Climate-growth-relations of *Fagus sylvatica* provenances of the International Beech Provenance Experiment of 1993/95 growing in Central Europe

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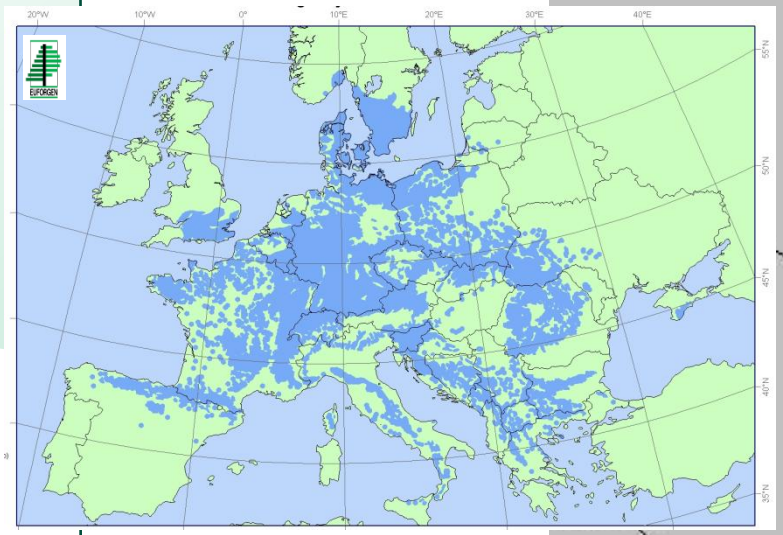
International Beech Provenance Experiment 1993/95

23 trial sites

126 provenances



International Beech Provenance Experiment 1993/95

Schädtbek (Schleswig-Holstein)
40 m asl
100 (49) provenances
before acre

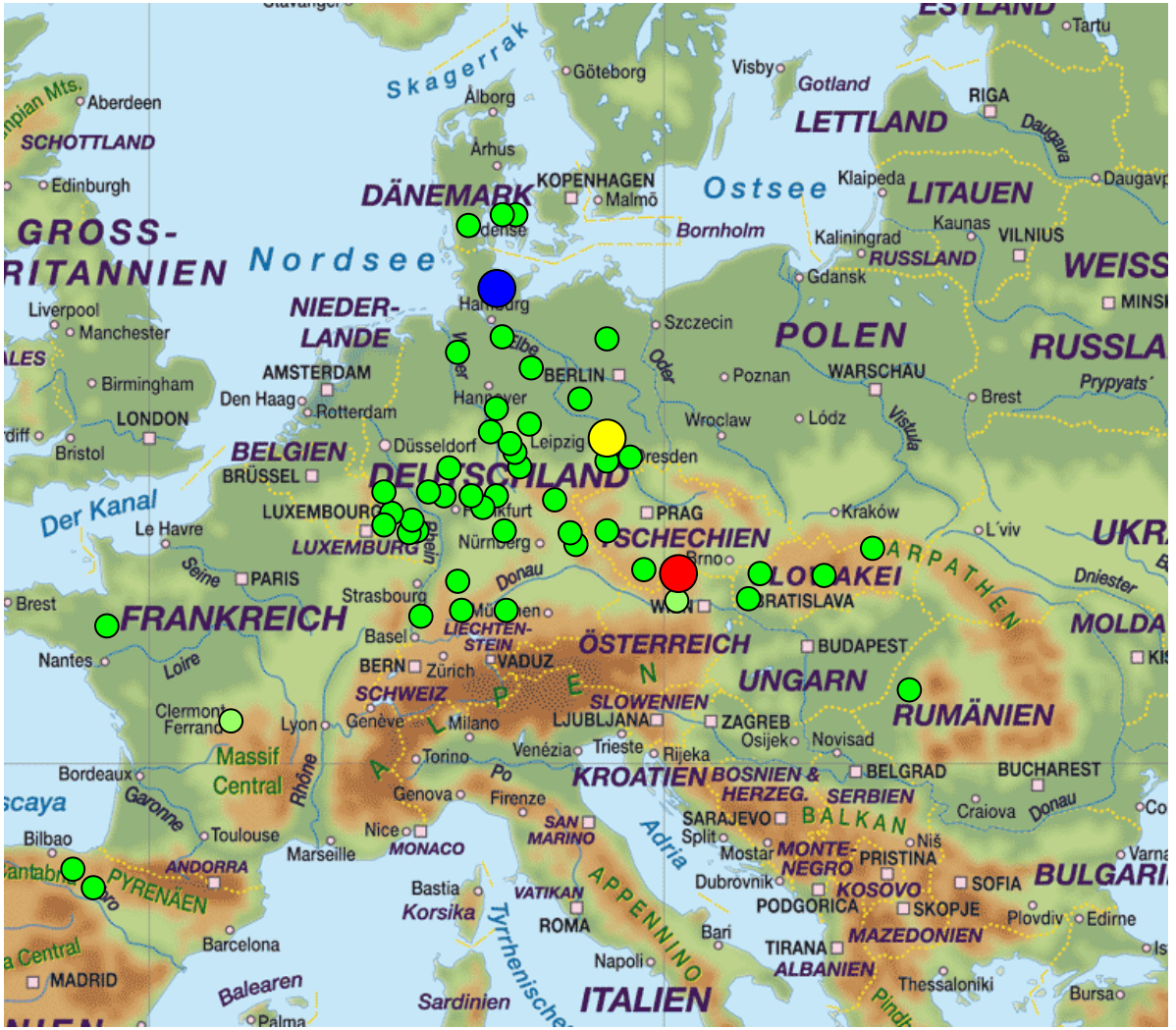
Malter (Saxony)
360 m asl
100 (47) provenances
before acre

