AGRIKULTURA CRI Journal 1 (1) **ISSN: 2782-8816 January 2021**

MORPHOLOGICAL CHARACTERIZATION OF TARO (*Colocasia esculenta*) CULTIVARS IN THE BICOL REGION, PHILIPPINES

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Abstract — The study focused on the characterization of taro, scientifically known as *Colocasia esculenta* in the Bicol Region, Philippines. Taro samples were collected from different provinces in the Bicol region and planting materials for each sample were grown in a germplasm collection site. Characterization of cultivars was based on the established botanical morphometrics such as length, width and diameter for leaf, petiole and corm using an ordinary ruler and meter stick. Color variations of leaf margin, dorsal and ventral blade and veins, petiole and corm flesh and fiber were identified.

Results indicated 17 taro cultivars, 13 of which were identified with its local names as Princesa, Agatpaya, Balitaka, Sinamar, Tinahig, Quinsol, Negrito, Lipod/Ipod, Binting dalaga, Ito-ini, Inuruon, kolduroy, Duguan/ Dugong dalaga while four (4) cultivars were unknown to the farmers. Sample of cultivars were subjected to morphological characterization using color of leaf or blade, petiole and corm and sizes as major distinguishing characteristics.

Leaf color ranged from dark green on the dorsal to pale green on the ventral surfaces but varied in distribution of purple color. Petiole color varied from purple to green or a combination of both. Corm color is from white to yellow flesh with fibers from yellow to purple.

Keywords **— Taro cultivars, characterization of corm, leaf blade, petioles.**

INTRODUCTION

Taro, gabi, natong scientifically known as *Colocasia esculenta* is a crop that has been maintained by farmers for millennia (Rao et al, 2010). Taro genetic resources have remained largely under the control of local communities. The history of its adaptation, use and diversification can teach us many things about using and conserving genetic resources.

The plant, occupies a significant place in the agriculture of the Asia-Pacific Region. It is in this region, more than any other in the world, that the crop attains its greatest importance as a staple food (FAO, nd). It is particularly important for food security since many tropical areas often experience unfavorable environmental conditions (Beyene, 2013). Corms and leaves are usually consumed, taro supplies much-needed protein, vitamins and minerals, in addition to carbohydrate energy.

The socio-cultural importance of taro in the region is very high. The crop has evolved to be an integral part of the culture, and features prominently in festivals, social gift-giving and the discharge of social obligations. More recently, taro has become a source of income for individuals, and an earner of foreign exchange. Its role in rural development has therefore been increasing, especially with respect to the provision of employment and the alleviation of rural poverty.

The highest genetic diversity and number of private alleles were observed in Asian accessions, mainly from India (Chairi et al, 2016). There were also data from the Philippines but none has been specifically published from the Bicol Region. Having a database on the characteristics of existing cultivars in the locale may support future endeavors involving the important resource of the region. Detailed descriptions of accessions based on morpho-agronomical characters have tremendous impact on the conservation and genetic improvement of the crop (Beyene, 2013).

Demand for taro continuously increase due to export of taro related products to different parts of the world (Manner and Taylor, nd; Tridge, nd) and more and more farmers are indulged in planting it usually in rice fields or lowland areas. These farmers have rich experiences in growing taro but never been documented creating a vacuum with regards to the basic knowledge needed in taro research and development in the region.

Local farmers rely on indigenous knowledge and practices in their farming and production initiatives. One significant knowledge which was not yet explored is the identification and creation of database on the existing genetic resources of taro in the region. Identification of varieties that can be grown in specific geographical location and ecological ecosystems may contribute to the management of this crop for a bounty harvest. It will also serve as guide to farmers on the proper cultivar to propagate on certain situations and purposes.

Common names for taro cultivars noted from the farmers is one important indigenous knowledge because it can be a tool to facilitate easy identification and exchange of the planting materials. Characterization of the plant parts (leaf, petiole and corm) for each variety may serve as feeders in the determination its potential uses.

