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Survey of Mangosteen Clones with Distinctive Morphology in Eastern of Thailand

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Abstract Mangosteen clone survey in Eastern Region of Thailand as Rayong, Chanthaburi and Trat Province in 2008 and 2009 showed diferential morphology as mangosteen phenotype was different and could be distinguished in 6 characters i.e small leave and small fruits trees, oblong shape trees, thin (not prominent) persistent stigma lobe thickness fruit trees, full and partial variegated mature leave color (combination of green and white color) trees, oblong shape leave trees and greenish yellow mature fruit color trees. Generally, rather short shoot, elliptic leaf blade shape, undulate leaf blade margin and thin or cavitied persistent stigma lobe thickness fruits are dominant marker of full seedless fruits that rarely found trees. Survey of mid-sized mangosteen orchards (200-300 trees) showed that over 70% full seedless fruits trees could be found only about 1-3% of all trees.

Keywords: clones, mangosteen, phenotypes

Introduction

Mangosteen is a tropical fruit that grows and bears good fruit in Thailand. The fruit is delicious. It is popular with consumers both in Thailand and abroad, and has been called the queen of tropical fruits. Considered current mangosteen fruit market, there is high demand both from domestic market and also exported in the form of fresh and frozen, annual income for the country more than ten million baht (Vandana *et al*, 2008), mangosteen is a fruit that is the main producing areas in the eastern and southern regions of Thailand. Although mangosteen is highly required of both external and internal markets, however, because of during production season when the mangosteen is produced for oversupply, with quality control of the mangosteen is difficult, usually found problems with translucent flesh and gamboge disorderof mangosteen fruit in the rainy season, therefore, therefore, the price of mangosteen is very low.

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Mangosteen is only a variety known as the native variety, because of mangosteen is grown with seed and the seed does not arise from fertilization, that almost any opportunity for mutations, although found that mangosteen clone from Nonthaburi, the fruit is smaller and relatively thin rind than mangosteen of the southern, however, there is no clear comparative study enough for variety separate. (Buasap *et al.*, 2008)

Usually, mangosteen are propagated using seeds, technically, because of the mangosteen without the mutation, the mangosteenis seed is not the fertilization between pollen and pistil, as the mangosteen flower is sterile stamen. However, in reality, to found the variation in external appearance of the some characteristics of mangosteen, such as appearance leaves of a seedling, number of seeds, rind thickness, taste, etc. These is lack of education and informations on academics and systematic studies.

Therefore, this study was conducted to collect information, the survey in the morphological characteristics of mangosteen accessions that grown in plantation, which is expected to be different from normal in the area of the eastern province of Thailand such as Rayong, Chantaburi and Trat. To guide in the selection of a good mangosteen accessions for propagation or develop the mangosteen clones that are suitable for management in order to reduce production costs or help in improving the quality of mangosteen production meets the requirements of the market.

Now, a few countries which are the competitors to produce mangosteen of Thailand such as Malaysia and Indonesia have developed new clones of mangosteen, which looks outstanding than mangosteen grown in the current. Therefore, it is very important for Thailand, we need to focus on the issue of developing a new mangosteen clones and seriously have to action immediately. Otherwise, the opportunity to produce mangosteen of Thailand will lag behind, and do not be competitive in the global market.

Mangosteen (*Garcinia mangostana* Linn.) is a tropical fruit trees to grow as evergreen trees, believed to have originated in the Sunda Islands. (certain areas of Malaysia) and the islands of Maluku. (certain areas of Indonesia) stems ranging in height from 7-25 meters, deep reddish-purple colored rind (exocarp) when ripe. The edible flesh is the aril with white and sweet and sour. Mangosteen is the tropical fruit trees in the genus close to the button mangosteen or Cherapu (*Garcinia prainiana*) and lemondrop mangosteen or Charichuelo (*Garcinia intermedia*) (Wikipedia, 2008), mangosteen is in a family of GUTTIFERAE (CLUSIACEAE) and genus *Garcinia*, plants in this genus contains 415 species of perennial, evergreen shrub spread from west Africa to tropical Asia until the Fiji Islands (Corner, 1988) cited by Ramage *et al.* (2004).

