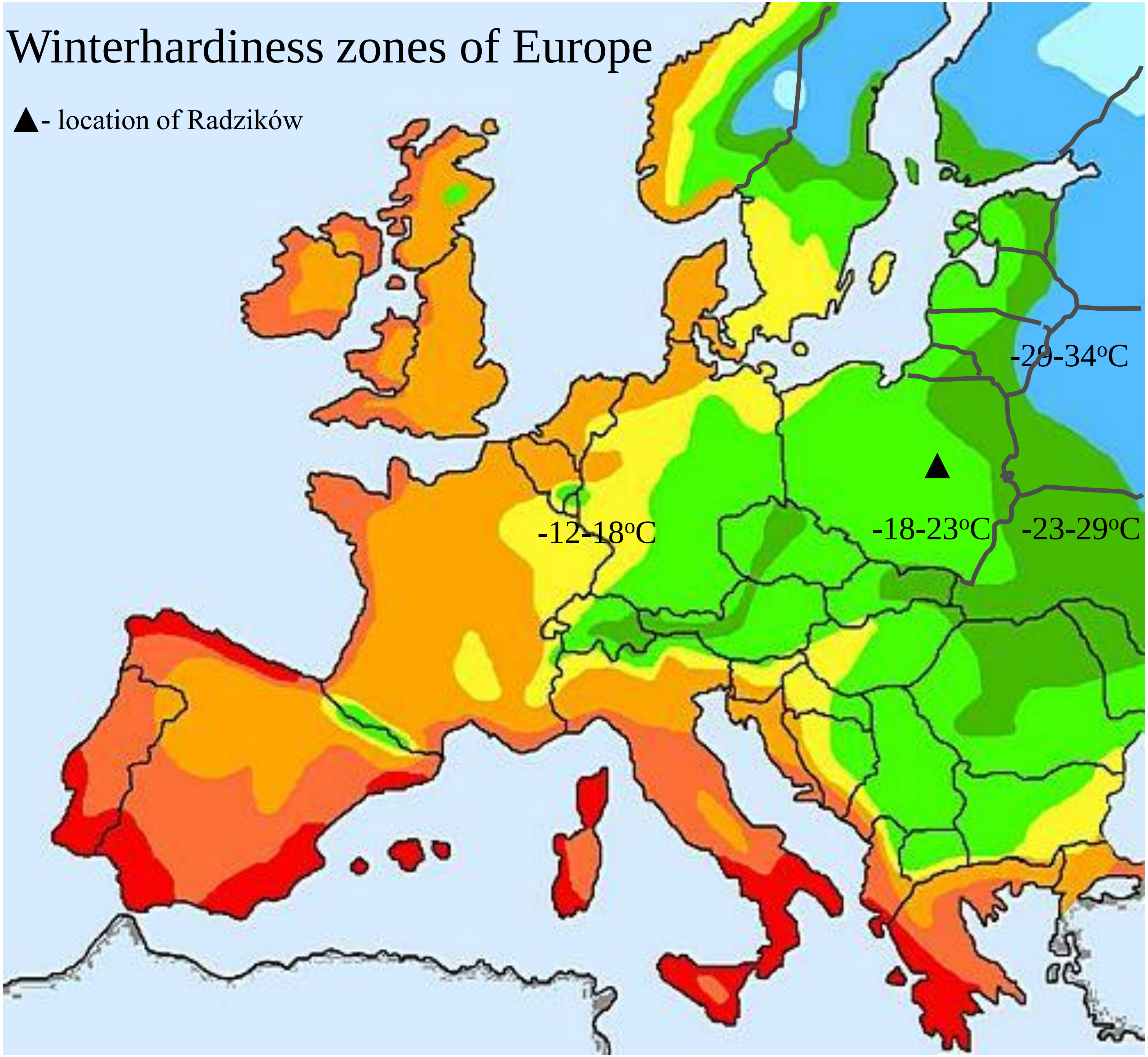
The ways of oat winterhardiness improvement in Poland

