

# Growth And Quality Of Selayar Citrus Fruit At The Different Rootstock

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**Abstract:** Selayar orange is the flagship orange of the province of South Sulawesi, Indonesia. It has grown by using Japansche citroen (JC) and local oranges rootstock. The purpose of this research was to study the fruit growth and quality of Selayar oranges that using rootstock Japansche citroen. This study used an independent-T test at an alpha level of 0.05 to compare the growth and quality of Selayar oranges using Japansche citroen (JC) rootstock with selayar oranges using local rootstock (The Control group). The results showed that there were no differences between the JC rootstock and the local rootstock in terms of against size, color and quality of Selayar orange juice.

**Key words :** Japansche citroen (JC), Selayar Citrus, Rootstock

## 1. Introduction

Selayar Orange is the flagship orange of South Sulawesi province, Indonesia. This orange has grown in the lowlands and tropical climate. Unlike with the sub-tropical oranges, ecosystem for the appearance of flowers on selayar oranges is highly dependent on rainwater or water supply, especially in the dry season [1]. Oranges in the tropical climate are also poor in color, they were green or greenish yellow even though the fruit was ripe [2], this is caused by the fruit that was not exposed to low temperatures during the fruit growth [1, 3, 4]. Selayar orange which is planted by farmers in generally comes from generative breeding. The development of orange trees with grafting techniques to shorten the juvenile period has begun, but it generally still use the rootstock of Selayar orange. The Indonesian government strive to introduce the high-quality rootstock, including the Japansche Citroen, but the local government and society of the Selayar district still refuse to maintain the quality and plasmanuthfa of Selayar orange (the principle of caution). So that the using of the JC rootstock was limited in number, it was given to farmers outside Selayar Island. If found on the Selayar island of Selayar, the number was limited and only developed for the scale of the experiment. The using of quality rootstock can provide added-value to develop oranges, increase productivity, shorten juvenile periods and improve fruit quality [5]. In Indonesia, Japansche citroen (JC) was commonly used because it has a broad adaptation to the marginal land and compatible with several types of oranges [6]. However, the use of Japansche citroen (JC) as rootstock is still limited to the study of compatible levels of rootstock with top stem, while the quality of the fruit produced was not well documented, including the use of Selayar tangerines. The use of Japansche citroen as rootstock has been successful and compatible with Selayar oranges, but it has not been known

the quality of the oranges produced. This study aims to determine the growth and quality of Selayar oranges using Japansche citroen (JC) type of rootstock and Selayar orange using Selayar local citrus rootstock as a control.

## 2. EXPERIMENTAL SECTION

### 2.1 Materials and Methods

The plants used consisted of 8 trees Selayar citrus with Japansche citroen (JC) rootstock for observation of fruit size and color (non destructive), while observing fruit juice (destructive) uses 7 trees. As control, Selayar orange trees are used which use the original Selayar rootstock type (local) with the same amount in each treatment and observation. So, there are 16 trees for non destructive observations and 14 trees for destructive observations. The total number of trees used is 30 Selayar orange trees.

### 2.2 Fruit size and color

Observation of the diameter (mm) size was observed using a slide caliper and changes in skin color of citrus fruit were measured by Color Reader (KONICA MINOLTA, Japan, CR-400). This tool has a color notation system (color systems L, a, and b). L \* notation specifies brightness parameters. The value of L \* = 0 means black and if it leads to the value of 100 the more white or bright. The notation + a \* (positive) gets higher, the more red and vice versa the value from 0 to -80 for green. -B \* (negative) notation from 0 to -70 for blue and + b \* (positive) values from 0 to +70 for yellow [7].

### 2.3 Juice Quality

The quality of juice is measured by measuring the total dissolved solids using a hand refractometer (ATAGO ATC-1, Japan). While the measurement of total acid was carried out by the basic titration method using 0.1 M NaOH, phenolphthalein liquid (1%) as an indicator.

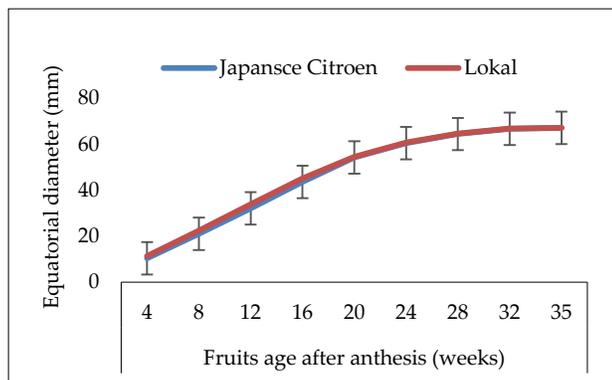
## 3. RESULT AND DISCUSSION

### 3.1 Fruit Size

The results of the analysis showed that there were no differences in the diameter of the Selayar citrus fruit using local orange rootstock (original Selayar) compared to those using Japansche citroen (JC) ( $p < 0.05$ ). The research data showed that the growth of Selayar oranges in both treatments increased, which was around 2.24 -2.77 mm per week or 0.98-1.1 cm per month to 19 weeks after anthesis (MSA) and

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tended to start slowing down to 20 HSP, even at the age of fruit 29-31 MSA the size of the fruit tends to stable, which is only 0.15 mm / week or 0.06 cm / month in both the rootstock treatments. At the time of fruit growth, it was noted that there was drought in August and September 2018, so that it was possible for drought to support the decrease in the size of the Selayar citrus fruit in the two rootstock treatments, and can also be a sign of entering the third stage [8].



