

Morphological Characteristics for Selected Individuals in *Cornus kousa* BUERG

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ABSTRACT

The purpose of this research is to establish basic database on *Cornus kousa* by way of investigation, analysis and comparison of characteristics of leaf and flower, then fostering good cultivar on each morphological characteristics - leaf length, leaf width, petiole length, left lateral vein, right lateral vein. Leaf length and leaf width in Mt. Jiri shows big tendency which is 83.5 mm, 52.4 mm each in comparison with the whole mean of 72.5 mm, 41.2 mm, whereas populations of Suwon and Mt. Halla has leaf length of 66.0 mm, 65.7 mm - 9.8%, 10.4% lower value in comparison with seven mean population; leaf width is 38.4 mm, 35.3 mm - 7.3%, 16.7% lower than whole mean and shows lowest tendency among seven selected populations. Long width of flower and short width of flower in Boeun shows big tendency which is 99.9mm, 96.5 mm each in comparison with the whole mean of 76.0 mm, 73.6 mm, whereas populations of Mt. Halla has 50.1 mm, 48.2 mm which shows lowest tendency. On petal length, petal width and length of flower petiole, Boeun populations have bigger and Mt. Halla shows little tendency. The measurement result of flower colors on each population by using Spectrum Color Mater shows followings: populations of Mt. Duckyoo and Mt. Halla shows lower lightness than any other populations, but wholly shows higher lightness which is refers brightness in seven selected populations. Thus it shows peculiarities of white flower color.

Key words : *Cornus kousa*, flower color character, Korean dogwood, morphological character, selection

INTRODUCTION

There are 40 kinds of *Cornus* species in the world including 4 kinds in Korea. It is deciduous, evergreen, bush or vegetation (Kim, 1996 a,b). *Cornus kousa* is also called as Korean Dogwood or Japanese Dogwood which lives in fields and mountains in the southern

area(Ahn and Shim, 2003). It is deciduous broad leaved tree with 12 cm in height and 50 cm in diameter, and it normally grows at altitude of 300-500 m except, that of 1,800 min Mount, Hanra in Jeju. its branch spreads horizontally and its cortex is smooth and beautiful just like that of Chinese quince(Adams and Roberts, 1967). it also has strong resistance to cold, and shade, showing

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good growth in deep and fertile soil. It is resistant to general pollution but badly grown in dry condition. The white splendid and tidy flower and red tempting fruit in fall are so beautiful which makes it valuable as a decorative plant such as garden tree, part tree, roadside tree, etc (Carpenter, 1975 and; Duncan and Matthews, 1969). This study aims at establishing basic data for cultivating good variety by type and character by comparing characteristics in leaves and flowers of *C. kousa*.

MATERIAL AND METHOD

Material

For the declared material for investigation of morphologic character of *Cornus kousa*'s leaf, 63 samples were selected, 8 to 10 in each group from 7 natural groups such as Suwon, Gwangkyosan, Gwanaksan, Chukryeongsan and Jungmisan, Boeun, Boeun American dogwood, Deokyusan, Jireesan, and Hanrasan chosen for the purpose of selecting superior population of *Cornus kousa* by Department of forest generic resources, Korea forest research institute in 2002, then we gathered matured leaves collected by direction from each place where the samples normally grew.

Morphologic character in leaves

With morphologic character examination on 7 selected groups of *Cornus kousa*, we measured 5 characters including leaf length, leaf width, and length of petiole, left lateral vein, and right lateral vein by collecting total of 900 leaves, 10 leaves each without normally disease lesions which were grown normally among 63 sample trees (Fig. 1).

Every examined data was compared and analyzed of morphological character between groups and individuals in groups with advance sample using SAS (Statistical Analysis System, 1987) program, then we

performed Analysis of Variance, Correlation Analysis and Principal Component Analysis, and considered generic relationship through cluster analysis.

Morphologic character in flowers

For morphologic character test, we examined 5 characters including long width of flower, short width of flower and petal length, petal width, and length of flower petiole on normally grown flowers among 63 sample trees, then measured color of flowers (Fig. 1).

With every data, we analyzed basic statistical amount using SAS statistics package (Ver. 6.12), multiple verification of Duncan to consider the significant difference between groups, and then studied generic relationship through cluster analysis, analysis of variance, correlation analysis and principal component analysis.

