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Diversity Dynamics of Semarang Apple (*Syzygium samarangense*)

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Abstract. Semarang apple (*Syzygium samarangense*) is one of the popular tropical fruits in Indonesia and its vicinity. This research was carried out in connection with diversity changes due to various factors. There are many lost cultivars because of cutting down. This study aimed to find out the diversity change of semarang apple in Java by a survey. Some permanent plots were established in some locations in Java. The results showed some reduction in cultivar number, but some new records of semarang apple cultivars were also recorded.

1. Introduction



Semarang apple (*Syzygium samarangense* (Bl.) Merr. & L.M. Perry) is one favorite fruit of the tropic whose economic value is high. It consists of many highly variable cultivars based on shape, size, color, and taste. The fruit is savory to consume as fresh fruit, salad, juices, and jellies [1]. Currently, plant breeders are trying to produce high-quality fruits for the future. The creation of the new cultivars, however, do not meet the extinction rate the cultivars.

Semarang apples (*S. samarangense*) are almost similar to water apples (*S. aqueum*) with some differences presented in Table 1. There are more than 100 cultivars of semarang apples distributed all over Indonesia but only about 10 cultivars of water apples..

Table 1. Differences between semarang apples (*S. samarangense*) and water apples (*S. aqueum*)

Characteristics	<i>Syzygium samarangense</i>	<i>Syzygium aqueum</i>
Tree	Small to large tree up to 10 m tall	Small tree 2-5 m tall
Leaves	Lateral veins of the upper surface smooth	Lateral veins of the upper surface furrowed
Fruit shape	Variable: bell shaped, rounded, ovoid, etc.	Less variable: button or bell shaped.
Fruit color	Very variable: white, pink, red, maroon, yellowish, light green, dark green, brown blackish, not glossy	Less variable: white, pink, red with glossy surface
Fruit taste	Sweet and astringent	Sour
Pest resistancy	Not resistant	Resistant



Characteristics	<i>Syzygium samarangense</i>	<i>Syzygium aqueum</i>
		

This research was carried out in connection with diversity changes due to various factors. Many cultivars have lost and been cut down, and new cultivar appears at a nursery. Some intermediate cultivars, between semarang apple and water apple, become rare.

The long term goal of this study was to save the semarang apple cultivars with the specific target to determine population changes of semarang apples; thus, the extant and the extinct cultivars were recorded. This current research was based on a survey and comparison between the present and past data. We expect to determine the conservation strategies of various potential cultivars as superior local fruit, which can then be promoted to improve the community economy.

The cultivation and maintenance of semarang apple are very simple. In general, the plants begin to flower and fruit three years after planting. In the following year, the fruits can be harvested three times a year with harvesting time depending on the cultivars.

We collected semarang apple cultivars as many as possible for conservation purposes, although many of them were not easy to grow. The semarang apple, having red, white, or green fruits, are simple to grow and produce fruits. However, these plants are often attacked by pests. The plant is also suitable for ornamental plant because of its beautiful color.

The semarang apple has quite varied fruit colors, including white, green, yellowish, pink, red, maroon, brownish, and blackish [2]. Within each fruit color, fruit shape is variable such as globose, bell-shaped, or oblong, with variable water content, i.e., low or high. There are also some variations in fruit texture such as hard or soft. The combination of the characters has produced many cultivars. In this research, we tried to solve the tree cutting problems that led to the cultivar diversity decrease.

The diversity of semarang apple may change due to natural factors such as climate change, land conversion, and other human activities. A study on the dynamics of plant diversity has been conducted by some authors [3] who stated that the changes were due to disturbance. The diversity of semarang apple is relatively dynamic and tends to decrease.

Some studies have been conducted to monitor vegetation changes of some cities using Landsat TM [4]. The results showed that method of post classification correction (PCC), direct multivariate classification (DMC), and 6-dimension multivariate post classification (6-D MPC) could detect the change of cover in urban areas and their vicinities. A plant diversity dynamics of ricefield was conducted to understand the history of land use of the rice fields [5]. The diversity dynamics on trees in East Kalimantan has also studied [6]. Furthermore, climate-driven diversity dynamics in plants was done [7].

A study on the semarang apple in some location in Java, such as in Bogor, Cileungsi, Banyumas, Kebumen, and Yogyakarta was conducted [8]. However, human activities, such as pruning and cutting, caused a cultivar decrease. Due to climate change, the phenology of flowering time might also change.

The flowering and fruiting time of semarang apple may change because of the climatic factor changes, such as rainfall, temperature, and seasonal change. In the last few years, the climate and weather have changed very significantly. The dry season that in the past took place between April -

October, now no longer valid. In fact, the rain continued to fall swiftly from April to October. This phenomenon is very influential on various flowering and fruit season.

In Indonesia, there has been anomaly limit of season change. In the past, the inclusion of the rainy and dry seasons was almost always predictable. As a tropical country, we estimate that the rainy season arrives when the sun is in the southern hemisphere from October to April. The dry season occurs when the sun is on the north of the equator that is in April-October. Now the beginning of the season is difficult to estimate because there has been a phenomenon of warming sea surface temperatures that the temperature has risen 1.5 - 2°C in the south of Sumatra, Java, Nusatenggara.

