

The background of the slide features a dense field of green oat plants under a clear blue sky. The plants are tall and slender, with numerous small, pointed leaves and seed heads. The perspective is from a low angle, looking across the field.

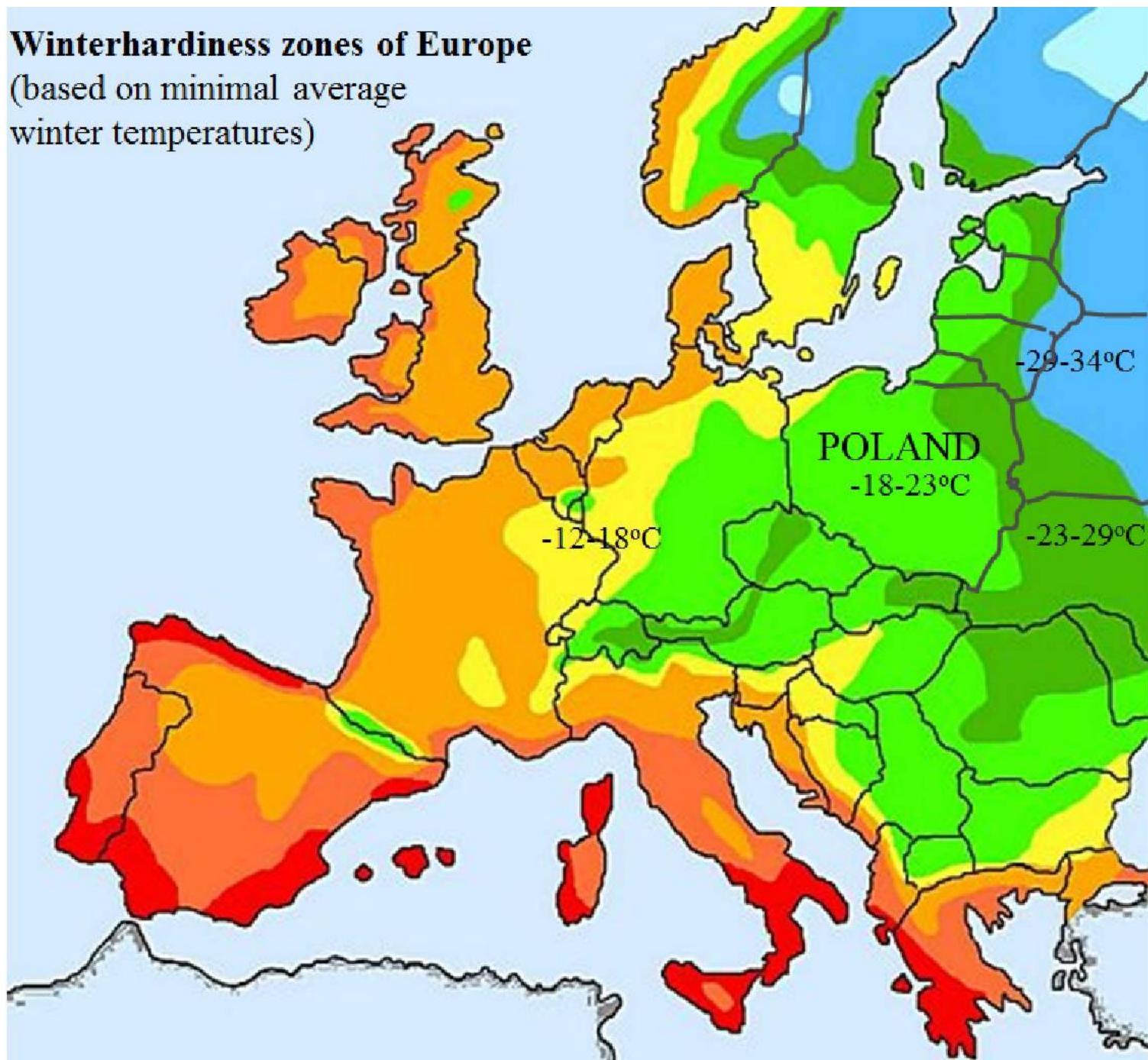
Progress in winter oat improvement in Poland based on crosses with *Avena macrostachya*

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Winterhardiness zones of Europe

(based on minimal average
winter temperatures)





The advantages of winter cereals, in relation to spring ones:

- higher yield
- better use of winter water resources
- earlier ripening
- diseases escape
- earlier start of growth
- protection against winter erosion of soil

Avena macrostachya

Cosson et Durrieu de Maisonneure, 1855 r.