Usually mangosteen is a dioecious plant, the female flowers are attached by sterile stamens (infertile staminodes) (Lim, (1984on the fruit growth, mangosteen seeds are developed from the nucellus tissue, called an embryonic that adventitious embryony, which mangosteen are grown in Thailand in general, each fruit is mostly found less than 3 seeds, but if a quite small fruit probably no seeds at all. The proportion of the different parts of mangosteen in each fruit size, was studied by Surapong, cited by Norramatt *et al*. (2008) found that in the fruit size, large, medium and small, it was the proportion of aril pulp was 31.9%, 30.7% and 30.8% of weight, respectively. Aril pulp weight of mangosteen in each size has a different less than 1%, the average seed number of fruits are 2 seeds for large fruits, 1 seed for medium fruits and 0.8 seed for small fruits.

However, there are arguments and confusion in the report found that the mangosteen are fertile stamens, and the male mangosteen trees by Idris and Rukayah ((1987reported that the male mangosteen trees are similar to female trees, but their flowers are smaller and upside down under leaves, short filaments, sessile stigma, round, yellow, no-lobed flowers, dry and fall off within 3-2 days, so they could not fruit set because of all flowers male expression. There was an attempt to identify the exact number of mangosteen chromosomes, which the report of the imprecise chromosome number, as polyploidy chromosomes (2n = 76, 96, 90-88, (120-110, which due to could not count a lot of small mangosteen chromosomes for exact numbers, therefore making it impossible to identify the genetic differences of the mangosteen in each group correctly. There is an assumption that mangosteen is likely from a combination of native plants in the genus Garcinia, namely 2 species of Malaysia native plant include seashore mangosteen (*G. hombroniana*) (2n = 48) and *G. malaccensis* (2n = ≈ 42). The morphological characteristics of mangosteen up to 13plants with similarities to two species such as resin color, petal color, peel color and the stigma base of the fruit look like *G. malaccensis*, smooth skin of stigma end, the jagged curved of the stamens clearly, the spherical fruit shape, smooth skin of fruit peel are similar to *G. hombroniana*, flowering period, the depth of the notch on the curved stigma, diameter of stigma, characteristics of the female flowers with a sterile stamen section, the taste of the fruit pulp are mixture characteristic of *G. malaccensis* and *G. hombroniana* (Richards,1990).

Normally, seed of plants, which most of the caused by adventitious embryony is maintained sexual reproduction (Richards, 1986) but for mangosteen that are not found the male tree in nature, the mangosteen seed for propagation is an apomictic, but the fact that the mangosteen is different or uneven appearance phenotype that appears at times such as mangosteen, some

clones are grown in the Sabah and Sarawak state of Malaysia, the shape of fruits as oval to round, and fruit size larger than normal, in Sulu the Philippine Islands found mangosteen species with thick rind and high acid content of mangosteen fruit, in the areas of Indonesian Borneo mangosteen fruit pulp contains four segments and each segment with seeds with equal size (Yaacob and Tindall, 1995). The report of the plant variability found occasionally in the phenotype of the mangosteen that grow in North of Queensland, which were introduced from different sources. It is characterized with the abnormal growth, the difference of fruit size, yield and productivity, period growth of the juvenile, some mangosteens are growth of the branches pointing upward and position of fruit bearing different from normal (Almeyda and Martin, 1976; Verheij, 1991; Sando *et al*., 2005) which external characteristics of such expression is not possible to prove conclusively what caused the genetic variability of plants or the environment.

