Sub Theme : Biodiversity and Conservation
ISBN : 978-602-8915-93-9

# BIODIVERSITY OF SALAK PLANT (*Salacca zalacca* (Gaertner) Voss)

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## ABSTRACT

Suwaru Salak Plant ( *Salacca zalacca* ( Gaertner) Voss) have been in cultivation for along time, since the Dutch coloni era in Suwaru, Gondanglegi , Malang, Indonesia. They were propagated with seed (generative propagation) the segregation process make so far more diversity (hybrid lines) in populations at salak farm. There are three main cultivars (Budeng, Madu, and Gading) and 33 Suwaru-fruit Salak Lines ( SSL ). The purpose of this research was to find the mthod of improvement of the cultivars. Cultivars and hybrid lines (SSL) were tested at six different objectives using variance and cluster analysis. Six experiments had been carried out, i.e. : (1) phenotype potential of salak Suwaru : (2) pollen fertility; (3) type of crossing; (4) fruit set management; (5) the time management of harvesting; (6) phenotype evaluation of salak Suwaru genotypes. This mean that pollen fertility (iodine test method) was good since it exceeded 60 %. The D type male flower had least paternal effect of acid content for cv.Madu (0.08%). The B type male flower had a highest tannin content (0.33%), paternal effect (xenia) of tanin content than A type ( 0.17% ), nearly 2 x. Xenia occured whwn the male parent carried the factor or when dominance was incomplete. Fruit set management increased fruit weight, fruit diameter, fruit volume, but decreased fruit length. The time management of harvesting increased the fruit weight and changed its edibility by increasing sugar content, decrease some acid and fruit tannin. Cluster and variance analysis showed that the degree of variance among the hybrid lines of salak Suwaru fruit was high. SSL10 and SSL28 hybrid lines may therefore be recommended as new cultivars.

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Key words: Biodiversity, salak fruit, improvement, paternal effect, cultivars.

## INTRODUCTION

Salak Suwaru plant grown by farmers in Suwaru village, Gondanglegi subdistric, Malang regency. The planting area covers 800 ha, with the production of 15 tons per hectare.

The salak palm is one of 11 important commodities of East Java province, which is put in the development plan in the year of 1998 – 2000 ( Jaya, 1998 ).

ISBN : 978-602-8915-93-9

Figure 1. Major three salak Suwaru varieties i.e. Madu, Budeng and Gading

Figure 2. Fruits set of salak Suwaru on tree

Figure 3. Salak fruit with two seed in each fruit, one is seedless

The salak farmers in Suwaru village still uses a traditional method in organic cultivation in which chemical fertilization is not currently applied. Salak Suwaru consisted of major three varieties i.e. Madu, Budeng, and Gading. These cultivars show different characters.

The quality standard of salak fruit in Indonesia (SNI 01-3167-1992) is based on the fruit uniformity, fruit oldness rate, fruit hardness, fruit skin damage and number of rotten fruits.

ISBN : 978-602-8915-93-9

Figure 4. Salak Fruit set in good condition especialy adequate of water.

The quality classification of salak fruit according to the market including (1) AA quality, healthy, big size ( a kg contains 11-13 fruit ) with yellowish skin fruit; (2) AB quality, healthy, medium size ( a kg contains 15 – 19 fruits ) with yellowish skin fruit; (3) C quality, a kg contains 25 – 30 fruits the skin color is black; (4) BS quality, rotten, broken fruits and untrated (Nazaruddin and Kristiawati, 1991). In the markets, the quality, the quality of the salak Suwaru Fruit is very diverse. Some of them are included in quality group from AA, AB, C, to BS, having the sweet to astringent sour taste.

The salakfruit has sweet, sour and astringent sour tastes depending on its vareiety and maturity (Kusumo, *et.al*., 1995). The sweet is mostly caused by reduction sugar (glucose and fructose), and can be detected by the edge part of human tongue nerves (Tranggono and Sutardi, 1990). The sour taste can be identified by using gas chromatograps, because of sccinic acid, adipat acid, malat acid and citric acid (Suter, 1998). The astringnt taste is caused by the presence of tannin in the fruit, functioning as a growth barrier for bacteria. Decrease of the sour and astringent taste in the fruit is a major part of processes in getting ripe (Isbandi, 1983).

## MATERIALS AND METHOD.

### Research Location and Material

The research was done in Suwaru village, Gondanglegi subdistrict, Malang regency, East Java, Indonesia, 28 kilometers Southward Malang city. It is about 300 meters above sea level.

