AGRIVITA VOLUME 34 No. 2 *JUNE-2012* *ISSN : 0126-0537*

CHARACTERIZATION OF FRUIT ON SEVERAL SALAK VARIETIES AND THEIR HYBRIDS

Sri Hadiati*) , T. Budiyanti, A. Soemargono, and A. Susiloadi

Indonesian Tropical Fruit Research Institute
Jl. Raya Solok-Aripan km 8, P.O. Box 5, Solok West Sumatra, 27301 Indonesia
*) Corresponding author Phone : +62-755-20137 E-mail :shadiati@yahoo.com

Received: February 12, 2012/ Accepted: June 19, 2012

ABSTRACT

The objective of this study was to characterize salak of local varieties and their hybrids. The fruits characterized were taken from plants that were grown in October 2004. The results revealed that fruits ≥ 61 g were mostly produced by hybrids, in which one of their parents was Mwr or Ph. Fruits with flesh thickness ≥ 0.85 cm were mostly yielded from Sdp, Sdm, and hybrids where one of their parents was Sdp or Mwr. While fruits with edible portion ≥ 65.0% were mostly yielded from Sdp, Gp, and hybrids where their female parents were Mwr, Ph, and Sdp. Fruits with small seeds (≤ 3.0 g) were observed on Gp, whilst those with big seeds (≥ 7.0 g) were on Sdm, Sdm-Sj and Sdp-Sj. Hybrids from the female of Ph and Sdp mostly gave sweet taste (TSS ≥ 20º Brix). Mwr x Sdp crossing produced non-astringent fruits, while Ph x Java (K, M, Mj), Sdp x Sjg and some Sdp x Mwr crossing as well as Mwr produced astringent fruits. The four superior characters, namely fruit ≥ 61 g, flesh thickness ≥ 0.85 cm, edible portion ≥ 65%, and TSS ≥ 20º Brix were found in Mwr-Sp-8, Sdp-Sj-8, and Ph-M-7. Fruits produced by Mwr-Sp-8 were not astringent, while those produced by Sdp-Sj-8 and Ph-M-7 were astringent. These findings suggest that the selection of parent can play an important role in improving the varieties of salak.

Keywords: salak, characterization, variety, hybrid, fruit

INTRODUCTION

Salak (*Salak* in Indonesian language), *Salacca edulis*, is one of the tropical fruit crops native to Indonesia, hence, it is not surprising that this plant has high diversity in genetic resource spreading in most provinces of Indonesia. There are 20 species of Salacca genus found throughout the world and 13 species of them have spread around South East Asia particularly Indonesia (Mogea, 1990). In Indonesia, there are the kinds of salak having commercial value and differences. From Java, for example, *Salacca zalacca* (Gaertner) Voss contains 2-3 seeds, from Bali, *Salacca amboinensis* (Becc) Mogea) contains 1-2 seeds and from Padang Sidempuan, *Salacca sumatrana* (Becc) has red and white flesh.

In general, consumers prefer salak fruit possessing thick flesh, sweet, slightly or not astringent, and long shelf life (Sunaryono, 1988). Varieties having such fully characters are hardly ever found in nature. For examples, Pondoh variety has superiority in sweet and non-astringent flavor, but its flesh is thin. Sidempuan variety produces big fruits, thick flesh, and 3-5 fruits per bunch, but its flesh is somewhat astringent, especially when unripe. Similarly, Bali variety has superiority in thick flesh but slightly astringent. To meet the demanded characters above, generating new varieties through assembling all characters should be attempted. Parents needed should have superior characters as addressed to wide genetic variability, and high heritability. A character with wide genetic variability will provide a high probability in the selection of best character. Characters with high heritability will be inherited easily and the selection can be carried out on early generation (Hadiati *et al.,* 2003 and 2009).

Some previous studies on distribution of varieties, identification of varieties in several production centers, and collection of genetic resources (e.g. Purnomo *et al*., 1996; Suskendriyati *et al*., 2000), and on flowering of Java and Bali salak (Nandariyah *et al*., 2000; Darmadi *et al*., 2002; Kriswiyanti *et al*., 2008) have been conducted. Those studies revealed

Accredited SK No.: 81/DIKTI/Kep/2011

http://dx.doi.org/10.17503/Agrivita-2012-34-2-p187-192

that fruits with thick flesh were found in Bali salak, with sweet taste without astringency in Pondoh salak, with many bunches and thick flesh in Sidempuan salak, and with spineless fruit skin in *Salacca affinis.* Hadiati *et al*. (2008) have crossed between parents of Java, Sidempuan, and Mawar. The generated hybrid plants have so far just evaluated on their growth both at the seedling stage and juvenile stage.