In Thailand, it was reported that mangosteen grown in the Southern quite different from mangosteen grown in the eastern, whether it was fruit shape, fruit size, rind thicknees, characeristics of leaves, which corresponds to Phonprasit (2002) said that, Nonthaburi mangosteen fruits have a rather small size with slender shape and relatively good quality pulp with thin rind, but southern mangosteen fruit is larger than Nonthaburi mangosteen, height weigh, short calyx, thick rind, reddish pink ripe color skin rind, and change of color skin rind to purple slowly than Nonthaburi mangosteen. Farmers in Chanthaburi, that grown mangosteen in their orchards found that mangosteen with some mutations, such as the tiered branching, each break set of tiered branches with three radial sub-branches, that is called Phaya mangosteen, mangosteen with mosaic leaves, mangosteen with twin trunks, however distinguishing characteristic of these phenotypes are not able to identify exactly be caused by genetic variance or the environment.

The study of the genetic information and evolutionary relationships of mangosteen with other plants in the genus *Garcinia***,** Yapwattanaphun ((2003 had used the technique Amplified Restriction Fragment Polymorphism (AFLP) with leaf samples to assess the genetic variability of mangosteen and plants in the genus *Garcinia*, including plants of some species in the family Guttiferae of various source. in Thailand, including Narathiwat, Rayong, Chanthaburi, Trat, Chumphon, Songkhla, Nakhon Si Thammarat, Surat Thani and *G. hombroniana*, Garcinia (*G. atroviridis*) from Nakhon Si Thammarat, Gamboge tree (*G. acuminate*), *G. hanburyi*, Chamuang (*G. cowa*) and large leave Pawa (*G. vilersiana*) from Chanthaburi, wild mangosteen (*G. costata*), Ma Pud (*G. dulcis*) and *G. rostrata* from Ubon Ratchatani, Mapud (*G. dulcis*) Madan (*G. schomburgkiana*). Pawa (*G. speciosa*) Krathing (*Calophyllum inophyllum*) and

Sarapee (*Mammea siamensis*) from Bangkok, *G. porrecta* from Trat, Mada Lhlung) *G. xanthocymus*) from Chiang Mai, overseas plants, including mangosteen and seashore mangosteen (*G. hombroniana*) and *G. malaccensis* and *G. sizygiifolia* from Bogor, Indonesian, and mangosteen in Malaysia from Johor, Perak, Kelantan, Pahang, Keith Dahl, Sarawak, Sabah, Selangor and some specimens of *G. tinctoria* from Brisbane, Australia, which obtained data of this study showed the remarkable possibilities of the genetic variability in mangosteen, although there is a lower level compared to the genetic differences of *G. malaccensis* and *G. hombroniana***,** that understood to be the parents of mangosteen, but possibility that the mutation of mangosteen is seem to come from conditions of the somatic clone, thus resulting in a somatic mutation and also found that mangosteen are more closer genetically to *G. malaccensis* than *G. hombroniana*, that *G. hombroniana* would be included in the same genotype with *G. rostrate, G. speciosa* and *G. sizygiifolia* before they cross-fertilized with mangosteen and *G. malaccensis* once again, and interesting in mangosteen samples from Trat, Thailand is identical of nucleotide additivity to *G. atroviridis*, *G. cowa*, *G. dulcis*, *G. malaccensis*, *G. mangostana*, *G. rostrata* and *G. vilersiana*, it is possible that such species are cross-hybridized with mangosteen in the past.

