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Variation in Fruit Characters between Normal- and Shrivelled-seed Lychee Varieties[1]

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Abstract Variation of fruit characters within and among trees were studied in two shrivelled-seed varieties of "Sah Keng" and "Kang Wei" and the most widely cultivated normal-seed variety "Hak Ip". Analysis of variance showed that the variation among trees contributed more to the total variability than that within tree. Analysis also indicated that the variation among locations was much greater than that of within and among trees, in "Hak Ip" variety.

In general, fruit length, fruit diameter, fruit weight, shell weight, and aril weight were not significantly different within tree. The protuberance of the shell, aril color, percentage of shrivelled seeds and ratio of aril weighs in fruit were not significantly different both within and among trees in most locations. The variation of soluble solids, flavor and seed size were different depending on the varieties and locations.

The shrivelled seed of "Sah Keng", "Kang Wei" and "Hak Ip" were 36%, 26%, and 0%, respectively. Eating quality of shrivelled-seed fruits were superior to normal-seed fruits in smaller seed size and higher aril ratio. The fruit diameter, fruit Weight, and shell weight were highly correlated to seed size in two shrivelled-seed varieties, but not in normal-seed variety. The fruit size and fruit weight of normal-seed variety were larger and heavier than shrivelled-seed fruit, however, the soluble solids was not significantly different.

The lychee (*Litchi chinensis*, Sonn.) is a subtropical evergreen tree and believed to be indigenous to Southern China where it has been cultivated for thousands of years. The cultivation now is extended to India, South Africa, Australia, Hawaii and Florida of USA [2,13]. Due to variation and mutation of seedlings and buds, there are many varieties of lychee in Southern China [1,2,13]. Groff (1921) listed 49 varieties of lychee from the province of Kwangtung [1]. Huang (1966) described 18 important varieties in Kwangtung and Kwangsi. He also listed the fruit characters of 14 varieties in Taiwan

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where the lychee has been cultivated for about 200 years [2].

The variation of fruits within tree is mainly affected by environmental factors. Generally the fruits harvested from sun-exposed outer zone of canopy were better than from shaded inner parts in fruit quality and characters. Hwang (1966) resported that the fruits harvested from the top and south of the tree were better than from the inside in fruit weight, fruit color and aril weight in "Hak Ip" variety of lychee [2]. Jackson *et al* (1971) emphasize that the storage quality was also different within tree in apple, and suggested picking and storing fruits from the exposed and shaded parts separately. Significant difference in fruit quality and mineral composition in fruits were also reported in citrus such as Valencia orange [6,10], grapefruit [11], Matou Wentan [8] and grape [12]. Sampling technique was also developed to minimize the errors caused by different positions within tree [10].

Shrivelled seeds (or small seeds, chicken tongue seeds) are the seeds that fail to develop fully. It is one of the most preferable fruit characters of lychee [1,2]. The percentage of shrivelled seeds changed depending on the varieties, locations, trees, management ands year [2]. The "Groff" variety could reach 90% of shrivelled seeds in Hawaii [13]. "Yu Her Pao", "No Mai Tze" and "Kwai Mi" were reported with higher percentage of shrivelled seeds and excellent fruit quality in Taiwan [2]. Due to poor pollination, the yield of these varieties were lower and unstable as compare with "Hak Ip". Accordingly only limited amount of shrivelled-seed varieties were planted for commercial purpose. As to "Hak Ip" variety, though fair in quality and rarely with shrivelled seeds, it is prominent for its high and stable yield performance. In recent years, two newly found varieties named as "Sah Keng" and "Kang Wei" separately, which might also introduced from Southern China, appear promising for their high yielding and high percentage of shrivelled seeds [3]. Few reports were made on these two varieties, however. The purpose of this study were to 1) understand the extent of variation of fruit characters within tree and among trees and minimize the sampling errors of further studies, 2) compare the fruit characters between normal-seed variety "Hak Ip" and shrivelled-seed varieties "Sah Keng" and "Kang Wei", 3) compare the fruit characters between normal-seed fruits and shrivelled-seed fruits within shrivelled-seed varieties, 4) understand the relationship between seed size and other fruit characters and the possibility of predicting the shrivelled seeds by fruit characters.