Gablitz (Lower Austria)
350 m asl
49 provenances
before spruce forest

47 common provenances

2 ES
1 (+1) FR
3 DK
33 DE:
- 6 NI
- 2 BB
- 1 NW
- 5 HE
- 3 TH
- 2 SN
- 6 RP
- 3 BW
- 5 BY

(1 AT)
2 CZ
5 SK
1 RO



Climatic characteristics of the trial sites (1)

	Schädtbek	Malter	Gablitz
annual temperature	8,3 °C	7,8 °C	8,9 °C
temperature (V-IX)	14,6 °C	14,7 °C	16,6 °C
temperature (Jan.)	0,1 °C	-1,4 °C	-2,2 °C
temperature (July)	16,8 °C	16,8 °C	19,0 °C
temperature-range	16,7 °C	18,2 °C	21,2 °C
annual precipitation	729 mm	787 mm	729 mm
precipitation (V-IX)	354 mm	397 mm	395 mm

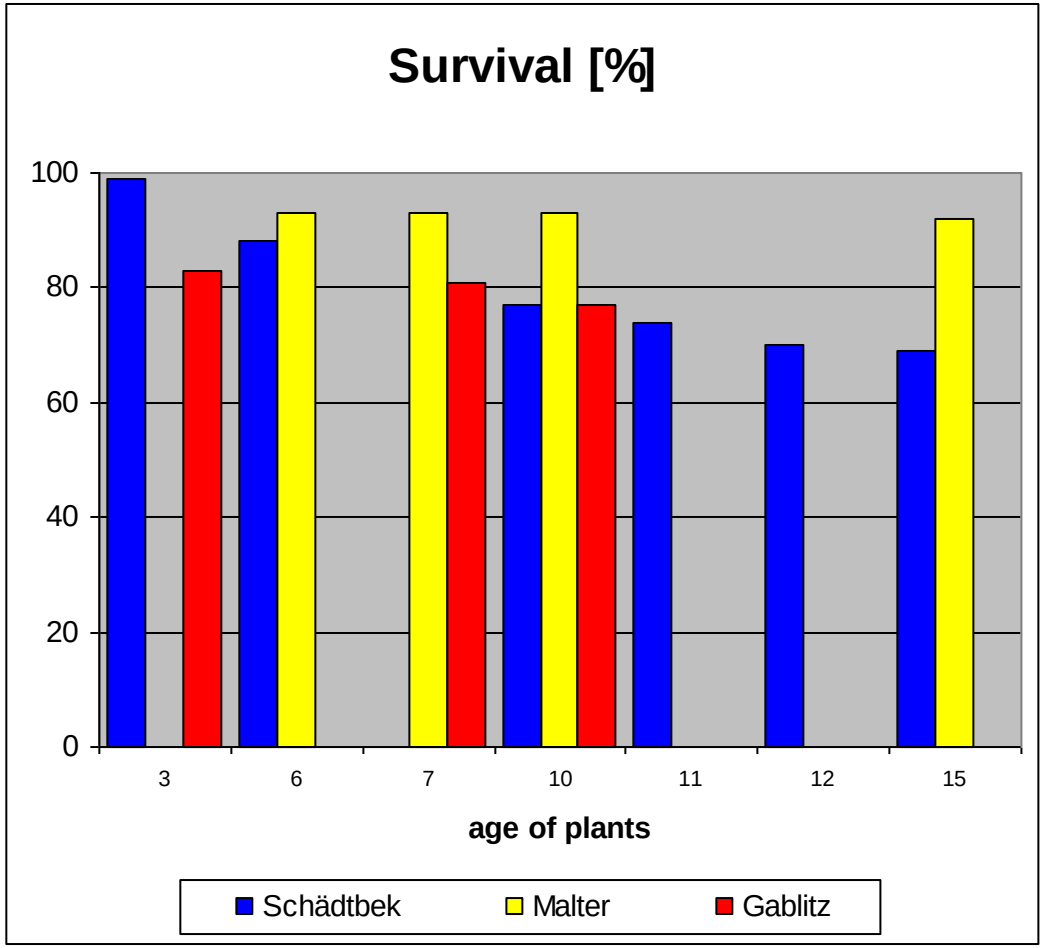
Climatic characteristics of the trial sites (2)

	Schädtbek	Malter	Gablitz
Aridity-index	Aridity-index annual precipitation / [annual temperature + 10]		
Continental I.	Continental index altitude / annual precipitation		
Climate-factor	Climate-factor by Amann annual precipitation * annual temperature / temp.-range		
Ellenberg-q.	Ellenberg-quotient temperature(July) *1000 / annual precipitation		

