数種のサクラ属植物の果実と種子

Naohiro NARUHASHI*: The Fruits and Seeds of Several *Prunus* Species

鳴橋直弘：数種のサクラ属植物の果実と種子

The fruits of *Prunus* L. represent a typical example for stone fruits. The fruit is divided into three parts, namely, epicarp, mesocarp, and endocarp. The epicarp and mesocarp are softer and disappear as a result of eating by animals and of rotting by bacteria and fungi. The endocarp, on the contrary, is harder and remains alive, and therefore it is generally called the seed, although it is not the exact definition.

The morphological development of fruits and seeds and their physiology in some *Prunus* species have been studied by STERLING (1953) and CHALMERS & VAN DEN ENDE (1977). In this study prunoidean stone fruits of various degree in size were selected, and the correlations among various characters of the fruits and the trend of variation in those characters were critically investigated.

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Materials and Methods

The following 12 different species or races of *Prunus* were selected for investigation.

1. *Prunus grayana* MAXIM. collected at Ozo in Ishikawa Pref.
2. *P. pendula* MAXIM. f. *ascendens* (MAKINO) OHWI collected in the campus of Toyama Univ.
3. *P. yedoensis* MATSUM. collected in the campus of Toyama Univ.
4. *P. avium* L. cv. Satōnishiki
5. *P. avium* L. cv. Bing
6. *P. mume* SIEB. et ZUCC., nom. cv. obsc.
7. *P. salicina* LINDL. cv. Gekkō
8. *P. salicina* LINDL., nom. cv. obsc., which is different from above no. 7 race.
9. *P. armeniaca* L. var. *ansu* MAXIM.
10. *P. persica* (L.) BATSCH. var. *nucipersica* SCHN-

Table 1. Mean values for 10 characters in 12 different taxa.

Taxon	n	DF (mm)	HF (mm)	VF (cc)	WF (g)	SGF	HS (mm)	LDS (mm)	SDS (mm)	WS (g)	WS/WF (%)
1. *Prunus grayana*	30	8.5	9.0	0.4	0.4	1.05	7.4	4.6	4.5	0.1	17.7
2. *P. pendula* f. *ascendens*	20	9.4	9.4	0.6	0.6	1.04	7.1	6.1	4.9	0.1	17.7
3. *P. yedoensis*	100	11.7	10.9	0.9	1.0	1.06	7.8	6.7	5.1	0.1	13.7
4. *P. avium* cv. Satōnishiki	50	21.5	19.6	4.8	5.2	1.06	11.0	8.8	6.7	0.2	4.6
5. *P. avium* cv. Bing	20	25.4	24.6	7.9	8.0	1.02	12.0	9.2	7.5	0.4	4.6
6. *P. mume*	20	38.4	35.5	27.0	28.0	1.04	21.0	18.0	14.2	2.4	8.4
7. *P. salicina* cv. Gekkō	13	46.1	46.6	53.5	53.9	1.01	23.7	16.4	8.9	1.0	1.8
8. *P. salicina*	20	48.8	48.7	61.2	61.3	1.00	31.5	23.6	19.0	5.4	8.8
9. *P. armeniaca* var. *ansu*	6	52.3	51.2	74.0	74.2	1.00	27.8	24.1	14.2	3.6	4.8
10. *P. persica* var. *nucipersica*	20	57.4	56.3	101.5	102.3	1.01	21.1	16.8	9.5	1.3	1.2
11. *P. persica* var. *nucipersica*	10	65.3	65.6	146.2	144.0	0.98	37.7	26.5	19.4	7.6	5.3
12. *P. persica* var. *persica*	21	81.6	76.1	280.3	266.2	0.95	38.6	28.8	20.1	8.8	3.3

DF : Diameter of Fruit, HF : Height of Fruit, VF : Volume of Fruit, WF : Weight of Fruit, SGF : Specific Gravity of Fruit, HS : Height of Seed, LDS : Long Diameter of Seed, SDS : Short Diameter of Seed, WS : Weight of Seed, WS/WF : Weight of Seed/Weight of Fruit, n : number of fruits used in this study

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EID., nom. cv. obsc.

11. *P. persica* (L.) BATSCH. var. *nucipersica* SCHNEID., nom. cv. obsc., wihch is different from above no. 10 race.