There were many economic benefits derived from taro. The leaves can be preserved or dried, and are an important food in times of scarcity. Petioles and stolons are also eaten fried or pickled. The inflorescence (a flowering stalk) is a delicacy in some food cultures of Asia and the Pacific. The corms and cormels are the most widely consumed plant part, the leaf blades, petioles, stolons, and inflorescences are also eaten,

depending on the cultivar and local food habits (Mathews et al 2017). Corms and leaves are also used for medicinal purposes. Having these parts characterized for each cultivar will introduce baseline data on the appropriate cultivar to be planted based on the purpose or intended utilization.

The undertaking focuses on the identification and characterization of taro (*C. esculenta*) cultivars in the Bicol Region. It determined the 1) available cultivars and characterized the color of the leaves, petiole and corm for each cultivar; and 2) established a germplasm collection of taro cultivars in the region.

MATERIALS AND METHODS

Description of the Locale

Research was conducted in the Bicol Region, Philippines wherein most of the research activities were done at the Central Bicol State University of Agriculture, San Jose, Pili, Camarines Sur (CBSUA). Bicol region comprises the southern part of Luzon, the largest island in the Philippine archipelago consist of six provinces, two of which were island provinces. The total land area is 5.9% of the total land area of the country. Around 69.3% of the total land area is alienable and disposable while the remaining 30.7% is public forest areas. The coordinates is 13° 30′ 0″ N, 123° 19′ 48″ E. The environment is very conducive for the production of C. *esculenta*, making it one of the commodities associated with the locale.

Cultivars Evaluated

Samples considered in the evaluation were those that are obtained after a regional collection of taro cultivars. Every cultivar noted to possess different characteristic/s from the other cultivars in the pre-evaluation were assumed a different sample variety. Taro seed pieces were collected from identified cultivars. The collected planting materials were grown in production site located at CBSUA compound and Pawili, Bula to produce enough samples for the morphological characterization. There were a total of 17 distinct cultivars subjected for characterization. Thirteen of which have local names derived from the farmers being interviewed while the rest are unknown.

Morphological Data Collection

Characterization was done 6 months after planting to ensure a well-developed mature plant parts. Botanist has been consulted for morphological parameters as basis of characterization such as color of the dorsal and ventral surfaces, vein, central portion and margin of the leaves, color of petiole and color of the corm flesh and skin. Leaf area, length of the stem and corm length and diameter were measured to establish the plant height as to small medium or tall variety. Data were recorded on individual plant basis.

Establishment of Germplasm Collection in a Field Genebank

Many important varieties of field, horticultural and forestry species are either difficult or impossible to conserve as seeds (Saad and Rao, 2001) because either no seeds are formed or if formed, the seeds are recalcitrant. One plant of such kind is taro, field genebanks (FGB) are commonly used for the conservation of taro genetic resources in the Pacific and other taro growing regions (Ebert and Wagainabete, 2018).

Planting materials of seventeen taro cultivars were collected, fifty seed pieces for each cultivar were planted in a designated site in the field genebank. One site of fifty plant per cultivar was maintained. Traditional farming system was employed in planting the seed pieces of taro with periodic weeding and cleaning of the plant where the old matured leaves were removed.

RESULTS AND DISCUSSION

Taro (*C. esculenta*) is an important member of the Araceae family and a staple food crop in many countries in the humid tropics and subtropics (Mathews, Lockhart and Ahmed, 2017). Before the start of the global trade and transport of agricultural commodities, taro was the world's most widely cultivated starch crop (Saad and Rao, 2001).

It is believed that taro originated in the tropics ranging from India to Indonesia (Mathews, 2004). This is supported by genetic diversity studies conducted by Chaïr et al (2006) which revealed that diversity was greater in accessions obtained from Asia compared to the Pacific, Africa, and the Americas. Within the Asian gene pool, India presented the highest numbers of alleles and private alleles.

In the Philippines particularly in the Bicol Region, taro is one important commodity because of its importance to the food security and regional economy. The region housed a number of taro cultivars grown by farmers in their farms that became their source of livelihood.

Taro Cultivars and its Characteristics

There are a number of taro cultivars noted in the Bicol Region. Results of this study revealed 17 different cultivars, 13 of which were locally named by the farmers while four were not identified.