Moreover Ramage *et al.* (2004) had used the technique Randomly Amplified DNA Fingerprinting (RAF) examined mangosteens 37 samples and plant samples in the genus *Garcinia* namely forest Pha Wa (*G. forbesii*), Apple kandis (*G. griffithii*), Ma Pud (*G. dulcis*), India Garcinia (*G .cambogia*), Ju Bu (*G. prainiana*), African Mangosteen (*G. livingstonei*), Australian native Mangosteens (*G. warrenii*) 11 samples, all plant specimens were collected from the plantation of Mangosteen growers in the northern Queensland 13 fields and 4 plant sample specimens from plant germplasm collection fields. Those plants, which originated or seeds were introduced to grow from different countries, found that mangosteen in 26 samples (70%) did not detect the genetic variation and the others on the 8 samples (22%) had a few genetic variation about 0.2-1% and 8 samples showed high levels of genetic variation more than 22%, that could be separated with 9 types of different genotype characteristics, and divided mangosteen into 3 different groups, group 1. included 26 samples from plants with no genetic differences, group 2included that mangosteen with large oval fruit-shaped like pears, and a season-long productivity, that origin from Borneo. group 3. included that tree canopys are different from normal mangosteens, their native from Java, Indonesian, the three mangosteen groups were genetic differences about 23-31 %. Malaysian Agricultural Research and Development Institute: (MARDI) and Green Tech (Greentech), Japan had studied the genetic diversity of cultivated mangosteen in Malaysia, found that

in many different genetic types of mangosteen, with fruits are small, hard rind, long pedicel, hard fruit pulp, long oval fruit shape, with buttocks, seedless, long shelf life, 9 aril segments, smooth surface rind, male mangosteen trees, mangosteen with early bearing in 4-5 years after growing and mangosteen with fruit bearing throughout the year (Mohamad and Abd, 2006).

Desdika and Indra (2008) reported that in East Kalimantan, Indonesia, found mangosteen tree, was about 40 years old, normally begin to bear fruit between November-January, average bearing about 100 kg per tree, the average fruit size 80-150 mm, rind thickness about 0.5-1.0 cm, with a slightly sour taste with 5-7 edible pulp aril segments depending on fruit size, some seedless fruit, some fruit only up 1 seed, no fruit with pulp translucent and gamboges symptoms, that is remarked the characteristics of seedless likely to be hereditary, because of such mangosteen would yield that looks with least seed or seedless annually, but there is no clear verification. However, the mangosteens that aged over 100 years, they are found that seedless fruits. Therefore, it may be hypothesized that the influence of the seedless should be depends on the genetics, environment and plant vigor, which is core components. It may be that, mangosteen with aborted seeds may be caused by mutations, because of the these mangosteens could be found in nature rather difficult, that Assoc. Prof .Dr. Kawit Wanichkul, Department of Horticulture, Faculty of Agriculture, Kasetsart University, Kamphaeng Saen Campus had commented that mangosteen, the fruit without pollination. Seeds created from tissue of ovary wall. The mangosteens with the completely food store, would lead to larger fruits, that add the chance to larger seeds, while the trees with incompletely food store, including heavy bearing trees, which lack of balance between source-sink relationship so the fruits are small and seedless or with aborted seeds, and observations from that older mangosteen trees, opportunity to have smaller fruit, and formed aborted seeds higher than the younger trees. (cited by Aksornniam, 2008).

Because of mangosteen have seeds developed from the ovary wall. It is not caused by sexual hybridization or changes in the chromosome (obligate agamospermy). Therefore, the mangosteen with a variation of a very narrow genetic base, as a result, breeding and developing the new clones of mangosteen are rather very more limitations. The use of biotechnological process models have been applied to the tissue and seedlings of Mangosteen (Goh *et al*., 1994; Normah *et al*., 1995; Te-chato and Lim, 1999, 2000), then stimulated or induced mutation of mangosteen by using various methods such as colchicine (Ratee, 1997) with grammar radiation in different mangosteen tissues, such as callus from leaves (Witaya and Sompong, 1998), the direct mangosteen seeds (Rostini *et al*., 2003).

