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Are *bzh* semi-dwarf hybrids deprived with regard to plot front-border effects in yield trials?

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described by Renard et al. 1999

semi-dwarf hybrids:

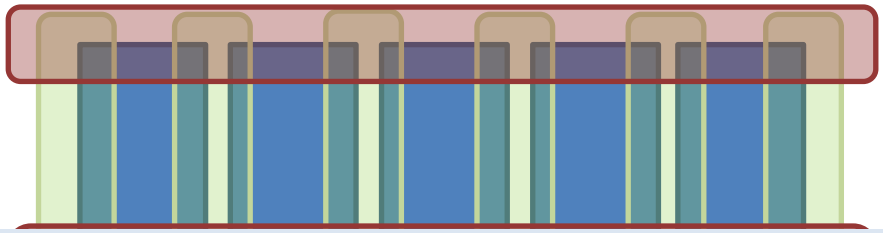
- shorter, higher harvest index
- better lodging stability
- winterhardiness
- higher nitrogen use efficiency
- drought tolerant

(Pinochet and Renard 2012)

- However, they have a small market share

Competition effect

- between plots/genotypes
- physiological and morphological differences
  - plant height
  - nutrient uptake
  - root system



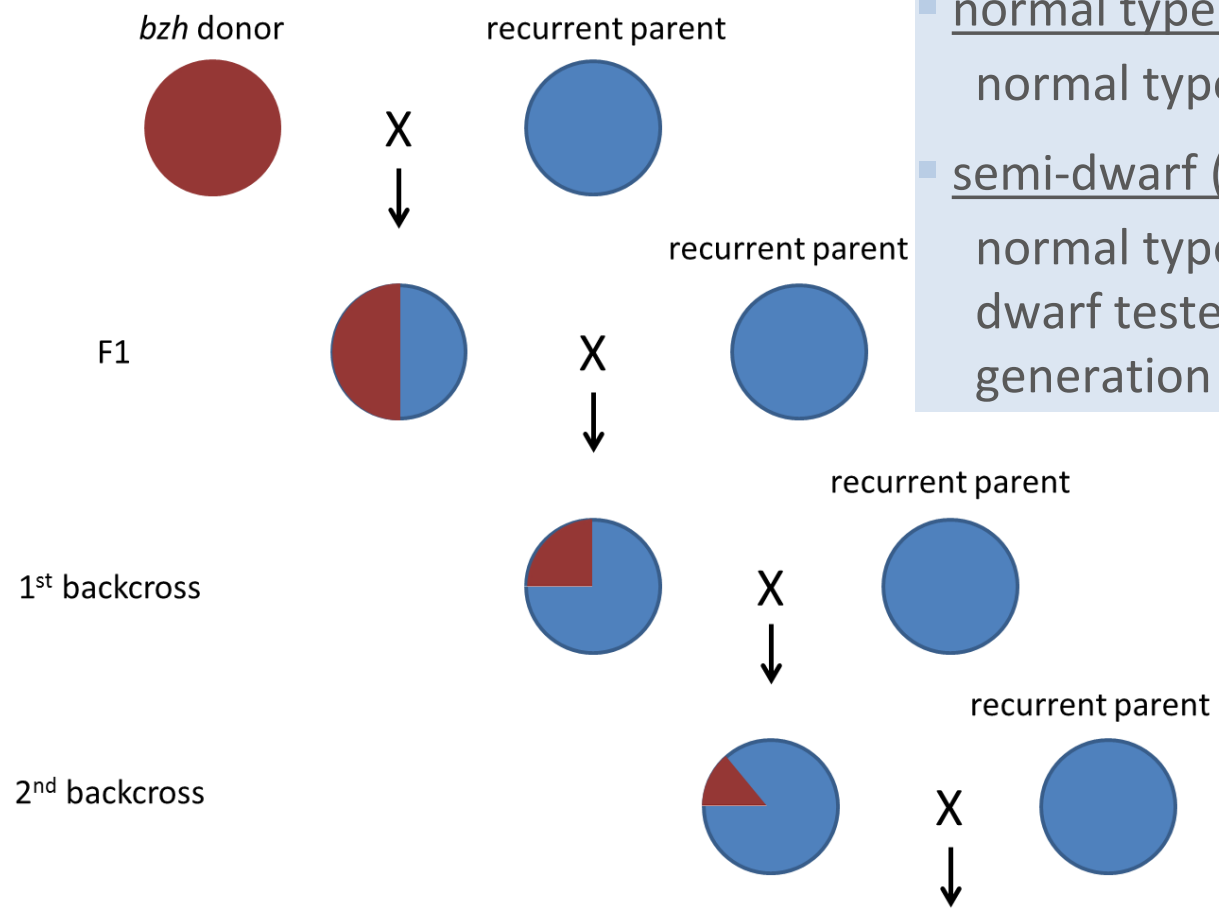
Plot front-border effect

- occur at the plot front-border to adjacent free areas/paths