Characteristics of the Blade

Blade or leaf is one important part of the taro plant. It has been a material used in many of the technologies or food products made from taro for commercial and economic purposes.

Shown in Table 1 are the taro cultivars and the morphological characteristics of its blade.

There were seventeen distinctly different cultivars of taro in the six provinces of the region. Those known and commonly identified by the farmers were ito ini (C2*), duguan* (C3), sinamar (C4), lipod (C5), quinsol (C6), *b*alitaka

Table 1. Morphological characteristics of the blade of taro cultivars in the Bicol region, Philippines (2016).

Cultivars	Common Name	Color of the Blade			
		Dorsal	Ventral	Margin	Vein at the ventral part
C1	Unknown-1	Dark green	Pale green	Green	Purple
C2	Ito Ini	Dark green	Pale green	Green	Dark purple
C3	Duguan	Dark green	Pale green	Green	Light green with tinge of purple
C4	Sinamar	Dark green	Pale green	Green	Light green
C5	Lipod	Dark green	Light green	Purple	Light purple to dark purple
C6	Quinsol	Dark green	Light green	Pale green	
C7	Balitaka	Dark green with purple dot at the middle	Light green	Pale purple	Pale green with light purple veinlet
C8	Unknown-2	Dark green with purple dot at middle	Pale green	Green	Light green veinlet
C9	Unknown-3	Dark green with purple dot at the middle	Pale green	Purple	Purple
C10	Princesa	Dark green	Pale green	Pale brown	Pale green
C11	Binting Dalaga	Dark green	Pale green	Green	Pale green
	Tinahig	Dark green	Pale green	Purple	Purple
C12		with small purple dot at the middle			
C13	Agat paya	Dark green with small purple dot at the middle	Pale green	Very light purple	Pale green
C14	Inuroan	Dark green with small purple dot at the middle	Pale green	Green	Pale green
C15	Negrito	Dark purple green	Dark green	Dark purple	Dark purple
C16	Unknown -4	Dark green with small purple dot	Pale green	Purple	Pale green
C17	Kulduroy	Dark green	Pale green	Dark green	Green

(C7), prinsesa (C10), binting dalaga (C11), tinahig (C12), agat paya (C13), inuruan (C14), negrito (C15) and kulduroy (C17). There were four more distinct cultivars which were not given identity by the Bicolano taro farmers and this were considered in this study as unknown-1 (C1), unknown-2 (C8), unknown-3 (C9) and unknown-4 (C16). Each of the identified cultivar were noted to possess a set of characteristics unique to it. Color of the blade of the samples were analysed based the color of its dorsal, ventral, margin and vein at the ventral part .

Dorsal. Dorsal is the part of the leaves that is facing the soil, back side of the ventral. Dorsal color of the taro samples from the region were generally dark green particularly the C1, C2, C3, C4, C5, C6, C10, C11, C15 and C17. Some cultivars however were noted to have small purple dot at the middle including C7, C8, C9, C12, C13, C14 and C6.

Ventral. Ventral is the upper portion of the leaf, the one that is facing the sunlight. Color of the ventral of taro samples studied ranges from dark to pale green. Specifically it was noted that only C15 has a dark green ventral, thirteen others have pale green ventral including C1, C2, C3, C4, C8, C9, C10, C11, C12, C13, C14, C16 and C17. The other three possess light green ventral such as the C5, C6 and C7.

Margin. Leaf margin is the boundary area extending along the edge of the leaf. Margin characteristics of taro cultivars studied in the Bicol Region were either green or purple. There were cultivars with green margin such as C1, C2, C3, C4, C8, C11 and C14 while C17 showed a dark green margin. Those with purple were C5, C6, C7, C9, C12, C13, C15 and C16 with intensity that changes from dark, pale and very light. A cultivar, C10 appeared distinct from the rest because of its pale brown margin.