Endemite from the Atlas mountains, Algeria

- The most distant to other species of *Avena*.
- The only open-pollination form of *Avena*
- The only perennial form of *Avena*.
- Winterhardy (in Canada, Poland).
- Resistant to diseases and pests.



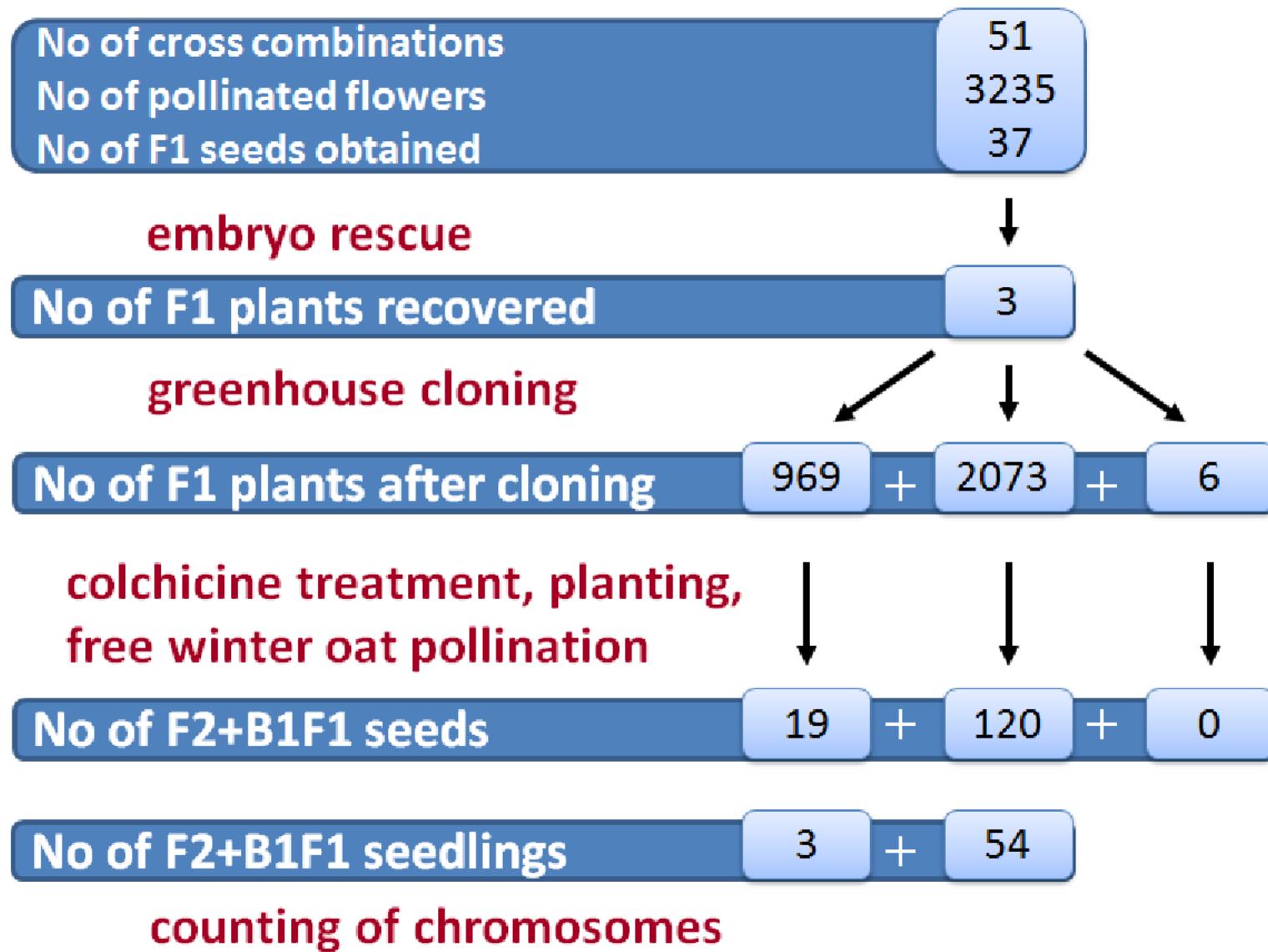
Resistance in *A. macrostachya*

Reported by	
crown rust	Loskutov I.G., St. Petersburg. Russia
stem rust	
septoria	
mildew	Herrmann M. Germany,
aphids	Weibull J. 1988. Sweden
BYDV	Jeżewska M. Poland
SBMV, winterhardines transfer	Santos A., Livingstone D.P., Murphy J.P. 2002. North Carolina. USA
winterhardines	Baum B.R., Rajhathy T. 1976 Canada

