수목생리학연구실
Forest Ecophysiology Lab

Species-specific relationship between environmental factors and radial growth rates for six years

2020. 05. 06.

Lee Minsu, Park Juhan, Cho Sunsik, Lee Hoontaek, Kim Hyun Seok

(1) Department of Forest Sciences, Seoul National University, Seoul, South Korea
(2) National Center for Agro Meteorology, Seoul, South Korea
(3) Interdisciplinary Program in Agricultural and Forest Meteorology, Seoul National University, Seoul, South Korea
(4) Institute of Future Environmental and Forest Resources, Research Institute for Agriculture and Life Sciences, Seoul National University, Seoul, South Korea

Background

- Climatic factors affect the environment of the forest, which also affects the physiological factors of trees (Fritts, 1976). → Especially, growth by species and tree stem growth is sensitive to environmental changes

- To understand and predict changes in forests, it is necessary to understand the characteristics of each species.

- Studies on the correlation analysis of annual diameter growth and environmental factors are being actively conducted in many countries.

- Due to the environmental difference in each region, there are different times when the environmental factors affect the radial growth.

⇒ To find out about the species-specific effects of envirotnments to temperate species in South Korea

Objectives

1) **To analyze the annual variation in radial growth of temperate tree species in Korea**

2) **To figure out species-specific climatic factors that limit radial growth**

Mt.

Mt. Taehwa

- Study site: Mt. Taehwa, Mt. Gwangneung

- Install hand-made dendrometer band

- Tree species

  Pinus koraiensis, Abies holophylla, Quercus aliena,

  Q. variabilis, Q. serrata, Carpinus laxiflora, C. cordata

- Initial Time : *P. koraiensis* : 2011 November

  Etc : 2012 November

- Periods: 2013 to 2019 (Mar to Dec)

- Envrionmeantal variables: Air temperature, Relative Humidity,

  PAR, Precipitation

- Correlation analyzed between environmental variables and

  annual diameter growth by species monthly.

