



## The Potential Fruit Crop of Cibodas Botanical Garden

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### Abstract

As an institute for ex situ plant conservation of high mountains, Cibodas Botanical Garden (CBG), has more than 1652 species and 8140 specimens of plant collections. An inventory of potential fruit crop in CBG which will support the conservation program had never been done before. The aim of this activity is to determine its potential collections as fruit crop. Descriptive analysis was used to analyze all the data achieved from registration unit and catalogue of (CBG). The results showed that 422 numbers of collections from 31 family, 56 genus and 114 species have high potential as a fruit crop. Moreover, Cibodas Botanical Garden has 74% collection of indigenous fruit (included 85 species) and 61% collection of underutilize fruit (included 68 species) from the total number of fruit plant collections. Most of potential plant collections are able to be developed as an edible fruit crop in Indonesia in order to enhance local food security through diversification of fruit crop.

### How to Cite

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## INTRODUCTION

Indonesia is one country with having a very high biodiversity; BAPPENAS (2003) reported that there are at least 38.000 species of plants with 55% of them are endemic from (of) Indonesia. It makes Indonesia as a unique natural laboratory of tropical plants (Purnomo et al., 2014). The natural of tropical rainforest which have high humidity, rainfall, and sunlight intensity makes it favorable for many plants to get optimum growth (Murdjoko et al., 2016). Biodiversity of Indonesia was also includes a diversity of tropical fruits. Waluyo (2011) reported that there are at least 592 accessions of fruits crops genetic resources were collected in Indonesian Agency for Research and Development, Ministry of Agriculture. However, there is only 95 out of 592 numbers of accessions that have been studied.

Genetic diversity of indigenous fruits of Indonesia is very high, and it is important to developed as and fruits crops. In spite of this, the research activity of Indonesian native fruits is very rare. In the other hand, the utilization and cultivation of indigenous fruits were very limited. Indigenous knowledge of wild edible plant is important for sustaining utilization of those plant species (Jasmine et al., 2007). Fruit breeding is an important program to improve the quality and productivity of indigenous fruits, in order to diversify the edible fruits of Indonesia (Uji, 2007a).

Cibodas Botanical Garden (CBG) is a worldwide nature reserve area which is included in the Cibodas Biosphere Reserve. It is located at the lower side of Mount Gede Pangrango, Cianjur, West Java, with an altitude of 1300-1450 meters above the sea level, air temperature of 18 – 20 °C, and the humidity of 90%. The spesification of environment make CBG as the wettest regions in West Java. CBG has duties and functions such as conservation, research, environmental education, tourism, and environmental services. Currently, CBG has collected 1652 species and 8140 specimens of plants as garden collections (CBG data registration unit December 2014). CBG collections consist of indigenous plant, exotic plants, and it came from exchange seed (such as Europe, Australia and Asia) and exploration of mountain forest in Indonesia. Among these collections consist of edible fruit plants or potential fruit crop plants, especially plants of highland region.

CBG as an ex situ plant conservation institution have to promote a potential collection. An inventory of potential fruit crop in CBG which will support the conservation program had never been done before. It give an effort to provide base

line data that can be helpful in ensuring sustainable potential fruit crop of CBG collection. This study aimed to invent and determine-potential collections as fruits crops in the domestication program.

## METHODS

The research has been done on potential plant collections which are potential for becoming fruit crops. The activities were started by field observation in the garden to determine some potential plants located in the CBG collection and continue by verifying the potential plant collection with the data on the catalogue book "List of Living Plant Collection Cultivated in Cibodas Botanic Garden" and website <http://siregist.krcibodas.lipi.go.id> from registration unit. This study used CBG living collections data up to the end of 2014, since there is no recent comprehensive up date to the data. Data included name of species, family, habitus, origin, distribution, and the number of living the collections were summarized. The information related to potential fruit was obtained by literacy studied.