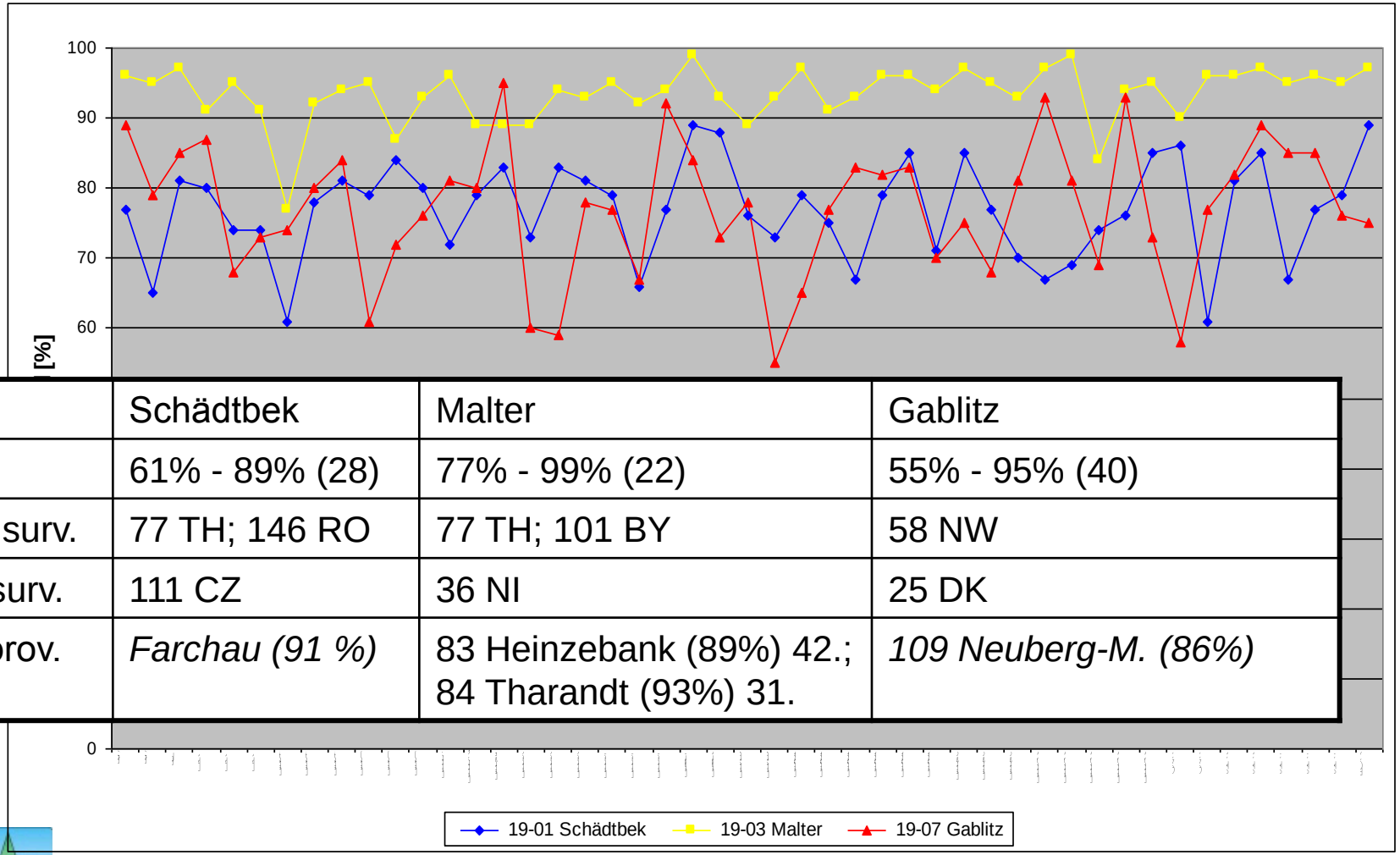
Survival

Schädbek (SH) and Gablitz (AT) decreasing

Malter (SN) constant