MATERIALS AND METHODS

Two shrivelled-seed varieties "Sah Keng" and "Kang Wei" were harvested separately from Chuchi and Wufeng where they were found. The "Hak Ip" variety from the same orchard was also harvested to compare the fruit characters between varieties. Since "Hak Ip" is the most popular and prominent variety in Taiwan. The fruit from other two locations were harvested to understand the variation of fruit characters among locations. The varieties, locations and date of harvest were listed as follows :

Varieties	Locations	Date of harvest
Sah Keng	Chuchi, Chiayi	June 15, 1982
Kang Wei	Wufeng, Taichung	July 4, 1982*
Hak Ip	Chuchi, Chiayi	June 15, 1982
Hak Ip	Wufeng, Taichung	June 27, 1982
Hak Ip	Minhsiung, Chiayi	June 21, 1982
Hak Ip	Nantou, Nantou	June 30, 1982

*"Sah Keng" and "Hak Ip" almost matured at the same time, "Kang Wei" matured about one week later than "Hak Ip".

Five trees about ten-years old were selected randomly in each location. The crown of each tree was devided into six sections according to directions and positions on the tree, that is, east west, north, south, top and inner part. The fruits of 4 directions (east, west, south and north) were harvested from outer portions of canopy (in 0.5 meter from surface of canopy toward inside).

The following fruit characters were measured : length of fruit (FL), diameter of fruit (FD), weight of fruit (FW), shell color of fruit (FC), protuberances on the shell (FS), weight of shell (SW), Soluble solids (SS), flavor (FLV), length of seed (SL), diameter of seed (SD), percentage of shrivelled seed (RA) and ratio of aril weight in whole fruit (A/W). The shell color was rated from 1-10, the fruit full of red color was rated as 10 while that of light green was rated as 1. The protuberances on the shell was scored from 1-5. More smooth shell and with no apparent protuberance was rated higher, while prominent protuberances was rated lower. The color of aril was rated from 1-5. More transparent aril was scored higher, pale white was lower. The flavor of fruit was also scored from 1-5, more delicious and sweeter fruit was higher, off-flavor and acid fruit was rated as 1.

The data of fruit characters from each location was analyzed. After homogeneity test of variance, the "Hak Ip" variety from four locations were subjected to combined analysis. The variation within tree, among trees and among locations and the correlation coefficients between fruit characters were also computed.

RESULTS

The Variation of Fruit Characters within and among Trees

The variation of fruit characters within and among trees were presented in Table 1. In general most fruit characters were not significantly different within tree, while the

differences among trees were significant. The fruit length, fruit diameter, fruit weight, shell weight and aril weight showed this trend. The protuberances on the shell, aril color, percentage of shrivelled seeds and ratio of aril weight in fruit were not significantly different both within and among trees in most locations. Only "Hak Ip" variety from Minhsiung showed significant difference among trees on percentage of shrivelled seeds. Apparently genetic difference existed among trees in this orchard. The soluble solids and flavor were significantly different within and among trees in "Hak Ip" from Chuchi and in "Kang Wei" variety, while the difference were not significant in other locations. The soluble solids content of fruits harvested from outside of canopy were higher than from inside (Table 2). The variation of fruit diameter was irregular and different from that of soluble solids content.

Table 1. Test of significance of fruit characters within and among trees in three lychee varieties.

Varieties[1] & Locations	Source of Variation	df	Fruit Characters[2,3]													
			FL	FD	FW	FC	FS	SW	AW	AC	SS	FLV	SL	SD	RA	A/W
SK CC	Within Tree	5	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	Among Trees	4	**	**	**	ns	ns	**	**	ns	ns	ns	*	*	ns	ns
KW WF	Within Tree	5	ns	ns	ns	ns	ns	ns	ns	ns	*	*	ns	ns	ns	ns
	Among Trees	4	**	ns	ns	ns	*	ns	ns	ns	**	**	ns	*	ns	ns
HI CC	Within Tree	5	ns	*	ns	**	ns	ns	ns	ns	**	*	ns	ns	ns	ns
	Among Trees	4	**	**	**	**	ns	**	ns	ns	*	*	**	ns	ns	ns
HI WF	Within Tree	5	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	Among Trees	4	**	**	**	ns	ns	**	**	ns	ns	ns	ns	ns	ns	*
HI HH	Within Tree	5	ns	ns	*	ns	ns	ns	**	ns	ns	ns	ns	ns	ns	ns
	Among Trees	4	*	**	**	*	ns	**	**	**	nn	ns	**	**	**	ns
HI NT	Within Tree	5	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	Among Trees	4	**	*	**	**	**	**	**	**	ns	ns	ns	ns	ns	ns
HI Combined	Within Tree	5	ns	ns	ns	**	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
	Among Trees	4	**	**	**	*	ns	**	**	ns	ns	ns	ns	ns	**	ns
	Among Locations	3	**	**	**	**	**	**	**	**	**	**	**	**	**	**