Its climate type according to Schmidt and Ferguson is D. Its average precipitation is moderate, wth average of 6 wet months and 4 dry months. The soil

structure is sandy loam and light structure (Legowo et.al. 1996a and 1996b). The cultivation pattern is usually non monoculture and unchemicalfertilized. The salak plants are cultivated together with others fruit trees and coconut with irregular spacing.

The research material was the salak plants cultivated in Suwaru village, 25 years old. Each treatment consisted of 10 plants. The tools used were: pollination tool, length measurement, volume measurement, weight measurement, and hand refractometer.

**Experimental Design**

The experimental in laboratory used the complete randomized design (the second experiment), meanwhile the first, third, fourth, fith and sixth experiment used the randomized block design (Steel and Torrie, 1980).

**The First Research: Phenotype Potency of The Suwaru Snake Fruit.**

The independent variables were salak varieties meanwhile the dependent variables were some plant characteristics (Yitnosumarto, 1986).

**The Second Research: Pollen Fertility of Male Flower**

The independent variables were the four types of male flowers dependent variables were fertility of pollens (Knight, 1979., Bannier, 1927)

**The Third Research : Cross among Flower Types**

The independent variables were varieties and male flower types meanwhile its dependent variables were fruit component (Hayes *et.al*., 1955; Pandey and Lu, 1973; Dewey and Lu, 1973; Muluk, 1986; Kuntoro, 1997).

**The Fourth Research: Fruit Set Management**

The independent variables were varieties and some fruit per bunch meanwhile its dependent variables were fruit component (Gaspersz, 1991; Bowo & Soeparmo,1996).

**The Fifth Research Fruit Harvest Time**

Its independent variables were varieties and fruit harvest management meanwhile its dependent variables were fruit component (Prayitno, 1985).

**The Sixth Research: Evaluation of Phenotype Features of the Salak Suwaru**

The variables considered were bunch weight, fruit weight, and flesh weight (Hengky, 1994., Novarianto, *et.al*., 1994).

## RESULTS AND DISCUSSION

**The First Research Phenotype Potency of Salak Suwaru**

The first research showed that the number of fruit per bunch of cv. Budeng, Madu and Gading were 39.33; 32.00; 26.00 in average. The fruit weights were 73.1 g, 64.9 g and 51.5 g.

The skin colour for cv.Budeng was black, cv.Madu was blackish brown, and cv. Gading bronish yellow. These skin of cv. Gading had smoller scales.

**The Second Research Pollen Fertility**

The second research showed that pollen fertility of male flowers among A type (73.0%), B type (68.8 %), and D type (70.3 %) were not very different bat were different from C type (60.5%). The pollen fertility of the four male flower types (A,B,C, and D) was good ( > 60 % ), in average.

**The Third Research Cross among Flower Types**

The third research showed an interaction effect between varieties tested for flesh weight, sugar content, acid sugar ratio, and acid content.

The highest sugar content achieved when cv. Budeng and cv. Madu were pollinated by using male flowers of A types (15.8% and 15.5 %). Meanwhile, the lowest sugar content achieved when cv. Madu was pollinated by male flower of C type (12.6 %).

The highest acid content achieved by cv. Madu and cv. Gading after being pollinated with male flowers of C type ( 0.14 % and 0.15 % respectively).

Meanwhile, the lowest acid content showed by cv. Madu pollinated by male flower of D type (0.08%).

Male flower of type B produced the highest tannin content (0.33 %), meanwhile, the male flower of type A resulted in lowest tannin content (0.17 %).

**The Fourth Research Fruit Set Management**

The research of fruit set management increased the fruit weight, fruit diameter, and fruit volume, but decrease the fruit length.

**The Fifth Research Fruit Harvest time**

The fith research, fruits were harvested 6 months increased the fleshweight, and sugar content, but decreased the acid and tannin content.

The fruit weight of cv. Gading that were harvested after 5 mounths increased from 44.8 g to 69.2 g (harvested in the age 5 months). The sugar content of three varieties tend to increase when they were harvested in older age as well the acid-sugar ratio.

The acid and tannin content decreased when they were harvested in the younger age. For example, the acid contents of 0.45% (harvested in the age of 4.5 months) of the cv. Gading decreased to 0.15% (harvested in the age of 6 months). The tannin content of 0.64% (harvested in the age of 4.5 months), decreased to 0.27% (harvested in the age of 6 months).