3.1. Correlation between environment factor and radial growth
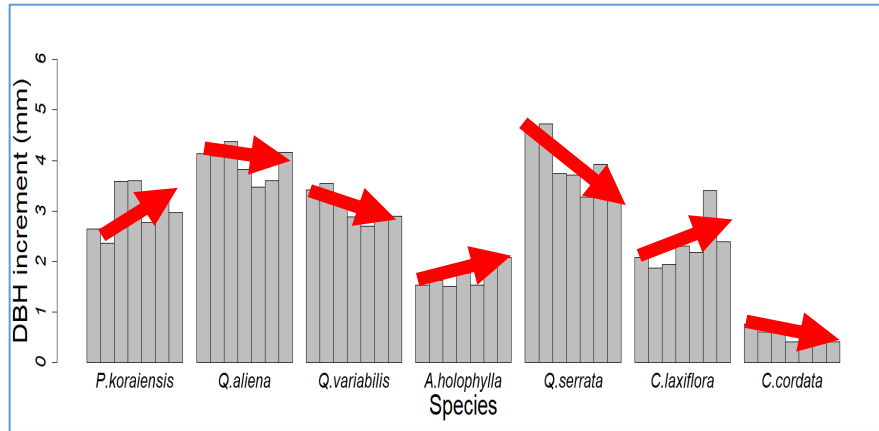
A.holophylla

C.laxiflora

A.holophylla to P_JAN

C. Laxiflora to P_Apr-JUN

$R^2 = 0.641$
$p = 0.031$

$R^2 = 0.67$
$p = 0.024$
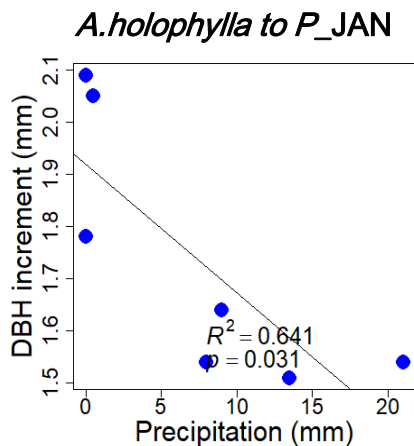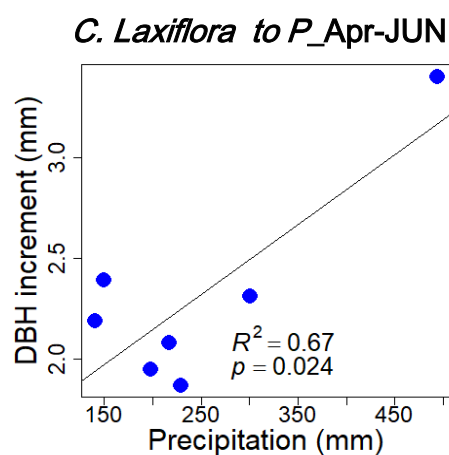
✓ Even in the same environment, different annual stem growth patterns are shown depending on the species.

✓ Negative correlation with winter precipitation(*A. holophylla*).

⇒ Winter Rainfall affect badly to needle fir's radial growth (lower soil temperature and radiation)

✓ Positive correlation with precipitation in the spring or summer of the current year that growth occurs.

⇒ Growth increases with more summer precipitation (Rolland et al. 1999, Macias et al. 2006, Marco et al. 2010, Latreille et al. 2017, Gazol et al. 2015)

3.1. Correlation between environment factor and radial growth

P. koraiensis

MAT (℃)

P.koraiensis to MAT_p5-p7

Precipitation (mm)

P.koraiensis to P_p4-p7

$R^2 = 0.656$
$p = 0.027$

$R^2 = 0.791$
$p = 0.0073$

Oaks

Q.variabilis to P_sep

$R^2 = 0.782$
$p = 0.0082$

Q.serrata to P_sep

$R^2 = 0.728$
$p = 0.031$

Q.aliena to P_sep-oct

$R^2 = 0.467$
$p = 0.091$
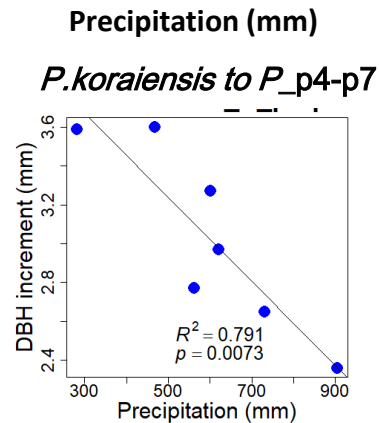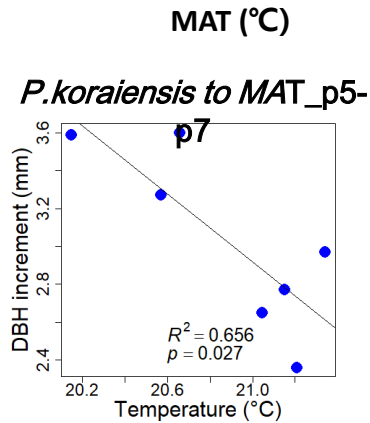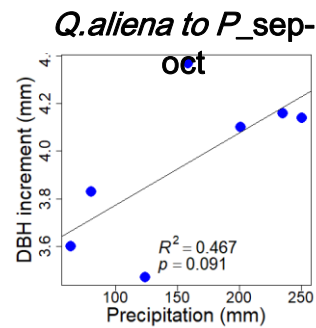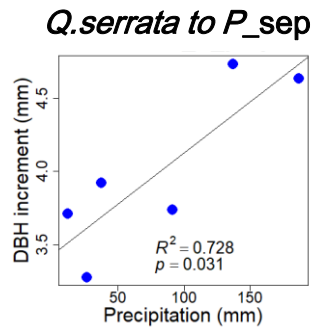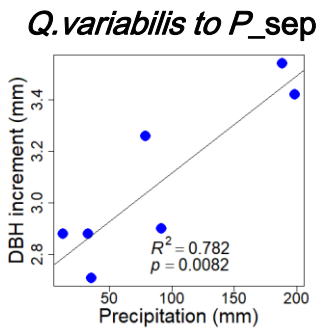
✓ Negative correlation with MAT and Precipitation in previous summer(*P. koraiensis*).