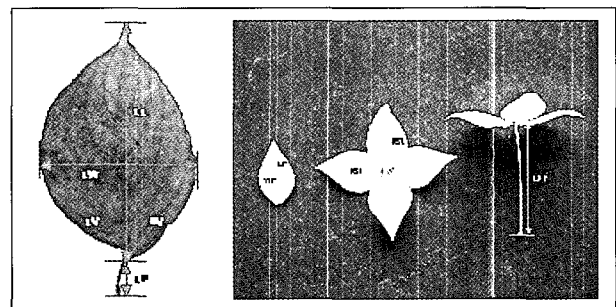


Fig. 1. Surveyed elements of leaf and flower morphological characteristics for *C. kousa*.

RESULT AND DISCUSSION

Leaf characteristics

1) Morphological characters

As the result of investigating 5 morphological characters including leaf length, leaf width, length of petiole, left lateral vein, and right lateral vein on 7 selected advance groups of various changes were shown, for example, the length and width of leaves, average variability appeared as 18.1% and 22.9% each, in the

range of 38.0 mm~117.0 mm and 19.0~87.0 mm respectively. In groups, the average variability in Jireesan had the most significant changes as 83.5 mm and 52.4 mm each followed by Boeun groups with 79.2 mm and 44.1 mm compared with 72.5mm and 41.2mm in average. In contrast, Suwon and Hanrasan groups with 66.0 mm and 65.7 mm in length of leaves respectively appeared to have 9.8% and 10.4% less values than average value of 7 groups, and with the width of leaves, they showed the least variability among

7 groups withas 38.4 mm and 35.3 mm respectively, which were 7.3% and 16.7% less than the average value. This tendency appeared the same in other examination and analysis of different characters. In addition, the range of variability by group in the length and the width of leaves showed 14.4~17.2% and 14.1~21.73% respectively. Among them, Hanrasan group appeared to have the least variability, while Jireesan and Suwon groups showed the most variability (Table 1).

The result of ANOVA to test significant difference

Table 1. Morphological characteristics of the leaf for *C. kousa* by selected trees.

District		Characters				
		LL (mm)	LW (mm)	LP (mm)	LV	RV
Suwon	Mean	66.04 e*	38.35 d	4.84 de	4.29 ab	4.18 b
	Range	38.0-99.0	20.0-58.0	2.0-11.0	3.0-6.0	3.0-6.0
	C.V	17.09	19.03	41.47	15.73	16.28
Mt. Gwanak	Mean	68.91 de	40.04 cd	4.52 e	4.41 a	4.44 a
	Range	44.0-90.0	20.0-57.0	2.0-5.0	3.0-6.0	3.0-6.0
	C.V	15.55	18.61	16.65	13.97	13.54
Mt. Chukryong	Mean	73.70 c	41.56 c	5.17 cd	4.19 bc	4.28 b
	Range	52.0-105.0	27.0-63.0	3.0-10.0	3.0-5.0	3.0-5.0
	C.V	15.84	19.26	35.92	11.26	11.64
Boeun	Mean	79.24 b	44.12 b	8.36 a	4.11 bc	4.12 b
	Range	52.0-107.0	28.0-69.0	5.0-15.0	3.0-6.0	3.0-5.0
	C.V	15.81	19.14	23.95	13.79	12.09
Mt. Duckyoo	Mean	71.48 cd	38.01 d	4.53 e	4.15 bc	4.18 b
	Range	55.0-100.0	19.0-63.0	2.0-10.0	3.0-6.0	3.0-5.0
	C.V	15.99	20.67	31.45	13.34	11.92
Mt. Jiri	Mean	83.49 a	52.38 a	5.43 bc	4.41 a	4.48 a
	Range	49.0-117.0	33.0-80.0	4.0-8.0	4.0-6.0	4.0-6.0
	C.V	17.19	21.73	20.48	11.79	12.30
Mt. Halla	Mean	65.69 e	35.31 e	5.81 b	4.05 c	4.13 b
	Range	47.0-88.0	25.0-47.0	4.0-10.0	3.0-5.0	3.0-5.0
	C.V	14.40	14.12	23.68	13.76	14.04
Total	Mean	72.49	41.22	5.59	4.22	4.25
	Range	38.0-117.0	19.0-87.0	2.0-15.0	3.0-6.0	3.0-6.0
	C.V	18.13	22.89	36.32	13.79	13.54

* Different letters indicate Duncan's multiple range tests (Significant at $p < 0.05$).

Table 2. Analysis of variance for leaf morphological characters of *C. kousa*.

Characters	Among populations	
	MS	F-value
LL	3993.00	29.38
LW	2664.75	41.49
LP	172.35	68.93
LV	1.87	5.78
RV	1.93	6.10

between groups and individuals in groups on the measured values is shown in Table 2.