- do tall hybrids have a larger photosynthetically active canopy by being able to lean further into paths than semi-dwarfs?
- calculated as a percentage:

$$\frac{\text{complete plot} - \text{core plot}}{\text{complete plot}}$$

Are *bzh* semi-dwarf hybrids deprived with regard to plot front-border effects in yield trials?

- Experimental approach: near-isogenic hybrid pairs, three environments, two plot treatments: core plot harvest and complete plot harvest



Development of plant material

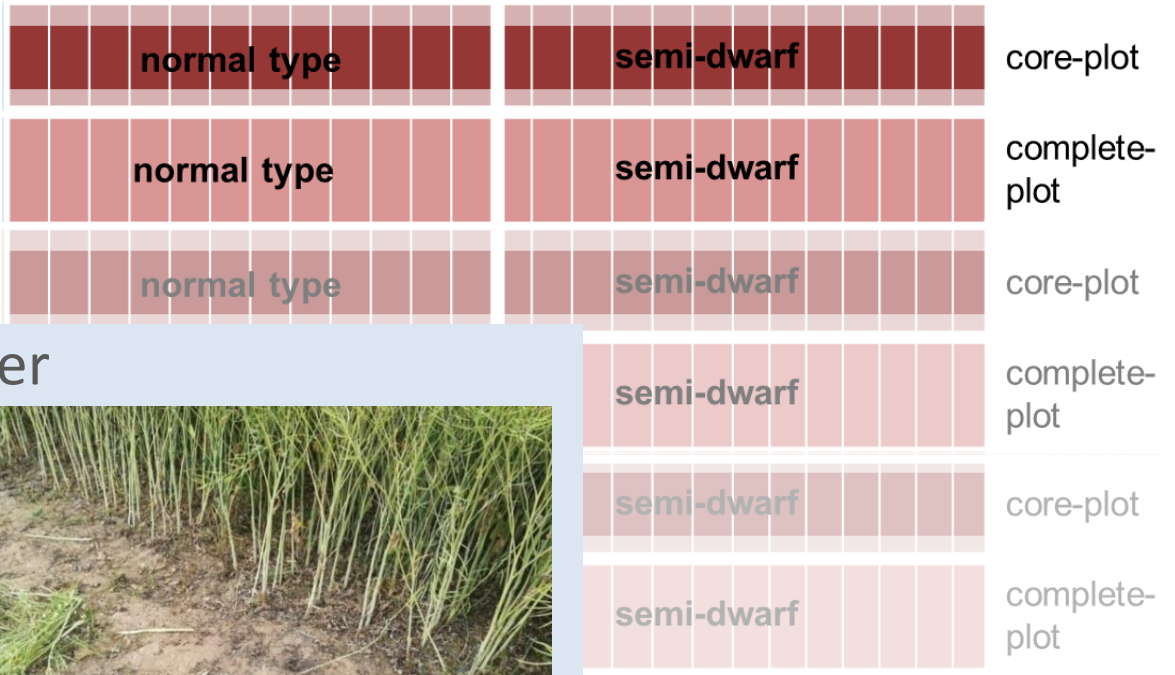
- 8 near-isogenic hybrid pairs
- normal type (*Bzh/Bzh*):
  normal type line X normal type tester line
- semi-dwarf (*bzh/Bzh*):
  normal type line X dwarf tester line
  dwarf tester line in second backcross generation

