Genetic parameters of growth and adaptive traits for aspen (*Populus tremuloides*): implications for tree breeding

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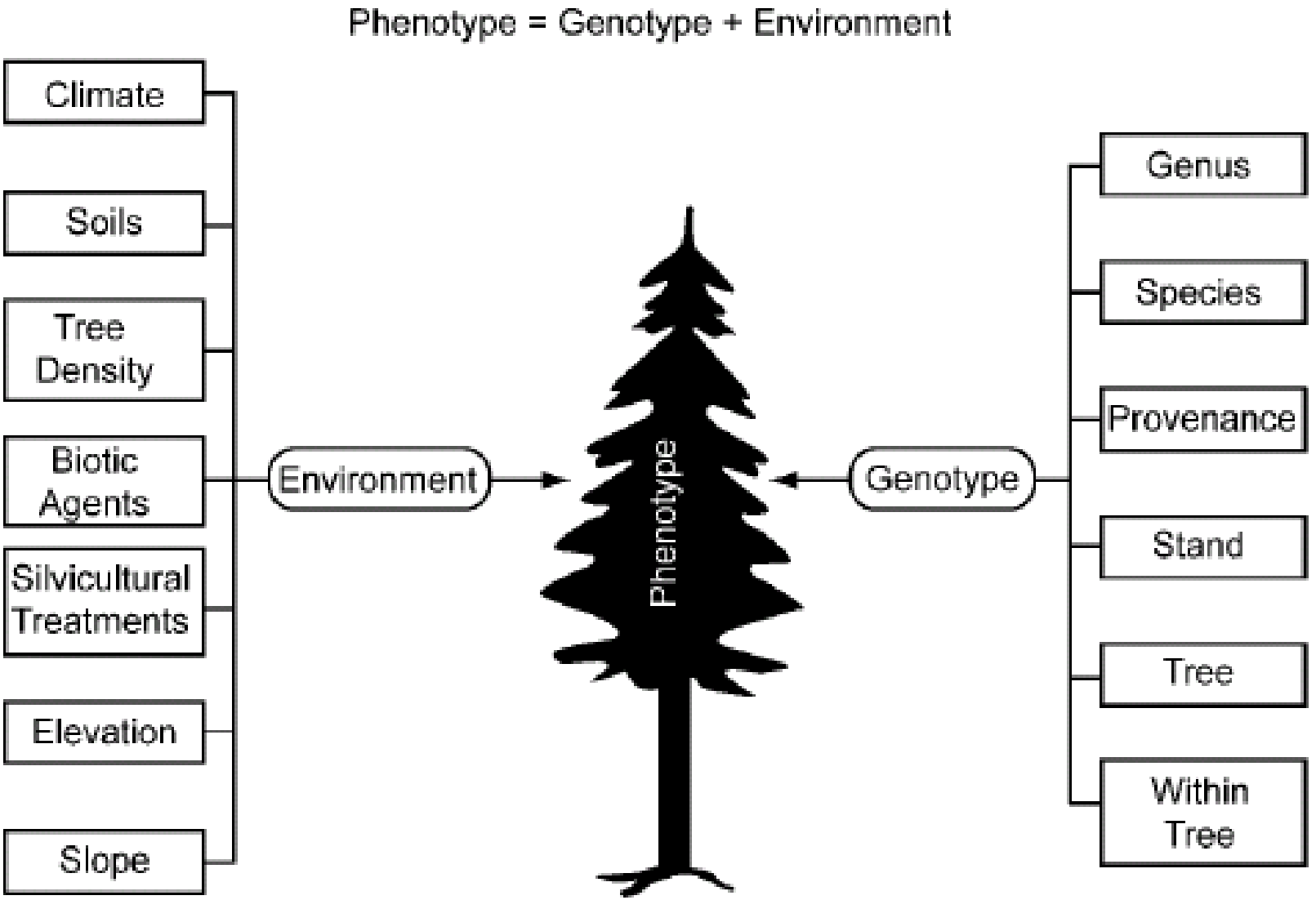
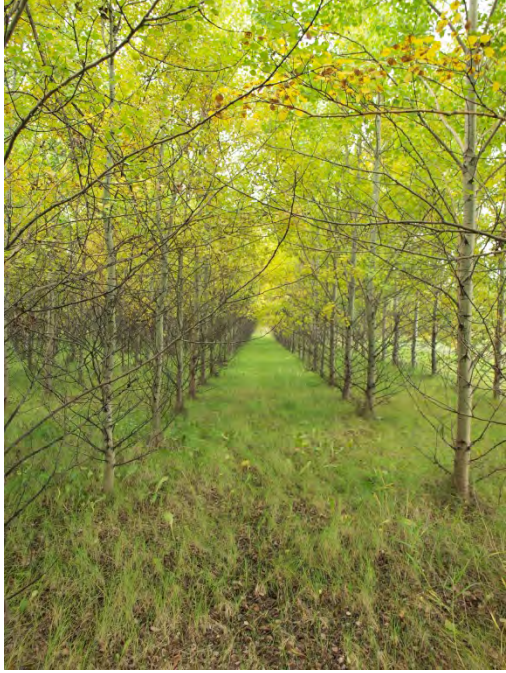
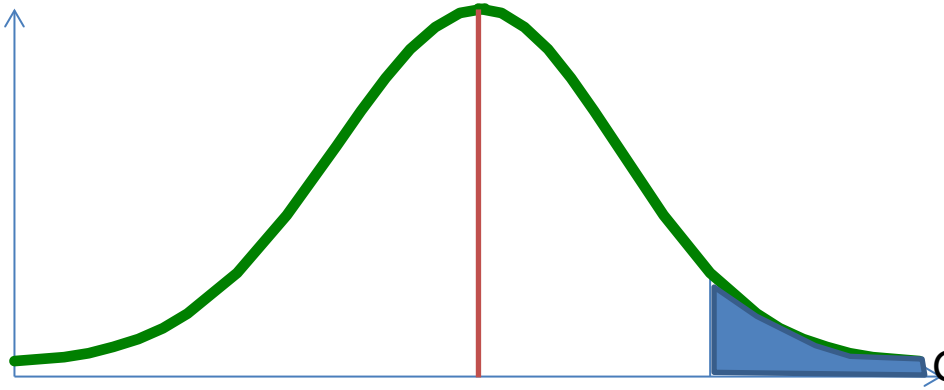
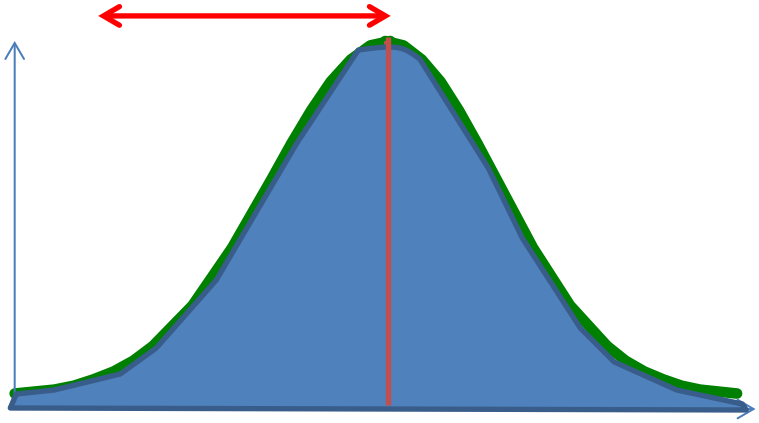