To date, the fruits produced by hybrid plants have not yet been evaluated on the qualitative and quantitative aspects. The objective of this study was to characterize fruits of hybrids and local varieties of salak.

MATERIALS AND METHODS

The study was carried out at the Aripan Experimental Station, Indonesian Tropical Fruit Research Institute on ultisol soil type, 413 m above sea level from 2007 to 2009 (two fruiting seasons). Salak plants used in this study were local varieties, i.e. Mawar (Mwr), Gula Pasir (Gp), Sidempuan Putih (Sdp), Sidempuan Merah (Sdm), and Sanjung (Sjg), and hybrids from crossing between parents of Pondoh (Ph), Sidempuan Putih (Sdp), Sidempuan Merah (Sdm), Mawar (Mwr), Sanjung (Sjg), and Java (K, Mj, M). All these plants were grown from seeds with planting distance of 3 m x 3 m in October 2004.

Characterization was performed on fruits of each plant, covering the weight of fruit and seed, the thickness of flesh, the edible portion, the number of seeds per fruit, Total Soluble Solid (TSS), and the astringent taste. The thickness of flesh was the average of four sides of each fruit. All activities relating to the culture practiced in the field were carried out as optimally as possible. These activities included weeding, fertilizing, defoliating, and pollinating. In addition, trimming the shoots and controlling the pest were conducted as well. Fertilizer applied was NPK (15:15:15) at the dosage rate of 250 g/plant at 4 months intervals. Each grove was kept maximum two followers.

RESULTS AND DISCUSSION

The result of characterization revealed that there was variation in quality of fruits produced by each plant. This variation also took place among individual plants within one cross (Table 1). It might be explained by the fact that salak plant belongs to open-pollinating plant while the plants grown were from seed; hence, plant individuals from the same bunch uncertainly had the similarity in genetic and phenotype range. This suggested that selection in salak plant should be made on individual plant and then the selected candidates were propagated vegetatively.

Based on SNI 01-3167-1992 fruit size was grouped into three classes, i.e. big (≥ 61 g), medium (33–60 g), and small (≤ 32 g). In this study the weight of fruits varied from 21.05 to 92.95 g in which the fruits with big, medium, and small size were15.48, 69.05, and 17.85 %, respectively. The plants producing big size of fruits (≥ 61 g) were as many as 14 plants or only 16.5%. Twelve of these 14 plants were hybrids from crossing where one of the parent plants was mainly Mawar (Mwr) as male parent or Pondoh (Ph) as female parent (Table 1). The biggest size (92.95 g) was produced by Ph-Mwr-4 that was the hybrid plant from crossing between Pondoh female and Mawar male.

In general, the consumers prefer salak fruit with thick flesh. In this study the flesh thickness of fruits yielded from tested plants ranged between 0.47 and 1.20 cm. Only 32 of 85 plants produced fruits with the flesh thickness of ≥ 0.85 cm, which were mostly produced by Sidempuan (Sdp, Sdm) and hybrids where one of their parents was Sdp or Mwr (Table 2). The thickest fruit flesh was 1.20 cm observed on Mwr-Sdp-8. In contrast, hybrids with the female parent Pondoh variety largely produced fruits with the flesh thickness of < 0.85 cm. Purnomo *et al*., (1994a) pointed out that the thickness of flesh was positively associated with activity of Rubisco enzyme within leaves. This enzyme had direct and strong effect on the flesh thickness. The activity of Rubisco enzyme on hybrids from Pondoh x Bali, their reciprocal, and Pondoh x Pondoh was less than that on hybrids from Bali x Bali. This indicated that the use of Pondoh either for male or female parent in crossing will generate hybrids that produce fruits with thin flesh. Hence, this result has confirmed the result obtained from the current study.