**The Sixth Research Evaluation of Phenotype Features of The Suwaru Salak**

The sixth research showed a relatively great population uniformity of salak line in the location by claster analysis.

The lines that could be classified into similar group of cv.Budeng, were SSL 19 (Suwaru fruit salak line number 19), SSL 15, SSL 11, and SSL7.

The lines that could be classified into similar groupof cv. Gading were SSL29, and SSL 26.

The lines that could be classified into similar groups of cv. Madu were SSL30, SSL25,SSL22, SSL20,SSL17,SSL16,SSL13,SSL 12, SSL 8,and SSL4.

The lines that could be classified in other groups of cv. Budeng, cv. Madu, and cv. Gading were SSL28, SSL27, SSL24, SSL23, SSL18, SSL14, SSL10, SSL6, SSL2, and SSL1.

In 20 $^{th}$ genetic distance, 33 population samples could be split to be three groups that were SSL10, SSL28, and the rest group, including three local varieties as a comparison. Based on analysis of salak fruit population sample style in plantation of three farming groups in Suwaru village, it could be concluded that the most appropriate group analysis was 20 $^{th}$ genetic distance.

In the fifth genetic distance, 33 samples from the salak fruit in Suwaru village consisted of 25 groups ie. SSL10,SSL27,SSL9,SSL24, SSL6, SSL18, SSL2, SSL11,SSL19, Budeng, SSL15,SSL7, Gading, SSL26, SSL21,SSL5, SSL29, SSL13, Madu, SSL25, SSL16,SSL24, SSL23, SSL14, SSL3,SSL1,SSL28, and the rest groups ( SSL30, SSL17, SSL22,SSL20, SSL12,SSL8).

In terms of bunch weight (BW), fruit weight (FW) and flesh weight (MW) variables, the lines of SSL10 ( of 10) was higher than cv Budeng, Madu, and Gading. The bunch weight of SSL 11 line was the higest but its fruit weight and flesh weight were still lower than SSL 10. The SSL 11 showed that its number of fruits per bunch were in enough quality but its fruit was lower than SSL10 (Salak Suwaru Line with selection number of 10) was higher than the cvs. Budeng, Madu, and Gading. The bunch weight of SSL 11 line was the highest but its fruit weight and flesh weight were still lower than SSL 10. The SSL 11 showed that its number of fruits per bunch were in enough quantity but its fruit size was lower than SSL 10.

The salak Suwaru Fruit with selection number of 28 (SSL28) could be proposed as a new variety. The Salak Suwaru Fruit selection number of 28 (SSL 28) in terms of bunch weight (BW), fruit weight (FW), and fruit flesh weight(FMW) variables was more excellent than other comparison local varieties of the Budeng, Madu and Gading so that it can be proposed as a new local variety. In term of bunch weight , actually, the Salak Suwaru Fruit with selection number of 25 (SSL25) had the highest potency. Unfortunately, it was not followed by other variables.

**Phenotype Potency of the Salak Suwaru Fruitd**

Factors affecting the number of fruits per bunch included: number of flowers per bunch, percentage of flower to be fruit, and fruits abortion. The number of

flowers per bunch for the Budeng variety was the highest of 46.33 followed by the Madu and Gading varieties of 42.33 and 37.00 respectively. The highest number of fruit per bunch was achieved in the cv. Budeng of 39.3 followed by the cv. Madu and cv Gading of 32.0 and 26.0 respectively. The highest in fruit weight was the cv. B udeng (73.1g) followed by cv. Madu ( 64.9g ) and cv. Gading (51.5g). In this research, it was not known the male parent because farmers using whatever male flowers existing in the garden performed pollination. Genetically, from here, it be seen that the cv. Budeng was the most excellent in terms of the number of female flowers per bunch, number of fruits per bunc and fruit weight.

**Pollen Fertility of Male Flower**

The male flowers of A, B, and D type have lengthening primary stems and subsidiary stem bunches.

The primary stem of C type flower are not visible, i.e. flowers of female plants. The pollen fertility of the four types of male flowers investigated were good ( > 60%) (Bannier, 1927; Sobrizal, 1995).

The pollen germination and pollen tube formation immediately happen by the time of the pollen clings on the pistil head. The lengthening speed of the pollen tube highly depend on variety and environment, ranging 34 mm/h (Greulach, 1973). Through this pollen tube, sperm will unite together with ovule withinthe embryo sac ( Moenarni, 1966).