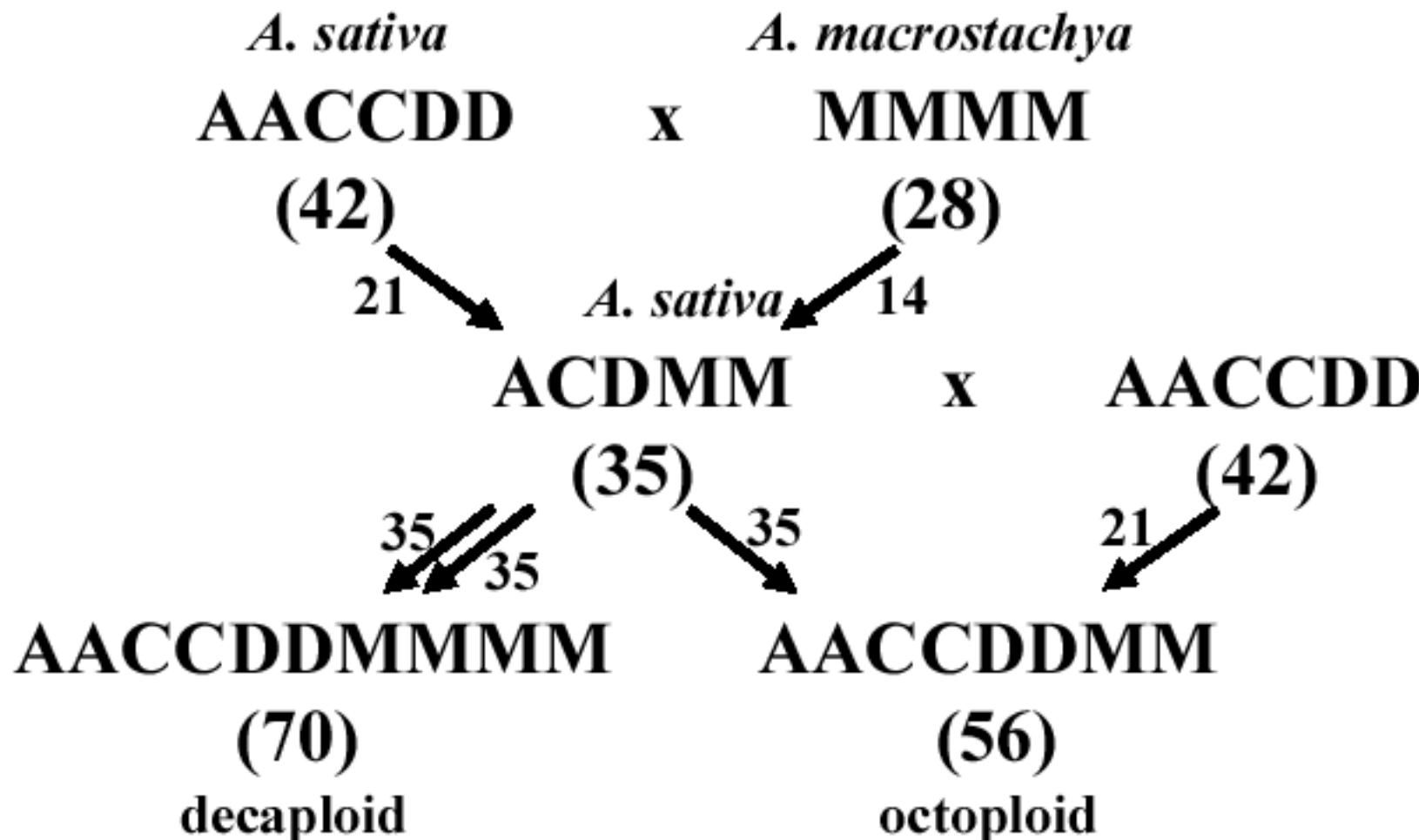


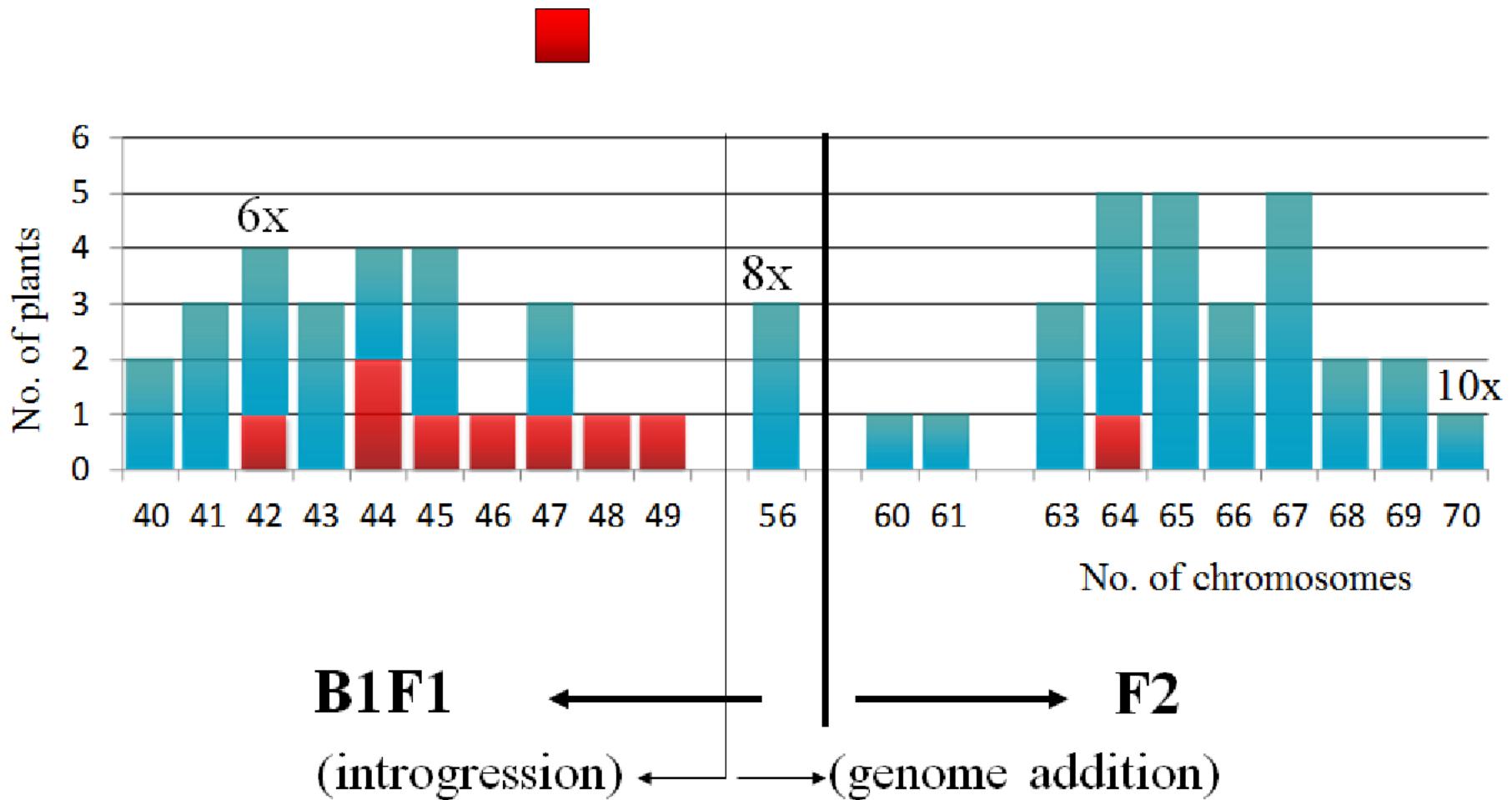
Avena macrostachya plants in Radzików after moderately severe winter of 2005/2006