Table 1. Fruit characters of salak plants observed

Plant	Fruit weight (g)	Flesh thickness (cm)	Edible fruit (%)	Seed weight (g)	TSS (ºBrix)	Seeds number/ fruit	Flavor*
Mwr-1	43.54	0.86	69.04	5.22	19.37	2-3	-
Mwr-2	41.03	0.55	63.37	3.82	16.50	2	-
Mwr-3	47.70	0.98	69.71	3.52	17.48	2-3	-
Mwr-4	42.32	0.66	66.49	4.98	20.25	2-3	-
Mwr-5	38.55	0.54	70.19	4.29	20.55	3	-
Mwr-6	24.74	0.64	62.45	3.93	18.05	1-2	-
Mwr-7	24.00	0.51	54.04	5.57	18.50	1	-
Mwr-Sdp-1	31.56	0.61	52.44	6.17	19.95	1-2	-
Mwr-Sdp-2	31.54	0.60	62.59	3.75	19.75	2	-
Mwr-Sdp-3	38.97	0.88	65.02	3.88	15.00	2	-
Mwr-Sdp-4	24.95	0.67	53.47	4.55	18.75	1-2	-
Mwr-Sdp-5	48.42	0.79	66.85	5.40	19.80	1-2	-
Mwr-Sdp-6	35.06	0.81	67.11	3.85	19.25	2	-
Mwr-Sdp-7	27.23	0.52	62.61	3.82	19.00	1-3	-
Mwr-Sdp-8	62.00	1.20	66.78	5.41	20.00	1-3	-
Mwr-Sdp-9	42.24	0.78	72.38	4.00	18.36	2-3	-
Mwr-Sdp-10	45.30	1.00	74.19	3.56	16.50	2	-
Ph-K-1	47.41	0.73	70.45	4.59	20.00	3	+
Ph-K-2	52.91	0.81	70.29	4.07	17.00	2-3	+
Ph-K-3	48.00	0.83	70.40	3.75	20.60	2-3	+
Ph-K-4	38.61	0.75	63.79	4.18	19.85	2	+
Ph-K-5	34.36	0.73	67.17	3.19	21.70	2-3	+
Ph-K-6	33.82	0.83	66.20	4.93	20.75	1-2	+
Ph-K-7	50.72	0.81	74.49	4.75	19.75	3	+
Ph-K-8	40.75	0.69	65.35	5.58	18.88	1-3	+
Ph-K-9	51.70	0.75	66.83	4.40	18.25	3	+
Ph-M-1	61.39	0.70	72.29	5.32	20.43	3	+
Ph-M-2	62.85	0.85	67.62	4.65	21.63	3	+
Ph-M-3	30.77	0.47	63.96	4.33	23.00	2-3	+
Ph-M-4	52.31	0.79	65.59	4.82	20.83	1-3	+
Ph-M-5	56.81	0.78	71.13	4.50	18.80	3	+
Ph-M-6	52.80	0.78	62.03	4.98	20.03	3	+
Ph-M-7	75.24	0.96	67.32	5.89	22.10	1-3	+
Ph-M-8	48.69	0.74	70.65	4.39	19.25	3	+
Ph-M-9	57.22	0.91	76.51	3.77	20.38	3	+
Ph-Mj-1	33.00	0.70	63.88	3.73	19.75	2-3	+
Ph-Mj-2	52.83	0.86	65.51	4.06	16.00	2-3	+
Ph-Mj-3	56.84	1.07	66.57	4.77	17.96	2-3	+
Ph-Mj-4	50.24	0.78	71.89	4.34	19.25	2-3	+
Ph-Mj-5	45.35	0.69	71.03	6.31	22.65	2-3	+
Ph-Mwr-1	40.48	0.69	71.96	3.65	19.15	3	+
Ph-Mwr-2	60.07	0.86	67.35	5.90	1800	2-3	+
Ph-Mwr-3	65.40	0.98	63.67	6.43	18.90	1-3	+
Ph-Mwr-4	92.95	0.79	72.05	5.45	17.00	2-3	+
Ph-Mwr-5	78.50	1.01	63.52	6.96	19.75	1-3	+