3 environments

- 2017: Reinshof (University of Göttingen); humid summer
- 2018: Reinshof (University of Göttingen) and Eilensen (KWS SAAT SE); hot and dry summer

Experimental design

- three repetitions in each environment
- split-split plot design



Removal of plot front-border

Plot front-border effect in semi-dwarfs and normal type hybrids

Plot type	Core-plot seed yield (dt ha^{-1})			Complete plot seed yield (dt ha^{-1})			Plot front-border effect (%)	
environment	semi-dwarf		normal type	semi-dwarf		normal type	semi-dwarf	normal type
Reinshof 2017	36.5	ns	38.1	41.5	ns	42.0	12.1	9.3
Reinshof 2018	42.5	ns	41.3	48.4	+	47.4	12.3	12.8
Eilensen 2018	34.2	ns	34.0	37.6	ns	35.9	8.9	5.4
Mean	37.8	ns	37.8	42.5	+	41.8	11.2	9.6

Semi-dwarf hybrids have a higher plot front-border effect than normal type hybrids

⟹ semi-dwarf hybrids are not deprived in yield trials

Straw yield and harvest index *

Plot type	Core-plot			Complete plot		
environment	semi-dwarf		normal type	semi-dwarf		normal type
Mean straw yield (dt ha^{-1})	41.3	**	52.7	45.4	**	61.7
Mean harvest index	0.49	**	0.43	0.50	**	0.42

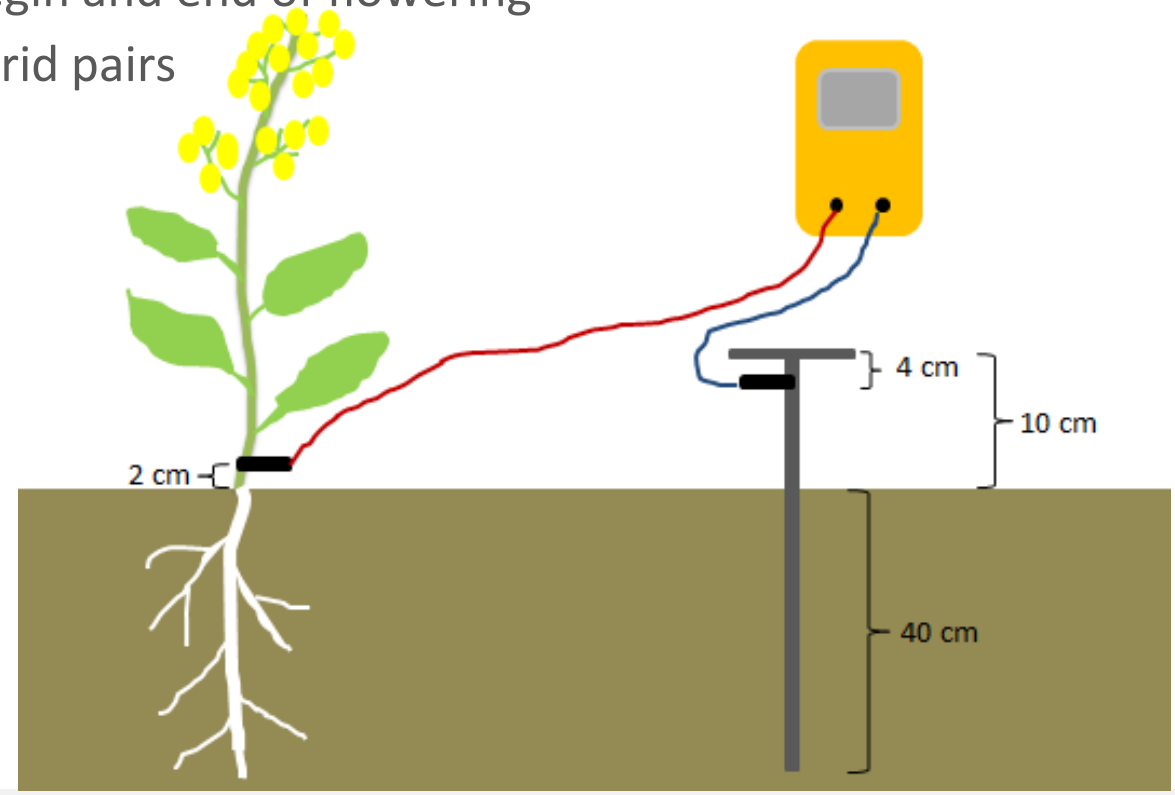
Semi-dwarf hybrids have a significantly lower straw yield and therefore a higher harvest index