12. *P. percica* (L.) BATSCH. var. *percica*, nom. cv. obsc.

Nos. 4－12 were obtained from fruit stores. The number of fruits investigated for each taxon varied from 6 to 100 (cf. Table 1).

The longest diameter and height of the fruits were measured by a slide calipers and the weight by a usual balance, and the volume was calculated by means of increasing water volume in measuring cylinder. The widest and narrowest diameter per seed were measured, because the cross-sections of the seeds are often broader to narrower oblong or elliptical in shape.

Results and Discussion

The mean values for 8 characters of 12 taxa obtained in this study are shown in Table 1. Standard deviations and variances were omitted from the table, because the fruits sold in the markets are usually selected based on the size and quality for commercial purposes and thus do not show real variances of the fruits themselves.

The specific gravity of the fruits and the proportion of seed weight to fruit weight are also given in Table 1. The plant names in this table were written in order from small to large fruit size. The figures of diameter and height of fruits showed a gradual increase, however, the volume and weight of fruits increase exponentially. Roughly speaking, the specific gravity of fruits showed a decreasing tendency in spite of the increase in fruit size. The four characters of seed, namely, the height, long and short diameters, and weight showed increasing values with some exceptions (See HS, LDS, SDS, and WS in Table 1). Two races of both *P. salicina* and *P. percica* var. *nucipersica* showed nearer figures in the characters of fruits, whereas in the characters of seeds they showed very different values. The proportion of seed weight to fruit weight revealed generally a decreasing trend, although there were exceptions (cf. Table 1).

Table 2 shows the correlation coefficients among 10 characters which are supposed to show the linear relationships between them. As shown here, the value of the correlation coefficient between the diameter and height of fruits was $+0.998$ ($p<0.001$). This is a linear relationship as shown in Fig. 1 and its linear regression line is expressed by $Y=0.97X+0.23$. It became evident that the changes of two characters, i.e., the diameter and height of fruits showed the same trend with the change in fruit size, i.e., fruit volume.

A similar examination was made for each taxon and their relationships described by linear regressions are given in Fig. 2. This is for the purpose of finding the variation pattern in each taxon. It is evident that the slopes closely resembling indicate the same tendency of variation. The patterns of regression lines of three taxa: *P. armeniaca* (9) and *P. persica* var. *nucipersica* (10 & 11) were different from others. It may not be astonishing even if two races belonging nectarine, *P. persica* var. *nucipersica*, reveal remarkably different patterns of variation in fruit characters, because we know even culti-

Table 2. The correlation matrix among 10 characters. Values of correlation coefficients (n=12)
For symbols, see Table 1. $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

	1. DF	2. HF	3. VF	4. WF	5. SGF	6. HS	7. LDS	8. SDS	9. WS	10. WS/WF
1. DF	——									
2. HF	0.998***	——								
3. VF	0.900***	0.884***	——							
4. WF	0.909***	0.894***	0.999***	——						
5. SGF	-0.920***	-0.923***	-0.907***	-0.911***	——					
6. FS	0.951***	0.956***	0.837***	0.846***	-0.906***	——				
7. LDS	0.948***	0.949***	0.816**	0.826***	-0.884***	0.987***	——			
8. SDS	0.867***	0.865***	0.765**	0.772**	-0.829***	0.959***	0.960***	——		
9. WS	0.853***	0.847***	0.875***	0.877***	-0.879***	0.932***	0.912***	0.951***	——	
10. WS/WF	-0.734**	-0.732**	-0.510	-0.521	0.560	-0.592*	-0.600*	-0.459	-0.365	——

vated races of the same species often display exceedingly great discontinuous variations which are not found between different species. On this point we need further data concerning infra- or inter-populational variabilities of a race and also inter-racial variations of a species.