1. Varieties : SK=Sah Keng, KW=Kang Wei, HI=Hak Ip.
   Locations : CC=Chuchi, WF=Wufeng, MH=Minhsiung, NT=Nantou.
2. Description of fruit characters : see materials and methods.
3. ns : not significant, * : significant at 0.05 level, ** : significant at 0.01 level.

Table 2. The variation of soulble solids and fruit diameter of fruits from different positions on the trees in three lychee varieties.

Varieties & Locations	Hak Ip (Chuchi)	Hak Ip (Wufeng)	Sah Keng (Chuchi)	KangWei (Wufeng)
Soluble Solids				
East	17.1 ab	18.0	16.4	18.6 a
West	16.3 b	18.2	15.8	17.7 bc
South	16.5 b	17.5	16.0	18.0 abc
North	17.2 ab	18.3	16.4	17.7 bc
Top	17.9 a	17.8	15.9	18.4 ab
Inside	16.5 b	17.6 (ns)	15.9 (ns)	17.6 c
Fruit Diameter				
East	3.34 ab	3.40	3.44	3.33
West	3.37 a	3.41	3.41	3.34
South	3.34 ab	3.45	3.35	3.35
North	3.25 abc	3.40	3.34	3.33
Top	3.23 bc	3.43	3.20	3.36
Inside	3.20 c	3.43 (ns)	3.28 (ns)	3.42 (ns)

* Mean within column followed by the same letter are not significantly different at 5% level.

Estimates of variance components indicated that variation among trees contributed more to the total variability than within tree. In combined analysis of four location of "Hak Ip" showed variation among locations was much higher than among trees and within tree. The fruits from Wufeng gave the highest value on all fruit characters in four locations (Table 3).

Table 3. The variation of fruit characters of "Hak Ip" lychee at four locations.

Locations	Fruit Length	Fruit Diameter	Fruit Weight	Shell Weight	Aril Weight	Soluble Solids	Seed Length	Ratio of Aril in Whole Fruit
Wufeng	3.46 a	3.42 a	22.7 a	3.5 ab	16.7 a	17.9 a	1.97 b	0.73 a
Nantou	3.37 b	3.32 b	20.8 b	3.6 a	14.5 b	17.4 b	2.03 ab	0.69 b
Chuchi	3.41 ab	3.29 b	19.9 c	3.4 bc	13.9 bc	16.9 c	2.04 a	0.69 b
Minhsiung	3.38 b	3.20 c	19.2 c	3.2 c	13.5 c	17.0 c	1.90 c	0.70 b

* Mean within column followed by the same letter are not significantly different at 5% level.

Comparison between Normal-seed Variety "Hak Ip" and Shrivelled seed Varieties "Sah Keng" and "Kang Wei".

Comparison between "Sah Keng" and "Hak Ip" varieties were shown in Table 4. With the exception of fruit color and aril weight, other characters were significantly

different between varieties. The percentage of shrivelled seeds of "Sah Keng" reached 36% in comparison to 0% of "Hak Ip". The "Sak Keng" variety was also superior on fruit size, fruit weight, and aril weight. The protuberances on the shell of "Sah "Keng" was more prominent than that of "Hap Ip", while the aril color was not so transparent as the 'Hak Ip'. The ratio of aril weight is not significantly different between these two varieties. Though the soluble solids and flavor of "Sah Keng" was lower than the "Hak Ip", however it was not detected easily by tasting. The mean of seed size of Sah Keng was smaller than that of Hak Ip.