<u>Bogusław Łapiński</u> and Agnieszka Rachwalska

National Centre for Plant Genetic Resources and Grodkowice Experiment Station of the
Plant Breeding and Acclimatization Institute
Radzików, 05-870 Błonie,
Grodkowice, 32-015, Kłaj
Poland



Winterhardiness zones of Europe
▲- location of Radzików
-29-34°C
-12-18°C
-18-23°C
-23-29°C

Yields and minimal temperatures of ground surface. Radzików, 2009 - 2016


Winter oat trial in Krzeczowice. February 2016
BARLEY

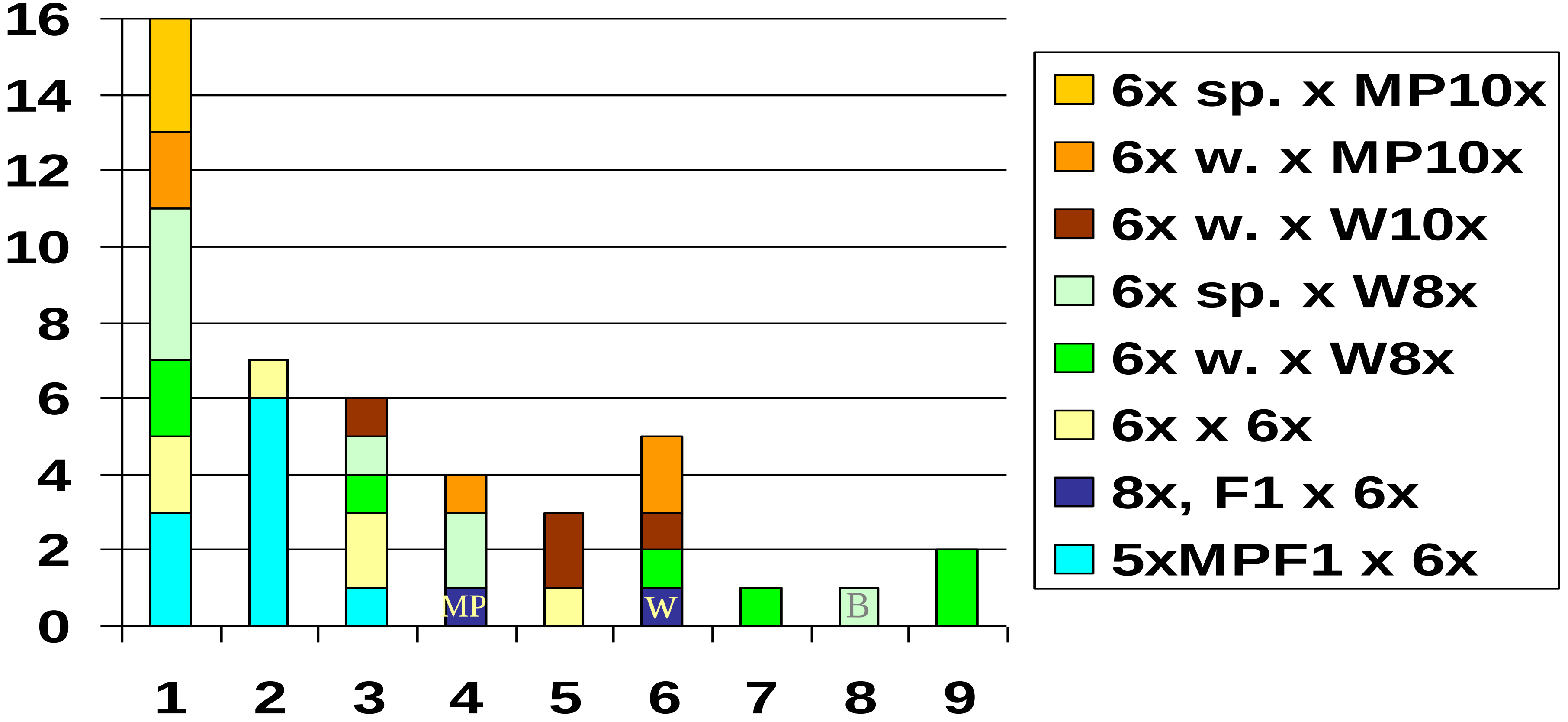

Loss of chlorophyll in winter oat.
Radzików 2006

Avena macrostachya

wild autotetraploid
endemite from Atlas mountains
most distant to other *Avena* species,
outcrosser,
perennial,
winterhardy,
resistant to some diseases and pests

