

# Leaf Morphological Characteristics of *Sorbus alnifolia* Selected Populations

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**Abstract** - The purpose of this study was to establish basic database on *Sorbus alnifolia* by investigating, analyzing and comparing characteristics of leaf, and then foster good cultivar on each morphological characteristics - leaf length, leaf width, petiole length, left lateral vein, right lateral vein. Leaf length and leaf width in Osan showed distinct tendency in comparison with the whole mean : 103.4mm and 63.3mm, 86.4mm and 62.9mm, respectively. Populations of Mt. Dukyoo and Mt. Halla showed leaf length of 52.8mm and 58.2mm respectively 32.6% and 39% lower than the mean of ten population. Leaf width of Mt. Gwangyang and Mt. Chiak was 52.8mm and 51.9mm, respectively 17.6% and 16.2% lower than whole mean, respectively, and showed the lowest tendency among ten selected populations.

**Key words** - Selection, *Sorbus alnifolia*, Leaf morphological characteristics

## Introduction

Recently, according to the elevation of the standard of living and change of nationalism, the tendency of using native tree of species for material of landscape architecture is appearing. But the use and supply of the native tree species are very difficult because it doesn't examine an ecological characteristics of those closely (Lee *et al.*, 1998).

*Sorbus alnifolia* (Siebold. et Zucc.) K. Koch, which is a spontaneous fallen broadleaf tree from an altitude of 100~1,300m, through Korea's entire mountain area is strong a crowd, sound-proofing and cold resistance characteristics and it grows well even from drying barren land. From the West, it is called "Korean mountain ash" because is many in the mountain of Korea and is named "Patbea" in Korea, because the fruit is similar to a red bean. The *S. alnifolia* is also strong especially in the acid rain (Lee, 1996). In the future, the *S. alnifolia* has a good prospect. But, the *S. alnifolia* is the actual condition which uses the *S. alnifolia* which in order for the propagation to be hard is growing spontaneously from the mountain like that (FGIA, 1994). This study aims at establishing basic data for cultivating good variety by type and character by comparing characteristics in leaves and flowers of *S. alnifolia*.

## Materials and Methods

### Sampling

For the declared material for investigation of morphologic characteristics of *S. alnifolia*'s leaves, 97 samples were selected, 8 to 10 in each group from 10 natural groups such as Osan, Gwangkyosan, Chungyang, Chukryeongsan and Chiaksan, Surisan, Gwangyang, Deokyusan, Jirisan, and Hallasan chosen for the purpose of selecting superior population of *S. alnifolia* by the Department of Forest Genetic Resources, Korea Forest Research Institute in 2006. We collected matured leaves from each place where the samples normally grew.

### Morphological characteristics of leaves

With morphologic characteristics of 10 selected groups of *S. alnifolia*, we measured 5 characteristics including leaf length, leaf width, and length of petiole, left lateral vein, and right lateral vein by collecting total of 1,250 leaves, 10 leaves each without any disease lesions which were grown normally among 97 sample trees.

Every examined data were compared and analyzed for morphological characteristics between groups and individuals using SAS (Statistical Analysis System, 1996) program performing Analysis of Variance, Correlation Analysis and Principal Component Analysis, and considered generic relationship through cluster analysis.

## Results and Discussion

### Morphological characteristics

As the result of investigating 5 morphological characteristics

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including leaf length, leaf width, length of petiole, left lateral vein, and right lateral vein on 10 selected advance groups of various changes were as follows : average variability of the length and width of leaves appeared to 2.7% and 14.3%, in the range of 28.0mm~113.8mm and 38.9mm~87.3mm respectively. In groups, the average variability in Osan had the most significant changes as 103.4mm and 63.3mm each and followed by Gwanggyosan groups with 98.2mm and 54.5mm compared with 86.4mm and 62.9mm in average (Table 1).

The result of ANOVA to test significant difference between groups and individuals in groups on the measured values is shown in Table 2.

**Correlation between leaf characteristics**

The result of analysis of correlation between leaf characteristics are shown in Table 3. The range of total correlation coefficient showed -0.4651 to 0.4032 in which the correlation coefficient in left lateral vein and right lateral vein had the most positive (+) correlation as 0.4032. It appeared to have the most negative (-) correlation in leaf length and leaf width as 0.4651.

