INTRODUCTION AND PROVENANCE TRIALS OF EASTERN WHITE PINE (*PINUS STROBUS*) IN KOREA

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Introduction of eastern white pine (*Pinus strobus*) was started in early 1900's with small scale in Korea. The real provenance trial sets were established in 1964 with five provenances at one site. Three experimental sets for provenance trials were analyzed in this study. *P. strobus* were used to analyze the growth performance of provenances over sites, growth patterns, provenance by site interaction and correlation between ages. The superior provenance of *P. strobus*, suitable environmental conditions were proved.

Materials and Methods

Set 1: As a first provenance trial of *P. strobus*, five provenance seeds (four provenances from north America and one from Canada) had been introduced and established at one site (Hwasong city) in 1964. Growth performance was analyzed among provenances at age 20.

Set 2: Second provenance test set were established with two provenances and four seed sources (USA, Italy, and New Zealand) over four sites in 1972. The growth and growth pattern over ages were studied among provenances. The growth of *P. strobus* was used to analyze provenance by site interaction, correlation between growth and environmental conditions and between ages.

Set 3 : Third set was established with six provenances (from USA) at one site (Hwasong city) in 1986. Growth performance and growth pattern over ages were analyzed.

Results and Discussion

Set 1: The growth performance of *P. strobus* by provenances was investigated over ages. The height (5.0 m) and D.B.H. (9.4 cm) of New York provenance was best at age 20. The growth of Pennsylvania (height 4.3 m, D.B.H. 7.2 cm) was worst. The volume of NY provenance was over 3 times than reference pine (*P. koraiensis*). The needle length of NY provenance was 10.3 cm, and that of Ontario provenance was 7.1 cm.

Set 2: Growth and growth pattern of provenances varied over sites. The volume growth at age 39 was best at the Chuncheon site among the four sites, and that of North Carolina provenance was proved to be superior in every site. Growth pattern of height and diameter were very different between provenances and sites. Height and diameter growth were positively correlated with ages. Height growth was positively correlated with annual precipitation, number of foggy days and sand contents in the soil while diameter growth was positively correlated with longitude, altitude and clay contents in the soil of the test sites. Variance component analysis revealed that there is a provenance by site interaction in diameter growth but no interaction in height growth. The

portion of interaction tern of total variation explained 2.0~2.5% in height and 18.9~24.6% in diameter of the total variation according to the analysis of covariance and AMMI model, respectively. North Carolina provenance was proved to be best provenance with good adaptability (stability) and performance and New York provenance was worst.

Table 1. The mean individual volume growth of the *P. strobus* provenances and seed sources at age 39 at the four test sites in Korea (m^3)

	Chun-cheon	Gunpo	Cheong-ju	Imsil	mean
New York	0.832^{b}	0.489^{a}	0.451^{c}	0.515^{b}	0.599^{b*}
North Carolina	0.936^{a}	0.495^{a}	0.612^{a}	0.827^{a}	0.727^{a}
Rotorua	0.666^{c}	0.306^{c}	0.586^{ab}	0.515^{b}	0.605^{b}
Induno Olona	0.855^{ab}	0.409^{abc}	0.551^{ab}	0.717^{a}	0.626^{b}
Bagnolo	0.648^{c}	0.381^{bc}	0.548^{b}	0.502^{b}	0.547^{c}
Ternavasso	0.807^{b}	0.441^{ab}	0.535^{bc}	0.676^{ab}	0.615^{b}
P. koraiensis	0.390	0.110	0.482	0.262	0.324

Table 2. Comparison of the interaction portion of the total variance from the covariance analysis and AMMI analysis for height and DBH of *P. strobus* provenances at age 20 and 39

Age	20		39	
	Analysis of covariance	AMMI	Analysis of covariance	AMMI
Height	1.2	1.0	2.5	2.0
DBH	6.4	5.2	24.6	18.9

Set 3: The results of the 27-year-old *P. strobus* provenance test with six provenances indicated that the growth of the southern provenances (Georgia, North Carolina) were superior to the northern provenances (Minnesota, Wisconsin). At age 27, the annual height growth was still increasing while diameter growth was gradually decreasing.

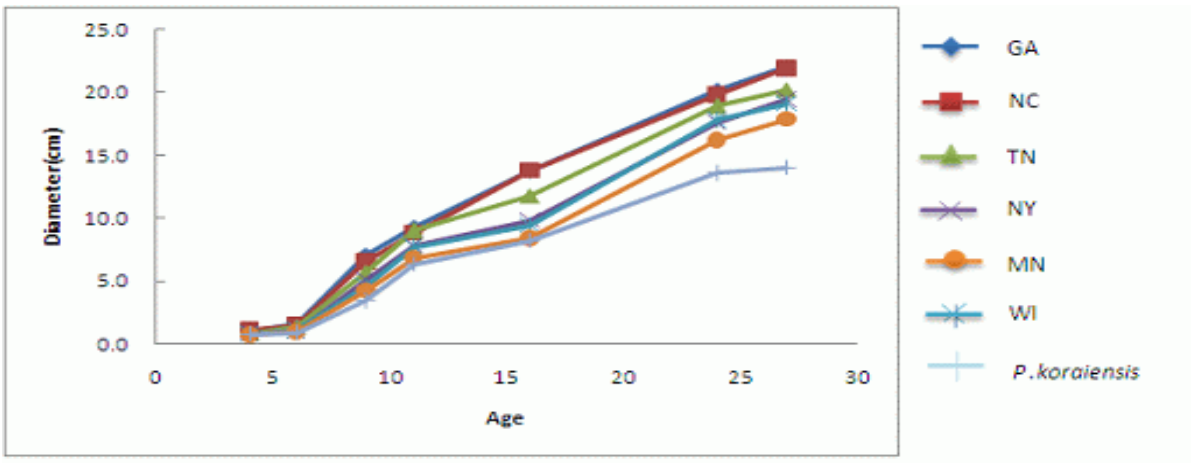

Figure 1. DBH growth pattern of *P. strobus* provenances over ages at Hwasong test site in Korea

Table 3. The Pearson's correlation coefficient of DBH growth of the provenances of the '86 provenance test among ages in Hwaseong

	4	6	9	11	16	24	27
4							
6	0.872*						
9	0.851*	0.975**					
11	0.783*	0.949**	0.957**				
16	0.934**	0.989**	0.969**	0.934**			
24	0.747ns	0.909**	0.950**	0.957**	0.892**		
27	0.740ns	0.881**	0.941**	0.922**	0.869**	0.992**	

Conclusions

In case of *P. strobus*, the growth of southern provenance was better than that of northern provenance in general. The growth was positively correlated between ages, it means that early selection of superior provenance would be possible. The result of provenance test, provenance by site interaction and growth pattern revealed that North Carolina was the best provenance in Korean environments.

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