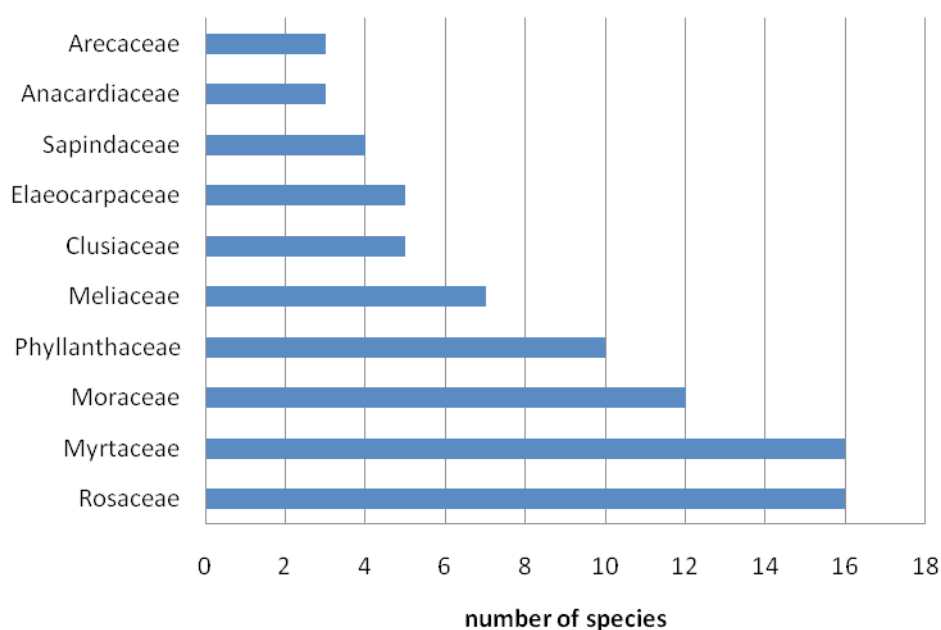
The plant collections in CBG, which had major (primary used as fruit crop) and minor (have other benefits besides fruits) functions as edible fruit, were used in the analysis (Verheij & Coronel, 1992). In other hand, the species with hard-skinned fruits or fruit with a hard dry pericarp or shell (nut) had not been put into potential species for fruit crops on this study (Uji, 2007b). Moreover, a descriptive analysis by Walpole (1995) was conducted to provide information and summarize the data.

## RESULTS AND DISCUSSION

Based on the observations and analysis of CBG collections, CBG has high potential fruit collections that can be developed as fruit crops. Up to the end of 2014, there were 422 fruit crop collections which consist of 31 family, 56 genera and 114 species. Fig 1 shows the families distribution of fruit crop collections in CBG. The results show that this collection mostly came from the families of Rosaceae (16 species) and Myrta-ceae (16 species), followed by families of Mora-ceae (12 species), Phyllanthaceae (10 species) and Meliaceae (7 species).

### Rosaceae

Rosaceae is one of the largest fruit family that high potential to be develop into fruit crops in CBG. Moreover, the results showed that there



**Figure 1.** Family distribution of Fruit Crop Collections in CBG

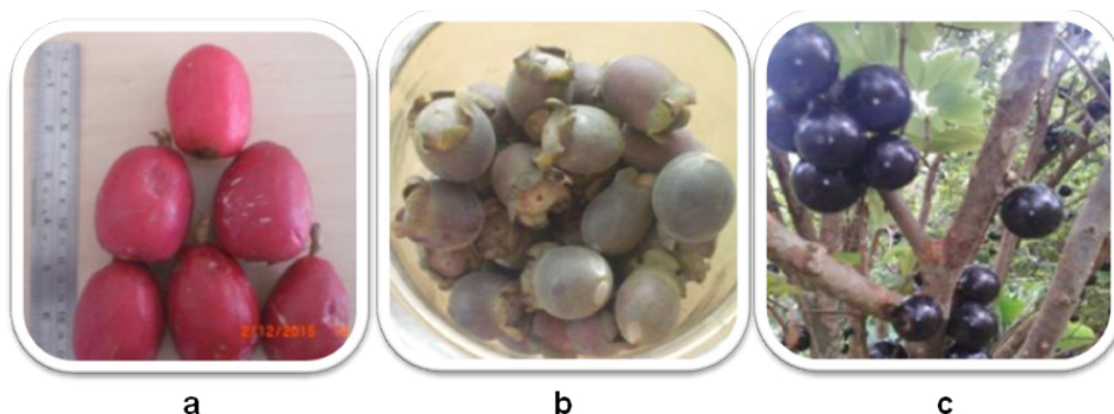


**Figure 2.** Fruits of Rosaceae Family in CBG (a) wild raspberry (*Rubus* spp.) (b) loquat / papalaan (*Eriobotrya japonica*)