Plant	Fruit weight (g)	Flesh thickness (cm)	Edible fruit (%)	Seed weight (g)	TSS (ºBrix)	Seeds number/ fruit	Flavor*
Ph-Mwr-6	39.50	0.54	64.71	4.93	19.50	3	+
Gp-1	25.41	0.83	71.78	2.92	15.67	1-2	-
Gp-2	29.18	0.70	51.34	5.23	18.00	1	-
Gp-3	24.27	0.79	75.61	2.71	17.00	1-2	-
Gp-4	35.60	0.61	58.43	3.92	20.00	2	-
Gp-5	41.56	0.91	72.50	2.75	18.75	1-2	-
Gp-6	27.85	0.56	61.83	4.29	18.00	1-2	-
Gp-7	30.77	1.00	59.34	3.13	19.33	1-2	-
Gp-8	21.05	0.63	57.62	4.07	18.50	1	-
Gp-9	24.95	0.81	65.89	3.41	17.75	1	-
Gp-10	32.65	1.15	69.86	4.01	17.75	1	-
Sdm-1	57.48	1.00	63.34	7.25	22.13	1-2	+
Sdm-2	42.49	1.05	54.37	5.59	20.83	1-2	+
Sdp-1	50.57	1.04	73.60	5.31	18.45	2-3	+
Sdp-2	74.11	1.04	67.06	5.84	20.35	2-3	+
Sdp-3	30.41	0.94	51.69	6.23	17.50	1-2	+
Sjg-1	34.35	0.71	49.02	3.94	19.75	3	+
Sjg-2	73.59	0.71	70.35	5.19	21.13	3	+
Sjg-3	48.43	0.71	76.38	4.43	22.30	3	+
Sdm-Sjg-1	46.23	0.75	65.24	5.44	18.86	1-2	+
Sdm-Sjg-2	53.99	0.73	58.96	7.21	21.70	1-2	+
Sdm-Sjg-3	46.36	1.04	68.72	3.37	14.75	2-3	+
Sdm-Sjg-4	57.32	0.60	64.65	4.14	20.17	2	+
Sdm-Sjg-5	43.39	0.93	70.13	7.04	19.25	1-2	-
Sdm-Sjg-6	62.20	0.91	66.32	5.70	20.25	1-2	-
Sdm-Sjg-7	51.20	0.78	56.35	6.89	21.50	2	+
Sdm-Sjg-8	55.29	0.59	66.97	8.25	20.50	2	+
Sdp-Mwr-1	88.86	1.16	71.96	6.54	19.20	2-3	+
Sdp-Mwr-2	72.36	0.88	69.61	5.32	17.40	2-3	-
Sdp-Mwr-3	42.81	0.63	67.69	5.33	20.80	2-3	+
Sdp-Mwr-4	63.47	0.66	67.21	5.57	17.00	2-3	+
Sdp-Sjg-1	47.15	0.78	65.28	3.76	19.65	3	+
Sdp-Sjg-2	48.87	0.94	64.46	3.88	20.67	2-3	+
Sdp-Sjg-3	56.68	0.87	65.84	7.23	20.00	2-3	+
Sdp-Sjg-4	54.58	0.94	65.81	7.06	20.00	1-2	+
Sdp-Sjg-5	37.88	0.62	58.58	4.99	20.25	3	+
Sdp-Sjg-6	56.50	1.00	69.29	6.82	21.59	2-3	+
Sdp-Sjg-7	43.19	0.91	67.42	8.60	16.90	1-2	+
Sdp-Sjg-8	62.39	1.00	75.28	4.48	20.40	2-3	+
Sdp-Sjg-9	50.59	0.80	64.72	6.50	21.07	1-2	+

Remarks: * (-) = non-astringent; (+) = astringent; TSS = Total Soluble Solid

Edible portion of fruit is also a character desired by the consumers. In the current study the edible portion of fruits varied from 49.02 to 76.51%. The portion of edible fruits in Ph-M-9 and in Sjg-3 was 76.51% and 76.38%, respectively, being the highest among the portions of edible fruits of all salak plants observed. The edible portion of fruit in the two plants was even higher than that in the superior varieties of salak plant such as Pondoh Super (59.06%), Gula Pasir (73.38%), and Swaru (73.23%) (Nandariyah *et al*., 2000; Purnomo *et al*., 1994b; Kusumo *et al*.,

1995). From Table 2 it appears that there were 56 salak plants having the portion of edible fruit as much as ≥ 65%. Most of them (76.8%) were hybrids that their female parents were from Mawar, Pondoh, and Sidempuan.

Seed size is also a character influencing the consumers' demand. The consumers usually prefer salaks containing small or unfilled seeds due to the bigger portion of edible fruits. Salak plants observed had seed weight ranging from 2.71 to 8.60 g. Small seeds (≤ 3.00 g) were recorded on Gp while the big ones (≥ 7.00 g) were mostly on Sdm, Sdm-Sjg and Sdp-Sjg.

The value of TSS of all fruits observed varied from 14.75º Brix on Sdm-Sjg-3 to 23.00º Brix on Ph-M-3. From the overall salak plants observed, 38.09% of them which were mostly hybrids from crosses using Pondoh and Sidempuan as female parent had TSS ≥ 20.00º Brix (Table 2). Hence, the fruits produced by these hybrid plants were sweeter than those produced by Pondoh Super (18.68º Brix), Gula Pasir (18.07º Brix), and Madu (17.00-19.00º Brix). Purnomo *et al*., (1994b) revealed that Pondoh Hitam was the best common combiner parent for sweet flavor. Parent plants that perform the good common combining ability become heterosis phenomenon in a crossing, generating better performance on the first hybrid (F_1) than that on their parents (Borojevic, 1990).