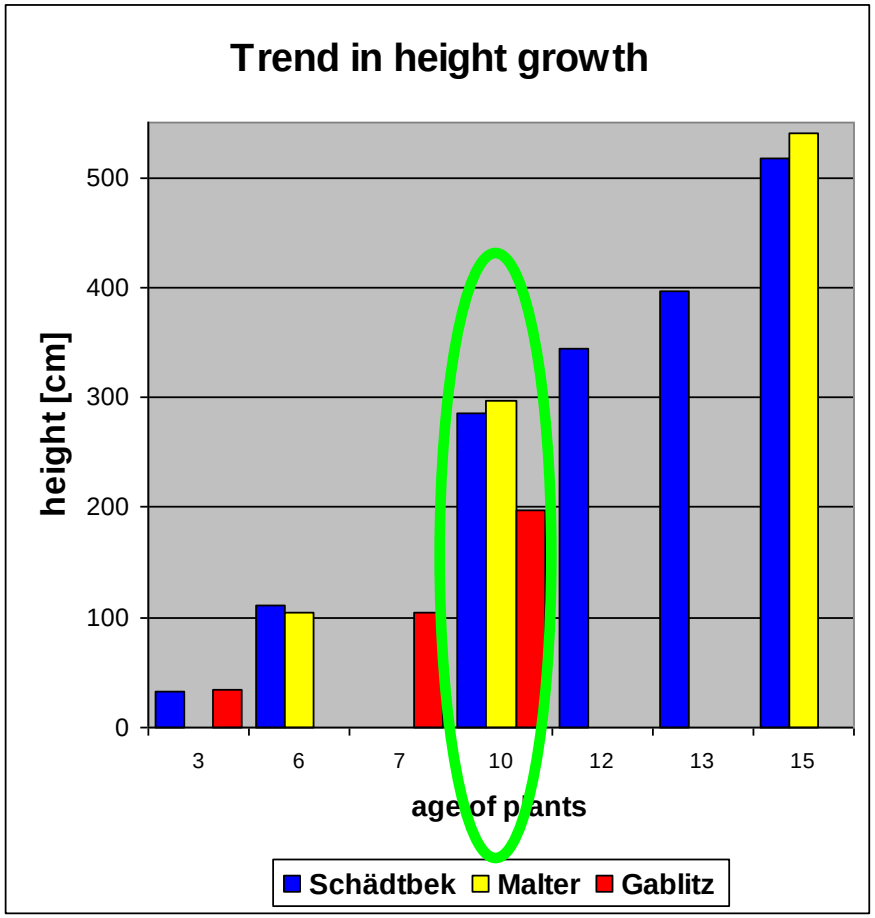


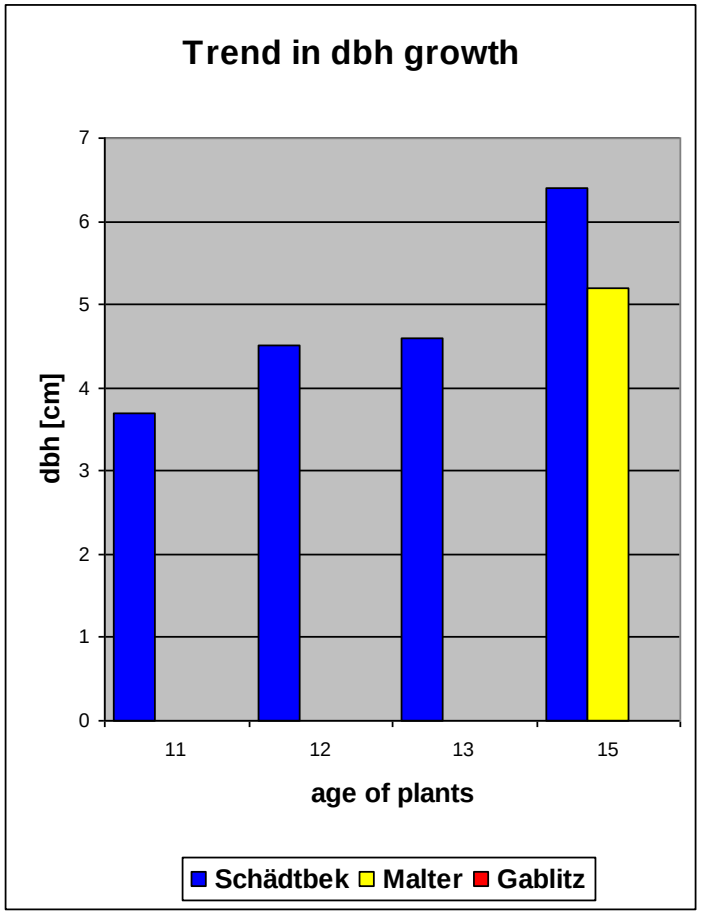
Survival, age 10 (47 provenances)