White et al., 2007. Forest genetics. CAB International, London, UK.

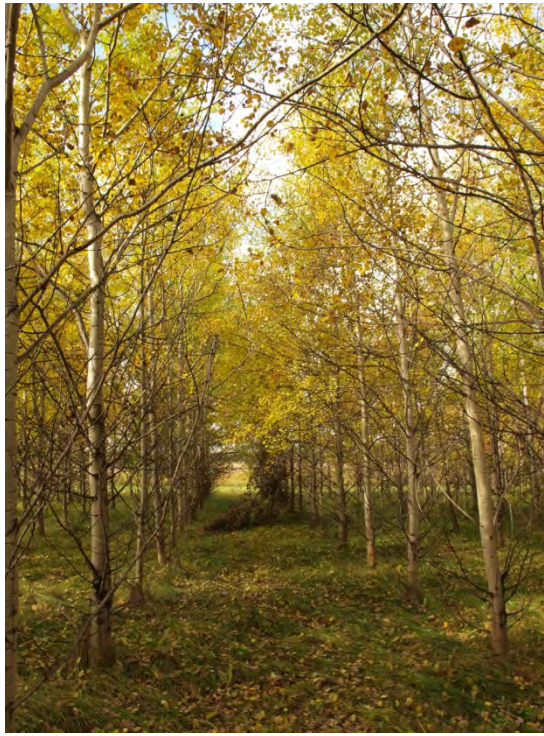
Selection and breeding for height

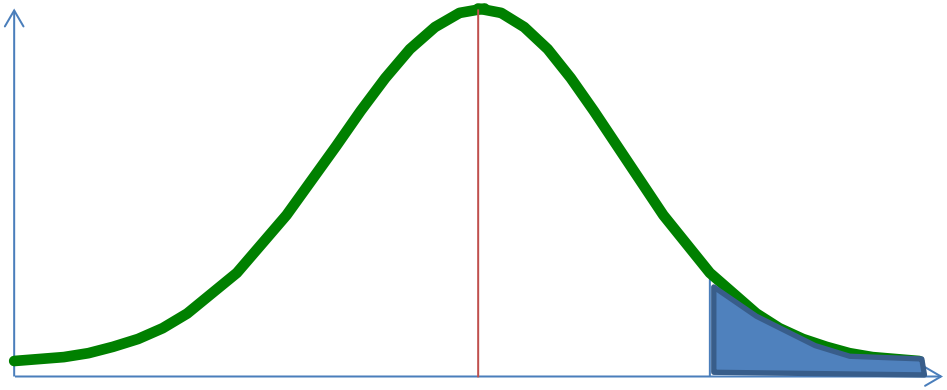


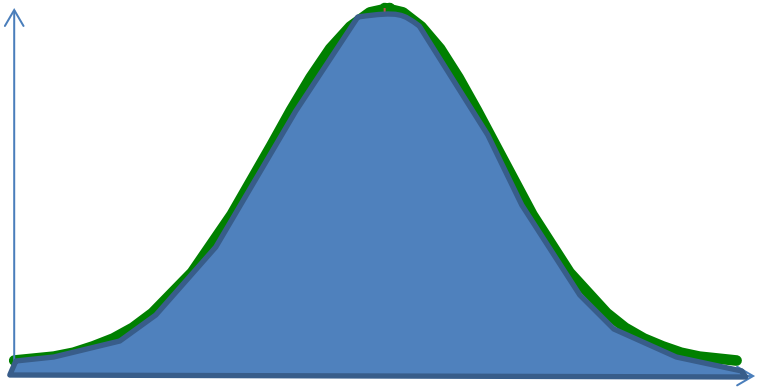




Adaptive trait response