Veins at the ventral part. Samples showed either green or purple vein at the ventral part with varying intensities. Those with purple veins at the ventral includes C1, C2, C9, C12, and C15, with color intensity that ranges from dark purple to pale and light. Three cultivars reflected unique viens such as C5 having light to dark purple veins, while C3 and C7 indicated green with tinge of purple. The rest of the cultivars such as C4, C6, C8, C10, C11, C13, C14, C16, and C17 showed veins of green to light green.

Results showed that most leaves of taro is generally green on the dorsal part, this must be due to the bifacial structure of the leaf wherein only one surface is directly exposed to sunlight. In the ventral side of the blade is generally light green in color. The presence of purple pigment on the leaf vein at the ventral side of the blade for some cultivars served as basis for identifying the differences of the cultivars. Likewise, the presence or occurrence of purple pigment at the middle of the lamina was likewise considered for characterization since there are prominent differences on leaves of every cultivars in terms of the ventral veins. Figure 1 presents sample leaf for each cultivar noted in the Bicol Region.

Characteristics of the Petiole

A stalk that attaches the leaf blade to the stem is called a petiole, the length of the petiole determines the height of the taro plant. Each taro leaf is made up of an erect petiole and a large lamina.

Taro cultivars have varying petiole characteristics as indicated in the differences in the point, the colors vary its intensity from dark green to light green. Two other cultivars were noted with greater variation in its point of attachment to the blade such as C11 which is yellow green, and C13 is pink.

Base. Base of the petiole showed different characteristics among the sample cultivars subjected to

observations. Color comes in green, purple, pink and white. Those with green base such as C1, C2, C4, C5, C9, C12, C14, C16, and C17 showed intensities from dark to light to pale green. Cultivars with purple base were C3 and C15, C8 has a touch of purple and white. Pink base was likewise observed in C6 and C10, C7 has pale green and pink base.