2) Correlation between leaf characters

The result of analysis of correlation between leaves characters are shown in Table 3. The range of total correlation coefficient showed 0.0592 to 0.7712 in which the correlation coefficient in left lateral vein and right lateral vein had the most positive correlation as 0.7712, while, it appeared to have the most negative correlation in length of petiole and left lateral vein as 0.7712.

Flower character

1) Flower shape character

After we examined morphologic characters of 5 flowers in 7 advanced groups of the average values of longer width and shorter width of flowers were 76.0 mm and 73.6 mm respectively, along with 32.0~160.0 mm and 30.0 mm~153.0 mm each in the range, and the average variability appeared to be 27.39% and 27.41% respectively. Hanrasan group had the least variability as 50.1 mm in long and 48.2 mm short, this appeared

similar in length and width of flowers, and the length of flower stalk which Boeun group showed significant more variability than the average, and Hanrasan group showed the least variability (Table 4). The results of ANOVA to test significant difference between groups and individuals in groups are shown in Table 5.

2) Correlation between flower characters

The results of analysis of correlation on flower characters are shown in Table 6. The range of total correlation coefficient showed 0.5411 to 0.9909 in which the correlation coefficient in longer width and shorter width of flowers had the most positive (+) correlation as 0.9909. While, it appeared to have the most negative (-) correlation in width of flower leaves and the length of petiole as 0.7712.

3) Flower color characteristics

As we examined each flower color by grouping using spectrophotometer, Deokyusan and Hanrasan showed the lower Lightness (L) than other groups, however, the lightness value which shows the brightness in 7 selected

Table 3. Coefficient of correlation for each leaf morphological characteristics.

Charactrers	LW	LP	LV	RV
LL	0.7698	0.3495	0.3614	0.3686
LW		0.2752	0.4781	0.4743
LP			0.0592	0.0776
LV				0.7712

Table 4. Morphological characteristics of the flower for *C. kousa* by selected trees.

District		Characters				
		LWF (mm)	SWF (mm)	PL (mm)	PW (mm)	LFP (mm)
Suwon	Mean	75.89 c	74.50 c	37.36 c	23.57 c	51.13 cd
	Range	33.0-105.0	33.0-105.0	13.0-56.0	10.0-32.0	33.0-76.0
	C.V	21.12	21.23	22.51	21.83	15.74
Mt. Gwanak	Mean	74.05 cd	71.48 cd	37.00 c	21.74 d	61.59 b
	Range	44.0-95.0	43.0-90.0	25.0-70.0	12.0-34.0	44.0-80.0
	C.V	14.83	14.70	20.21	21.31	15.74
Mt. Chukryong	Mean	76.80 c	74.32 c	38.20 c	21.67 d	54.51 c
	Range	45.0-117.0	40.0-111.0	21.0-60.0	10.0-35.0	20.0-85.0
	C.V	26.35	25.73	27.30	24.60	24.75
Boeun	Mean	99.86 a	96.50 a	49.54 a	28.88 a	71.30 a
	Range	70.0-160.0	65.0-153.0	30.0-82.0	18.0-45.0	38.0-125.0
	C.V	17.17	17.08	18.42	18.39	22.25
Mt. Duckyoo	Mean	70.55 d	68.70 d	34.34 d	19.21 e	47.25 e
	Range	55.0-95.0	54.0-93.0	17.0-45.0	11.0-30.0	25.0-73.0
	C.V	11.69	11.91	13.55	18.08	21.24
Mt. Jiri	Mean	85.55 b	82.51 b	43.11 b	27.51 b	50.55 de
	Range	52.0-115.0	50.0-110.0	25.0-60.0	17.0-35.0	20.0-80.0
	C.V	20.74	21.05	22.07	16.43	27.47
Mt. Halla	Mean	50.14 e	48.20 e	24.13 e	12.85 f	39.55 f
	Range	32.0-75.0	30.0-73.0	15.0-40.0	7.0-28.0	17.0-63.0
	C.V	19.58	20.63	22.57	27.10	28.21
Total	Mean	76.02	73.64	37.60	22.13	53.90
	Range	32.0-160.0	30.0-153.0	13.0-82.0	7.0-45.0	17.0-125.0
	C.V	27.39	27.41	29.37	31.08	28.69

* Different letters indicate Duncan's multiple range tests (Significant at $p < 0.05$).

Table 5. Analysis of variance for flower morphological characters of *C. kousa*.

Characters	Among populations	
	MS	F-value
LWF	22312.47	100.06
SWF	20959.45	100.11
PL	5958.79	90.58
PW	2730.91	127.40
LFP	10224.50	71.48

Table 6. Coefficient of correlation for each flower morphological characters.