are 6 potential genera as fruit crops, i.e *Eriobotrya*, *Malus*, *Prunus*, *Pyracantha*, *Pyrus*, *Rubus*. *Rubus* and *Eriobotrya* were the genera that have a very high potential to be developed as a fruit crops but they have not been utilized yet.

On 2015, Surya et al. (2015) reported that CBG has 12 species of *Rubus* (*R. acuminatissimus*, *R. alceifolius*, *R. alpestris*, *R. chrysophyllus*, *R. ellipticus*, *R. elongatus*, *R. fraxinifolius*, *R. lineatus*, *R. mollucanus*, *R. pyriformis*, *R. rosifolius*, *Rubus* sp) that were collected from Indonesian mountain forests. *Rubus*, also known as wild raspberries (Figure 2.a), is highly potential fresh fruits, beverage raw materials and medicinal plants.

*Eriobotrya japonica* was distributed from Himalaya region to Japan and throughout Southeast Asia went southwards to Sumatera, Malaya, and Borneo (Kalkman, 1993). In Indonesia, *E. japonica* has been used as ornamental plant in highland (Verheij, 1992). *E. japonica* often called loquat or papalaan (Sundanese) could be eaten as fresh fruit, salads, and also commonly use as raw material for jam, jelly and chutney. The fruit was similar to apples in many aspects, with high sugar, acid and pectin content (Facciola, 1990). In the other hand, the collections from genera *Malus* and *Pyrus* which is a family of apples and pears, never bear any fruit since its planting in CBG.



**Figure 3.** Fruit of Myrtaceae family in CBG (a) *Syzygium* sp (Jambu papua), (b) *Rhodomyrtus tomentosa* (Kemunting) (C) *Plinia cauliflora* (Jaboticaba)

### Myrtaceae

In CBG, Myrtaceae is a family with high number of fruit collections other than Rosaceae. *Syzygium* spp., *Psidium* spp. and *Eugenia* sp., belong to Myrtaceae, are a genus with high number of species in CBG. Family of Myrtaceae was divided into two subspecies, i.e. Leptospermoideae and Myrtoideae. Reynertson et al. (2005) reported that subfamily Myrtoideae such as *Syzygium*, *Psidium*, *Eugenia*, *Myrciaria*, *Plinia*, *Catinga* and *Calycorectes* has a high potential to be developed as commercial fruit. There are about 500 species of *Syzygium* that were distribute in tropical and subtropical regions. In Indonesia, *Syzygium* has been spread and naturalized in almost all areas, from lowland up to 1200 meters above sea level (Verheij & Coronel, 1992).

*Syzygium malaccense*, *Syzygium polyanthum*, and *Syzygium jambos* are several collections in CBG that are originating from Indonesian mountain forests. *S. malaccense* is one of Indonesia original species. *S. malaccense* known as “jambu bol” is native to Southeast Asia, restricted to Java, Sumatra and Peninsular Malaysia, and naturalized in the United States and South America. The fruits of “jambu bol” are red with streaks of pink or white; thick flesh, rather dry and fragrant, but often savorless (Panggabean, 1992). In addition, CBG has *Syzygium* sp. which is refer to “Jambu Papua”. The collection of *Syzygium* sp. was obtained during exploration program to Papua on 1992. *Syzygium* sp. or Jambu Papua is potential to be developed as fruit crops. It has good shape and size as fresh fruit but sour taste (Fig. 3.a). Although it has sour taste, CBG proceed it as sweet meat. *Rhodomyrtus tomentosa* (Figure 3.b) or “kemunting” belongs to Myrtaceae that also has potential as fruit crops. These plants with a wide range of agro-climatic which is ranging from the coast to an altitude of 2400 meters abo-

