Journal of Root Crops, 2016, Vol. 42 No. 2, pp. 18-23
Indian Society for Root Crops
ISSN 0378-2409, ISSN 2454-9053 (online)

Morphological Evaluation of Taro (*Colocasia esculenta* Linn.) Genotypes Collected from Manipur State of India and their Yield Performance

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Received: 11 November 2016; Accepted: 2 December 2016

Abstract

A total of nine traditional genotypes or cultivars of taro (*Colocasia esculenta* (L.) Schott), locally called *Hao-paan*, *Ingkhol-paan*, *Lam-paan*, *Mukhi-paan angangba*, *Mukhi-paan angouba*, *Paan-angangba*, *Paan-gong*, *Singda-paan* and *Yerum-paan* have been collected and identified from Manipur. These plants are widely consumed by ethnic people of Manipur in various forms of traditional cuisines. The cultivars namely *Mukhi-paan angangba*, *Ingkhol-paan* and *Paan-angangba* are generally accepted as the tasty among the nine. The botanical characteristics and agronomic data of the nine cultivars were studied for morphological traits such as corm shape, size and other yield parameters using RBD with three replicates. The yield of corm and cormel was highest in *Mukhi-paan angouba* (604 g plant^{-1}) while least in *Lam-paan* (205 g plant^{-1}). Considering the taste and yield the four genotypes namely, *Mukhi-paan angangba*, *Mukhi-paan angouba*, *Paan-angangba* and *Ingkhol-paan* are preferred for commercial cultivation.

Key words: *Colocasia esculenta*, cultivars/genotypes, yield performance, ethnobotanical uses.

Introduction

Taro (*Colocasia esculenta* (L.) Schott) is a member of the monocotyledonous plant family Araceae (Singh et al., 2003) and is widely cultivated in tropical and subtropical regions of the world (Okonwo, 1993) for its edible corms. South central Asia, probably in India or Malaysia (Onwueme, 1978) is considered as the centre of origin. The Indian subcontinent is considered as the primary centre of origin for the genera Colocasia (Janseens, 2001). The plant is perennial in nature and survives through stem tuber commonly called corm. The plant consists of a central corm from which cormels, roots and shoots arise (Onwueme, 1978). In India, *C. esculenta* is extensively grown in West Bengal, Bihar, Uttar Pradesh, Assam, Orissa, Kerala, Andhra Pradesh and Tamil Nadu. It is also popular in Northeastern states of India and successfully grown throughout the region due to its adaptability to a wide range of soil and climatic conditions (Devi, 2013). However, the crop performs well in humid and loam-sandy soils.

Taro is used as a staple food in the parts of Asia, the Pacific, the Caribbean and Hawaii. It was prevalent in the Mediterranean region long before potato made an appearance (Jianchu X *et al*., 2001). The main economic parts of *Colocasia* are corms, cormels and often the leaves are also finds a place in traditional cuisines. The corms and cormels are usually boiled, baked, roasted or fried and consumed in conjunction with other foods like fish and coconut preparations. The leaves are usually boiled or prepared in various ways mixed with other condiments like spinach (Janseens, 2001; Onwueme, 1999).

In Manipur, a large number of traditional genotypes/cultivars of *C. esculenta* are found and generally cultivated in farm lands and kitchen gardens. It is one of the important cash crops in Manipur. These plants are used mainly in the preparation of three important cuisines of Manipur namely, *Paan-thongba*, *Paan-eronba* and *Paan-ootti*. The plant is also associated with a very popular folk tale of Manipur called '*Hanuba-Hanubi Paan-thaba*'. A substantial quantity and varieties of *C. esculenta* corms and cormels are sold in the local markets of Manipur more prominently during August-December. The present paper aims to study the diversity of traditional genotypes of *Colocasia* in Manipur in terms of plant characters, yield and productivity. Traditional uses of *Colocasia* in Manipur state are also documented.