**Cross Among Flower Types**

Response of the three varieties of Budeng, Madu and Gading, toward the four male flower types was very different. It was caused by the genetic factor differences among either the variety achieved the highest fruit sugar content of 16.6 %. In addition, when these varieties pollinated by using male flowers of the C type, its sugar content decrease to 12.6% and its fruit acid content was the highest (0.15%). Conversely, the fruit acid content of the Madu variety would be the lowest value of 0.08% when using male flowers of the D type pollinated it and, also, the fruit sugar content would be the lowest value of 11.5 %.

The male flowers of the B type shared the astringent taste almost twice than that of the A type (0.33% and 0.17%)

**Fruit Set Management**

The increase of fruit weight influenced by fruit set management treatment is caused by: the competition among fruits in the bunch become smaller, the assimilate stock proportion for each fruit becomes bigger. In the time of fruit growth, the water, carbohydrate, fat and protein reserves were drained to the fruits from other parts of the plant (Darmawan and Baharsjah, 1983). The phenotype performance of fruit weight is influenced by the genetic factors (Soerjoatmodjo, 1984). Variation in the biology system can be caused by the feature inheritance (genetic) and environment factors (Weish and Mogea, 1991; Makmur, 1998; Crowder, 1988).

**Harvest Time**

The distinct metabolism changes in fruit ripeness are softening of the flesh, increasing of the sugar content, decreasing of the acid content. The fruits, especially young fruits, contain carbohydrate, fat, protein and organic acids (in the fruit vacuole cell). In the orange fruit, this acid organic is citric acid, meanwhile, in the salak fruit, it contain both organic acids and other tannin compounds (Greulach, 1973).

By getting older, in addition to the increasing of the fruit size and softening of the flesh most of carbohydrates in the salak fruit are changed to sugar, most of acids and tannins are also changed to sugar ( in the forms of fructose, glucose , and sucrose) The typical smell characterizing of the salak fruit will also emerge. The changes of the above items are closely related to the genetic material of plant varieties, in this term are Budeng, Madu, Gading, so that varieties have different tastes in sweetness, acidity, and astringency. For example, fruit of the cv.Gading harvested in the age of 4.5 months had 44.8 g in weight, harvested in the age of 6 months had 69.2 g in weight. The acid content of the cv. Gading harvested in the age of 4.5 months was 0.45%, and harvested in the age of 6 months was 0.15%. The tannin content of the cv. Gading harvested in the age of 4.5 months was 0.64%, harvested in the age of 6 months contained 0.27%.

**Evaluation of Phenotype Performances of The salak Suwaru Fruit**

The cluster analysis showed that uniformity among the investigated samples of the salak fruit plants was quite large. The emergence of hope lines and local varieties in Suwaru village was caused by genetic segregation. It was caused by the dioeciously, cross pollination and generative propagation and then, it became homozygote and recessive homozygote plants (Dwidjoseputro, 1981; Crowder, 1988) this condition is not an obstacle, but it is a change to develop some new varieties because salak plant cloning technology has been considerably developed (Tirtawinata, 1998).

**CONCLUSION**

1. The number of fruits per bunch and fruit weight among the three investigated varieties was distinctively different. The cv. Gading had brownish yellow and smaller-scale skins, which were very different from the other varieties that having blackwish brown skins.
2. Response of the three varieties of the cv. Budeng, Madu, and Gading toward the four male flower types were very different. It was caused by the genetic factor differences between the varieties or the four male flower types. The cv. Madu pollinated by male flowers of the A type achieved the highest fruit sugar content (16.6%). In addition, when this varieties pollinated by male flowers of the C type, its sugar content decreased to 12.6%, and its fruit acid content was the highest **(0.15%). The male flowers of the B type shared the astringent taste almost** twice than that of the A type (0.33% and 0.17%).
3. The increase of fruit weight influenced by fruit set management treatment (to reduce some of fruits in each bunch) is caused by: the competition among fruits in the bunch become smaller, the assimilate stock proportion for each fruit becomes bigger.
4. The fruit harvest Time Research, producing crops in older fruit age (6 months), increased the flesh weight, fruit sugar but it decreased the acid and tannin. The sugar content of three varieties increased when they were harvested in older age as well as the fruit acid sugar ratio. The fruit acid and fruit tannin content decreased when they were harvested in the older age.
5. The salak Suwaru fruit with selection number of 28 (SSL28) in term of bunch weight (BW), fruit weight (FW) and flesh weight (FFW) variables were more

excellent than other comparison of the cvs. Budeng, Madu and Gading so that it can be proposed as a new local variety.

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