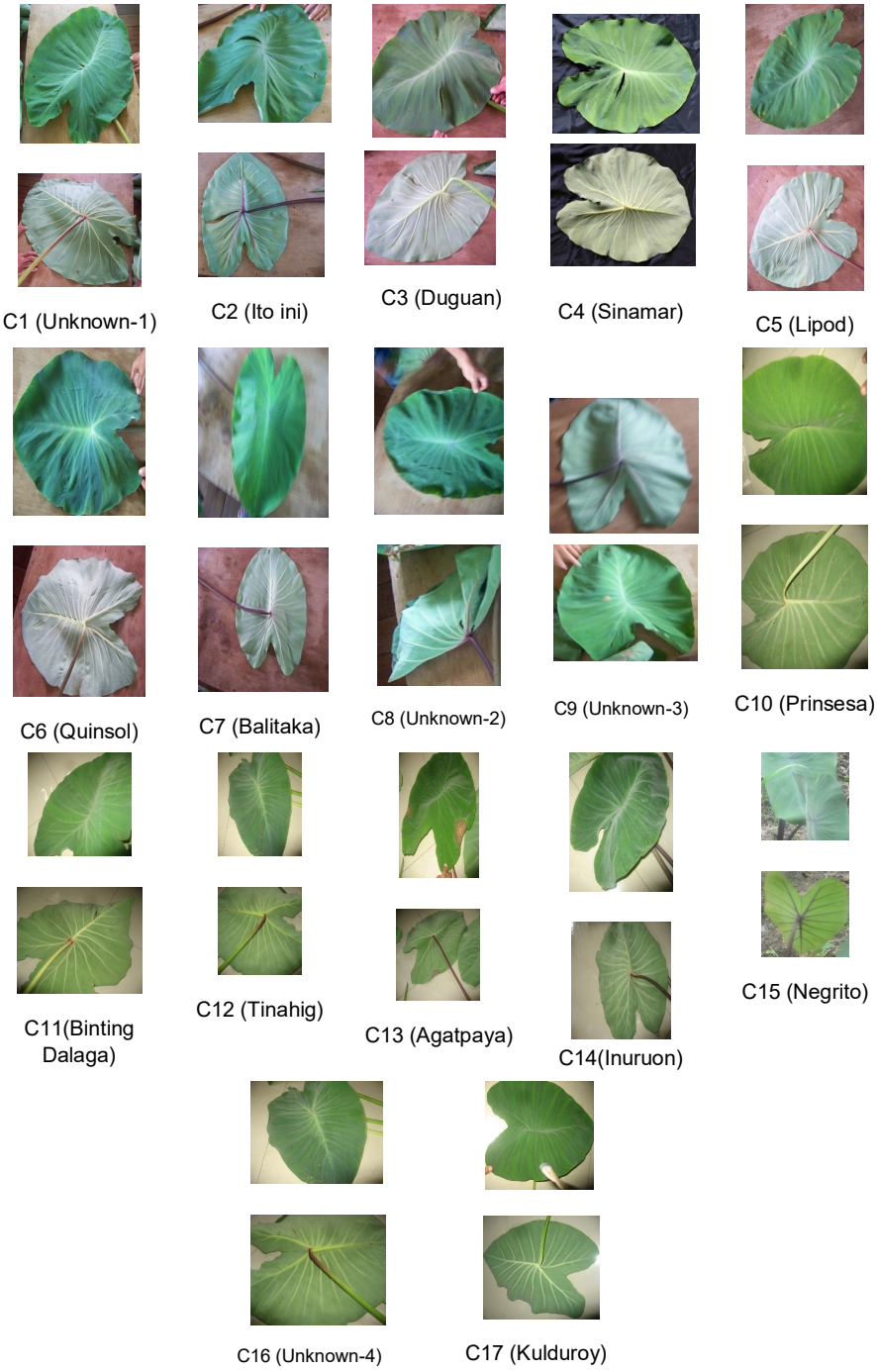

Fig. 1. Sample Leaf for Each Taro Cultivar in the Bicol Region, Philippines.

Fig. 2. Petiole of taro cultivars in the Bicol Region, Philippines.

***Entire length of the petiole*.** was observed to show of attachment to the blade; its base and the entire length.

***Point of attachment to the blade*.** The part of the petiole that is attached to the blade of the identified cultivars possesses color that may either be green, dark or light green, yellow green, purple and even pink. Cultivars with purple petiole were C1, C5, C7, C9, C12, C14, C15, C16, however of varying intensity as specified in Table 2. Similarly those cultivars with green point of attachment includes C2, C3, C4, C6, C8, C10, C17variations as either unicolor or with streak of other colors. Most unicolors were colored green, either dark or light. Cultivars noted to possess such characteristics were C1, C4, C6, C8, C11, and C14. Others showed a mix of colors as indicated in Table 2. Petiole of every cultivar is shown in Figure 2.

It can be noted in Table 2 that taro cultivars have varying petiole characteristics as indicated in the differences in the point, the colors vary its intensity from dark green to light green. Two other cultivars were noted with greater variation in its point of attachment to the blade such as C11 which is yellow green, and C13 is pink.

***Base*.** Base of the petiole showed

Table 2. Petiole characteristics of taro cultivars in the Bicol Region, Philippines.

Variety	COLOR OF THE PETIOLE		
	Point of Attachment to the leaves	Base	Entire length
C1	Purple	Green	Green
C2	Dark green	Dark green	¾ of its length is purple
C3	Light green near to point of attachment	Light purple	Light purple from the base and green at the middle of its length
C4	Dark green	Dark green	Dark green
C5	Light purple	Green	Light purple to dark purple
C6	Dark green	Pinkish	Dark green
C7	Light purple	Pale green to pinkish,	Light purple with streak of dark purple along its length
C8	Dark green	Purple and white	Dark green
C9	Light purple	Light green	Dark green at the lower part & purple at the middle extending upward
C10	Pale green	Pink	Yellow green
C11	Yellow green	White	Green
C12	Purple	Pale green	Dark to light purple
C13	Pink	White	Pinkish with streak of purple
C14	Purple	Dark green	Dark green
C15	Dark purple	Purple	Dark purple
C16	Dark purple	Dark green	Dark green to purple
C17	Light green	Light green	Light green with streak of dark green along its length

different characteristics among the sample cultivars subjected to observations. Color comes in green, purple, pink and white. Those with green base such as C1, C2, C4, C5, C9, C12, C14, C16, and C17 showed intensities from dark to light to pale green. Cultivars with purple base were C3 and C15, C8 has a touch of purple and white. Pink base was likewise observed in C6 and C10, C7 has pale green and pink base.