The octoploids and decaploids at winter sowing

Distribution of cold resistance scores in the best selections of 45 crosses between winter (w.) or spring (sp.) hexaploids (6x) of *A. sativa* and octoploid (8x) or decaploid (10x) hybrids (*A. sativa* x *A. macrostachya*) produced from the winter-hardy *A. sativa* cultivar 'Wintok' (W) or a non-winterhardy 'Mirabel-Pendragon' (MP) line.

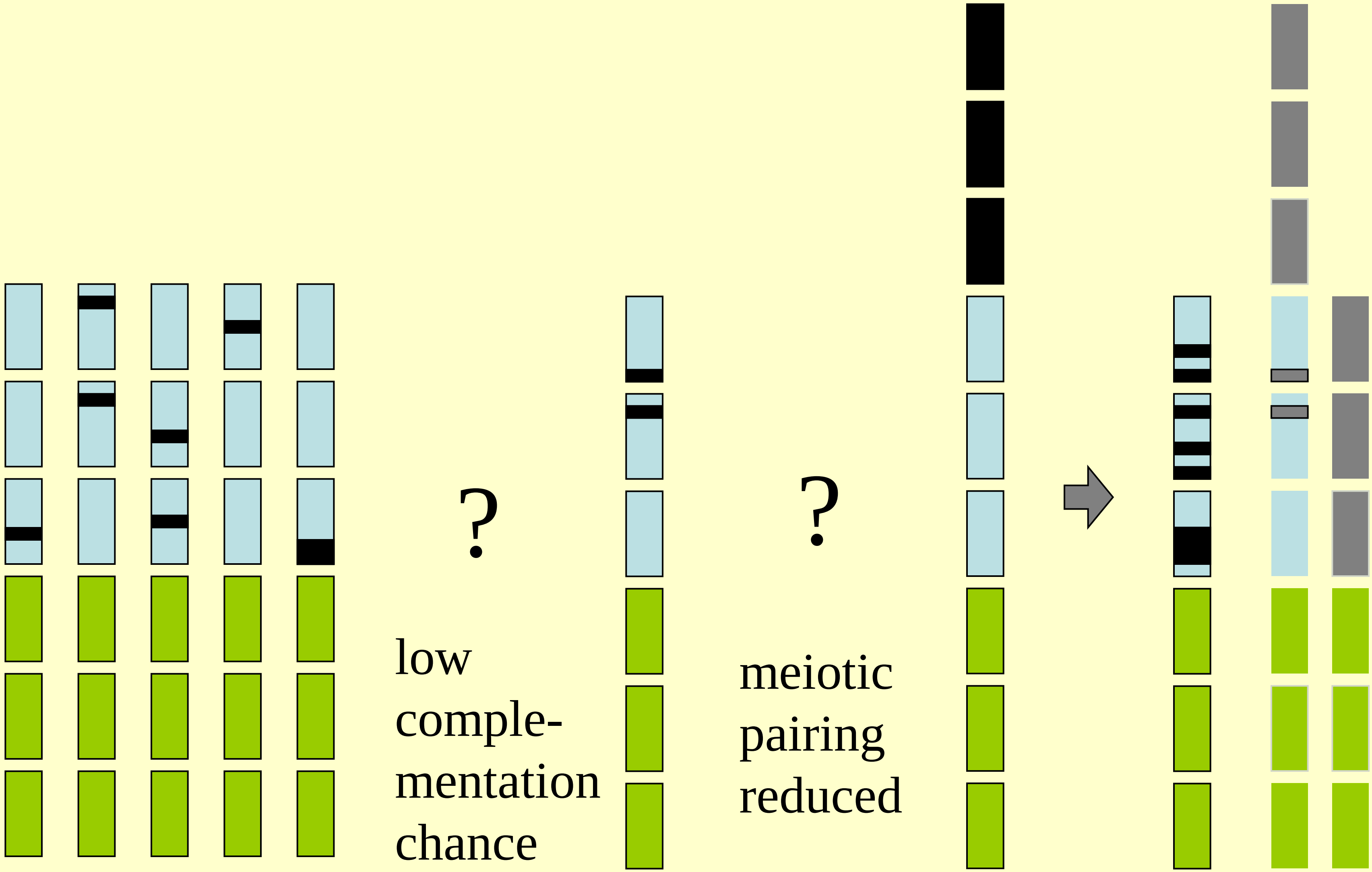


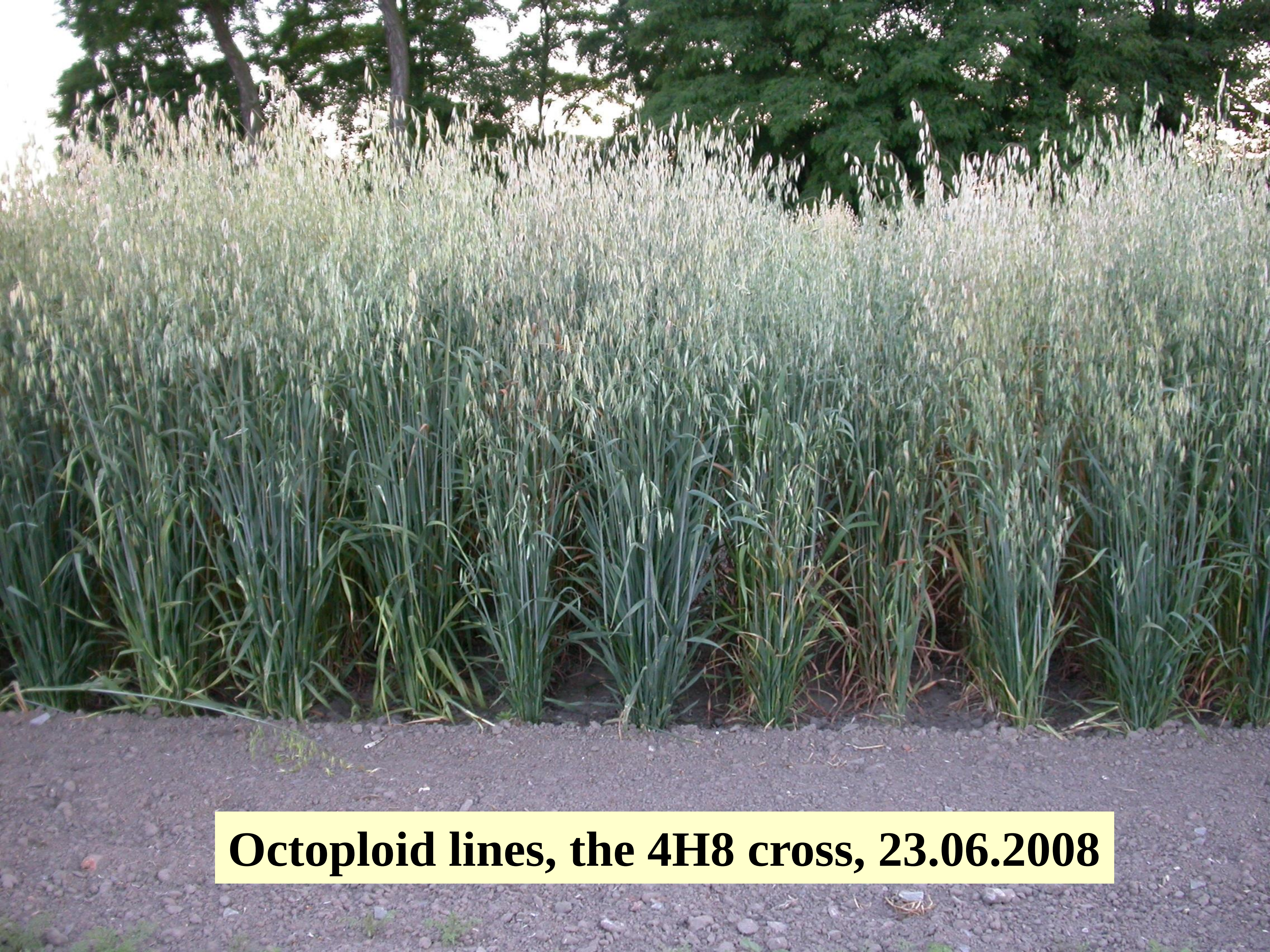
Breeding strategies after wide crossing:

