influence the number of flowers per plant but it affected the weight of inflorescence (Table 4). Lower plant density produced greater weight of inflorescence per plant. Plant density plays an important role in intercropping, because it is related to the light penetration into the canopy. Limited penetration of sunlight into the canopy might be one of the reasons for lower weight of inflorescence. This might be due to the higher the population density, the greater the effect of shading in intercrop system, as observed by Hang et al. (1984).

Different *S. edule* plant spacing did not significantly influence seed weight of soybean per plant (Table 5); however, there was a significant reduction in seed weight per plot area with increasing plant density of *S. edule*. With increased *S. edule* plant distance, population density of soybean increased: this could have resulted in increased interplant competition for light, water and nutrients, resulting in decreased seed weight of soybean at higher planting distances.

CONCLUSIONS

Saccharum edule grows widely, both in the lowland and in the highland of Papua. At present there have been 77 *S. edule* accessions collected from the Papua and West Papua regions. Jayapura and Wamena are considered the areas with the highest *S. edule* diversity. The morphological characters mostly observed among regions or among population within region of Papua and West Papua are plant number per cluster, plant height, stem color, internode length and flower color.

Among all other accessions, 'Yu Nggang' produced higher protein content and had the greatest P, Mg, Fe, Zn content, whereas accession 'Yu Mencang' and 'Yu Ming' produced greater carbohydrate content than all other accessions. This indicates that the inflorescence of *S. edule* offers tremendous nutrition. Further research is needed to develop this plant, particularly in cultivation and food processing techniques.

S. edule with the planting density of 200×200 cm produced highest plant weight, fresh biomass weight, number of suckers, flower number and weight under an intercropping system with soybean. Soybean seed weight per plant and per plot area increased with decreasing population number or reducing plant density.

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Literature Cited

Daniels, J. and Roach, B.T. 1987. Taxonomy and evolution. p.7-84. In: DJ. Heinz (ed.), Sugarcane Improvement through Breeding. Chapter 2. Elsevier, Amsterdam, Netherlands. 11.

D'Hont, A., Grivet, L., Feldmann, P., Rao, S., Berding, N. and Glaszmann, J.C. 1998. Determination of basic chromosome numbers in the genus *Saccharum* by physical mapping of ribosomal RNA genes. Genome 41:221-225.

Glyn. 2004. Sugarcane. 2nd ed. Blackwell Publishing Company. Oxford. UK. p.7.

Grant, V. 1971. Plant speciation. New York: Columbia University Press.

Hang, N., McCloud, D.E., Boote, K.J. and Duncan, W.G. 1984. Shade effects on growth, partitioning, and yield components of plants. Crop Science 24:109-115.

Karafir, Y.P. and Vokames, J. 2003. Mengenal sayur lilin dan sayur gedi serta pemanfaatannya dalam diversifikasi menu oleh penduduk distrik nimboran dan sekitarnya. Prosiding Lokakarya Pangan Spesifik Lokal Papua. (in Indonesian language).

Mawikere, N.L. 2005. Plasma nutfah kelapa Papua dan hubungan kekerabatannya dengan populasi kelapa Indonesia lainnya dan Papua New Guinea berdasarkan penanda RAPD [Disertasi]. Bogor: Program Pascasarjana, Institut Pertanian Bogor. (in Indonesian language).

Mawikere, N.L., Hartana, A., Guhardj, E., Suharsono and Aswidinnoor, H. 2007. Keanekaragaman dan hubungan genetika plasma nutfah kelapa di kawasan Malesia Timur berdasarkan penanda RAPD. Zuriat 18(1):81-92 (in Indonesian language).

Mudaliar, T. 2007. Duruka (*Saccharum edule* L.) growing in Fiji. Technical Bulletin. Ministry of Primary Industries Fiji. No 4. June 2007.

Nuraeni, E. 2008. Karakter morfologi dan kandungan β-karoten pada tiga aksesi ubijalar (*Ipomoea batatas* (L.) Lam) Lokal Papua. Skripsi Sarjana Pertanian. Fakultas Pertanian dan Teknologi Pertanian Universitas Negeri Papua. (in Indonesian language).

Quartermain, A.R. 2006. Underutilized species policies and strategies. A Report. National Agricultural Research Institute (NARI) Lae, Papua New Guinea. Analysis of national and institutional policies in Papua New Guinea that directly or indirectly affect the use of currently underutilized species of crops for food and agriculture.

Tables

Table 1. Proximate composition of *Saccharum edule* inflorescence.

Accession	Moisture (%)	Ash (%)	Crude fat (%)	Crude protein (%)	Carbohydrate (%)
1. Yu Nggang	88.14	1.91	1.03	6.57	2.36
2. Yu Mru	89.34	1.72	1.27	4.63	3.04
3. Yu Kwam	88.63	1.51	1.22	7.23	1.41
4. Yu Ming	86.44	1.63	1.26	5.30	5.39
5. Yu Mencang	86.42	1.73	1.30	4.50	6.06
6. Yu Brop	89.10	1.58	1.35	5.46	2.54
7. Yu Krea	88.13	1.42	1.32	5.53	3.60
8. Yu Kefye	89.41	1.43	1.22	5.52	2.41

Table 2. Mineral composition of *Saccharum edule* inflorescence.