Astringency is a character not preferred by the consumers. This character is so common in salaks, that it becomes one of the constraints in expanding this commodity in the international market. In this current study, it was revealed that non-astringent fruits were produced by Gula Pasir, Pondoh, Mawar and hybrids from Mwr x Sdp even at the unripe stage. Conversely, astringent fruits were produced by hybrids of Ph-K, Ph-M, Ph-Mj, some Ph-Mwr, Sdm-Sjg, Sdp, Sdm, and Sjg. Apparently, although Pondoh is not astringent at all even at unripe stage if it as female parent was crossed with Java (K, M, Mj) and Mawar as male parents, the hybrids generated would produce astringent fruits. Java varieties (K, M, Mj) that have astringent character are more dominant than Pondoh; as a result, their hybrids produced fruits with astringent flavor. Similarly, when Sidempuan (Sdm, Sdp) as female parent were crossed with Sanjung (Sjg) as male parent, their hybrids produced astringent fruits. Fruits of Sidempuan and Sanjung are usually somewhat astringent particularly at the unripe stage, while fruits of Sdp x Mwr are astringent and not astringent in part.

From the two tables above, it can be seen that the fruits that completely had those four superior characters in terms of fruit weight ≥61 g, flesh thickness ≥ 0.85 cm, edible fruit ≥ 65%, and TSS ≥ 20º Brix were produced by Mwr-Sdp-8 and Sdp-Sjg-8, Ph-M-7 hybrid plants. Moreover, fruits produced by Mwr-Sdp-8 were not astringent and those by Sdp-Sjg-8 and Ph-M-7 were astringent. These hybrids should be proposed to be superior varieties and grown in large scale in suitable areas.

Table 2. Salak plants having superior characters

No.	Character	Salak plant*
1	Fruit weight (≥ 61 g)	**Mwr-Sdp-8;** Ph-M-1; Ph-M-2; **Ph-M-7**; Ph-Mwr-3; Ph-Mwr-4; Ph-Mwr-5, Sdm-Sjg-6; Sdp-2; Sdp-Mwr-1; Sdp-Mwr-2; Sdp-Mwr-4; **Sdp-Sjg-8;** Sjg-2
2.	Flesh thickness (≥ 0.85 cm)	Ph-M-2; **Ph-M-7**; Ph-M-9; Ph-Mj-2; Ph-Mj-3; Ph-Mwr-2; Ph-Mwr-3; Ph-Mwr-5; Mwr-1; Mwr-3; Mwr-Sdp-3; **Mwr-Sdp-8;** Mwr-Sdp-10; Sdp-Mwr-1; Sdp-Mwr-2; Sdp-Sjg-2; Sdp-Sjg-3; Sdp-Sjg-4; Sdp-Sjg-6; Sdp-Sjg-7; **Sdp-Sjg-8**; Sdp-1; Sdp-2; Sdp-3; Sdm-Sjg-3; Sdm-Sjg-5; Sdm-Sjg-6; Sdm-1; Sdm-2; Gp-5; Gp-7; Gp-10
3	Edible fruit portion ≥ 65%	Mwr-3; Mwr-Sdp-3; Mwr-Sdp-6; **Mwr-Sdp-8;** Mwr-Sdp-9; Mwr-Sdp-10; Ph-K-6; PH-K-2; **Ph-M-7**; Ph-M-9; Ph-Mj-3; Ph-Mj-2; Ph-Mwr-1; Ph-Mwr-3; Ph-Mwr-4; Gp-3; Gp-4; Gp-10; Gp-9; Gp-1; Sdm-Sjg-3; Sdm-Sjg-6; Sdp-1; Sdp-2; Sdp-Mwr-2; Sdp-Sjg-7; **Sdp-Sjg-8;** Sdp-Sjg-9
4	TSS ≥ 20°Brix	Mwr-4; Mwr-5; **Mwr-Sdp-8;** Ph-K-5; Ph-K-6; Ph-K-3; Ph-K-1; Ph-M-1; Ph-M-2; Ph-M-6; **Ph-M-7**; Ph-M-9; Ph-M-3; Ph-M-4; Ph-Mj-5; Gp-4; Sdm-1; Sdm-2; Sdm-Sjg-6; Sdm-Sjg-4; Sdm-Sjg-7; Sdm-Sjg-8; Sdm-Sjg-2; Sdp-2; Sdp-Mwr-3; Sdp-Sjg-2; Sdp-Sjg-3; Sdp-Sjg-4; Sdp-Sjg-5; Sdp-Sjg-6; **Sdp-Sjg-8**; Sdp-Sjg-9; Sjg-2; Sjg-3