Morphometric Characteristics

Morphometric is one important aspect that is looked into when a plant like taro is being characterized. In looking at the growth pattern, one cannot do away with measuring the plant height and other growth determining parameters. The morphometric evaluation is important to establish the claim of what cultivar to propagate when plant height of the cultivar is to be considered. Table 4 presents the morphometric characteristics of taro cultivars noted in the Bicol Region.

***Petiole or stalk length*.** It can be gleaned from table 4 that height of taro ranges from 21 to 66 inches, revealing that it is not a tall plant. The shortest cultivar is C15 having an average petiole height of 21.2 inches, more than 40 inches lower than the tallest cultivar, C1. It can be inferred that C15 is just 1/3 in height of C1. All the rest of the cultivars have stalk length that is not so different from each other, of medium plant height of more or less 40 inches with an SD of 9.32.

Leaf blade. Morphometric of the blade includes the length and the

Table 4. Morphometric characteristics of different taro cultivars in the Bicol Region, Philippines.

Variety	Petiole or Stalk length (inches)	Leaf Blade		Corm	
		Length (inches)	Width (inches)	Length (inches)	Width (inches)
C1	66	28	21	8	3.0
C2	42.4	20	13	3.1	2.04
C3	45.4	17.2	12.4	7.3	2.75
C4	36	19.1	13.4	4	2.05
C5	38	17.4	12	5	2.36
C6	43.5	18.5	13.5	3.8	2.0
C7	38.2	16	12.2	3	2.1
C8	38.6	19	14	5.4	2.2
C9	46	18.1	12.9	4.5	2.5
C10	32.6	15	10.2	3	1.8
C11	39	15	10.5	4	1.75
C12	28.5	18.5	13.5	4	2.8
C13	46.5	17	12.6	3	2.3
C14	40.7	18	13.7	2.5	2
C15	21.2	12.5	8.4	1.2	.75
C16	35.5	12	9.2	3.8	2.5
C17	39	16	10	2	2.5
Mean	39.82	17.49	12.50	3.98	2.20
Standard Error	2.26	0.85	0.67	0.42	0.12
Standard Deviation	9.32	3.50	2.77	1.73	0.51

width. Data indicated that the length of the taro blade ranges from 12 to 28 inches, cultivars C15 and C16 revealing the shortest length and C1 showing the longest blade. All the rest of the cultivars are with length that are not so different from each other. It was however observed that cultivars with higher stalk length were also the ones with longer blade.

There is a positive correlation between the petiole and the leaf blade length given by r=0.7780 and also true with the petiole and leaf blade width as indicated by r=7925.

Width of the blade comes proportional with its length. Data showed that the width of taro blade ranges from 8 to 21 inches, C15 with the lowest width and C1 having the highest. This result is consistent with the findings for the stalk length and blade length.

Corm. Corm of the taro plant is not that big, however a good source of carbohydrate. Morphometric of the corm revealed that its length ranges from 2 to 8 inches and the width ranges from 2 to 3 inches. The cultivar with biggest corm is C1 and those with smallest corm is C15. Results is consistent with the findings for stalk length and leaf blade that those cultivars with longer stalk have longer and bigger blade. These cultivars were also the ones having big and long corm. Standard deviation of 1.75 and 0.51 for corm length and corm width , respectively indicated the consistency of data for corm. Correlation analysis further indicated that corm length and corm width is positively correlated with petiole length and width as proven by r=.6673 and 0.6208, respectively.

It can be noted that a tall cultivar of taro possesses the largest surface leaf area and the shortest plant height would also bear the narrowest leaf area. It implied that the leaf area is dependent on the plant height, and is the plant's mechanism to maintain a

balanced or proportioned plant growth. Moreover, statistical result on standard error showed that there was a minimal difference on the morphometric measurement except for a petiole length. Morphometric characteristic of taro cultivars post greater significance in the choice of what cultivar may be propagated for certain purpose.