**Figure 1.** Changes in the diameter of the Selayar citrus fruit are different from the rootstock during fruit growth

The diameter of the Selayar citrus fruit using the Japansce Citroen orange rootstock has the largest fruit diameter size is 81.99 mm and the smallest diameter is 56.13 mm on the 34 MSA observation of (final fruits Size, ), while those using local orange rootstock, the largest fruit diameter is 78.14 mm and the smallest is 53.64 mm. Japansche citroen (JC) is one type of rootstock that is widely used in Indonesia because it is generally compatible with various citrus varieties in Indonesia, extensive adaptability, good resistance to dry and saline environments. During the fruit growth period, which starts at the time of antesis until the aging phase of the fruit, it is noted

that rainfall is very high. This caused the effect of the rootstock between treatments not to be seen on the size of the fruit, because enough water is available, except in August and September 2018. In addition, Selayar oranges are lowland oranges which also have resistance to drought stress, so that under low rainfall conditions, both rootstock treatments show no difference in fruit size. The study [9] showed different responses from the use of several rootstocks to the diameter of the orange fruit 'Queen' orange. Orange "Queen" oranges that use rootstocks ri Carrizo Citrange 'are significantly different from those using Cleopatra Mandarin rootstock and" Troyer Citrange ". But the 'Carrizo' Citrange rootstock is not significantly different from Volkamer lemon, Sour orange, Swingle citrumelo, and the diameter of citrus fruit.

### 3.2 Fruit Color Change

Color change is an important attribute in determining fruit maturity, including citrus fruits. The movement of the color of the Selayar citrus fruit during growth was very slowly from green to yellow, except at the time of harvest before the rootstock treatment. The measurement results showed that there was no difference between Selayar oranges using local orange rootstock and Japansce citroen on fruit color ( $p > 0.05$ ). Data shows that the skin color of the fruit moves very slowly from dark green to bright green. Brightness of citrus fruits grown using local citrus rootstock brightness value ( $L^*$ ) of 36.79 and 38.61 using Japansce Citroen at 14 weeks after anthesis (MSA) and at 31 MSA  $L^*$  value was still 38.77 for rootstock local and 38.61 using Japansce citroen rootstock. Changes in the brightness value start to appear striking when the orange fruit is 33 weeks after anthesis, the brightness of the Selayar orange fruit changed to 45.38 using local rootstock and 47.06 using Japansce citroen rootstock and continued to increase to 35 MSA in both types of rootstock.

**TABLE 1**  
Effect of rootstock differences on the color of Selayar citrus fruit during growth

Fruits age (weeks)	Rootstocks	$L^*$	$a^*$	$b^*$
25	Lokal	37.29	-8.17	19.03
	Japansce Citroen	37.92	-8.04	18.60
26	Lokal	37.56	-8.24	19.20
	Japansce Citroen	38.08	-8.07	18.84
27	Lokal	37.76	-8.08	19.27
	Japansce Citroen	38.02	-8.16	19.20
28	Lokal	38.10	-8.14	19.40
	Japansce Citroen	38.06	-8.15	19.38
29	Lokal	38.34	-8.11	19.70
	Japansce Citroen	38.21	-8.22	19.75
30	Lokal	38.14	-8.01	20.49
	Japansce Citroen	38.14	-8.26	20.02
31	Lokal	38.77	-7.78	21.13
	Japansce Citroen	38.61	-7.96	20.46
32	Lokal	41.32	-7.30	23.59

	Japansce Citroen	42.45	-7.39	23.43
33	Lokal	45.38	-4.50	29.66
	Japansce Citroen	47.06	-4.52	29.93
34	Lokal	48.06	0.83	34.07
	Japansce Citroen	49.36	1.67	36.62
35	Lokal	51.28	4.90	40.64
	Japansce Citroen	52.45	6.09	41.97