However, at present, some countries with mangosteen production as Thailand trade competitors such as Malaysia and Indonesia have started to develop new clones of Mangosteen. For example reported by Department of Agriculture of Malaysia, have been registered the new 2 mangosteen clones include mangosteen clone GA1 and GA2, by clone GA1, ripe mangosteen fruit peel is dark brown, spherical fruit shape, medium fruit size, average fruit weight about 105g/fruit, fruit pulp is white and medium resolution texture and seedless fruit. The mangosteen clone GA2 is ripe fruit peel with dark brown eyes, oval fruit shape, larger fruit size, average fruit weight about 120 g/fruit, with white pulp is relatively high resolution texture, sweet taste fruit pulp with seeds (Department of Agriculture Malaysia, 2002). Therefore, it is imperative that Thailand must provide priority to the development of new mangosteen clones and promote to the farmers follow soon.

Materials and methods

Conducted field surveys in areas where mangosteen are cultivated intensively in total 3 provinces of 24 accessions including the province of Rayong, Chanthaburi and Trat, for information on the source to grow mangosteen that are specifically characteristic of mangosteens were asked from the Provincial Agriculture Office, District Agriculture Office, Local leaders such as Tambol headman, Village headman, Tambol Administrative, a survey area, plantation, as well as information about the award of the contest, mangosteen quality and style that exactly as the needs of the to conduct the following survey. The survey was conducted in Rayong province in Amphoe Mueang, Klang, Wang Chan and Khao Chamao, in Chanthaburi province area of Amphoe Tha Mai, Khao Khit Chakut, Makham, Khlung, Larm Sing and Mueang, Trad province in area of Amphoe Mueang, Khao Saming and Bo Rai in the season fruit production of 2008 from May-July 2008 and analyzed data during August-September 2008.The survey data criteria of International Plant Genetic Resources Institute (IPGRI, 2003) form were used in this survey. Our focusing on survey and collect data on the expression of the differences in the morphology of both the internal and external quality of the mangosteen fruit that different from the usual. The characteristics that different from normal mangosteens in the areas were observed, other morphological characteristic descriptors of mangosteens were recorded, such as the tree growth, maturity period, flowering, bearing, the appearance of the leaves, inflorescence/flowers, fruits, fruit disorders, etc. The same morphological characters of accessions having were calculated in percentage.

Results and discussion

The survey of the mangosteen accessions on different morphological characteristics in the eastern region of Thailand in three provinces, Rayong, Chanthaburi and Trat on 24 accessions in 2008 and 2009 showed diferential morphology as mangosteen phenotype, was different and could be distinguished in 6 characters i.e small leaves and small fruits trees, oblong shape trees, thin (not prominent) persistent stigma lobe thickness and aborted seed fruits trees, full and partial variegated mature leave color (combination of green and white color) trees. (Table.1) The most frequent characteristics of mangosteen variations in survey plantations in general are small leaves and small fruits trees, which is consistent with reports of Phonprasit ((2002 described characteristics of the mangosteens that were found in Nonthaburi. While, the mangosteen trees with oblong fruit shaped to be found in the second (Table 1). It is usually found in the mangosteen fruit, which is small to a very small number, that is different from the report of the Department of Agriculture Malaysia (2002), mentioned fruit-shape of the Malaysia's mangosteen clone GA2 is oval and the fruit is relative large, weigh up to 120 g / fruit. Another interested characteristic variation of mangosteen is fruits with thin (not prominent) persistent stigma lobe thickness of mangosteen trees that are found to be quite difficult, the mangosteen trees in this accessions bear mostly fruits with aborted seed and seedless, although their fruits are relatively smaller than normal. Selected mangosteen of this accession propagated by grafting were planted for commercial purposes should be considered. The selection of these mangosteen accessions are propagated by grafting and cultivated for commercial purposes should be considered due to the size of the fruit is not too large, spherical fruit shape and seedless are probably comparable with GA1 mangosteen that reported by Malaysia's Department of Agriculture of Malaysia (2002).