Taro cultivars (Fig.3), based on their characteristics were associated by local farmers to certain utilization particularly in processing or cooking certain food products. Most lowland cultivars like C10, C5, C3, and C12 are efficient in leaf production and are the once used in cooking the commonly know "laing" of the Bicolanos. These are the varieties commonly found in Albay and Partido area, justifying for the involvement of these places in cooking "laing" either for personal consumption or for entrepreneurial purposes. The unknown varieties as claimed by some farmers and ordinary consuming individuals can also be utilized for cooking of Taro recipes.

Some cultivars can be grown in upland area such as C13, C7, C6, C10, and the 4 unknown varieties such as

Fig. 3. Corm of Taro Cultivars in the Bicol Region, Philippines.

C1, C8, C9 and C16. Most of these varieties are efficient in corm production as claimed by Nabua Taro farmers. Corm is also used in processing delicacies that are loved not only by local folks but also those from other places.

Taro Field Gene bank

Field genebanks (FGB) are commonly used for the conservation of taro genetic resources in the Pacific and other taro growing regions (Ebert and Wagainabete, 2018). Taro cultivars were noted to grow either in upland or lowland areas. It can be grown in all kinds of soil types but grows best in a friable loam soil, well-drained land. It can be planted in moist environment, in rice paddies and even in ones own backyard. Cultivars found in the Bicol Region are not so difficult to propagate because they all practically grow in all types of soil but there is one type of soil that a particular cultivar grows best. There were those that grow best in muddy or soil submerged in water while others are found in ordinary soil of the upland.

Field gene bank for taro established by this study were located on sites that were favorable for taro. Lowland varieties, were grown submerge in water particularly in a rice paddies or areas where the soil is always moist. The upland variety needed water occasionally during the period of its growth. All the noted taro cultivars were collected and planted in the established field gene bank to conserve its genetic resources.

Planting materials of 17 taro cultivars were collected, 50 seed pieces for each cultivar were planted in a designated area in the field genebank. One area of 50 plant per cultivar was maintained. Traditional farming system was employed in planting the seed pieces of taro with periodic weeding and cleaning of the plant where the old matured leaves were removed. Compost or organic fertilizer was occasionally applied to provide sufficient nutrient to the planted cultivars.

CONCLUSION

In the six provinces of the Bicol region, there were 17 distinctly different cultivars. These were identified *as* ito ini (C2), duguan (C3), sinamar (C4), lipod (C5), quinsol (C6), balitaka (C7), prinsesa (C10), binting dalaga (C11), tinahig (C12), agat paya (C13), inuruan (C14), negrito (C15) and kulduroy (C17). There were four more distinct cultivars which were not given identity by the Bicolano taro farmers and this were considered in this study as unknown-1 (C1), unknown-2 (C8), unknown-3 (C9) and unknown-4 (C16). Each of the identified cultivar was noted to possess a set of characteristics unique to it.

Most leaves of taro cultivar is green on the dorsal part, this must be due to the bifacial structure of the leaf wherein only one surface is directly exposed to sunlight. In the ventral side of the blade is generally light green in color. Purple pigment on the leaf vein at the ventral side of the blade for some cultivars served as basis for identifying the differences of the variety. Likewise, the presence or occurrence of purple pigment at the middle of the lamina was considered for characterization since there are prominent differences on leaves of every variety in terms of the ventral veins.

Colors of petiole of taro cultivars in the locale of study were different. It comes in green and purple of varying intensities or a combination of these colors. The colors are observed either in the whole length, at the base or at the point of attachment of the blade and the petiole. These characteristics together with the blade characteristics served as basis of identifying each of the taro cultivar in the region.