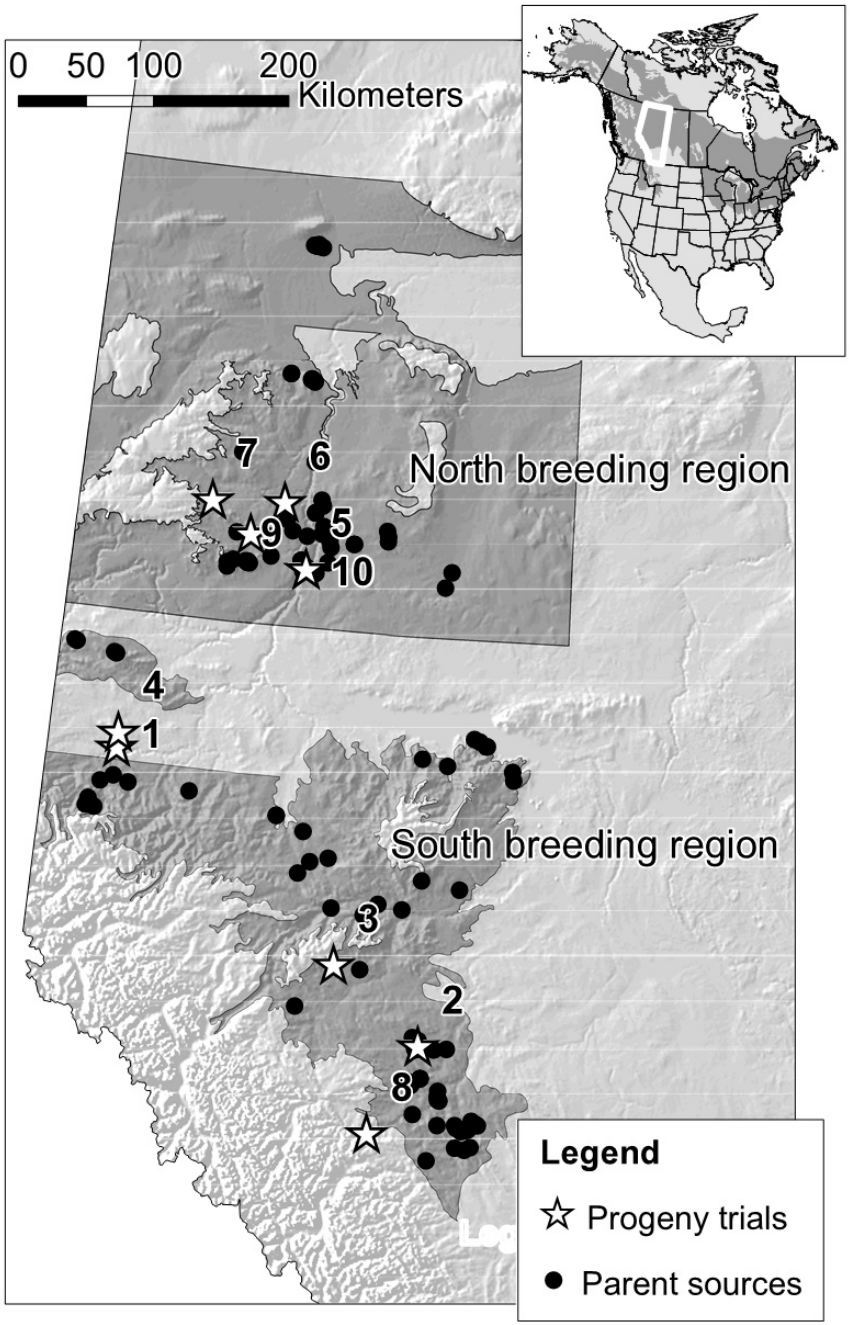




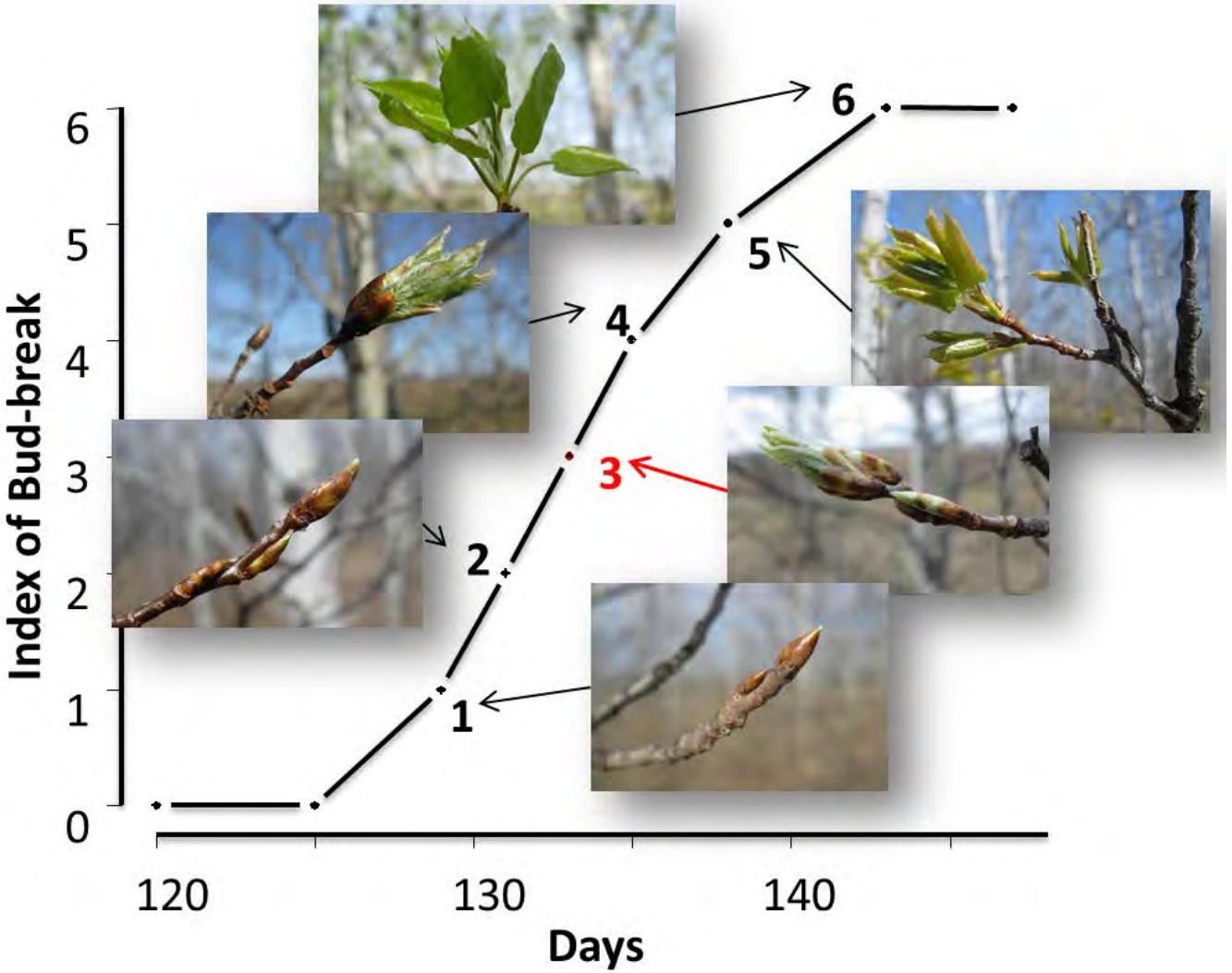


Questions

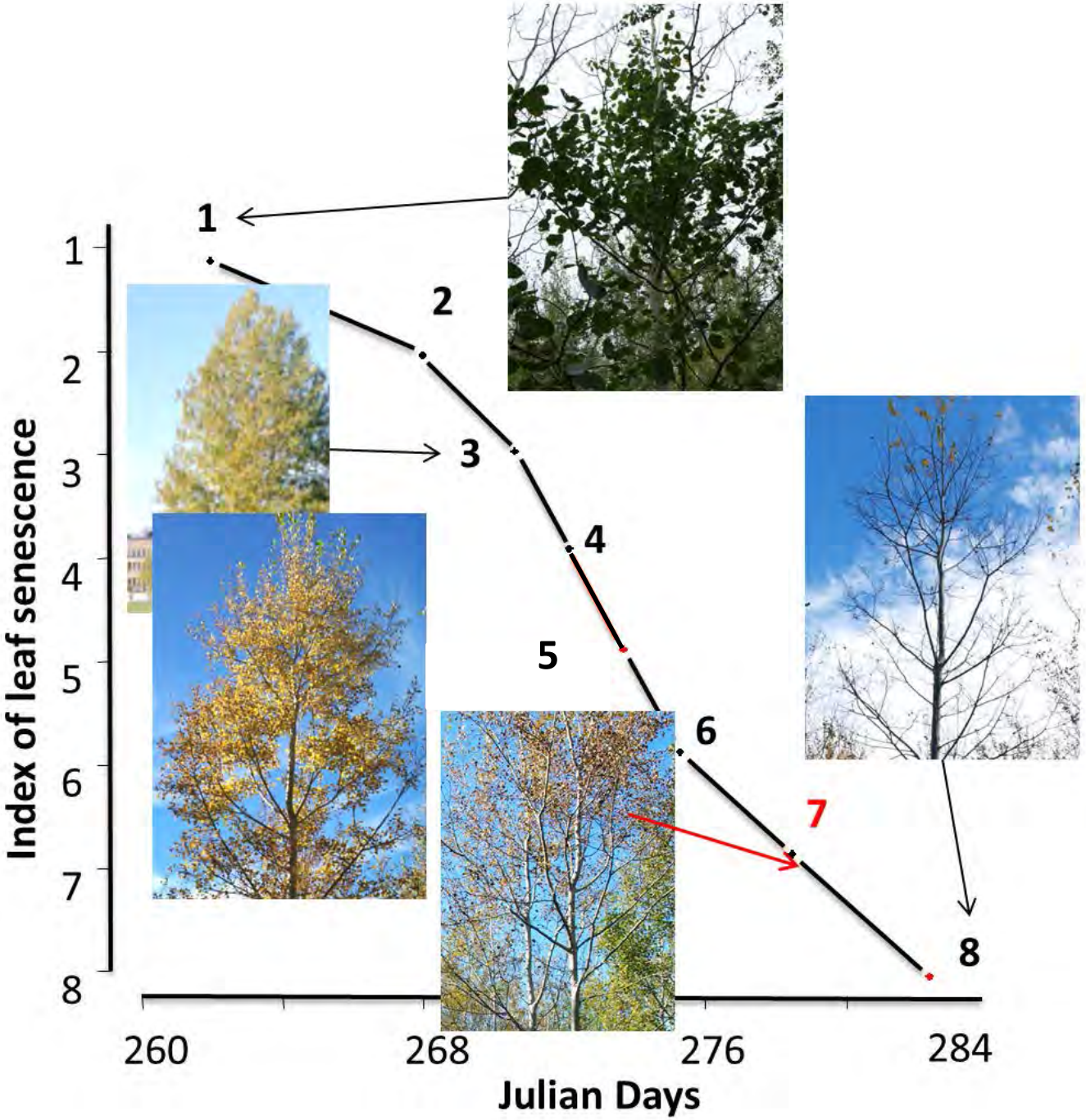
- Genetic parameters and potential for the improvement of height
- Consequences of selection—adaptive trait responses
- Spatial patterns of parental breeding values
- *Populus tremuloides* as an example tree species


0 50 100 200
Kilometers
North breeding region
South breeding region
7
6
5
9
10
4
1
3
2
8
Legend
Progeny trials
Parent sources