Crossing and propagation of the hybrids



Expected changes in genomic composition





6x

6x

8x

Sens 8x

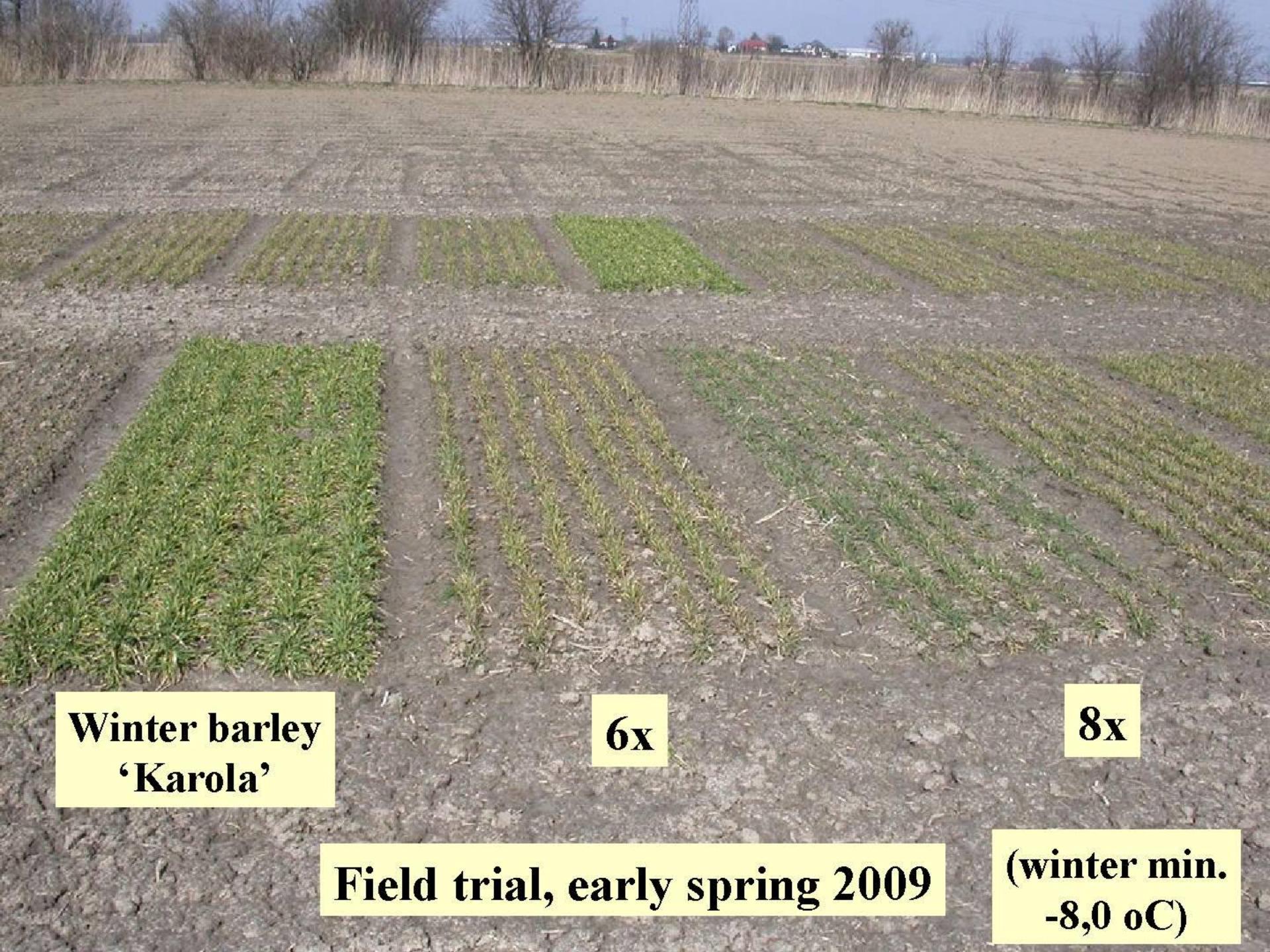
Winter oat nursery 23.04.2006



8x

10x

The octoploids and decaploids at winter sowing 2006