Table 3. Coefficient of correlation for each leaf morphological characters

Charactrers	LW	LP	LV	RV
LL	-0.4651	0.3495	-0.1017	-0.1217
LW		0.1322	0.05796	0.1626
LP			-0.1307	-0.2737
LV				0.4032

acronyms is same as Table 1

Table 1. Morphological characteristics of leaf of *S. alnifolia* by selected trees

District		Characters				
		LL (mm)	LW (mm)	LP (mm)	LV	RV
Osan	Mean	103.38 a	63.30 c	18.30 b	9.18 c	8.72 d
	Range	73.0-136.0	42.0-90.0	10.0-28.0	6.0-78.0	6.0-11.0
	C.V	11.83	12.59	16.65	57.27	11.88
Chukryeongsan	Mean	93.75 c	55.13 de	16.16 d	9.32 c	9.27 c
	Range	68.0-121.0	40.0-78.0	6.0-26.0	7.0-11.0	7.0-11.0
	C.V	11.44	13.68	19.10	10.41	10.52
Surisan	Mean	97.21 b	56.52 d	19.88 a	8.95 c	8.54 d
	Range	28.0-132.0	37.0-88.0	14.0-30.0	6.0-90.0	6.0-10.0
	C.V	12.37	17.17	13.52	65.17	11.01
Chiaksan	Mean	96.72 b	51.91 f	16.55 cd	8.93 c	8.49 d
	Range	68.0-121.0	29.0-72.0	9.0-27.0	6.0-90.0	6.0-11.0
	C.V	11.80	17.06	22.46	65.42	11.21
Chungyang	Mean	93.75 c	61.22 c	15.95 d	9.12 c	9.16 c
	Range	65.0-122.0	5.0-85.0	7.0-25.0	7.0-11.0	7.0-11.0
	C.V	11.98	15.75	19.69	10.80	10.23
Gwangkyosan	Mean	98.21 b	54.52 de	17.21 c	9.41 c	9.42 c
	Range	65.0-130.0	33.0-80.0	10.0-22.0	7.0-12.0	7.0-12.0
	C.V	13.17	16.14	15.04	11.63	11.43
Jirisan	Mean	86.75 d	53.56 ef	12.63 f	11.88 a	12.01 a
	Range	64.0-114.0	31.0-76.0	7.0-25.0	9.0-14.0	8.0-41.0
	C.V	12.22	15.10	26.66	8.55	19.09
Deokyusan	Mean	52.75 g	93.76 a	17.16 c	10.67 b	10.68 b
	Range	31.0-73.0	71.0-118.0	10.0-24.0	8.0-13.0	8.0-13.0
	C.V	16.40	11.36	17.42	9.63	9.62
Hallasan	Mean	58.23 f	86.97 b	14.41 e	10.52 b	10.51 b
	Range	41.0-75.0	66.0-116.0	1.4-22.0	8.0-13.0	8.0-13.0
	C.V	14.49	11.16	33.83	9.04	9.25
Gwangyang	Mean	83.06 e	52.80 ef	12.06 f	11.89 a	11.90 a
	Range	61.0-114.0	35.0-70.0	7.0-17.0	9.0-14.0	9.0-14.0
	C.V	11.44	13.47	17.01	7.81	7.97
Total	Mean	86.381	62.969	16.031	9.987	9.870
	Range	28.0-113.8	38.9-87.3	8.14-24.6	7.3-34.6	7.2-14.7
	C.V	12.714	14.348	20.138	25.573	11.221

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

acronyms; LL (leaf length), LW (leaf width), LP (length of petiole), LV (left lateral vein), RV (right lateral vein)

Table 2. Analysis of variance for leaf morphological characteristics of *S. alnifolia*

characters	Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
LL	Model	9	533573.8957	59285.9884	503.13	<.0001
	Error	1970	232132.3750	117.8337		
	Corrected Total	1979	765706.2707			
LW	Model	9	414711.9853	46079.1095	582.41	<.0001
	Error	1970	155861.5911	79.1176		
	Corrected Total	1979	570573.5764			
LP	Model	9	10468.76057	1163.19562	111.05	<.0001
	Error	1970	20634.11375	10.47417		
	Corrected Total	1979	31102.87432			
LV	Model	9	2456.25227	272.91692	27.03	<.0001
	Error	1970	19889.67500	10.09628		
	Corrected Total	1979	22345.92727	348.620887	248.36	<.0001
RV	Model	9	3137.58798	1.403716		
	Error	1970	2765.321111			
	Corrected Total	1979	5902.909091			

acronyms is same as Table 1

### Principal Component Analysis

The result of Principal Component Analysis of the characteristics in 5 leaves of 10 selected groups of *S. alnifolia* (Fig. 1), and the result of contribution of each principal component to its unique values and general variability is shown in Table 4.