Progeny trials – Measurements
Bud break



Fall leaf senescence

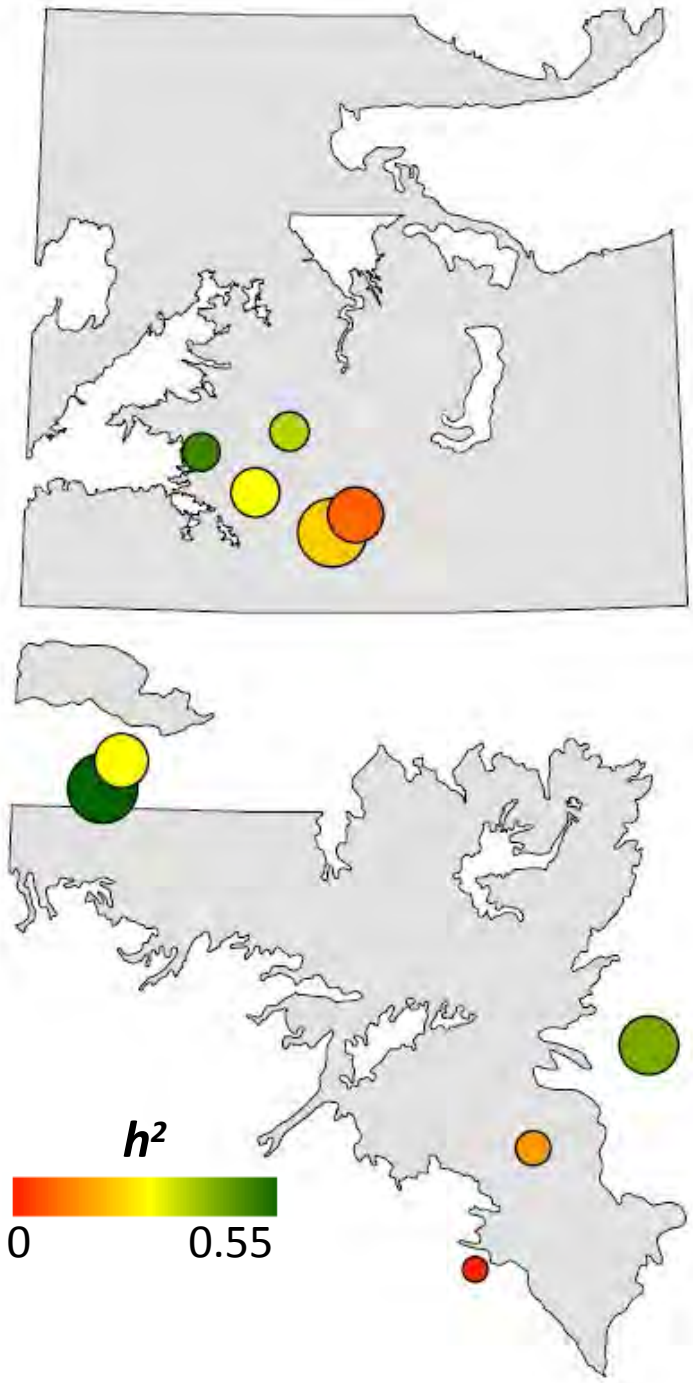


Phenotypic effect= Genotypic effect+ Environmental effect

Genetic effect= Additive + Non-additive

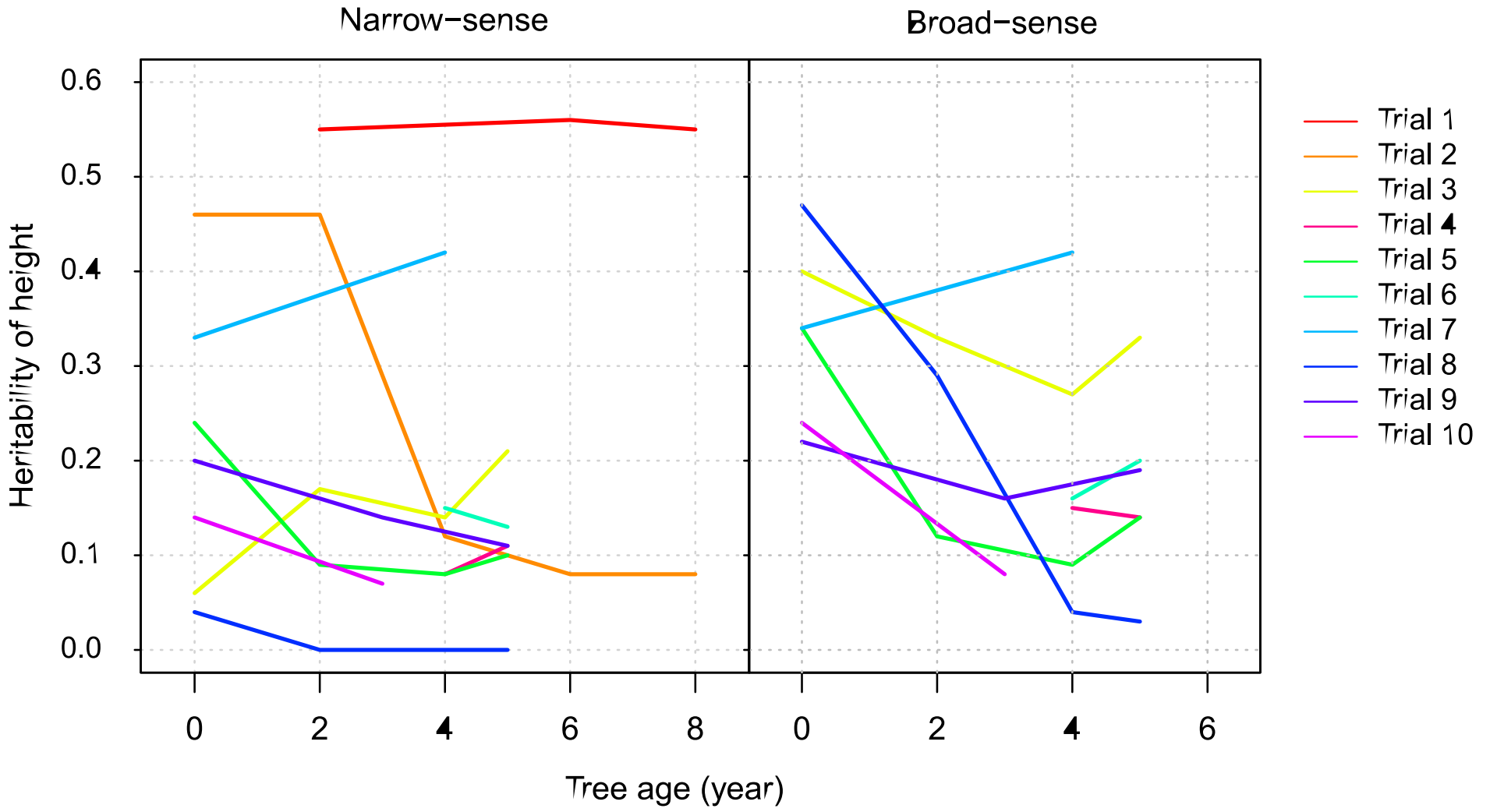
Heritability = $V_{Genotypic} / V_{Phenotypic}$

Trial Code[1]	Age of Measurement	Narrow-sense heritability ($\hat{h}^2$)		Broad-sense heritability ($\hat{H}^2$)	
		Height	DBH	Height	DBH
Southern Breeding Region					
01-81-05	8	0.55 (0.16)	0.54 (0.17)		
02-35-05	8	0.08 (0.10)	0.03 (0.09)		
03-36-07	5	0.21 (0.08)	0.19 (0.07)	0.33 (0.03)	0.25 (0.02)
04-83-07	5	0.11 (0.05)		0.14 (0.02)	
08-37-07	5	No estimate		0.03 (0.03)	
Northern Breeding Region					
05-11-07	5	0.10 (0.03)	0.06 (0.03)	0.14 (0.02)	0.09 (0.02)
06-10-07	5	0.13 (0.04)		0.20 (0.02)	
07-13-07	4	0.42 (0.45)		0.42 (0.22)	
09-13-08	5	0.11 (0.06)	0.14 (0.05)	0.19 (0.02)	0.17 (0.02)
10-11-08	3	0.07 (0.03)		0.08(0.02)	