Methodology

The nine traditional genotypes or cultivars of *taro* were collected from various localities of Manipur through field survey and from Imphal market (the state capital of Manipur). The field trial for growth performance and yield was carried out in randomized block design (RBD) in the experimental farm of the Central Agricultural University, Imphal with three replicates each genotype during 2009-2011. Seed corms were planted in month of April at a spacing of 60 cm × 45 cm in a plot size of 2 m × 4 m accommodating 30 plants per plot. The morphological characterizations of the crops were carried out as per descriptors list of IPGRI for *Colocasia* (Anonymous, 2000). The data on crop performance and yield were recorded in the second year of cultivation as optimal growth and yield of the crop was achieved in the 2nd year of its planting. Harvesting was done during the month of November month in the 2nd year of its cultivation. Ethno-botanical data and folk-tale of *Colocasia* were collected through interview with resource person. Taste preference of the *Colocasia* genotypes was made based on the information provided by some local villagers and consumers (n=32; 8 villagers of the 4 villages namely, Singda, Iroishemba, Uripok and Langjing. The community based data like folk-tale, ethnobotany and taste preference were collected with Prior Informed Consent (PIC) of the concerned community/resource person.

Results and Discussion

Crop characteristics and yield

Morphological characteristics like plant height, lamina colour, shapes of corm and cormels of the nine genotypes/cultivars of *C. esculenta* collected from Manipur are presented in Table 1. Out of the nine genotypes *Lam-paan* is cultivated to a small extent only due to its acridity. Occasionally, it is cultivated for its leaves which are fed to pigs. The rest eight species are generally cultivated for food purpose. The average height of the nine genotypes ranged from 32 cm to 48 cm. The tallest among them is *Lam-paan* and the shortest being *Ingkhol-paan* which is dark green to purple colour. The shape of the corms are round and cylindrical types whereas the shape of the cormels are of pointed, cylindrical, conical to round shape in genotypes studied (Table 1). The corms/cormels of the nine genotypes are shown (Fig. 1).

Corms and cormels were well developed in all the genotypes except in *Lam-paan* where the corm development was poor with thin and elongated corms. All the genotypes except the *Lam-paan* produce cormels while the *Lam-paan* hardly produces cormel (Table 2). The average number of cormels was highest in *Mukhi-paan angouba* (11 cormels), followed by *Mukhi-paan angangba* (10 cormels), *Paan-angangba* (9 cormels) and

Table 1. Morphological characteristics of nine genotypes of taro from Manipur

Genotype/Cultivar	Average plant height (cm)	Leaf lamina colour	Corm shape	Cormel shape
Hao-paan	39	Dark green	Round	Pointed
Ingkhol-paan	32	Green	Round	Conical
Lam-paan	48	Dark green	Cylindrical	Round
Mukhi-paan angangba	38	Green	Cylindrical	Cylindrical
Mukhi-paan angouba	46	Light green	Cylindrical	Cylindrical
Paan-gong	38	Dark green	Round	Conical
Paan-angangba	39	Green	Cylindrical	Conical
Singda-paan	33	Purple	Cylindrical	Cylindrical
Yerum-paan	40	Dark green	Round	Round