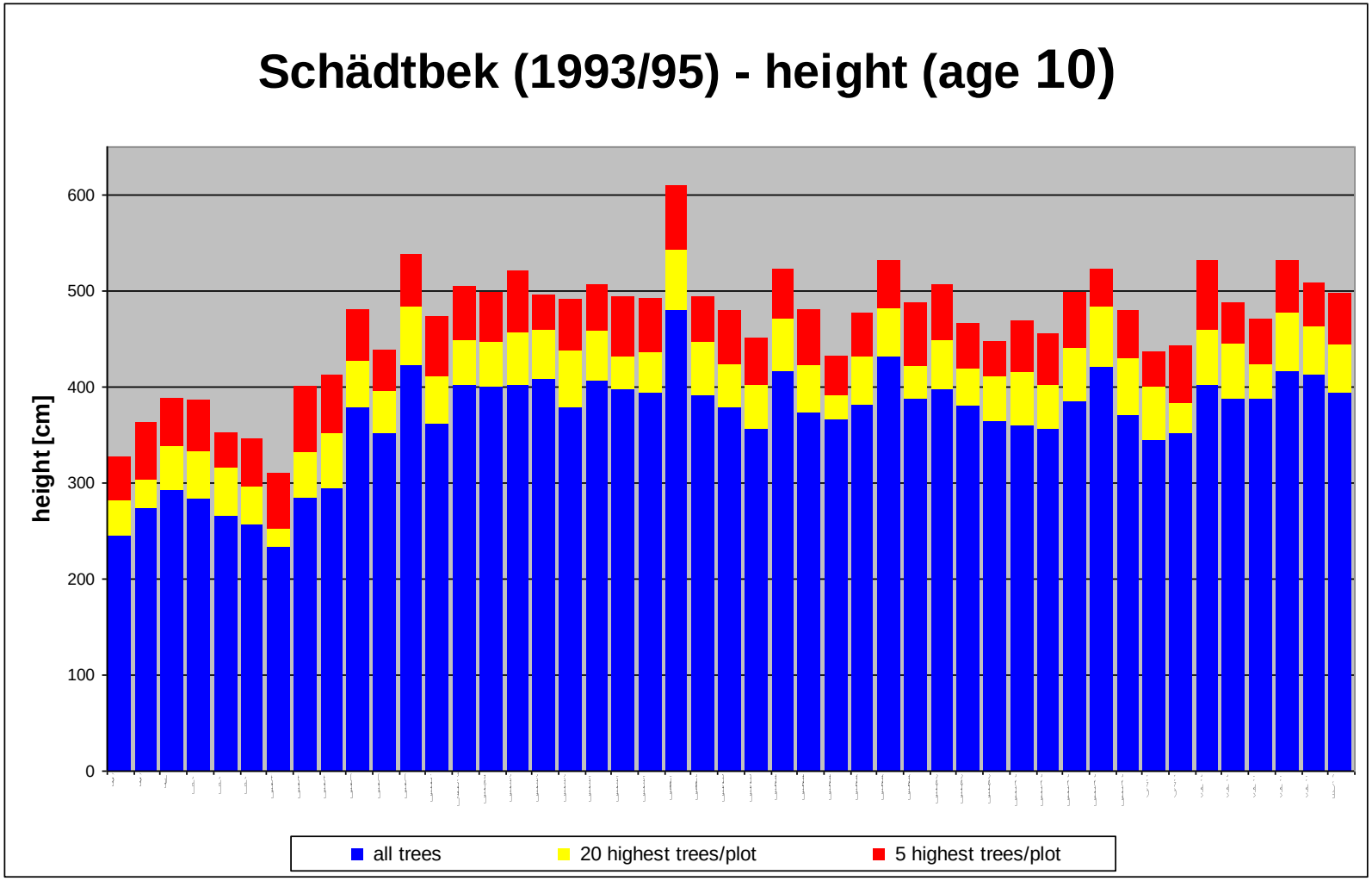
	Schädtbek	Malter	Gablitz
range	61% - 89% (28)	77% - 99% (22)	55% - 95% (40)
highest surv.	77 TH; 146 RO	77 TH; 101 BY	58 NW
lowest surv.	111 CZ	36 NI	25 DK
„local“ prov.	*Farchau (91 %)*	83 Heinzebank (89%) 42.; 84 Tharandt (93%) 31.	*109 Neuberg-M. (86%)*