	introgression	incorporation*	alloploidization
trait genetic architecture:	simple	composed	composed
what transferred:	small fragment of alien DNA	numerous DNA fragments	whole alien genome
ploidy level	maintained	maintained	increased
breeding method:	back-crossing	intercrossinng among recombinants	chromosome doubling and selfing

*) Simmonds N.W. 1993. Introgression and incorporation, strategies for the use of crop genetic resources. Biol. Rev. 68:539-562.

Which parent for crossing is better for re-building a genetic system decomposed by interspecific recombination?



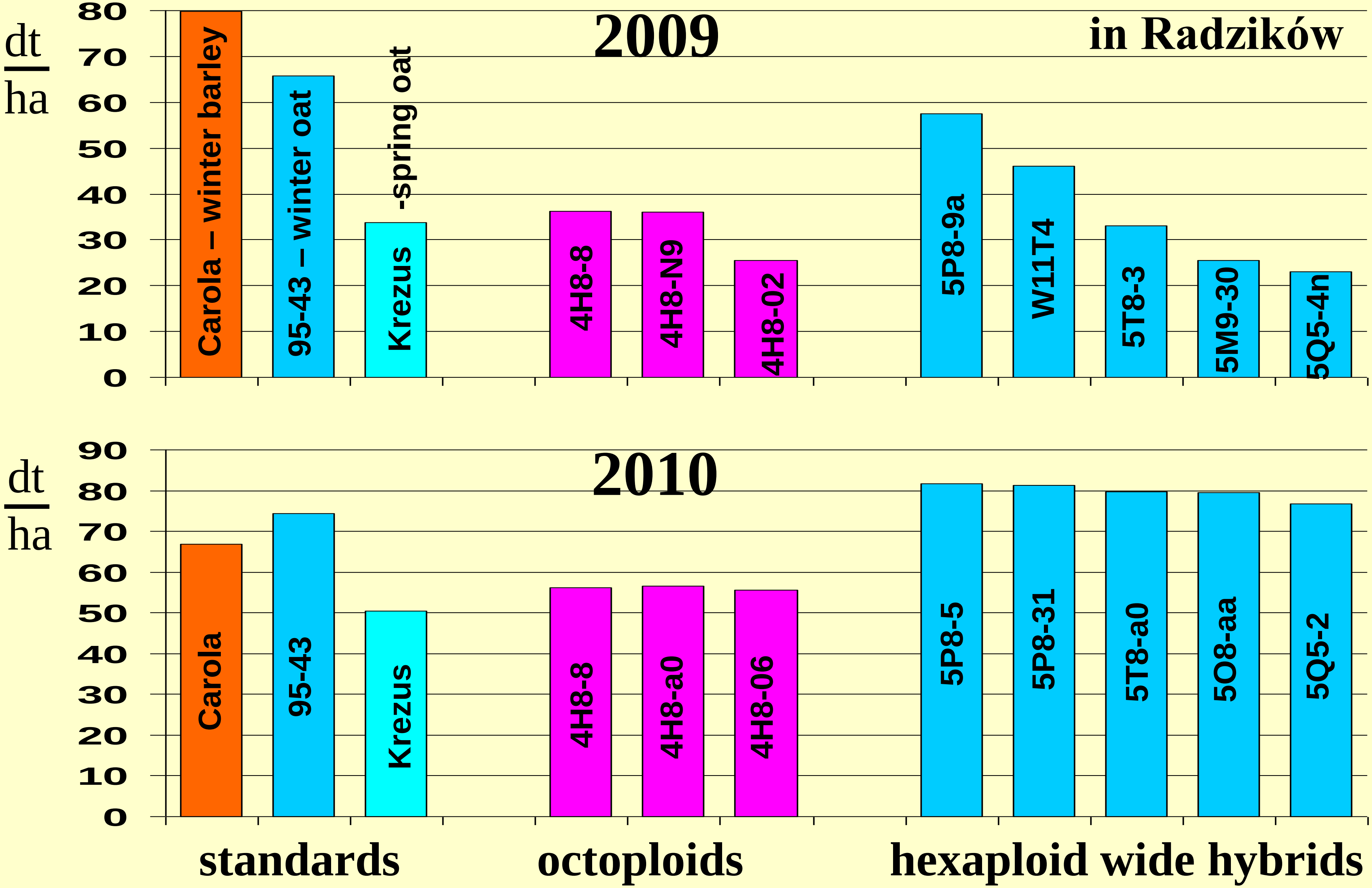


Octoploid lines, the 4H8 cross, 23.06.2008

Comparison of early alloploids in triticale and oat

	8x or 6x triticale	8x oat A.s x A.m.
yield reduction in primary synthetics	**~50%**	**~30%**
time necessary to restore yield potential	**~50 gns**	**?**
winterhardiness	**weak**	**high**
time necessary to restore winterhardiness	**~ 50 gns**	**none**
disease resistance	**high**	**variable**
grain	**large shrivelled**	**large plump**
grain nutritious value	**high**	**high**

Yields of winter oat hybrids of *Avena sativa* with *A. macrostachya*



Krezus (TKW 25,7 g) **4H8.a (TKW 55,2 g)**

Krezus (HC 26,2 %) **4H8.a (HC 25,0 %)**

Conclusions

1. Crossing of common oat with 8x or 10x *sativa-macrostachya* allo-ploids is effective in transgressive improvement of winterhardiness.

2. Some spring oats are good cross components for winterhardiness improvement.

3. Relatively high performance of the *sativa-macrostachya* primary octoploids is a good prognostic for application of alloploidy in improvement of oat.

4. In spite of risk of winter killing, cultivation of the hexaploid oat wide hybrids in Poland is economically feasible on sufficiently fertile soils, in regions with stable snow cover.