*Mean values were not significantly different (T-test.  $P > 0.05$ )*

The value of a \* on both rootstocks also shows a slowly color change with a negative (-) value which means green, from 18 MSA to 33 MSA. The discoloration of the orange fruit begins to move to a positive value (+) which indicates leaving the green color at the age of 34 MSA in the two rootstock treatments. The b \* notation on 34 moves also reaches 34.07 in a and 36.62 for the rootstock of Japansce citroen. When the fruit is 33 MSA with the condition of fruit with color like this is the minimum standard criteria for Selayar citrus fruit harvest that is done by farmers. Selayar orange fruit will have a greenish yellow color. The color of citrus fruits developed in tropical countries will remain green [1, 10] or yellowish green even though the fruit has matured [4]. This is more due to temperature differences [2, 11]. When the lemon is still in the tree, the fruit's skin color starts to change from green to yellow at a temperature below 15 °C, and perfect changes occur at temperatures below 6 °C [12]. In citrus fruit synthesis xanthophyll is formed when the daytime temperature is low (+ 20°C) followed by cold temperatures at night (+ 7°C) with a soil temperature of around 12°C [3].

### 3.3 Fruit Juice Quality

The acid content and citrus sugar are important variables because they become the standard maturity of fruit maturity and consumer acceptance. It is known that rootstock contributes to the absorption of water and nutrients, by changing canopy development and photosynthesis and carbohydrate formation, helping to adapt roots to certain stress conditions and induction of certain diseases in citrus plants [13]. This condition will improve the quality of citrus fruits, especially the fruit sugar content. Measurement of changes in juice quality included the content of juice, total

acid and sugar (brix<sup>o</sup>), which was observed starting at the 18th week after anthesis. The fruit juice content increases with the size and age of the fruit. In observing the total acid content, there is a decrease along with changes in fruit age. On the contrary, sugar content (Brixo) increases in both treatments of Selayar orange rootstock. Based on table 2, seen the treatment of the lower stem does not affect the percentage of juice, total acid, fruit sugar level and sugar / acid ratio ( $p > 0.05$ ). Data shows that there is no difference in the quality of citrus fruits grown using local citrus rootstock (Selayar) and JC rootstock against the sugar content of Selayar citrus fruit. This also happened in research [5], there is no difference in the content of orange sugar Late Valves are grown with the type of rootstock Sour orange, Carrizo and troyer. In the same study [5], Rhode Red Valentine's orange uses Sour orange rootstock and Carrizo shows no difference in fruit sugar content. Table 3 shows that the acid content decreases and conversely sugar increases with age and fruit size. The main sugar transferred from the leaves into the fruit is sucrose, which is broken down into two other sugars, namely glucose and fructosa. Although sucrose is the main sugar, it does not rule out the possibility of rupture and resynthesis when moving towards the fruit, this is a way to maintain the concentration gradient of the leaves when the sugar is not unloaded. Sucrose can continue to move to the fruit even though it accumulates in very high concentrations in juice [14]. The total acid content of citrus fruits after reaching peak concentration amid fruit growth decreases and continues to decrease even though it has been harvested. The decrease occurs related to the anerobic respiration during the fruit ripening stage as energy.

**TABLE 2.**

*Effect of rootstock differences on the percentage of juice content, sugar, total acid, and the index of the maturity of Selayar citrus fruits during growth.*

Fruits age (weeks)	Rootstock	Jus (%)	Gula (brix <sup>o</sup> )	Total Acid	Indeks kemasakan
25	Lokal	43.8	9.26	2.49	3.72
	Japansche citroen	43.6	9.32	2.41	3.87
26	Lokal	43.9	9.84	2.12	4.64
	Japansche citroen	44.0	9.96	2.15	4.62
27	Lokal	44.2	10.20	1.93	5.28
	Japansche citroen	44.6	10.04	1.97	5.09
28	Lokal	44.7	10.30	1.85	5.56
	Japansche citroen	44.5	10.29	1.89	5.45
29	Lokal	44.9	10.32	1.76	5.88
	Japansche citroen	44.7	10.38	1.64	6.32
30	Lokal	45.2	10.36	1.39	7.45

	Japansche citroen	45.1	10.41	1.45	7.17
31	Lokal	45.6	10.45	1.27	8.20
	Japansche citroen	45.6	10.58	1.29	8.19
32	Lokal	47.6	10.58	1.19	8.91
	Japansche citroen	47.5	10.61	1.17	9.05
33	Lokal	47.7	10.63	1.11	9.61
	Japansche citroen	47.8	10.72	1.15	9.33
34	Lokal	48.4	10.74	1.09	9.83
	Japansche citroen	48.5	10.82	1.10	9.84

*Mean values were not significantly different (T-test.  $P > 0.05$ )*

#### 4. CONCLUSION

Citrus fruits from plant propagation using JC rootstock produce fruit size and fruit color that are not different from those produced from citrus trees using original selayar rootstock. The acid content decreases during the growth of citrus fruits, on the contrary there is an increase in fruit sugar content. There is no difference in citrus from breeding with JC rootstock types and local rootstock types to the content of juices, sugars, acids, and the index of the maturity of selayar orange fruit.

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