h²
0
0.55

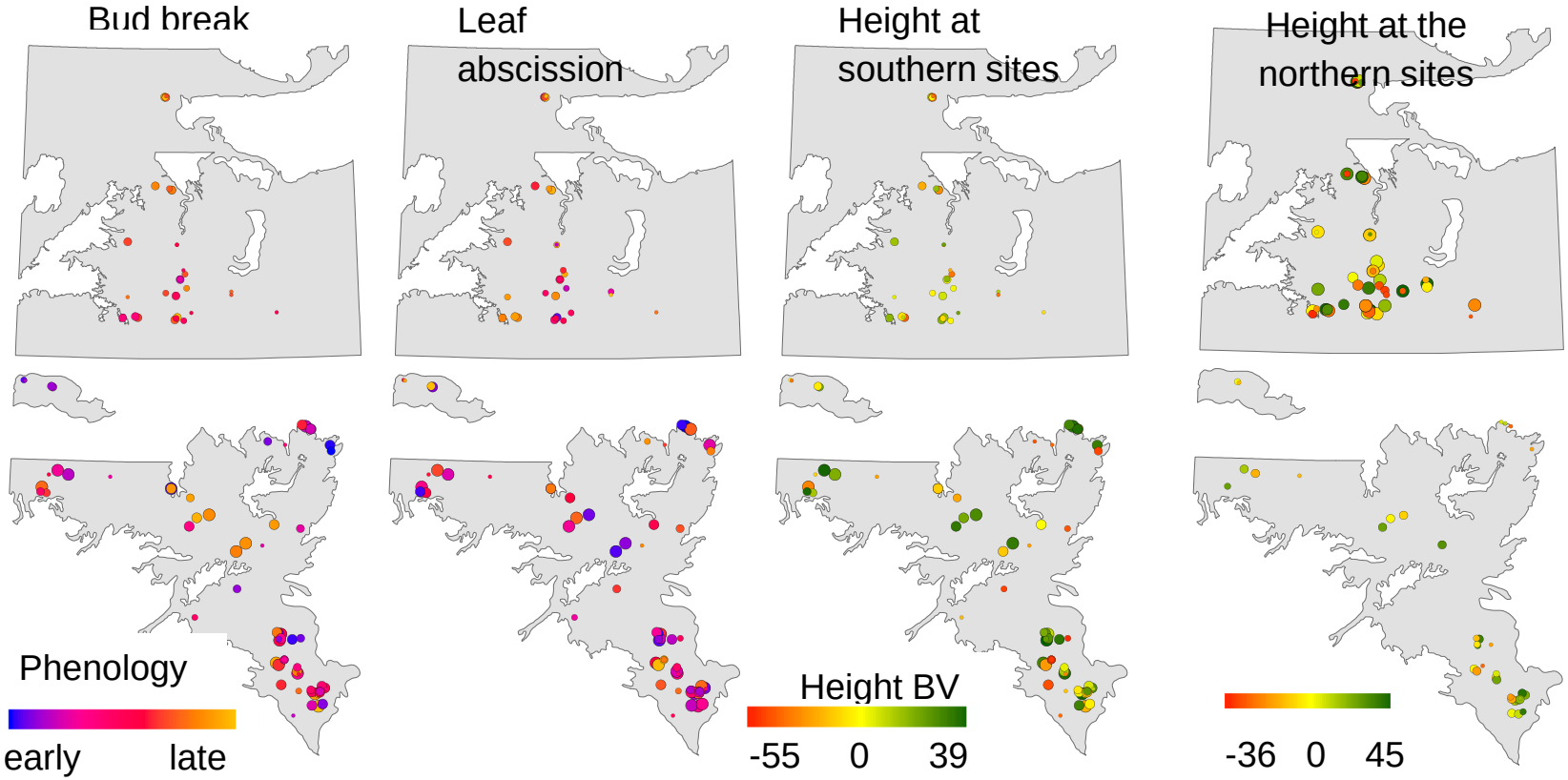
Phenology

Trial Code	Age of Measurement	Narrow-sense heritability ($\hat{h}^2$)		Broad-sense heritability ($\hat{H}^2$)	
		Bud break	Leaf abscission	Bud break	Leaf abscission
02-35-05	7,8	0.46 (0.15)	0.33 (0.14)		
03-36-07	4,5	0.37 (0.10)	0.42 (0.10)	0.46 (0.03)	0.46 (0.03)
08-37-07	4,5	0.36 (0.07)	no estimate	0.36 (0.07)	0.05 (0.05)


Narrow−sense
Broad−sense
Heritability of height
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
2
4
6
8
Tree age (year)
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5
Trial 6
Trial 7
Trial 8
Trial 9
Trial 10

Growth and adaptive traits correlations

	Trial 02-35-05		Trial 03-36-07		Trial 08-37-07	
Correlation	Genetic	Phenotypic	Genetic	Phenotypic	Genetic	Phenotypic
HT - BUD	-0.30 (0.21)	-0.23 (0.06)	-0.19 (0.05)	-0.25 (0.02)	no estimate	-0.42 (0.05)
HT - LAB	0.83 (0.09)	0.57 (0.04)	0.58 (0.04)	0.37 (0.02)	no estimate	0.28 (0.06)
BUD - LAB	-0.08 (0.22)	-0.05 (0.07)	0.15 (0.07)	0.00 (0.03)	no estimate	-0.20 (0.06)
SURV - BUD		-0.34 (0.09)		-0.07 (0.06)		-0.03 (0.20)
SURV - LAB		0.55 (0.11)		0.29 (0.04)		0.20 (0.12)
SURV - HT		0.58 (0.11)		0.42 (0.04)		0.00 (0.15)


Bud break
Leaf abscission
Height at southern sites
Height at the northern sites
Phenology
early
late
Height BV
-55
0
39
-36
0
45

Conclusions

- Growth and survival are associated with early budbreak and late leaf abscission(r=-0.3 and 0.7)
- Inadvertent selection
- No spatial pattern for breeding values
- Messages for practices

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