* in two environments

Do the two hybrid growth-types differ in root system size?

Root electrical capacitance (EC) measurement

- measurement at begin and end of flowering
- 8 near-isogenic hybrid pairs
- 3 environments
- 2 repetitions
- 12 plants per plot



Chloupek (1972)

Root electrical capacitance in semi-dwarf and normal type hybrids

Environment	semi-dwarf		normal type
Root EC begin of flowering (nF)	3.5	ns	3.3
Root EC end of flowering (nF)	2.6	ns	2.5

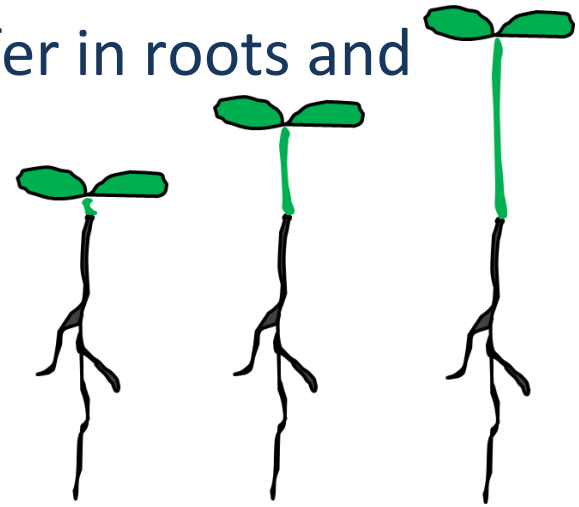
mean root EC measured at beginning and end of flowering
did not differ significantly for growth types

- ⟹ root EC as a measurement for root system size (Chloupek et al. 2006)
- ⟹ would indicate a higher root:shoot ratio of semi-dwarf hybrids

How does the *bzh* and *Bzh* expression differ in roots and shoots?

Expression analysis of *bzh* and *Bzh*

- two primer pairs
- three genotypes
- two seedling tissues: hypocotyl and root
- three biological and three technical repetitions