Height and dbh growth

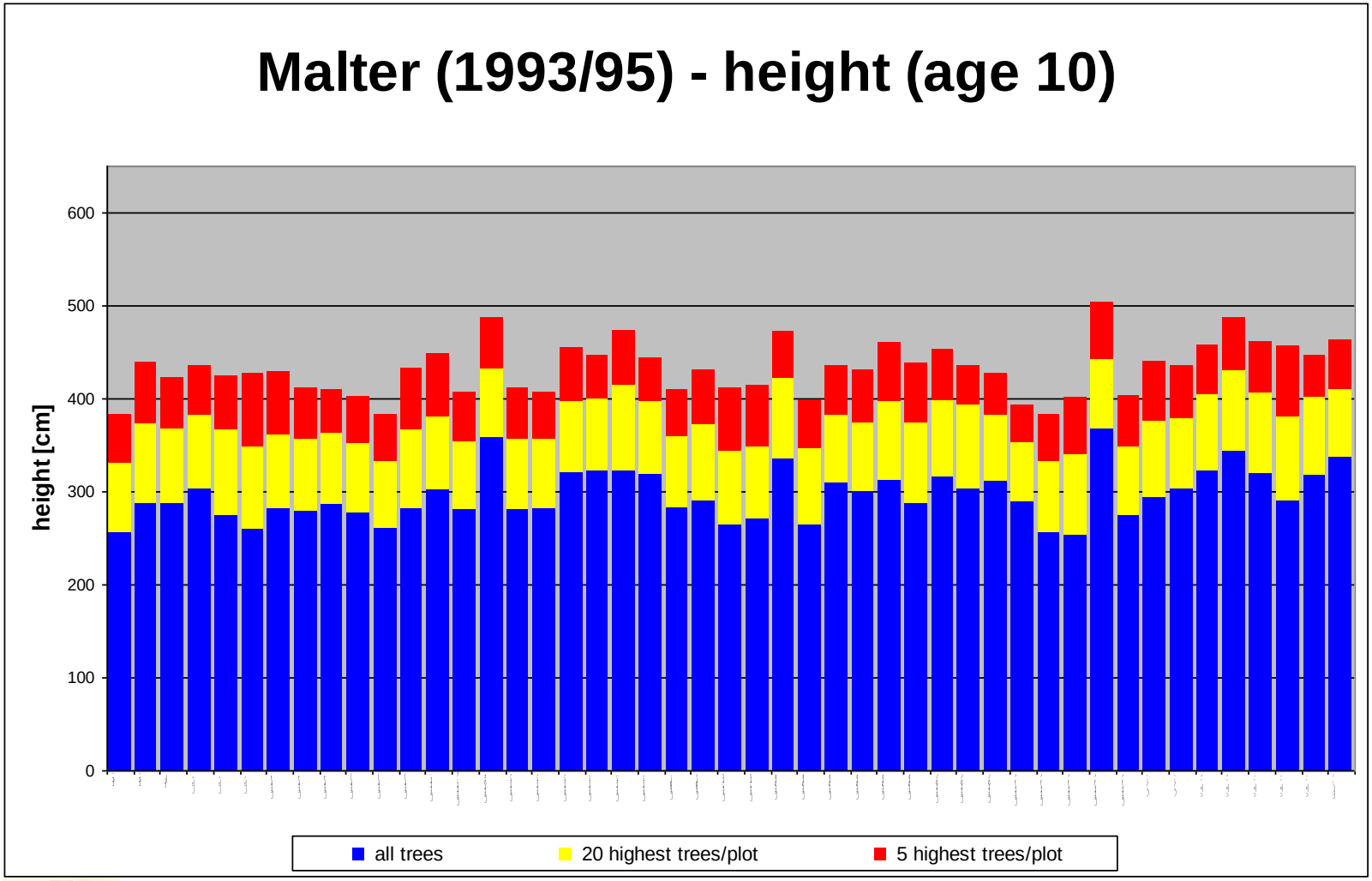




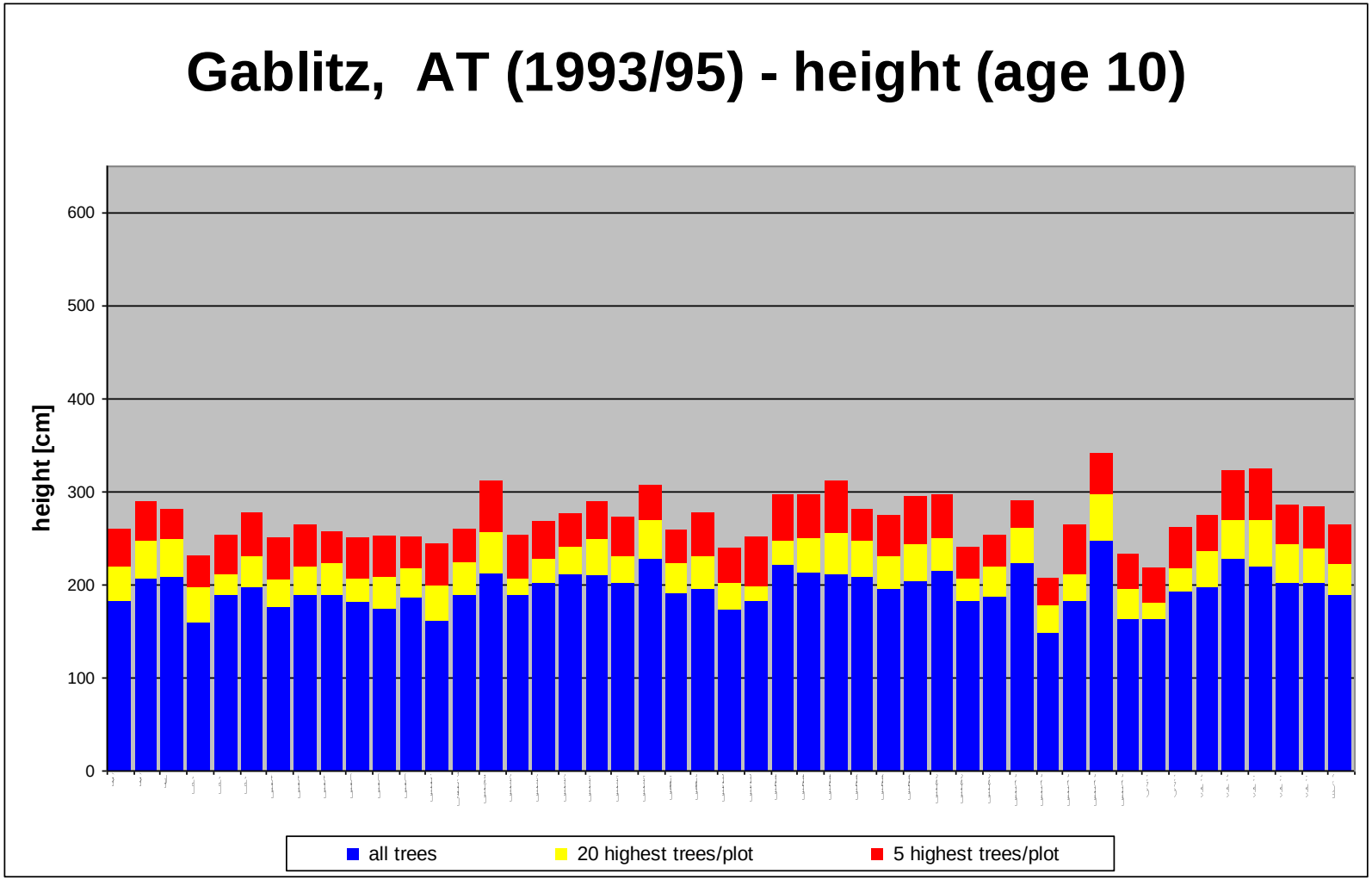
Height growth (1)



Height growth (2)



Height growth (3)