Charactrers	SWF	PL	PW	LFP
LWF	0.9909	0.9479	0.8246	0.6150
SWF		0.9429	0.8244	0.6139
PL			0.7985	0.6279
PW				0.5411

groups was high in general. So the color showed white character (Fig. 2. A), while, 2 individuals from

Deokysan were unusual individuals which showed red (Fig. 3. B).

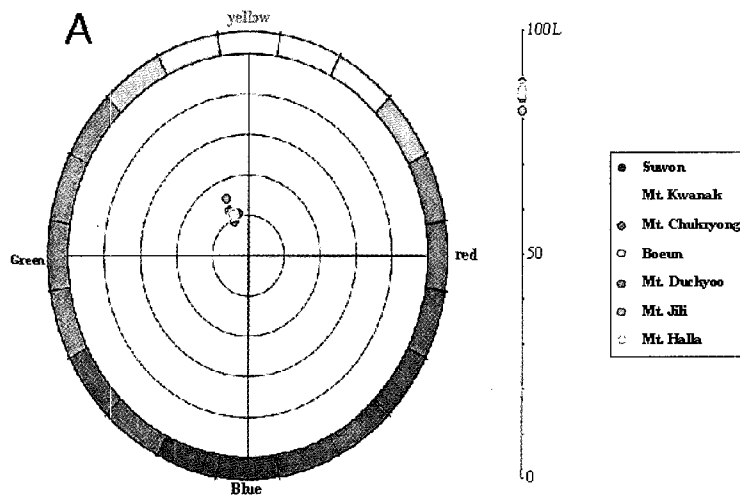


Fig. 2. Flower color characteristics of *C. kousa* in the all district (A).

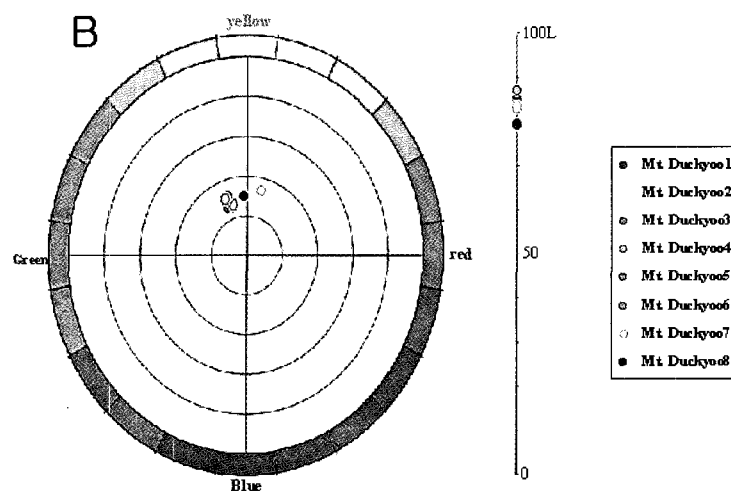


Fig. 3. Flower color characteristics of *C. kousa* in the Mt. Duckyoo (B).

Principal Component Analysis

The result from Principal Component Analysis of characters in 13 leaves and flowers of 7 selected groups of *Cornus kousa*, and the result of contribution of each principal component to its unique values and general variability are shown in Table 7.

As we examined unique value on each character obtained from principal component analysis, the unique value of the 1st main component was 8.06 which accounts for 62% in total distribution, and 2.53 for the 2nd main component with 82% of total distribution, and 1.45 for the 3rd main component which accounts for 93% in total distribution.

Table 8 shows the result from analysis of unique value of each character in main components indicating correlation coefficient between individual main components and morphologic characters to estimate what character 13 virtual individuals have in each main principal component.

In the 1st main component, color b only showed negative value among 13 morphologic characters with the range of 0.3199 to 0.3500, while other characters

showed positive values. In particular, it showed high correlation in order of length of flower leaf, longer width and shorter width of flower, and width of flower leaf, which means it contributes more than other characters.

For the 2nd principal component, the values of left lateral vein and right lateral vein showed very high correlation as 0.5681 and 0.5857 respectively, followed by 0.2526 in leaf width.

In the case below the 3rd principal components, the unique value was less than 1 with no significant meaning. As general, *Cornus kousa* has high contribution in leaf length and width, and longer width and shorter width of flower.

Cluster analysis

The results from cluster analysis using Single linkage method based on characters in 13 leaves and flowers of 7 selected groups of *Cornus kousa* are as seen in Fig. 4.