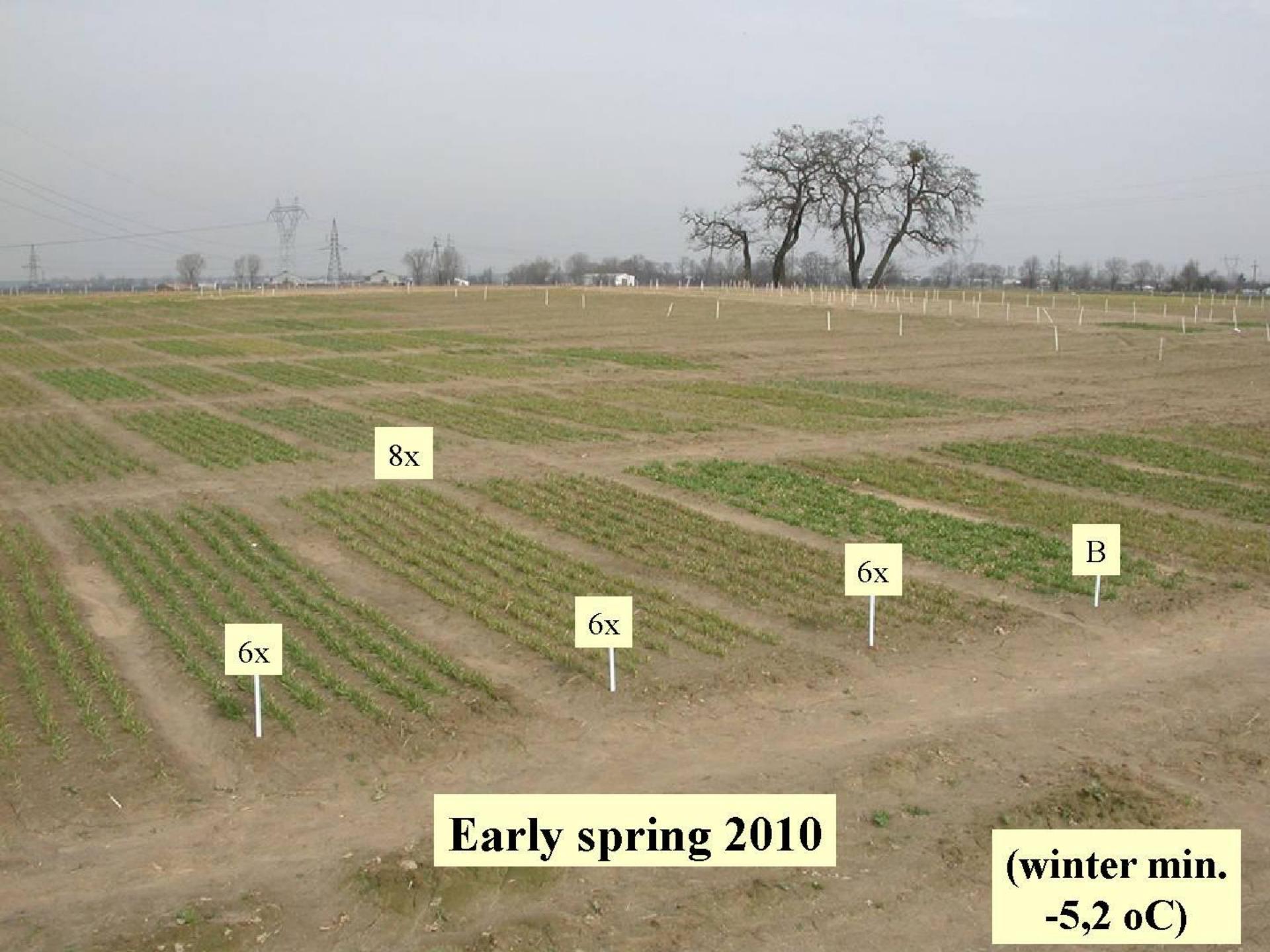
**Winter barley
‘Karola’**

6x

8x

Field trial, early spring 2009

**(winter min.
-8,0 oC)**



Early spring 2010

**(winter min.
-5,2 oC)**



Field trial, February 2011/2012 (-14,3°C on ground level)