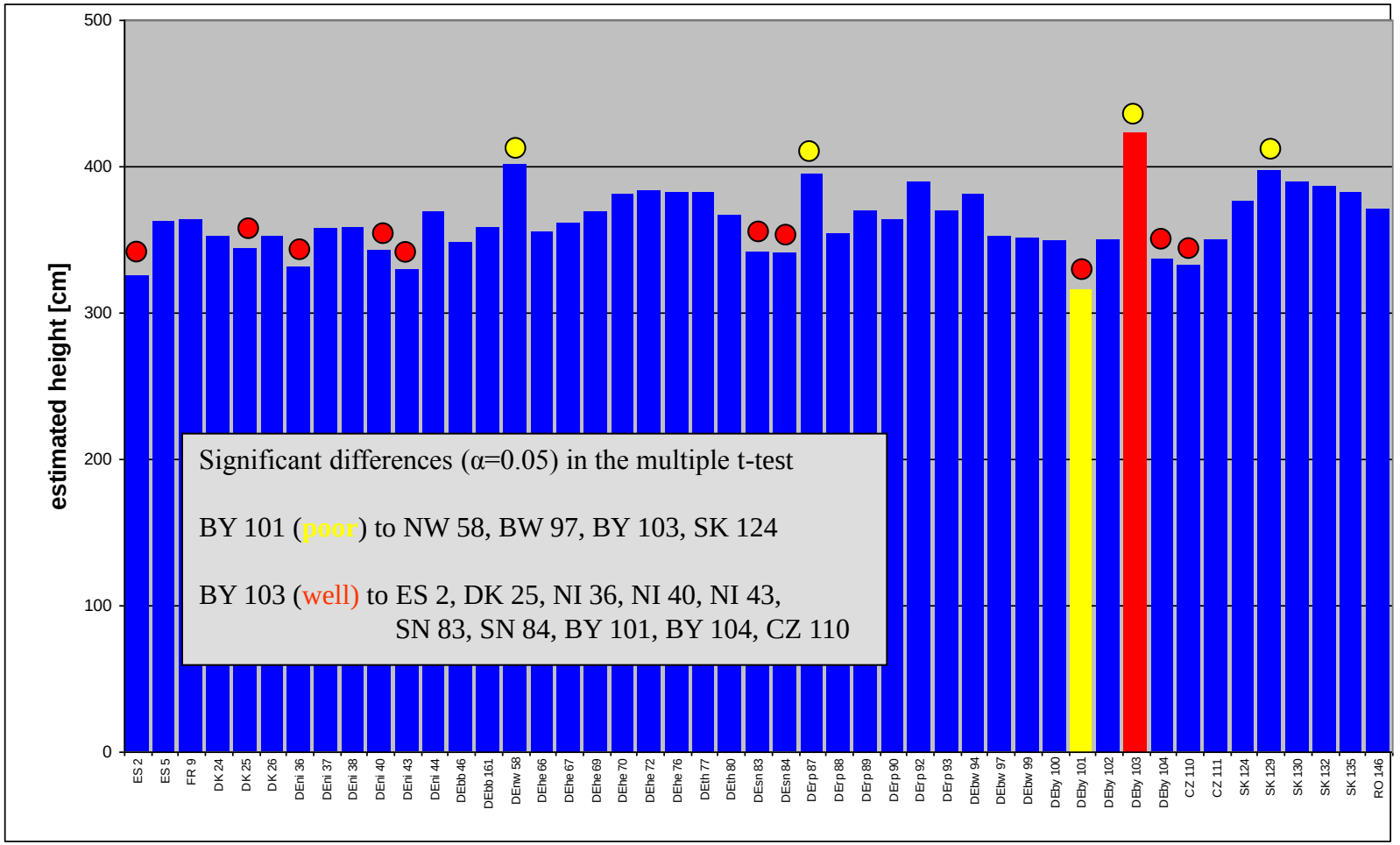


Height growth (4) – analysis of variance

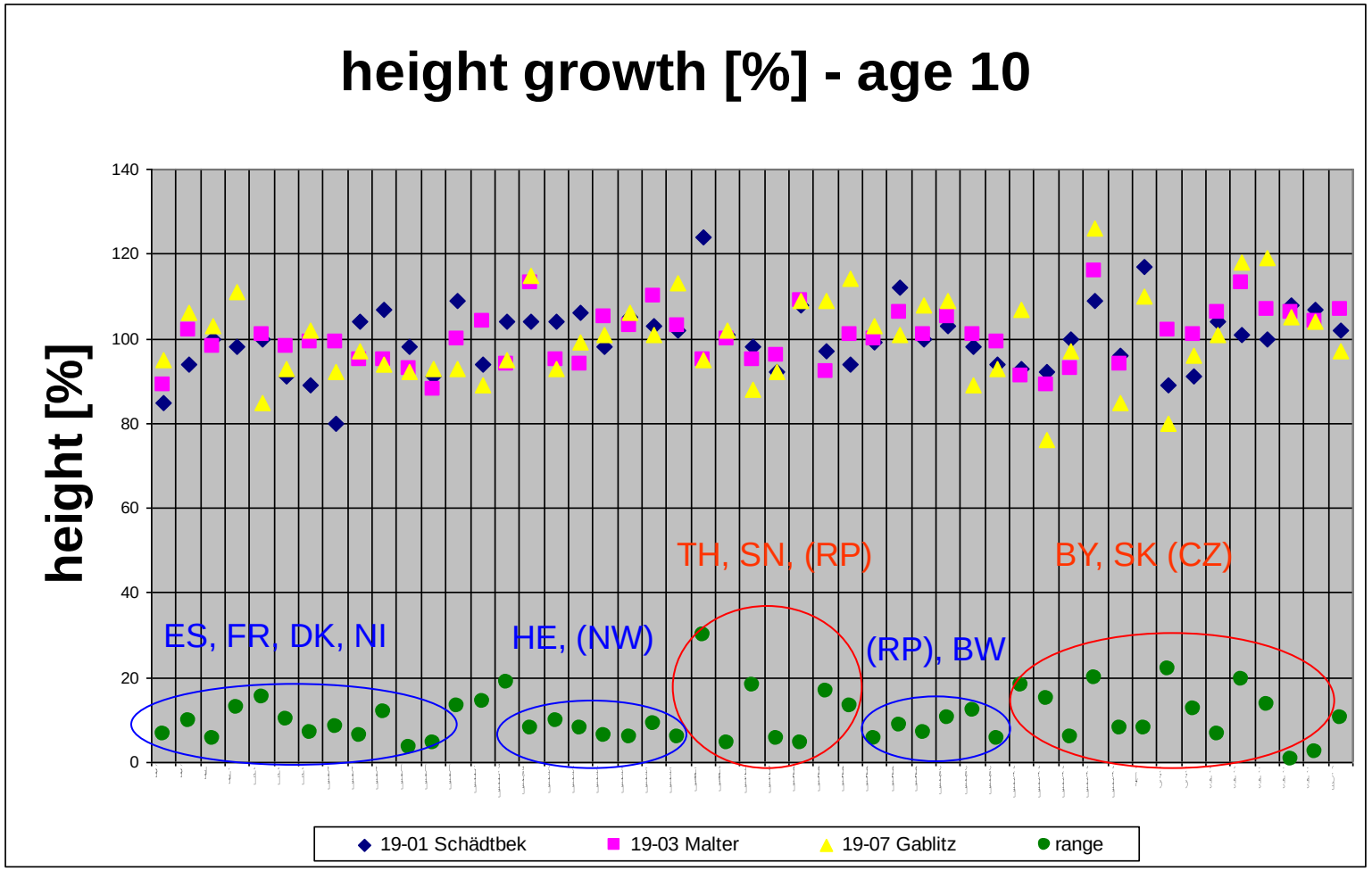
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	140	2266176.344	16186.974	9.53	<.0001
HK	46	202680.793	4406.104	2.59	<.0001
vers	2	1932502.765	966251.383	568.83	<.0001
HK*vers	92	130992.786	1423.835	0.84	0.8397
Error	282	479025.517	1698.672		
Corrected Total	422	2745201.861			

Significant differences (α =0.05) between provenances (HK) and sites (vers)

Height growth (4)



unresponsive – sensitive provenances



Results (height, age 10, Schädtbek) – stepwise selection

1) all trees
   4 variables: temp. (July), temp. (May-Sept.), Climate-factor, altitude
   R^2= 0,1461

2) 20 highest trees / plot
   5 variables: temp. (July), temp. (May-Sept.), Climate-factor, Aridity-index, precipitation (May-Sept.)
   R^2= 0,1875

3) 5 highest trees / plot
   5 variables: temp. (July), temp. (May-Sept.), Climate-factor, Aridity-index, precipitation (May-Sept.)
   R^2= 0,2188

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	Temp. (Juli)		1	0.0560	0.0560	8.4843	5.22	0.0247
2	Temp. (Veg.)		2	0.0327	0.0888	7.2073	3.13	0.0806
3	Klimafaktor		3	0.0686	0.1573	2.3446	7.00	0.0097
4	Aridität sindex		4	0.0328	0.1902	1.0572	3.45	0.0668
5	Nieders. (Veg.)		5	0.0286	**0.2188**	0.1911	3.08	0.0830

Results (height, age 10 + 15, Malter) – stepwise selection

Age 10:

1) all trees
2) 20 highest trees / plot
3) 5 highest trees / plot

} no variable

Age 15:

1) all trees