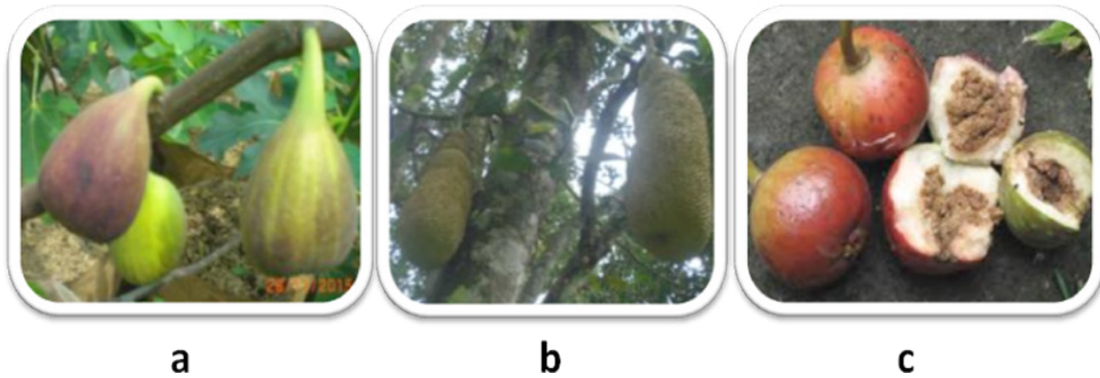
ve sea level, have purple-black fruit, juicy, and sweet taste while mature (Aman, 2002). One species of Myrtaceae collection fruit plant which has economic value is *Plinia cauliflora* (Jaboticaba) (Figure 3.c). This fruit is known as “Jaboticaba / Brazilian grape” with shapes and black color like wine. In Brazil, jaboticaba’s are largely eaten fresh; their popularity has been likened to that of grapes in the United States. Fresh fruit may begin to ferment 3 to 4 days after harvest, so they are often used to make jams, tarts, strong wines, and liqueurs.

### Moraceae

Moraceae, third majority fruit plant collections in the CBG, has the potential to be developed as fruit crops. There were genus *Ficus* and *Artocarpus*. In Indonesia, *Ficus* reached 252 species or about 68.66% from total number of species in Malesia region. *Ficus* were spread in almost all of Indonesian islands from the lowland to lower mountain (<1500 meters above sea level), and some species were found in the mountainous area between 1500-2500 meters above sea level (Yusuf, 2011). CBG has 6 species of *Ficus* i.e. *F. fistulosa*, *F. hirta*, *F. lepicarpa*, *F. sinuata*, *F. variegata* and *F. Carica*, that potentially able to be developed as fruits crop. *Artocarpus* is a native plant of Southeast Asia and commonly grown in Malaysia and Indonesia. *Artocarpus* has aggregate fruits that can be eaten, either as fresh or processed fruits. CBG has *Artocarpus* (*A. altilis*, *A. champeden*, and *A. heterophyllus*) that have already been used as fruit crops. Moreover, Figure 4 showing some fruits from family of Moraceae in CBG.

Referring to Figure 1, there were three genera which had high economic value such as *Garcinia* spp. (Mangosteen) from Clusiaceae, *Mangifera* spp. (Mango) from Anacardiaceae, and





**Figure 4.** Fruit of Moraceae family in CBG (a) *Ficus carica* (buah Tin); (b) *Artocarpus heterophyllus* (Jackfruit); (c) *Ficus variegata* (Kondang)

*Nephelium* spp. (Rambutan) from Sapindaceae. Moreover, these groups belong to national priority fruits (Winarno, 2000; Uji, 2007)