2. Methods

The sample of semarang apples (*Syzygium samarangense*) were collected from many areas in Java. It consisted of various cultivars such as apple, bangkok, camplong, cikampek, cincalo semarang, cincalo gondrong, cincalo merah, cincalo hijau, demak, madura putih, kaget hijau, lilin hijau, lilin merah, madura merah.

Sampling was done on permanent plots established in 2011 - 2018 at various locations in Banyumas, Kebumen, Cileungsi, Bogor, and Yogyakarta, which has a rare collection. The collected samples included leaves, flowers, and *S. samarangense* fruits present in the field for each cultivar. The specimens were dried and labeled for herbaria, then stored at Herbarium Fakultas Biologi Unsoed (PUNS) as a reference in the future. The diversity of semarang apples in 2018 was compared with those in the year 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018.

3. Results

The results showed that some cultivars of semarang apples were absent due to cutting down and land conversion. On the other hand, there was one additional cultivated cultivar, namely *Syzygium samarangense* 'Variegatum' in Taman Buah Mekarsari Cileungsi Bogor in 2013. Comparison of the tree presence from 2011 to 2018 was available in table 2.

Table 2. The presence of semarang apple cultivars from 2011 to 2018 in Java

No	Cultivar Names	Year							
		2011	2012	2013	2014	2015	2016	2017	2018
1	Jambu kaget hijau								
2	BT3 Hijau								
3	Madura Putih								
4	Kaget putih								
5	Demak								
6	Cincalo hijau								
7	Green Pudding								
8	Black Diamond								
9	Sukaluyu								
10	Jambu Citra								
11	Maroon Baturraden								
12	Jambu Unsoed								
13	Irung Petruk								
14	Pink Rose Apple								
15	Tangkweh								
16	Variegata								
Cultivar number		15	14	13	12	11	11	7	7

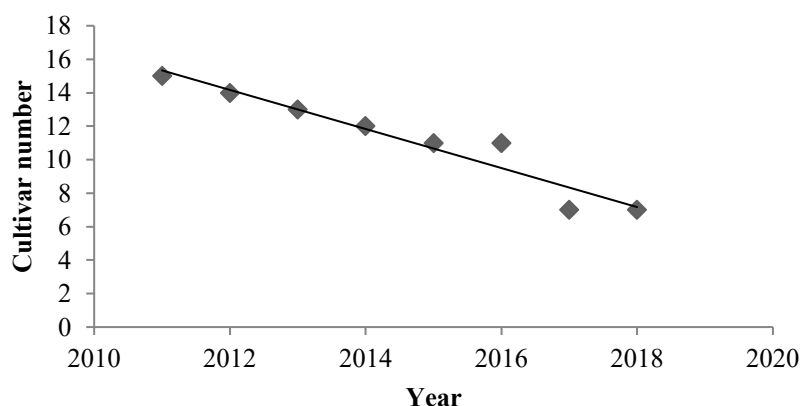


Figure 1. The trend of a number of Semarang apple cultivars from 2011- 2018 in Java.

The analysis revealed that, statistically, there was no significant difference among years. Although the cultivar number decreased due to cutting in some places, the decrease, in general, was a minor (Table 3). From 2011 to 2018, there have been changes in the presence of Semarang apple cultivars. Nine of 16 (56%) observed cultivars were cut down, only one cultivar (6%) was newly found (Variegata), and the rest (38%) remain to exist. Thus, the most numbers of Semarang apple decrease very significantly.

Tabel 3. Analisis of Variance

Source	DF	Seq SS	Adj SS	Adj MS	F	P
C5	3	5.562	5.562	1.854	0.52	0.680
Error	10	35.867	35.867	3.587		
Total	13	41.429				

S = 1.89385 R-Sq = 13.43% R-Sq (adj) = 0.00%

Jambu maroon baturraden was found in 2011 in Kemutug Lor Village Baturraden. Its fruits were maroon or blackish red. However, in the year 2012, the tree was cut down. Another Semarang apple which was cut down was jambu silado on Jl Raya Sumbang Padamara and possibly extinct. Some other Semarang apples cut down in 2013 were (1) jambu putih kekuningan in Purwokerto Lor, to the west of Satpol PP office, (2) Jambu kaget Putih at Jl Gelatik Kebumen, (3) Jambu hijau demak at Jl Suharso, to the west of GOR Satria Purwokerto.

The trees cut down in 2014 included (1) Pink Sukaluyu, to the north of Cikebrok Market, (2) a Semarang apple near the east gate of IPB Darmaga Bogor. On the other hand, a new cultivar found in 2014 was Jambu Semarang variegata in Taman Buah Mekarsari Cileungsi Bogor. The reason for the cutting was mainly due to pest, less delicious fruit taste, and land conversion.

4. Conclusion

For the last eight years (2011-2018), there has been a change in several cultivars of Semarang apples, either decrease in cultivar diversity or addition of new cultivars. The missing Semarang apples included 'Kaget Putih' and 'Maroon Baturraden' whereas the new cultivar appeared was 'Variegata' cultivar.

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