Mangosteen with variegated leaves both whole tree and partial tree. Characterized mutations of mangosteens are expressive with variegated leaves, that both appear throughout the trees and only parts of the trees, but they are very rare, in the mangosteen seed propagations over two thousand seeds, the mangosteen seedling are found that only one variegated leaves trees. (from inquiry the mangosteen growers) The variegated leaves mangosteens, are growing very slowly, which is probably due to the low rate of photosynthesis is possible that the amount of chlorophyll in the leaves of them are lower than normal, this is consistent with the data (Downton and Grant, 1994) found that some ornamental plants with low rates of photosynthesis. The plant propagation

material producers usually take the variegated leaves mangosteens are available in ornamental plants by the grafting propagation.

To study on variability in the morphology of mangosteen should focus on qualitative characteristics, because of the quantitative characteristics usually depend on environment changes. According to the report of Mansyah *et al*. (2010) was conducted a study only 11 specific characteristics of mangosteen in Indonesia, including, canopy shape, mature leaf color, number of flowers and fruits per cluster, pedicel length, fruit shape, fruit-base shape, stigma lobe shape, size, and thickness, the number of fruit segments, and rind thickness, others such as leaf and fruit size were also not evaluated because these characteristics were quantitative and affected by environmental conditions, fruit color was not used because it depended on harvest index.

Table 1. Results of the survey mangosteen accessions with differences of morphological characteristics in the eastern region of Thailand, for 24 accessions

No.	Mangosteen with different morphological characteristics.	Number of Accessions
1	Mangosteen with leaves and fruits are small	9
2	Mangosteen with oblong fruit shaped	5
3	Mangosteen with thin stigma lobe thicknees and aborted seed of fruit	4
4	Mangosteen with variegated leaves whole tree	3
5	Mangosteen with variegated leaves partial tree	3
	Total	**24**

Figure 2.1 Mangosteen with leaves and fruits are small in Amphoe Khlung, Chanthaburi province.

Figure 2.2 Mangosteen with oblong fruit shaped in Amphoe Khao Khit Chakut, Chanthaburi province.

Figure 2.3 Mangosteen with thin stigma lobe thicknees and aborted seed of fruit in Amphoe Khlung, Chanthaburi province

Figure 2.4 Mangosteen with variegated leaves whole tree in Amphoe Mueang Trad province.

Figure 2.5 Mangosteen with variegated leaves partial tree in Amphoe Larm Sing Chanthaburi province.

Table 2. Percentage of characteristic descriptor details of growth, leaf inflorescence/flower, fruits, seeds and fruit disorders for 24 different mangosteen accessions that were surveyed in the eastern region of Thailand. (criteria of IPGRI, 2003)

Growth descriptors				
Tree type	Seedling (100%)			
Tree vigor	Low (36.6%)	Medium (36.6 %)	High (25.3%)	
Maturity period	Intermediate (66.7%)	Late (33.3%)		
Trunk surface	Smooth (60.0%)	Rough (40.0%)		
Tree growth habit	Erect (26.7%)	Intermediate (33.3%)	Spreading (40.0%)	
Crown shape	Pyramidal (78.9%)	Spherical (10.5%)	Oblong (10.5%)	
Branching density	Sparse (35.7%)	Medium (35.7%)	Dense (28.6%)	
Branching pattern	Erect (5.9%)	Semi-erect (23.5%)	Horizontal (47.1%)	Irregular (23.5%)
Leaf descriptors				
Young leaf colour	Light green (42.9%)	Light green with brownish tinge (%42.9)	Variegated (14.3%)	
Mature leaf colour	Light green (23.5%)	Green (41.2%)	Dark green (23.5%)	Variegated (11.8%)
Leaf density	Sparse (17.6%)	Medium(%64.7)	Dense (17.6%)	
Arrangement of leaves	Opposite) 100%)			
Leaf blade shape	Oblong (100%)			
Leaf apex shape	Acuminate (100%)			
Leaf base shape	Oblique (11.8%)	Rounded (47.1%)	Cuneate (11.6%)	Shortly attenuate (29.4%)