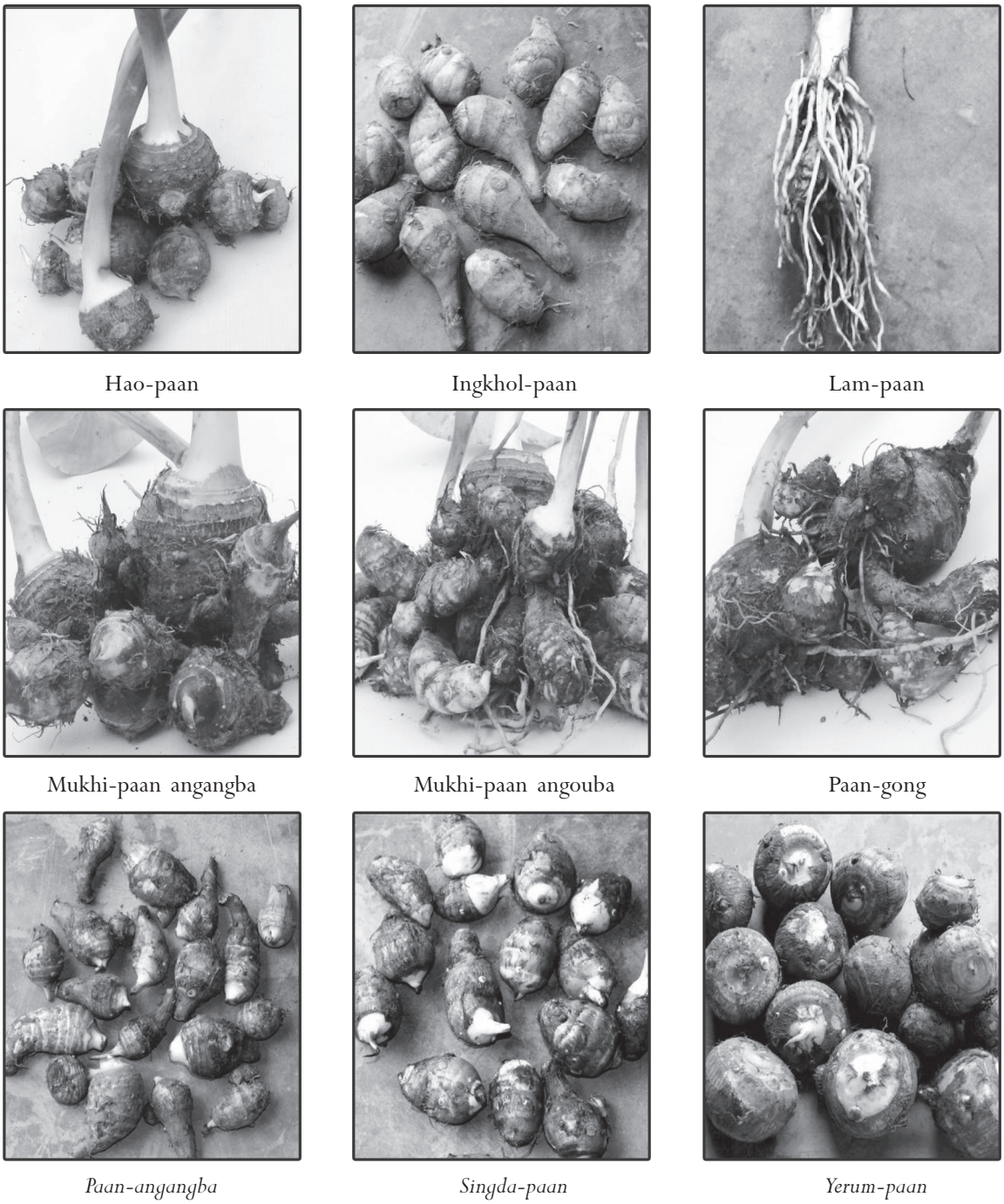

Fig.1. Corms of taro genotypes from Manipur state.

Paan-gong, *Singda-paan* and *Yerum-paan* with 8 cormels each, *Hao-paan* (6 cormels) whereas rudimentary in case of *Lam-paan.* The biomass/yield (weight of both corm and cormels) was highest by *Mukhi-paan angouba* (604 g/ plant), followed by *Mukhi-paan angangba* (600 g plant^{-1}), *Ingkhol-paan* (580 g plant^{-1}), *Paan-angangba* (530 g plant^{-1}), *Paan-gong* (504 g plant^{-1}), *Yerum-paan* (500 g plant^{-1}), *Hao-paan* (423 g plant^{-1}), *Singda-paan* (411 g plant^{-1}), and least in *Lam-paan* (205 g plant^{-1}). Average total biomass of plants ranged from 1320 g plant^{-1} to 710 g plant^{-1}with the highest in *Mukhi-paan angouba* and least in *Lam-paan* (Table 2). Based on the community taste ranking, three genotypes namely, *Paan-angangba*, *Mukhi-paan angangba* and *Ingkhol-paan* ranked the tastiest; *Mukhi-paan angouba, Singda-paan and Yerum-paan* ranked tastier; *Hao-paan* and *Paan-gong* ranked tasty while one germplasm called *Lam-*