Thank you for the attention

Literature

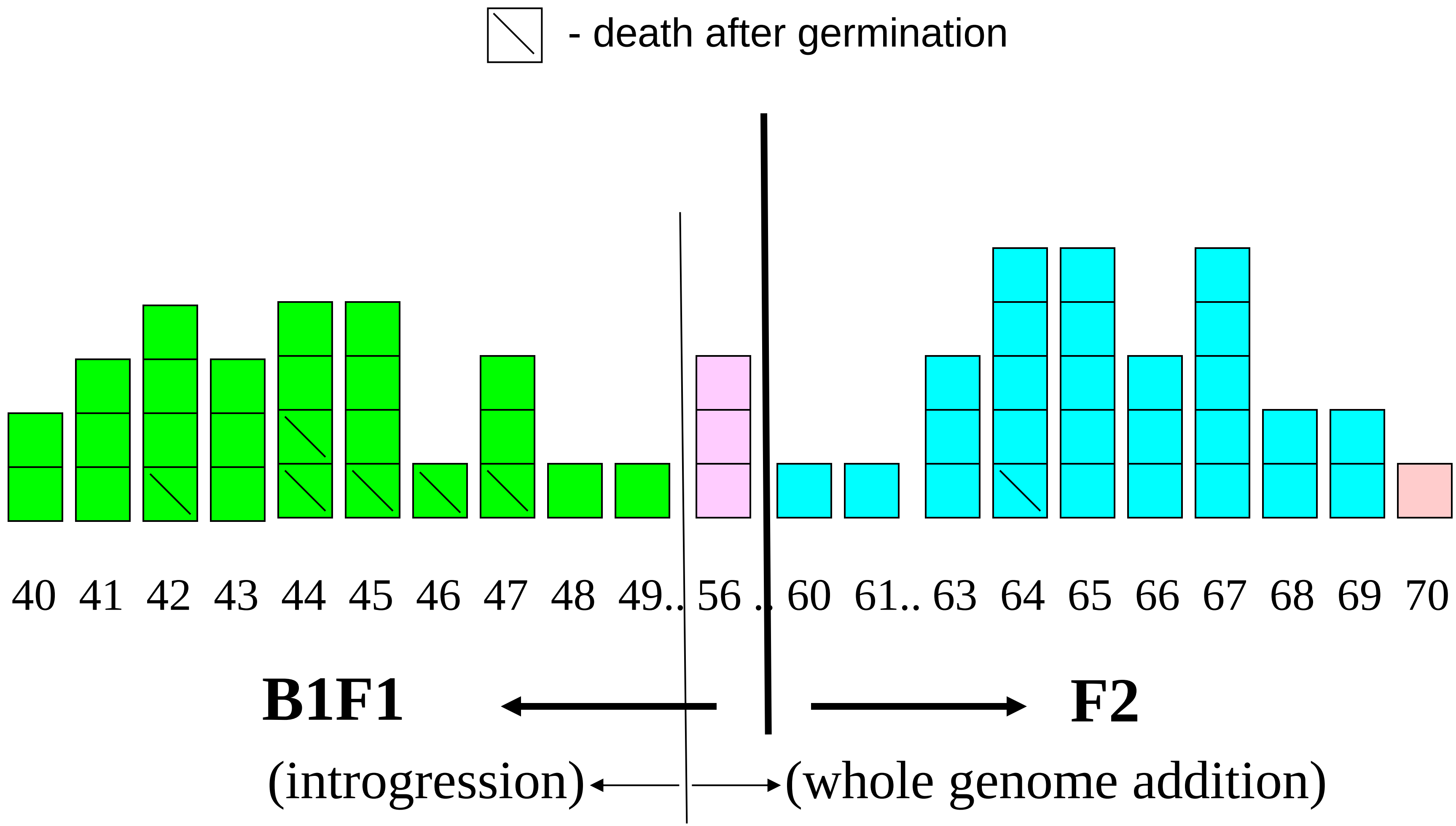
Prospects for alloploidization in oat – in relation to results in triticale

Hede A. 2001. A New Approach to Triticale Improvement. Paper presented at the Research Highlights of the CIMMYT Wheat Program, 1999–2000, Oaxaca, Mexico.

Loss of DNA

Ma X.F., Gustafson J.P. 2008. Allopolyploidization-accomodated Genomic Sequence Changes in Triticale. Ann Bot. 101(6): 825-832.

Chromosome numbers in B1F1 and F2 of the *Avena sativa x A. macrostachya* hybrids, 2004.



Winter oat nursery 23.04.2006

SIWEK (6x, cultivar)
TKW = 22,6 g

7.B/12 (6x x 10x, F_4 plant)
TKW = 29,1 g

Crossing and propagation of the hybrids:

No of cross combinations	51
No of pollinated flowers	3235
No of F1 seeds obtained	37
embryo rescue	
No of F1 plants recovered	3
greenhouse cloning	
No of F1 plants after cloning	969 + 2073 + 6
colchicine treatment	
free winter oat pollination	
No of F2+B1F1seeds	19 + 120 + 0
No of F2+B1F1 seedlings	3 + 54
counting of chromosomes	

Expected changes in genomic composition