Bzh fw

5´– **CAATCTGGTGGCTTGCGAAGGT**CCGGACCGTGTTGAGAGACATGAGACGCTGAGTCAATGGTCGAACCGGTTCGGTTCG

TCCGGTTTTGCGCCGGCGCATCTCGGGTCTAACGCGTTTAAGCAAGCGAGTACGCTTTTGGCTTTGTTTAATGGAGGCGAAGG

TTATCGTGTGGAG G/A AGAATAATGGGTGTTTGATGTTGAGTTG –3´

3´– **CTCTTATTACCCACAAACTACAACTCAAC** –5´

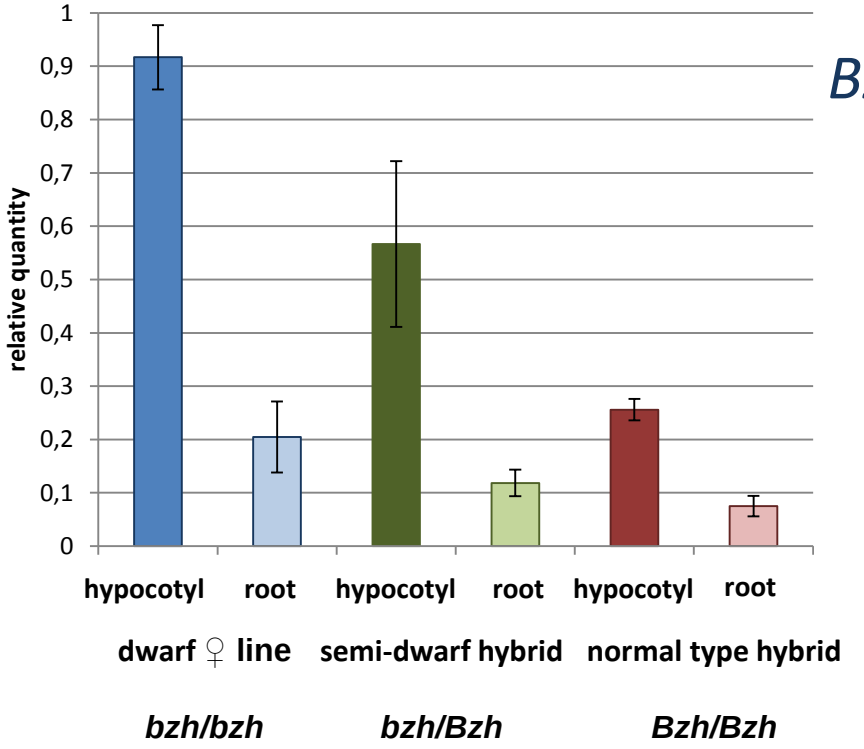
3´– **TTCTTATTACCCACAAACTACAACTCAAC** –5´

Primer *Bzh* rev

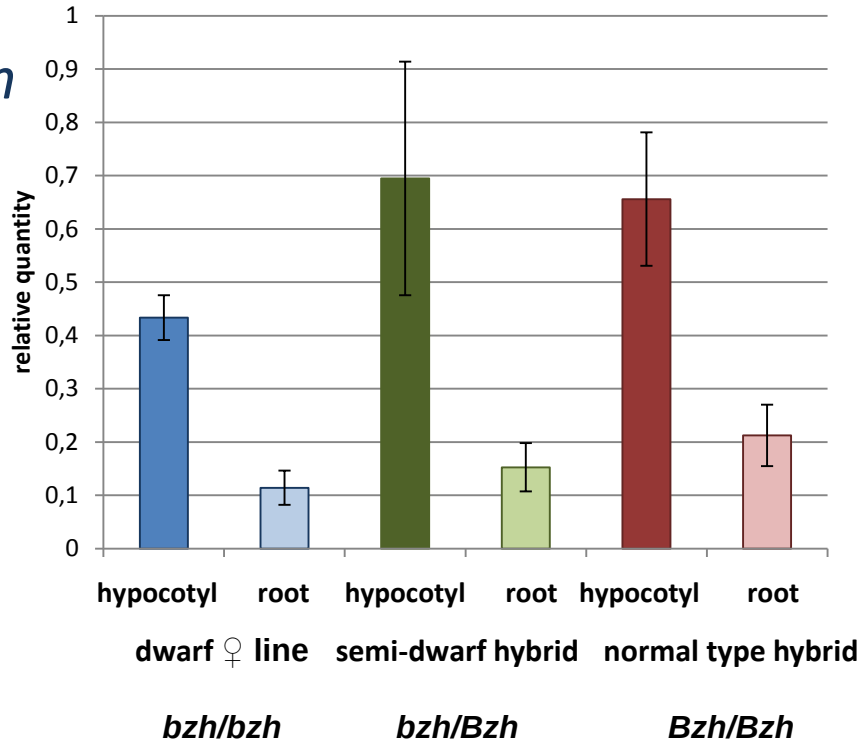
Primer *bzh* rev

Expression analysis of *bzh* and *Bzh*

bzh



Bzh



- semi-dominant effect apparent
- higher expression of the *bzh/Bzh* alleles in hypocotyls than in roots

Take home message

Semi-dwarf hybrids have a higher plot front-border effect than normal type hybrids

⟹ semi-dwarf hybrids are not deprived in yield trials

No significant difference in root system size under field conditions

⟹ root EC as a measurement for root system size

⟹ would indicate a higher root:shoot ratio of semi-dwarf hybrids

The *bzh* and *Bzh* alleles are not only expressed in shoots, but also in roots

⟹ the semi-dominant effect becomes apparent

Thank you for your attention!

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