Table 2. Growth and yield performance of nine genotypes of *Colocasia esculenta* from Manipur

Genotype/Cultivars	No. of cormel	Average corm yield (g plant^{-1})	Average fresh biomass (g plant^{-1})
Hao-paan	6±2	423	992
Ingkhol-paan	12±3	580	813
Lam-paan	Rudimentary	205	710
Mukhi-paan angangba	10±2	600	1044
Mukhi-paan angouba	11±1	604	1320
Paan-gong	8±2	504	745
Paan-angangba	9±1	530	827
Singda-paan	8±1	411	893
Yerum-paan	8±2	500	984

paan ranked least tasty (Fig. 2). Except *Lam-paan*, all the 8 genotypes are cultivated while *Lam-paan* is generally grown in wild habitat mainly in the humid areas.

Ethnobotany

The corms and cormels of all the genotype of *Colocasia esculenta* except *Lam-paan* are fondly eaten by ethnic people of Manipur in three major cuisines namely, *Paan-eronba*, *Paan-thongba* and *Paan-ootti* (Table 3). Sometimes, the corms are sliced and fried in edible oil and taken as snacks. In case of *Lam-paan*, the leaf lamina is used in preparation of traditional dish called *Paan-khokla ootti* which is luster green in colour; otherwise the corm is hardly eaten. The leaf of *Lam-paan* and *Singda-paan* is good feed for piggery. Local villagers cultivate this genotype in small-scale only for this purpose; otherwise it is collected from the wild habitats. *Colocasia* leaves are a good source of protein, minerals and vitamins i.e. â-carotene and ascorbic acid and have great potential to qualify as good vegetables for hypersensitive, diabetic and obese people due to their antioxidant properties (Thomas and Oyediran, 2008). Despite being a good source of carbohydrate and minerals; its wide use is restricted as corms and cormels contain anti-nutritional factors namely, the trypsin inhibitor, total oxalate, soluble oxalate and calcium oxalate (Sen et al 2006). Soluble and insoluble oxalates are also found in young and older leaves of taro (Oscarsson and Savage, 2007). It is a common belief that *C. esculenta* genotype grown in wild is not preferred as it irritates throat and thus unhealthy to eat.

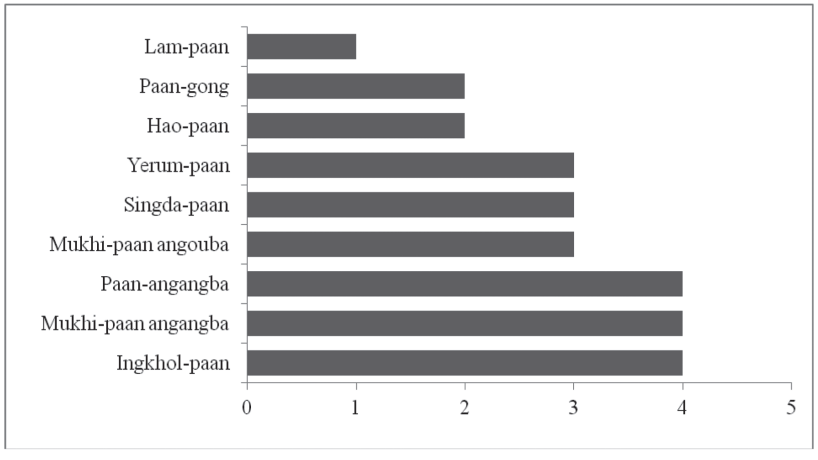

Fig. 2. Taste preference ranking of the nine genotype/cultivars of taro (*Colocasia esculenta* (L.) Schott) from Manipur