The fruit size, fruit weight and aril weight of "Kang Wei" were smaller than "Hak Ip" variety (Table 4). The shrivelled seeds of "Kang Wei" was 26%, higher than "Hak Ip". The rank of protuberances on shell of fruit was significantly different between varieties, however it could not be distinguished on the basis of fruit appearance. The soluble solids content, flavor and aril weight ratio were not significantly different between "Kang Wei" and "Hak Ip" varieties.

Table 4. Comparison of fruit characters between normal-seed variety "Hak Ip" and shrivelled-seed varieties "Kang Wei" and "Sah Keng" in lychee.

Varieties	Fruit Characters*												
	FL	FD	FW	FS	SW	AW	AC	SS	FLV	SL	SD	A/W	RA
Sah Keng	3.60	3.36	21.2	3.5	4.2	14.9	3.7	16.1	3.4	1.6	1.1	0.70	36
Hap Ip	3.41	3.29	19.9	3.9	3.4	13.9	4.1	16.9	3.6	2.0	1.3	0.69	0
LSD 5%	0.05	0.06	1.0	0.11	0.15	0.8	0.1	0.4	0.12	0.1	0.1	0.01	8
1%	0.07	0.08	1.3	0.15	0.20	1.0	0.1	0.5	0.16	0.1	0.1	0.01	11
Karg Wei	3.25	3.36	21.3	4.5	3.6	15.9	4.1	18.0	4.2	1.7	1.1	0.75	26
Hak Ip	3.46	3.42	22.7	4.4	3.5	16.7	4.4	17.9	4.3	2.0	1.3	0.74	0
LSD 5%	0.05	0.04	0.7	0.07	0.16	0.5	0.1	0.3	0.11	0.1	0.1	0.01	6
1%	0.06	0.05	0.9	0.09	0.21	0.7	0.1	0.4	0.15	0.1	0.1	0.01	8

*Description of fruit characters : see materials and methods.

Comparison between Normal-seed and Shrivelled-seed Fruits within Shrivelled-seed Varieties "Sah Keng" and "Kang Wei"

After fruit characters were measured, the data of shrivelled seed varieties were devided into two sets according to the seed size. The seed length and diameter above 1.5 and 1.0cm were assigned as normal seed, the seed length and diameter smaller than 1.5 and 1.0cm were shrivelled seeds. The fruit characters between normal- and shrivelled-seed fruits wers compared and the correlation coefficients were estimated in two varieties separately. The results were shown in Table 5 and Table 6. The fruit length, fruit diameters, fruit weight and shell weight of shrivelled-seed fruits were smaller than normal-seed fruits in both varieties. The ratio of aril weight in shrivelled-seed fruit was higher than normal-seed fruit. Evidently, it was affected by seed size. The soluble solids and flavor were not significantly different between shrivelled- and normal-seed fruits. Both shrivelled seed varieties showed the same results in comparing the fruit characters between normal- and shrivelled-seed fruits.

Table 5. Comparison of fruit characters between fruit with normal and shrivelled seed within variety in lychee.

Variety	Seed Size	Fruit Characters*							
		FL	FD	FW	SW	AW	SS	FLV	A/W
Sah Keng	Normal	3.67	3.46	22.8	4.5	15.4	16.1	3.5	0.63
	Shrivelled	3.50	3.17	18.2	3.6	13.6	15.7	3.3	0.73
	LSD 5%	0.12	0.12	1.0	0.1	1.2	0.5	0.3	0.03
	1%	0.21	0.20	1.7	0.2	1.9	0.8	0.4	0.05
Kang Wei	Normal	3.23	3.41	22.1	3.7	16.2	18.0	4.2	0.73
	Shrivelled	3.21	3.23	19.7	3.3	15.7	18.1	4.2	0.80
	LSD 5%	0.02	0.07	1.3	0.3	0.8	0.2	0.1	0.02
	1%	0.04	0.11	2.2	0.5	1.4	0.3	0.2	0.03

*Description of fruit charactrse : see materials and methods.

Since seed size was composed of seed length and seed diameter, these two characters were used in calculating the correlation coefficients with other fruit characters. The seed length and seed diameter were positively correlated with fruit diameter, fruit weight and shell weight in both shrivelled seed varieties. The correlation between seed size and aril weight, soluble solids content and flavor were not significant (Table 6). The ratio of aril weight in fruit was negatively correlated with seed size. The correlation coefficients between seed size and other fruit characters were low or nonsignificant in normal-seed variety "Hak Ip".