As the result of cluster analysis, 3 groups were divided on the base of 13 distances. Suwon, Chukryeongsan, and Deokyusan were in Group 1,

Table 7. Eigenvalue and its contribution obtained from principal component analysis.

Principle component	Eigenvalue	Difference	Propotion	Cumulative (%)
1	8.0641	5.5278	0.6203	62.03
2	2.5363	1.0903	0.1951	81.54
3	1.4460	0.7649	0.1112	92.66
4	0.6811	0.5290	0.0523	97.09
5	0.1520	0.0317	0.0116	99.07
6	0.1203	0.1203	0.0092	100.00
7	0.0000	0.0000	0.0000	100.00
8	0.0000	0.0000	0.0000	100.00
9	0.0000	0.0000	0.0000	100.00
10	0.0000	0.0000	0.0000	100.00
11	0.0000	0.0000	0.0000	100.00
12	0.0000	0.0000	0.0000	100.00
13	0.0000	0.0000	0.0000	100.00

Table 8. Eigenvector associating to eigenvalue obtained from principal component.

Morphological characters	Prin 1	Prin 2	Prin 3
LL	0.2897	0.0690	0.4352
LW	0.2746	0.2526	-0.3721
LP	0.1808	-0.4348	-0.1330
LV	0.1161	0.5681	0.1488
RV	0.0890	0.5857	-0.0486
ŁWF	0.3486	-0.0526	0.0786
SWF	0.3477	-0.0546	0.0907
PL	0.3500	-0.0251	0.0741
PW	0.3445	0.0636	0.0497
LFP	0.2742	-0.1028	0.3904
L	0.2235	0.0582	0.5674
a	0.2742	-0.0749	-0.3645
b	-0.3199	0.2153	-0.0105

Jireesan was for Group 2, and Boeun and Hanrasan were in Group 3. In principal main analysis of general character, flower character showed more contribution than leaf, and it showed similarity with the result of flower character in cluster analysis of general character.

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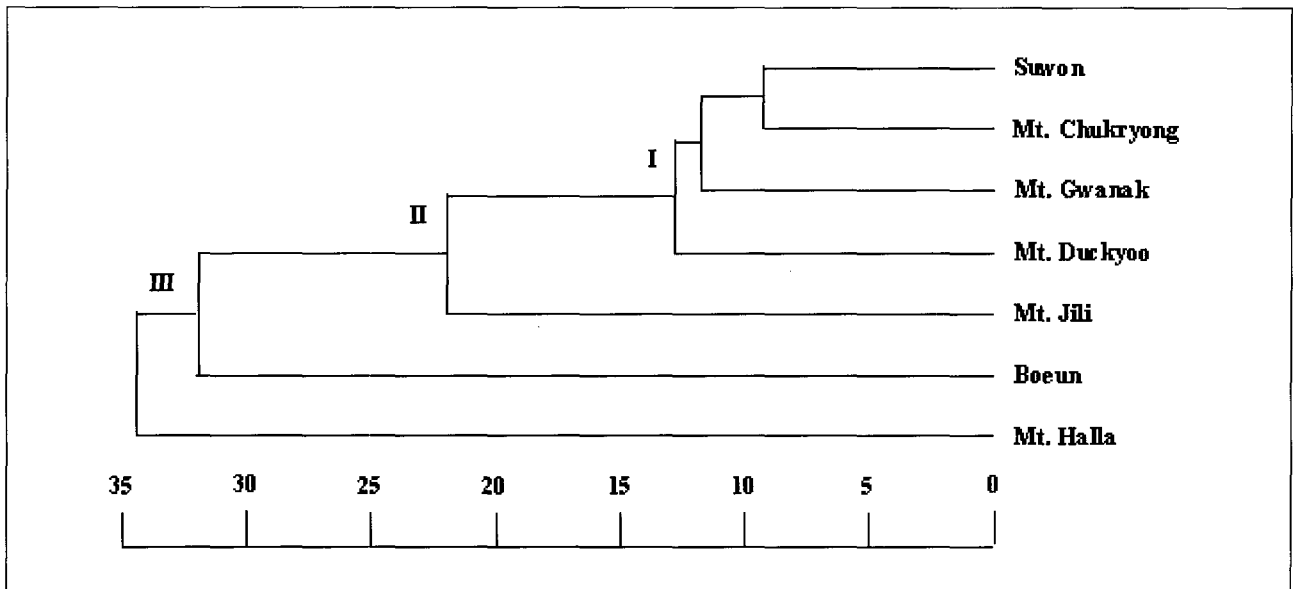


Fig. 4. Cluster dendrograms of studied districts of *C. kousa* by selected trees based on 13 all morphological characteristics.

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