It is traditionally believed that regular intake of taro results in formation of calculi inside our body leading to stone-cases. The petiole juice of taro plant particularly, *Lam-paan* and *Yerum-paan* is applied on injuries and insect bites (Table 3). The dried leaf petiole of *Paan-gong* is eaten as chutney locally called *Singju* and stored for use during off-seasons. In Manipur, fresh leaf lamina of *Colocasia* is boiled with fresh milk and the soup is given to women to enhance the chance of pregnancy (Singh et al., 2003). It is a traditional knowledge that fermented fish (locally called *ngari*) reduces the irritation to throat caused while eating taro; hence a piece of *ngari* is added while making taro preparations. Generally children upto the age of 10 years are not given taro containing food items in Manipur. Boiling of the tubers reduce the level of soluble oxalates in the cooked tissue below detectable level as soluble oxalates gets leached and hydrolyzed in cooking solutions (Sen et al., 2006; Catherwood et al., 2007) that reduces acridity and the anti-nutritional factors and enhances the availability of crude fibre and protein in *Colocasia* leaves (Oscarsson and Savage, 2007; Levu et al., 2009). Raw corm, cormel and leaves of most of the taro are unsuitable for consumption. Cormels are tastier than corms; hence farmers prefer high cormel yielding genotypes like *Mukhi-paan angouba* and *Mukhi-paan angangba* (Table 2).

Table 3. Ethnobotanical uses of taro

Genotype/Cultivar	Ethnobotanical uses
Hao-paan	Corm/cormel is prepared as local dishes called *Paan-thongba*, *Paan-eronba* and *Paan-ootti*. Corm slices are cooked with other vegetables. Corm boiled and eaten as substitute of rice.
Ingkhol-paan	Corm/cormel is prepared as local dishes called *Paan-thongba*, *Paan-eronba* and *Paan-ootti*.
Lam-paan	Leaf lamina is cooked as *Paan-ootti*. Leaf is a good feed for piggery. Petiole juice is applied in insect bites.
Mukhi-paan angangba	Corm/cormel is prepared as local dishes called *Paan-thongba*, *Paan-eronba* and *Paan-ootti*.
Mukhi-paan angouba	Corm/cormel is used in the preparation of *Paan-thongba*, *Paan-eronba* and *Paan-ootti*. The Corm is generally boiled and eaten as snacks.
Paan-gong	Dried leaf petiole is prepared into chutney locally called *eronba/singju* along with fermented fish. Leaf lamina is used in packing of breakable items.
Paan-angangba	Corm/cormel is used in the preparation of local dishes called *Paan-thongba*, *Paan-eronba* and *Paan-ootti*.
Singda-paan	Corm/cormel is used in preparing local dishes called *Paan-thongba*, *Paan-eronba* and *Paan-ootti*. Leaf is feed to piggery.
Yerum-paan	Corm/cormel is used in the preparation of local dishes called *Paan-thongba*, *Paan-eronba*, *Paan-ootti*. Juice extract of fresh leaf petiole is applied in cuts and injuries.

Paan-thongba: Corm/cormel is cooked with a pinch of soda (sodium bicarbonate) along with black-gram or without black-gram

Paan-eronba: Corm/cormel lamina is boiled and smashed with fermented fish locally called *ngari*. It is chilli based. Frequently fruits of foxnut (*Euryale ferox* Salisb.) is used an important ingredient in this cuisine. The cuisine is garnished with leaf/shoot of *Ocimum canum* (locally called *Mayangton*).

Paan-ootti: Corm/cormel/leaf is cooked with rice and a pinch of soda (sodium bicarbonate). If leaf is used, the cuisine is called *Paan-khokla-ootti.*

Conclusion

(i) There are atleast nine genotypes or cultivars of taro (*Colocasia esculenta* (L.) Schott) which are grown in Manipur.

(ii) The corms, cormels and leaves of *C. esculenta* are edible and used in the preparation of various traditional cuisines of Manipur namely, *Paan-thongba*, *Paan-eronba* and *Paan-ootti* (including *Paan-khokla ootti*).

(iii) Based on taste and crop yield, the four genotypes namely, *Mukhi-paan angouba*, *Mukhi-paan angangba*, *Paan-angangba* and *Ingkhol-paan* are identified as preferred types for large-scale cultivation and production.

Acknowledgement

The authors are thankful to all the 32 resource persons who have provided information on ethnobotanical data, folk-tale and taste preference ranking. The authority of CAU, Imphal is acknowledged for permission to undertake these experiments.

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