Table 6. The correlation coefficients between seed size and fruit characters in three lychee varieties.

Fruit Characters	Sah Keng	Variety	Kang Wei	Variety	Hak Ip	Variety
	Seed Length	Seed Diameter	Seed Length	Seed Diameter	Seed Length	Seed Diameter
Fruit Length	0.42 ns	0.47 ns	0.46 ns	0.43 ns	0.18 ns	0.05 ns
Fruit Diameter	0.68 *	0.70 *	0.90 **	0.94 **	0.16 ns	0.23 *
Fruit Weight	0.77 **	0.79 **	0.87 **	0.85 **	0.17 ns	0.27 **
Shell Weight	0.73 *	0.77 **	0.83 **	0.82 **	0.12 ns	0.11 ns
Aril Weight	0.52 ns	0.53 ns	0.44 ns	0.42 ns	0.02 ns	0.13 ns
Soluble Solids	0.40 ns	0.47 ns	0.10 ns	0.04 ns	− 0.04 ns	0.19 *
Flavor Score	0.60 ns	0.59 ns	0.15 ns	0.13 ns	− 0.23 *	0.06 ns
Ratio of Aril Wt. in Fruit	− 0.89 **	− 0.92 **	− 0.96 **	− 0.96 **	− 0.36 **	− 0.28 **

ns : not significant.
* : significant at 5% level.
** : significant at 1% level.

DLSCUSSION

The variation within tree was not so large as among trees in most fruit characters. Estimates of variance components indicated that variation among trees contributed more to the total variability than within tree. Because of larger variability among trees, sampling more trees and less samples within a tree will gain an estimate of desired accuracy. The soluble solids contents is postulated as the synonym of quality in lychee. Higher value of soluble solids was obtained when the fruits harvested from outer portion of canopy where most of lychee fruits were produced. Avoiding to pick the fruits from inner parts will reduce the errors of sampling. Li *et al* studied the variation of fruits in Matou Wentan and tankan also found that the variance components among trees and among orchards were larger than within tree [7,8]. The variance component within tree were not over 10% of total variability in all fruit characters measured in Matou Wentan [8]. Through the calculation of variance components within tree and among tree, the repeatability of Matou wentan and tankan were estimated. It provides some genetic information of fruit characters when the heritability could not be obtained [7,8]. Since there was no report on the genetic behaviors of fruit characters of lychee, study of repeatability based on variance components within and among trees would be valuable.

The variation within tree could be classified into two group : First, the soluble solids content and fruit color changed with the different positions on the tree. The fruits from outer portion of canopy tend to have a higher value than that from inside. Secondly, the fruit size, fruit weight, aril weight and seed size were less affected by different positions. This result was different from Huang's reports. Huang found that the fruits from south direction were larger and heavier in size and weight than those from the other directions, but the soluble solids from south and top were lower than those from inside [2]. The sampling method may explain the different results. In this experiment, the fruits of four directions (east, west, south and north) were harvested from outer postion of canopy, but not from inner parts. Oranges from southern top canopy sectors also tend to have higher concentration of soluble solids and juice content than from other sectors [10]. Jackson found the apple fruits from the outer zones of the tree were larger, better colored and shrivelled and appeared to be more matured in terms of ground color than fruits from the inner zones. After storage the fruits from the outer zone developed significantly less core flush, higher incidence of bitter pit and rotting than fruits from the inner zones [5]. The differences between positions within tree were also reported in grapefruit [11], Matou Wentan [8] and grape [12].

The "Hak Ip" is a variety with normal seeds. The difference of seed size among trees were not significant. Huang reported only 1.79% of shrivelled seeds was obtained in natural condition [2]. However, 100% of shrivelled seeds could be gained in bagging and without artificial pollination [4]. In this study, the percentage of shrivelled seeds in 3 locations were zero, while from Minhsiung, two plants with 25% and 50% of shrivelled seeds repectively were recorded in natural condition. It indicated, apparently, that genetic differences exist among trees in this orchard.The percentage of shrivelled seeds were different

by varieties, years, management and locations [2]. This study showed that the differences within and among trees were not significant in the same location in shrivelled varieties "Sah Keng" and "Kang Wei". It is unknown however that to what extent will be affected by different locations and years.