Leaf blade margin	Entire (94.1%)		Undulate (5.9%)	
Leaf upper surface pubescence	Glossy (100%)			
Leaf lower surface pubescence	Not glossy (100%)			
Leaf midrib appearance	Prominent (100%)			
Leaf venation appearance	Prominent (47.06%)		Less prominent (52.94%)	
	Inflorescence/flower descriptors			
Flowering regularity	Regular (one or two regular seasons/year) (100%)			
Flower clustering habit	One flower per cluster (81.8%)		Combination of 1 and 2 flowers per cluster (18.2%)	
Sepal colour	Yellow (14.3%)	Yellow green (42.9%)	Green (14.3%)	Yellow with red margin (28.6%)
Petal colour	Yellow green (50.0%)	Yellow with red/pink margin (25.0%)	Green (25.0%)	
Flower size	Small (58.3%)		Medium (41.7%)	
Abundance of flowers	Profuse (50.0%)	Moderate (25.0%)	Sparse (25.0%)	
Position of flowers	Axillary (71.4%)		Terminal (28.5%)	
	Fruit descriptors			
Fruit ripening	Non-synchronous (100%)			
Fruit bearing habit	Regular (annual) (100%)			
Fruit bearing intensity	Poor (15.4%)	Medium (69.2%)		High (15.4 %)
Fruit shape	Spherical/ Round (31.2%)	Flattened (50.0%)	Ovoid (12.5%)	Oblong (6.2%)
Stigma lobe persistence	Persistent (100%)			
Persistent stigma lobe thickness	Thick (prominent) (81.2%)		Thin (not prominent) (81.2%)	
Blotches surrounding stigma lobe	Without blotches (100%)			
Colour of stigma lobe	Dark brown (100%)			

Pedicel attachment	Strong (100%)				
Pedical colour	Green) 33.3%(		Greenish red) 66.7%(		
Fruit size	Small < 90g/fruit) 90%)		Medium 140-90g/fruit (10%)		
Fruit skin thickness	Thin 72.7%		Medium (27.3%)		
Mature fruit colour	Deep purple (44.4%)	Purple (22.2%)	Red (22.2%)	Pink (11.1%)	
Fruit attractiveness	Poor (45.5%)		Intermediate (45.5%)		Good (9.1 %)
Aril texture	Intermediate (80.0%)			Firm (20.0%)	
Aril quality	Sweet (100%)				
Aril flavor	Intermediate (66.7%)			Strong (33.3%)	
Aril taste	Acid Sweet (44.4%)			Sweet (55.6%)	
Aril juiciness	Not juicy (55.6%)			Juicy (44.4%)	
Aril colour	Snowy White (55.6%)			Creamy White (44.4%)	
Number of arils per fruit	Six arils (77.8%)			Seven arils (22.2%)	
	Seed descriptors				
Seed shape	Ellipsoid (50%)			Irregular (50%)	
Seed coat colour	Light brown (80%)			Brown (20%)	
	Fruit disorders				
Observation on translucent	Not found (22.2%)	Very low (44.4%)	Intermediate (33.3%)		
Observation on gamboges	Not found (28.6%)	Very low (57.1%)	Intermediate (28.6%)		
Observation on fruit crack	Not found) 75.0%(			Very low) 25.0%(	

Accessiones survey of mangosteen tree with different morphology in the eastern region of the Thailand. By focusing on the characteristic expression of mangosteen trees in plantations of farmers in Rayong, Chanthaburi and Trat, which such methods could provide basic information about the variability of the characteristic expression of mangosteen is still unclear, as in the case of the mangosteen fruit without seedless or aborted seed, that due to the nature of the vigor condition of the mangosteen itself or genetic variation or caused by differences in environment, and this study could guide for clones selection process, or the new mangosteen clones development from the appropriate genetic resources trees, this should help to solve various problems in mangosteen production of farmers, that currently found. Whether the quality of productivity still unable to be regulated or improve the quality standards for the market requirements or the cost production factors for management in the

mangosteen plantations are too high, these may be in the form that can be modified by using the different mangosteen clones.

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