✓ Positively correlated to precipitation in previous autumn(Oak trees)

⇒ Affect carbohydrates storage

⇒ Substantial carry-over effect on radial growth, especially for fixed growth species.

❖ The major envrionmeantal limiting factor for the most of the species is *Precipitation*.

❖ Different species have **different environmental factors and time of year** that affect annual radial growth, and the environment in the previous year affect the tree radial growth of the following year.

❖ Tree species with fixed growth type have been mainly affected by the environment of the previous year, while of free growth species usually affected by the current year environment on their radial growth.

P. koraiensis

MAT (℃)

	p1	p2	p3	p4	p5	p6	p7	p8	p9	p10	p11	p12	t1	t2	t3	t4	t5	t6	t7	t8	t9
p1	0.8642	0.8	0.8052	0.7915	0.7701	0.7207	0.6673	0.4092	0.3441	0.3316	0.4584	0.3874	0.3177	0.2751	0.2922	0.3074	0.319	0.3587	0.4053	0.5046	0.5128
p2		0.6875	0.664	0.6766	0.6579	0.5689	0.4171	0.0932	0.0821	0.0565	0.2589	0.2295	0.1721	0.1382	0.1568	0.1881	0.2044	0.2428	0.2837	0.3844	0.3924
p3			0.4127	0.521	0.5008	0.3271	0.0631	-0.211	-0.173	-0.226	0.0555	0.0809	0.0383	0.0136	0.035	0.0829	0.104	0.1408	0.177	0.2817	0.2895
p4				0.5184	0.4563	0.1633	-0.216	-0.441	-0.365	-0.445	-0.07	-6E-04	-0.038	-0.058	-0.034	0.026	0.051	0.0874	0.1223	0.234	0.2434
p5					0.?5	-0.601	-0.81	-0.716	-0.61	-0.6	-0.282	-0.14	-0.156	-0.162	-0.135	-0.066	-0.038	-0.008	0.0164	0.1186	0.1304
p6						-0.823	-0.771	-0.703	-0.603	-0.6	-0.285	-0.145	-0.159	-0.164	-0.137	-0.068	-0.041	-0.012	0.0125	0.1128	0.1242
p7							-0.535	-0.597	-0.49	-0.5	-0.149	-0.049	-0.079	-0.092	-0.066	-0.004	0.0213	0.0548	0.0859	0.191	0.1994
p8								-0.602	-0.413	-0.4	0.0342	0.0724	0.02	-0.004	0.02	0.0731	0.0958	0.1336	0.1739	0.2886	0.2957
p9									0.0234	-0.0	0.4166	0.2924	0.1949	0.1457	0.1649	0.1972	0.2156	0.2582	0.3122	0.4341	0.4394
p10										-0.1?	0.5507	0.3455	0.2252	0.1656	0.1858	0.2178	0.2366	0.2825	0.3449	0.4747	0.4757
p11											0.6355	0.395	0.2619	0.1978	0.2184	0.2481	0.2654	0.3157	0.3843	0.5157	0.5102
p12												0.1198	0.0059	-0.015	0.0214	0.0959	0.1262	0.1807	0.2455	0.4067	0.407
t1													-0.165	-0.123	-0.057	0.0696	0.1139	0.1887	0.2891	0.4986	0.4812
t2														-0.074	0.0351	0.1686	0.2205	0.3198	0.4331	0.5587	0.5308
t3															0.1568	0.265	0.3342	0.45	0.506	0.5568	0.5359
t4																0.297	0.3806	0.5276	0.6105	0.6226	0.5921
t5																	0.5006	0.5633	0.4864	0.4879	0.4619
t6																		0.3504	0.2999	0.3959	0.387
t7																			0.1717	0.3475	0.3375
t8																				0.4502	0.3895
t9																					0.1607
t10																					
t11																					
t12																					