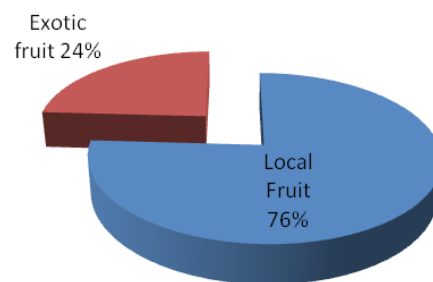
The other plant collections that have economic potential to be cultivated are *Antidesma bunius* (buah wuni) and *Baccaurea racemosa* (menteng) which derive from the family of Phyllanthaceae; *Aglaia eliptica* and *Aglaia edulis* (langsap) which derive from the family of Meliaceae; *Elaeocarpus angustifolius* (ganitu) which derive from the family of Elaeocarpaceae; and *Salacca zalacca* (salak) which derive from the family of Arecaceae.

*Antidesma bunius* (buah wuni) fruits have been used as a raw material for making tasty jelly jam, drinking juice and juice concentrate, in other hand *A. bunius* fruits traditionally used as a medicinal plant for gastric intestinal problem (Butkhup & Samappito, 2008). *Baccaurea racemosa* (menteng) is under-storey, evergreen, perennial tree reaching 15-20 m tall, it has an edible fresh stewed arillode, pickled, fermented or made into drinks (Lim, 2012). Although *Salacca* is able to be found in West Java and South Sumatera, its origin is still unclear (Uji et al., 1998; Uji, 2007). Several methods of fruit use have also been recorded. Ripe fruits are mostly eaten raw whereas unripe fruits are used variedly and cooked as vegetable, mixed with curry, eaten with salt and cooked with dry fish (Jeeva, 2009).

Local fruits mean Indonesian indigenous fruits and naturalized an exotic fruits that are found in Indonesia (Rifai, 1986). Verheij & Cornell (1992) reported that there are 400 species of edible fruits in Southeast Asia. Furthermore, Uji (2004) also recorded that there are 226 species of Borneo indigenous fruits that were able to be used as fruit germplasm, In the other hand, Siregar (2006) reported that there are 130 species of local fruits (indigenous or exotic) that have been consumed by the local people in Borneo.

Uji (2007) reported that more than 75% of wild fruits in South East Asia were found in Indonesia. Furthermore, based on his data there was 266 species of Indonesian indigenous fruits (included 4 subspecies and 2 varieties) that grew wildly and uncultivated yet.

A comparison of total fruit collections in CBG between exotic and local fruits show that the collections of local fruits (76%) was higher than exotic fruits (24%) (Figure 5). Moreover, referring to the data of Uji (2007), CBG has been able to collected 85 species out of 266 species of Indonesian indigenous fruits. It was quite far from total species target, due to CBG focus on high-mountain plant conservation. Although, CBG has some species from low land, but most of them were not able to produce a good fruits. It might be due to the temperature and rainfall in CBG.

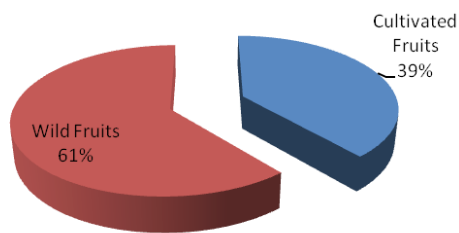


**Figure 5.** Comparison of exotic and local fruit collections in CBG

Furthermore, comparison of wild fruits and cultivated fruits in CBG show that 61% the potential fruits collections in CBG were not utilize yet (Fig.6). Unfortunately, the majority of cultivated fruits were exotic fruits. It means that a fruits collection in CBG has high opportunity to be developed as an alternative fruit crops in Indonesia.