Accession	P (%)	K (%)	Mg (ppm)	Fe (ppm)	Zn (ppm)
1. Yu Nggang	0.34	0.03	97.10	19.72	16.34
2. Yu Mru	0.20	0.03	95.91	18.62	16.10
3. Yu Kwam	0.24	0.03	90.19	15.88	12.10
4. Yu Ming	0.22	0.03	84.56	20.29	12.56
5. Yu Mencang	0.19	0.03	87.89	16.00	10.51
6. Yu Brop	0.22	0.03	90.88	17.19	16.91
7. Yu Krea	0.24	0.03	94.56	18.77	16.14
8. Yu Kefye	0.21	0.03	87.61	17.70	14.59

Table 3. Plant height, fresh weight and number of suckers per plant of *S. edule* intercropped with soybean at different *S. edule* planting distances.

Treatment	Plant height (cm)	Fresh weight (g)	Sucker number/plant
P1 (100×100 cm)	89.8c	82.3c	3.8bc
P2 (150×150 cm)	117.7ab	111.3b	4.5ab
P3 (200×200 cm)	130.1a	147.0a	5.0a
Monoculture	90.2	82.4	3.8

In a column, treatment means having a common letter are not significantly different by DMRT at α=5%.

Table 4. Flower number and weight of *S. edule* intercropped with soybean at different *S. edule* planting distances.

Treatment	Number of flower/plant	Weight of inflorescence/plant
P1 (100×100 cm)	3.3a	80.1b
P2 (150×150 cm)	3.3a	101.9b
P3 (200×200 cm)	3.8a	144.6a
Monoculture	3.4	90.2

In a column, treatment means having a common letter are not significantly different by DMRT at α=5%.

Table 5. Yield component of soybean intercropped with *S edule* at different *S. edule* planting distances.

Treatment	Seed weight/plant	Seed weight/plot area
Intercropping		
P1 (100×100 cm)	26.3a	1012.8c
P2 (150×150 cm)	27.3a	1693.1b
P3 (200×200 cm)	27.3a	3028.9a
Monoculture	28.6	3328.0

In a column, treatment means having a common letter are not significantly different by DMRT at α=5%.

Figures

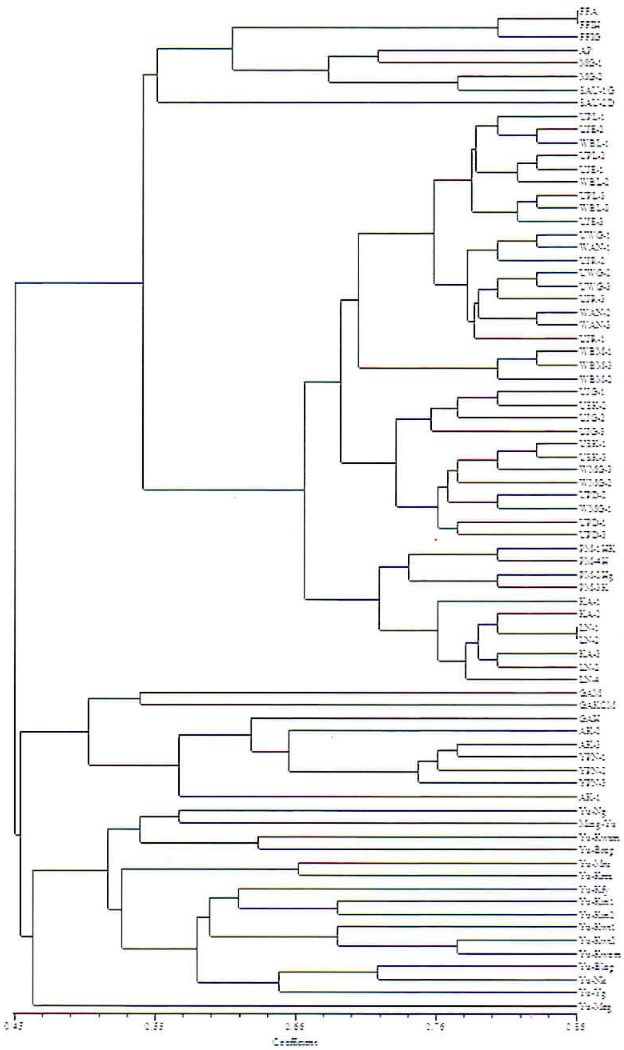

Fig. 1. UPGMA dendogram of 77 accession of *Saccharum edule* growing in Papua regions.

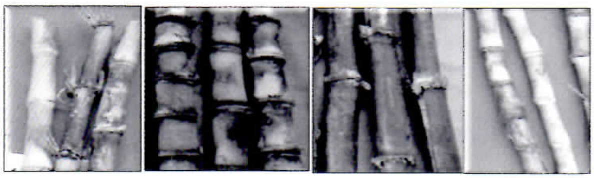

Fig. 2. The diversity of *S. edule*'s stem color.