The correlation coefficient between the diameter and height of fruits was also calculated in order to understand the contents of variation of each taxon, and the levels of significance are shown in Table 3. The relationships between the diameter

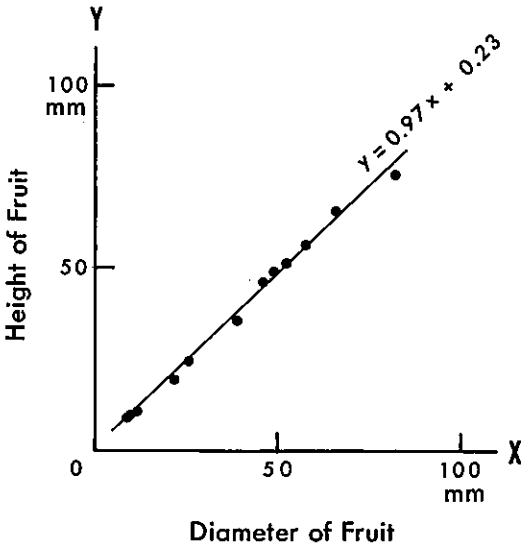

Fig. 1. Relationship between the diameter and height of fruits in 12 different prunoidean fruits.

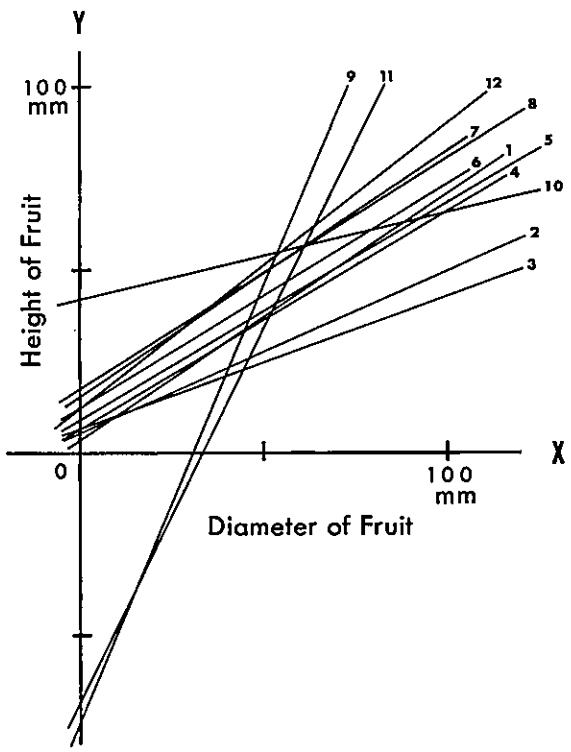

Fig. 2. Relationships between the diameter and height of fruits in each taxon.
1: *Prunus grayana*, 2: *P. pendula* f. *ascendens*, 3: *P. yedoensis*, 4: *P. avium* cv. Satōnishiki, 5: *P. avium* cv. Bing, 6: *P. mume*, 7: *P. salicina* cv. Gekkō, 8: *P. salicina*, 9: *P. armeniaca* var. *ansu*, 10: *P. persica* var. *nucipersica*, 11: *P. persica* var. *nucipersica*, 12: *P. persica* var. *persica*

Table 3. Variations of the level of significance in correlations between the diameter of fruits and four other characters. For symbols, see Table 1.
*p<0.05; **p<0.01; ***p<0.001 Data not shown were not significant.

Taxon	HF	HS	LDS	SDS
1. *Prunus grayana*	***	**	**	**
2. *P. pendula* f. *ascendens*	*			
3. *P. yedoensis*	***	*	***	***
4. *P. avium* cv. Satōnishiki	***	***	***	***
5. *P. avium* cv. Bing	***		*	
6. *P. mume*	**	*	***	***
7. *P. salicina* cv. Gekkō	**			
8. *P. salicina*	**		***	*
9. *P. armeniaca* var. *ansu*	**			
10. *P. persica* var. *nucipersica*				
11. *P. persica* var. *nucipersica*		*		
12. *P. persica* var. *persica*	***		**	*

of fruits and three other characters (the height, long and short diameters of seeds) are also included in Table 3. From this result, it is evident that *P. grayana, P. yedoensis, P. avium* cv. Satōnishiki, and *P. mume* are alike in their variation patterns. On the other hand, different trend of variability was noted in *P. pendula* and two different races of *P. persica* var. *nucipersica*.

The value of the correlation coefficient between the volume and weight of fruits was +0.999 ($p<0.001$). This suggests the constancy of the specific gravity in *Prunus* fruits in spite of the size differences of fruits. On the contrary, the values of the specific gravity gradually become lower with the increase in volume of the fruits. This difference may be understood from much smaller variabilities in the specific gravity.