There is a very rich corm characteristics of taro cultivars in the region which may be promising due to

its significance in the production of flour. The flesh comes in either yellow, white or pinkish with fiber that can either be purple, dark yellow, brown or light orange. The varying colors of the corm may add value to the product/s because of its natural color. There was also a slight difference noted in the color of the corm skin of the various cultivars. They generally comes in brown but corm skin of some cultivars have a touch of purple or pink. Majority of the taro cultivars were of medium height, though a few is tall and erect. Cultivars with green stems are of medium height

Leaf area is dependent on the plant height, tall cultivar possesses the largest surface leaf area and the shortest plant height would also bear the narrowest leaf area. These cultivars were also the ones having big and long corm.

Field gene bank for taro established by this study were located on sites that were favorable for taro. Lowland varieties, were grown submerge in water particularly in a rice paddies or areas where the soil is always moist. The upland variety needed water occasionally during the period of its growth. All the noted taro cultivars were collected and planted in the established field gene bank to conserve its genetic resources.

ACKNOWLEDGMENT

The author is thankful to the Department of Agriculture Bureau of Agricultural Research (DA BAR) for funding the project “Pre and Postharvest Technologies of Taro in the Bicol Region” of which this article is one of its studies. Sincere gratitude is due to Dr. Maria Dulce J. Mostoles, the Project Leader for her unselfish efforts in honing budding researchers in the university. The study leaders and research assistants in this project who in one way or another contributed towards the realization of this study and its publication.

REFERENCES

Beyene, T.M. 2013. Morpho-Agronomical Characterization of Taro (colocasia esculenta) Accessions in Ethiopia. Retrieved December 2016 from https://www.researchgate.net/publication/270706818_Morpho-Agronomical_Characterization_of_Taro_Colocasia_esculenta_Accessions_in_Ethiopia

Chair, H., Traore, R.E., Duval, M.F., Rivallan, R.; Mukherjee, A., Aboagye, M.; Van Rensburg, W.J., Adrianavalona, V., Pinheiro de Carvalho, A.A., Saborio, F., Sri Prana, M., Komolong, B., Lawac, F., and Lebot, V. 2016. Genetic Diversification and Dispersal of Taro (*Colocasia esculenta* (L.) Schott). Retrieved from https://doi.org/10.1371/journal.pone.0157712

Chaïr H, Traore RE, Duval MF, et al. (2006) Early and mid Holocene Tool -use and Processing of Taro (*Colocasia esculenta*), Yam (*Dioscorea* sp.) and Other Plants at Kuk Swamp in the Highlands of Papua New Guinea. J Archaeol Sci 33:595–614.

Ebert, A.W.; Wagainabete, L.M. 2018. Conserving and Sharing Taro Genetic Resources for the Benefit of Global Taro Cultivation: A Core Contribution of the Center for Pacific Crops and Trees. Retrieved from https://www.liebertpub.com/doi/10.1089/bio.2018.0017.

FAO (nd). Taro Cultivation in Asia and the Pacific. Retrieved from http://www.fao.org/3/ac450e/ac450e01.htm#TopOfPage

Manner, H.I.; Taylor, M. (ND). Retrieved from http://pacificschoolserver.org/content/

_public/Local%20Topics/Pacific%20Islands/Agriculture%20for%20Islands/Specialty%20crops/Taro.pdf

Matthews PJ, Lockhart PJ, Ahmed I. 2017.Phylogeography, Ethnobotany and Linguistics Issues Arising from Research on the Natural and Cultural History of Taro, *Colocasia esculenta* (L.) Schott. Man India 97:353–380.

Mohd Said Saad and V. Ramanatha Rao, eds. 2001. Establishment and Management of Field Genebank, a Training Manual. IPGRI-APO, Serdang.

Matthews PJ. 2004. Genetic Diversity in Taro, and the Preservation of Culinary Knowledge. Retrieved from https://www.researchgate.net/publication/29736057_Genetic_Diversity_in_Taro_and_the_Preservation_of_Culinary_Knowledge

Rao, R., Mathews, P., Eyzaguirre, P., Hunter, D. 2010. The Global Diversity of Taro: Ethnobotany and Conservation. SN 978-92-9043-867-0.

Tridge (nd). Overview of Taro Trade in the Philippines. Retrieved from https://www.tridge.com/intelligences/taro/PH