Comparison of "Hak Ip" variety from four locations showed the fruits from Wufeng ranked the highest value in all characters measured. It may be due to the effect of both genetic and environmental factors. Further study should be carried out to completely understand and explain which factor contributed more to the differences of fruit characters among locations.

The "Sah Keng" and "Kang Wei" varieties were apt to produce higher percentage of shrivelled seeds. Huang reported that the shrivelled seeds of "Yu Her Pao", "No Mai Tze" and "Kwai Mi" were 31.43%, 26% and 35.85%, respectively [2]. He also explained due to the rearing of bees, the shrivelled seeds of "Sah Keng" were reduced from 57.56% to 36.6% [3], the result is close coincide to this experiment where the shrivelled seeds of "Sah Keng" and "Kang Wei" were 36% and 26%, respectively. Rearing the bees in the orchards may explain the lower value of shrivelled seeds, but they were still close to the "Yu Her Pao", "No Mai Tze" and "Kwai Mi" [2]. The quality in terms of soluble solids of these two varieties were similar or approximate to "Hak Ip" variety. The yield of two shrivelled seed varieties were approximate to "Hak Ip" [3], but were higher and more stable than other shrivelled seed varieties such as "Yu Her Pao", "No Mai Tze" and "Kwai Mi". The maturity time of "Sah Keng" is the same as "Hak Ip", while the "Kang Wei" is about one week later than "Hak Ip". The different maturity time of two shrivelled seed varieties will extend the lychee supply in Taiwan where the lychee market was limited in two months for its short postharvest life [9]. The "Sah Keng" and "Kang Wei" would appear promising for higher percentage of shrivelled seeds and more stable yielding than other shrivelled seed varieties.

The consumer prefer shrivelled-seed fruits. Huang reported that the fruits with shrivelled seeds are better in quality than normal-seed fruits. To compare whether there are any difference between normal- and shrivelled-seed fruits, the fruits were devided into two sets depending on the seed size as described above. The shrivelled-seed fruits were smaller and lighter in fruit size and weight, but no difference in soluble solids content. It is evident that the quality between normal- and shrivelled-seed fruits were similar within variety. The shrivelled-seed fruits were superior for their smaller seed size, higher aril ratio and separate the seed and aril easily, but not for better quality. Improvement of quality could only be effectively obtained by breeding methods.

It is difficult to predict the shrivelled seeds from outer characters of fruits. The calculation of correlation coefficients between seed size and other fruit characters may provide valuable informations for predicting the shrivelled seed from outer characters of fruits. The seed size were highly correlated to fruit diameter, fruit weight and shell weight in two shrivelled-seed varieties. The fruit diameter and fruit weight could be measured without breaking the fruits. They would be useful index to predict the shrivelled

seed. This results confirm Huang's report and farmers' experience[2]. However, the correlation coefficients of "Hak Ip"variety were low and not significant showed the fruit characters were less affected by seed size in normal-seed variety.

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荔枝大核與小核種果實性狀變異之研究[1]

顏 昌 瑞[2]

摘 要

研究荔枝小核種沙坑及港尾晚生與大核種黑葉果實性狀品種間、株間與株內之變異，由變方分析結果顯示果實性狀株間變異大於株內變異；最廣泛栽培黑葉之四個地區綜合分析結果顯示地區間果實性狀變異大於株間及株內。果長、果徑、果重、果殼重及果肉重等性狀株間之差異爲顯著，而株內差異不顯著；在多數地區之果棘、果肉色、小核率及果肉率於株間及株內之差異均不顯著；而可溶性固形物，風味及種子大小之差異因地區及品種而有異。

沙坑、港尾晚生及黑葉等品種之小核率分別爲36%、26%及0%，二小核種之可溶性固形物與黑葉種相近，其他性狀之差別亦於本文中分別比較。

比較小核種沙坑及港尾晚生品種內大核果及小核果之差異，顯示大核果之果實大小及果重略大於小核果；但其可溶性固形物含量差異不顯著；小核果較大核果之優點爲種子小，高果肉率及易於剝除果肉。二小核種之果徑、果重及果殼重與種子大小之相關均高且顯著，而大核種果實性狀和種子大小之相關係數均低且不顯著。

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