**Table 1.** The collection of local fruits in Cibodas Botanic Garden

Family	Species	Indonesian Local Name	Origin
Anacardiaceae	<i>Mangifera laurina</i> Blume	Mangga pari ; Pelem kecil	Aceh
	<i>Mangifera odorata</i> Griff.	Mangga kweni	Java, Jambi
	<i>Mangifera similis</i> Blume.	Asem rawa	Aceh
Arecaceae	<i>Salacca zalacca</i> (Gaertn.) Voss	Salak	Jambi
Clusiaceae	<i>Garcinia beccari</i> Pierre	Burita	Aceh
	<i>Garcinia dulcis</i> Pierre	Mundu	Aceh
	<i>Garcinia mangostana</i> L.	Manggis	Aceh
	<i>Garcinia parviflora</i> Benth.	Kemenjing, Kandis	Aceh
Ericaceae	<i>Vaccinium varingiaefolium</i> (Blume) Miq.	Kicak-kicak, Cantigi ungu, Manis rejo	W. Java
Malvaceae	<i>Durio kutejensis</i> (Hassk.) Becc.	Lai	Borneo
	<i>Durio zibethinus</i> Rumph. ex Murray	Durian	Bengkulu
Melastomataceae	<i>Melastoma malabathricum</i> L.	Senduduk	W. Java
Moraceae	<i>Artocarpus altilis</i> (Parkinson) Fosberg	Sukun	Papua
	<i>Artocarpus champeden</i> Stokes	Cempedak	
Musaceae	<i>Musa acuminata</i> L.	Pisang	W. Java
Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamblang, Duwet	Java
	<i>Syzygium jambos</i> (L.) Alston	Jambu mawar	
	<i>Syzygium malaccense</i> (L.) Merr & L.M.Perry	Jambu bol	Jambi
	<i>Syzygium polyanthum</i> (Wight) Walp.	Daun salam	W. Java : Cibodas
Pandanaaceae	<i>Pandanus conoideus</i> Lam.	Buah merah	Papua : Wamena
	<i>Pandanus dubius</i> Spreng.	Pandan seran	Papua
Phyllanthaceae	<i>Antidesma bunius</i> (L.) Spreng.	Buni, Wuni	Indonesia
	<i>Baccaurea motleyana</i> (Müll.Arg.) Müll.Arg.	Rambai	Indonesia
	<i>Baccaurea racemosa</i> (Reinw. ex Blume) Müll.Arg.	Kepundung, Menteng	Indonesia
Rosaceae	<i>Rubus fraxinifolius</i> Poir.	Arben	W. Java : Cibodas
	<i>Rubus rosifolius</i> Sm.	Berereatan, Sabit	
Salicaceae	<i>Flacourtia rukam</i> Zoll. & Moritzi	Ganda rukem	Java
Sapindaceae	<i>Mischocarpus pentapetalus</i> (Roxb.) Radlk.	Rambutan pucat	W. Java , C. Java
	<i>Pometia pinnata</i> J.R.Forst. & G.Forst.	Matoa	Papua
Sapotaceae	<i>Mimusops elengi</i> L.	Tanjung	Jambi
Zingiberaceae	<i>Etilingera elatior</i> (Jack.) R.M.Sm.	Honje, Kecombrang	Aceh
	<i>Etilingera solaris</i> (Blume) R.M.Sm.	Honje Warak, Tepus	Aceh



**Figure 6.** Comparison of wild and cultivated fruits in CBG

Yosini (2011) reported that the Indonesian people would like to buy imported fruits than local fruits. It was probably due to the regulation of government and the price of imported fruits was cheaper than local production. Furthermore, apples, citrus and mango were the favorite fruits for consumption of Indonesian people. The magnitude of import fruits made the market was dominance by import fruits. So many things are being considered by consumers to buy the fruits. The limitation of fruits quality and production made the local farmer has low competitiveness than the import one.

Utilization and development of wild fruits is important to support food security by fruit diversification. Plant genetic resources and plant diversity of wild fruits is an asset for breeding program. Unfortunately, most of wild fruits belong to trees. It needs a good strategy of breeding methods to utilize and developing several wild fruits such as *Rubus* spp., *Syzygium* spp., *Sorbus* sp. and *Rhodomyrtus* sp, through domestication program.

## CONCLUSIONS

Cibodas Botanical Garden had high potential of plant collections from Indonesian mountain forests to be developed as fruit crops. Currently, CBG had more than 400 numbers of fruit collections from wild species that able to be used in domestication program. The best strategy of domestication program to utilize and develop these resources its able to transform the consumers perspective of local fruits. It would be in line with national program of food security through diversification of fruit crops.

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