Precipitation (mm)

	p1	p2	p3	p4	p5	p6	p7	p8	p9	p10	p11	p12	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11	t12
p1	0.305	0.027	-0.531	-0.471	-0.495	-0.529	-0.914	-0.764	-0.823	-0.814	-0.757	-0.778	-0.791	-0.770	-0.734	-0.676	-0.561	-0.564	-0.604	-0.658	-0.653	-0.617	-0.591	-0.581
p2		-0.148	-0.566	-0.475	-0.503	-0.539	-0.923	-0.774	-0.830	-0.819	-0.765	-0.786	-0.799	-0.778	-0.743	-0.687	-0.572	-0.573	-0.606	-0.657	-0.652	-0.617	-0.591	-0.582
p3			-0.581	-0.427	-0.504	-0.530	-0.913	-0.759	-0.813	-0.803	-0.749	-0.770	-0.782	-0.760	-0.724	-0.664	-0.548	-0.549	-0.579	-0.635	-0.632	-0.597	-0.569	-0.559
p4				-0.320	-0	-0.502	-0.890	-0.726	-0.793	-0.7	-0.730	-0.752	-0.765	-0.742	-0.701	-0.629	-0.506	-0.508	-0.551	-0.608	-0.612	-0.574	-0.545	-0.534
p5					-4	-0.495	-0.849	-0.671	-0.763	-0.7	-0.716	-0.741	-0.754	-0.732	-0.687	-0.596	-0.465	-0.469	-0.545	-0.593	-0.606	-0.561	-0.529	-0.517
p6						-0.326	-0.716	-0.563	-0.678	-0.7	-0.638	-0.661	-0.673	-0.645	-0.591	-0.473	-0.342	-0.349	-0.407	-0.466	-0.501	-0.456	-0.420	-0.405
p7							-0.695	-0.542	-0.684	-0.7	-0.657	-0.679	-0.693	-0.665	-0.601	-0.464	-0.320	-0.329	-0.384	-0.438	-0.481	-0.435	-0.397	-0.381
p8								0.207	-0.340	-0.2	-0.084	-0.109	-0.137	-0.074	-0.004	0.216	0.257	0.192	0.040	-0.106	-0.208	-0.146	-0.074	-0.044
p9									-0.733	-0.6	-0.350	-0.395	-0.416	-0.320	-0.241	0.107	0.197	0.120	-0.039	-0.167	-0.263	-0.211	-0.142	-0.112
p10										0.245	0.436	0.412	0.401	0.444	0.527	0.797	0.618	0.546	0.199	0.050	-0.074	-0.008	0.069	0.102
p11											0.374	0.336	0.300	0.363	0.428	0.626	0.476	0.409	0.149	0.008	-0.109	-0.046	0.027	0.059
p12												-0.128	-0.257	0.120	0.352	0.552	0.400	0.309	0.078	-0.056	-0.165	-0.107	-0.037	-0.007
t1													-0.262	0.306	0.428	0.577	0.414	0.319	0.087	-0.051	-0.163	-0.103	-0.032	-0.001
t2														0.543	0.455	0.602	0.428	0.336	0.099	-0.042	-0.155	-0.094	-0.022	0.009
t3															0.333	0.547	0.396	0.301	0.073	-0.066	-0.177	-0.117	-0.045	-0.015
t4																0.590	0.399	0.285	0.042	-0.095	-0.208	-0.148	-0.075	-0.043
t5																	0.235	0.100	-0.080	-0.207	-0.311	-0.259	-0.185	-0.153
t6																		-0.219	-0.170	-0.294	-0.400	-0.361	-0.276	-0.244
t7																			-0.137	-0.277	-0.396	-0.355	-0.269	-0.232
t8																				-0.379	-0.615	-0.427	-0.249	-0.196
t9																					-0.481	-0.201	0.059	0.172
t10																						0.426	0.590	0.728
t11																							0.420	0.598
t12																								0.622

Q. variabilis   Q. serrata   Q. aliena