   3 variables: temp. (July), temp. (May-Sept.), temp. (January)
   R^2= 0,1336
2) 20 highest trees / plot
   3 variables: temp. (July), temp. (May-Sept.), temp. (January)
   R^2= 0,1412
3) 5 highest trees / plot
   3 variables: temp. (July), temp. (May-Sept.), longitude
   R^2= 0,1470

Results (height, age 10, Gablitz) – stepwise selection

1) all trees
   1 variable: Climate-factor
   R^2= 0,0722

2) 20 highest trees / plot
   1 variable: Climate-factor
   R^2= 0,0602

3) 5 highest trees / plot
   1 variable: Climate-factor
   R^2= 0,0612

Conclusions

- Differences between sites with different environmental conditions
- Variation between provenances
- In height growth (age 10) a tendency indicates between geographical regions of
  (1) only unresponsive provenances, and
  (2) unresponsive and sensitive provenances, respectively.
- On the site Schädbek height growth is explained by up to 5 climate variables (22 %).
  This result could not be confirmed on other sites, and when changing the number of provenances.
- There might be significant difference in an higher age, because growth of beech is culminating later than in other tree species.

General conclusions

- Even knowledge on common species is incomplete
- Knowledge on rare species is missing or under-represented
- New problems (increasing demand on wood, “climate change”)
- Therefore, large and long-term experiments are necessary

Treebreedex

Thank you!

to my co-authors,

technical assistance,

nursery