The relationship between the diameter and volume of the fruits is not a linear relationship, but evidently cubic just as shown in Fig. 3, the formula being expressed as $Y=aX^3$. The a was calculated to be approximately 0.52. As shown in Fig. 3, the volume of fruits shows an exponential change and this may be true for the fruit shapes of the other remaining members of the genus *Prunus*.

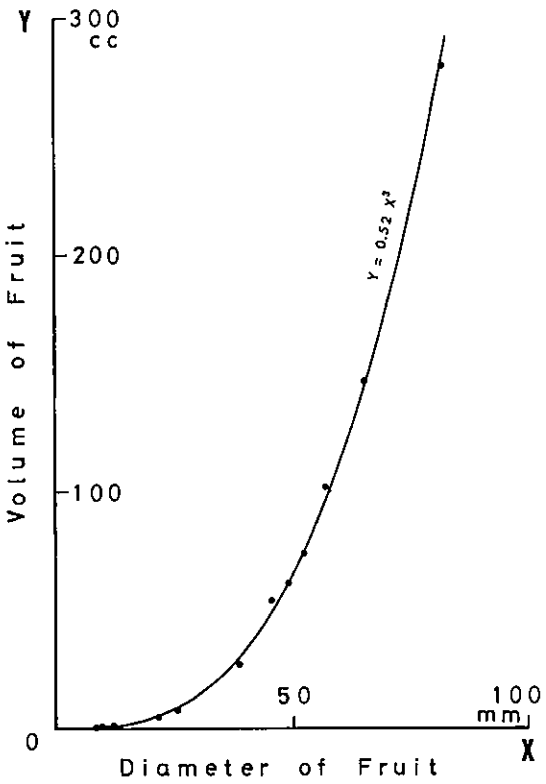

Fig. 3. Relationship between the diameter and volume of fruits in 12 different prunoidean fruits.

References

STERLING, C., 1953. Developmental anatomy of the fruit of *Prunus domestica* L. Bull. Torrey Botan. Club. 80: 457−477.

CHALMERS, D. J. and VAN DEN ENDE, B., 1977. The relation between seed and fruit development in the peach *(Prunus persica* L.*)* Ann. Bot. **41**: 707−714.

摘　要

サクラ属数種について，色々なサイズの果実と種子の変異の様子や関係を調べた。材料は次のものを用いた。1）ウワミズザクラ，2）エドヒガン，3）ソメイヨシノ，4）サクランボ(佐藤錦)，5）チェリー(ビング)，6）ウメ，7）スモモ(月光)，8）スモモ，9）アンズ，10）ネクタリン，11）ネクタリン，12）モモ。

各種の果実の最大直径，最大高さ，体積，重さ，比重，および種子の高さ，長直径，短長径，重さ，さらに果実の重さに対する種子の重さの%を Table 1 に示した。各形質は規則的に変化するが，種子における形質には例外も見られた。またスモモの2品種とネクタリンの2品種において，果実の形質は類似するが，種子では顕著な差があった。このことは分類群での種子形成の差と関係すると思われる。

Table 2 は各測定形質間の相関関係を示している。たとえば，果実の直径と高さの関係は Fig. 1 で画かれるような回帰直線で示される。このことはサクラ属植物の果実の形の一定さを示している。この回帰直線を個々の種について調べたのが，Fig. 2 である。この図から明らかなように，アンズおよびネクタリンの2品種は他のものとは異なっていた。品種間で相当な差が見られることから，この点に関しては十分な資料が必要と思われる。

果実の直径と高さについて，個々の種の変異の傾向を知るために変異係数を調べた。その結果のうち，有意水準のみを示したのが Table 3 である。またこの表には種子の3形質とのそれも加えてある。この表からわかるように，ウワミズザクラ，ソメイヨシノ，サクランボ佐藤錦，ウメにおいては類似した変異の様子を示し，エドヒガンやネクタリンの2品種においては差異を示した。

果実の直径と体積の関係は $Y=0.52X^3$ で示される (Fig. 3 参照)。また，この属での果実の大きさが一定の割合で増大することを示している。