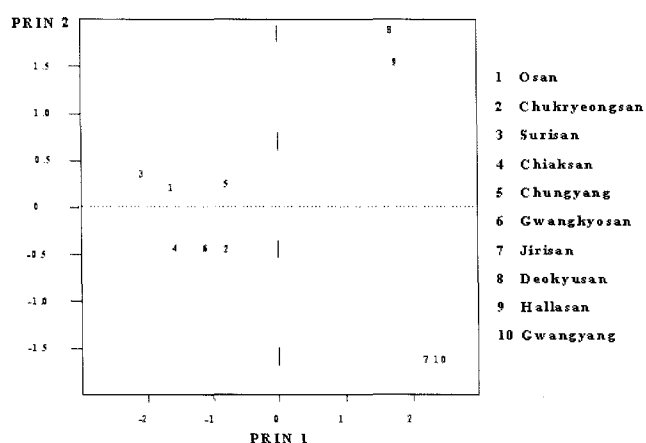


Fig. 1. Scatter diagram of *S. alnifolia*. by selected trees based on principal component 1 and 2.

As we examined unique value on each character obtained from principal component analysis, the unique value of the 1st main component was 3.21 which accounts for 64% in total distribution, and 1.57 for the 2nd main component with 96% of total distribution.

Table 5 shows the result from analysis of unique value of each character in main components, indicating correlation coefficient between individual main components and morphological characteristics to estimate what characteristics of 5 virtual individuals have in each main principal component.

In the 1st main component, color b only showed negative value among 5 morphological characteristics with the range of -0.4537 to 0.5347, while other characteristics showed positive values. In particular, it showed high correlation in order of right lateral vein and left lateral vein, which means it contributes more than other characteristics.

For the 2nd principal component, the values of leaf width and leaf length showed very high correlation as 0.7174 and -0.5114

Table 4. Eigenvalue and its contribution obtained from principal component analysis

Principle component	Eigenvalue	Difference	Propotion	Cumulative (%)
1	3.2104	1.6382	0.6421	0.6421
2	1.5722	1.4031	0.3144	0.9565

Table 5. Eigenvector associating to eigenvalue obtained from principal component

morphological characteristics	Prin 1	Prin 2
LL	-0.4183	-0.5114
LW	0.2318	0.7174
LP	-0.4537	0.3865
LV	0.5287	-0.1972
RV	0.5347	-0.1881

respectively, followed by 0.3865 in length of petiole.

### Cluster analysis

The results from cluster analysis using single linkage method based on characteristics of 5 leaves of 10 selected groups of *Sorbus alnifolia* are shown in Fig. 2.

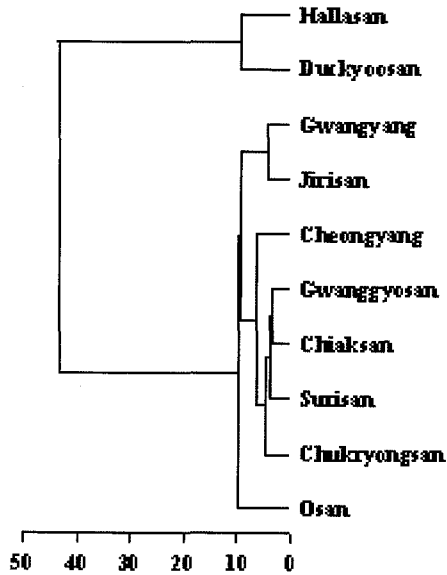


Fig. 2. Cluster dendrograms of studied districts of *S. alnifolia*. by selected trees based on 5 all morphological characteristics.

As the result of cluster analysis, 2 groups were divided on the base of 13 distances. Hallasan and Deokyoosan were clustered in Group 1 and Osan, Jirisan, Gwangyang, Cheongyang and Chukryongsan were in Group 2.

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