Remarks: *Bold letters indicate that the plant possesses the four-superior characters

CONCLUSIONS

There was variation in fruit characteristics among individual plants despite in one cross. The fruits that completely had those four superior characters in terms of fruit weight ≥61 g, flesh thickness ≥ 0.85 cm, edible fruit ≥ 65%, and TSS ≥ 20º Brix were produced by Mwr-Sdp-8, Sdp-Sjg-8 and Ph-M-7 hybrid plants.

ACKNOWLEDGMENTS

Appreciation is extended to Mr. Anang Wahyudi for crossing assistance. This work was funded in part by the Indonesian DIPA budget of fiscal year 2009.

REFERENCES

Borojevic, S. 1990. Principles and Methods of Plant Breeding. Development in Crop Science. 17. Elsevier. Amsterdam. pp.368.

Darmadi, A.G.K., A. Hartana and J.P. Mogea. 2002. Pembungaan salak Bali. Hayati. 9(2): 59-61.

Hadiati, S., Murdaningsih H.K., A. Baihaki and N. Rostini. 2003. Parameter genetik karakter komponen buah pada beberapa aksesi nenas. ZURIAT. 14(2): 53 – 58.

Hadiati S., A. Susiloadi, dan T. Budiyanti. 2008. Hasil persilangan dan pertumbuhan beberapa genotipa salak. Buletin Plasma Nutfah. 14(1): 26-32.

Hadiati S., A. Susiloadi, dan T. Budiyanti. 2009. Seleksi genotipa salak manis berdasarkan aktivitas tanin pada fase bibit. Agrivita. 31(1): 19 – 24.

Kriswiyanti, E., I. K. Muksin, L. Watiniasih and M. Suartini. 2008. Pola reproduksi pada salak Bali (*Salacca zalacca* Var. Amboinensis (Becc.) Mogea. J.Biologi. XI(2): 78-82.

Kusumo, S., F.A. Bahar, S. Sulihanti, Y. Krisnawati, Suhardjo and T. Sudaryono. 1995. Teknologi Produksi Salak. Puslitbang Hortikultura. Jakarta. pp.65.

Mogea, J. 1990. The Salak Palm Species in Indonesia. Voice of Nature. 85: 42 & 62.

Nandariyah, E. Purwanto, Sukaya and S. Kurniadi. 2000. Pengaruh tetua jantan dalam persilangan terhadap produksi dan kandungan kimiawi buah salak Pondoh Super. Zuriat. 11(1): 33 – 38.

Purnomo, S., A. Baihaki, R. Setiamihardja, and A.H. Permadi. 1994a. Study on the relationship of several enzyme activities in leaves by determination of quality selection criteria on salacca fruit. J. Crop. Sci. 3: 321 – 387.

Purnomo, S., A. Baihaki, R. Setiamihardja and A.H. Permadi.. 1994b. Relationship between several enzyme activities with fruit characters and their inheritance pattern in a diallel cross of Bali and Pondoh salacca. J. Crop. Sci. 4: 556–583.

Purnomo, S., A. Suryadi, Suhardjo, dan S. Hasni. 1996. Pemilihan induk superior di pusat-pusat Salak Jawa Timur. Proseding Seminar Hasil Penelitian dan Pengkajian Komoditas Unggulan, Malang, tanggal 12-13 Desember 1996.p: 243-273.

Sunaryono, H. 1988. Perkembangan Salak. Ilmu Produksi Tanaman Buah-buahan. Sinar Baru, Bandung. p: 151 – 159.

Susiloadi, A., S. Hadiati and T. Budiyanti. 2008. Keragaan pertumbuhan beberapa aksesi salak di Kabupaten Kampar. J. Agritek. 16 (5): 943-948.

Suskendriyati,H., A. Wijayati, N. Hidayah, dan D. Cahyuningdari. 2000. Studi Morfologi dan Hubungan Kekerabatan Varietas Salak Pondoh (*Salacca zalacca* (Gaert.) Voss.) di Dataran Tinggi Sleman. Biodiversitas. 1(2): 59 – 64.