A photograph of a agricultural field trial. The field is divided into several plots, each showing different growth stages or treatments of barley. The plots are separated by narrow paths. In the background, there is a line of bare trees and a distant building under a clear sky.

barley

Field trial, March 2011/12



Nursery, May 2011/12

Nursery, May 28 2012

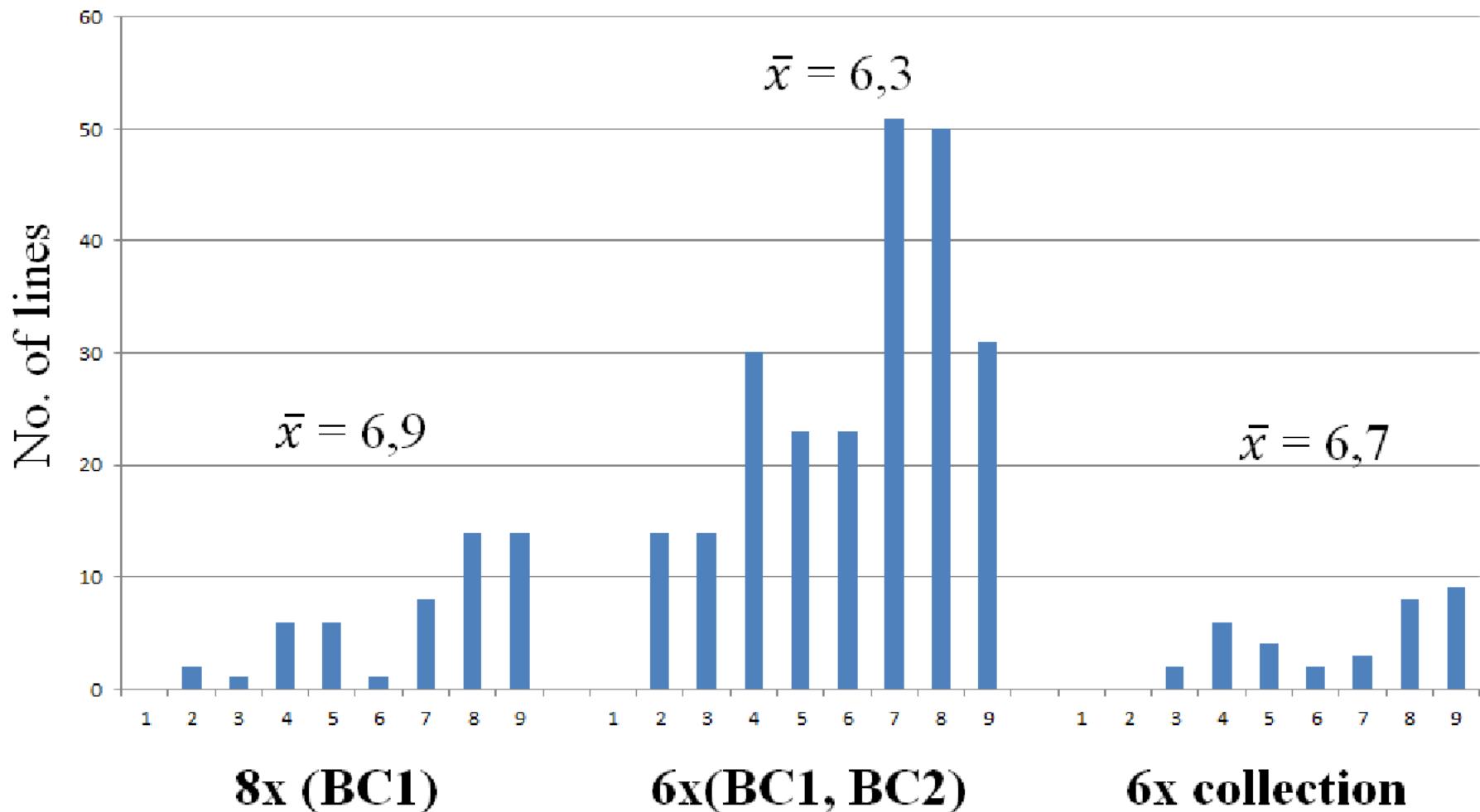
Ax346 (6x)

UOWHN nursery 2011/2012

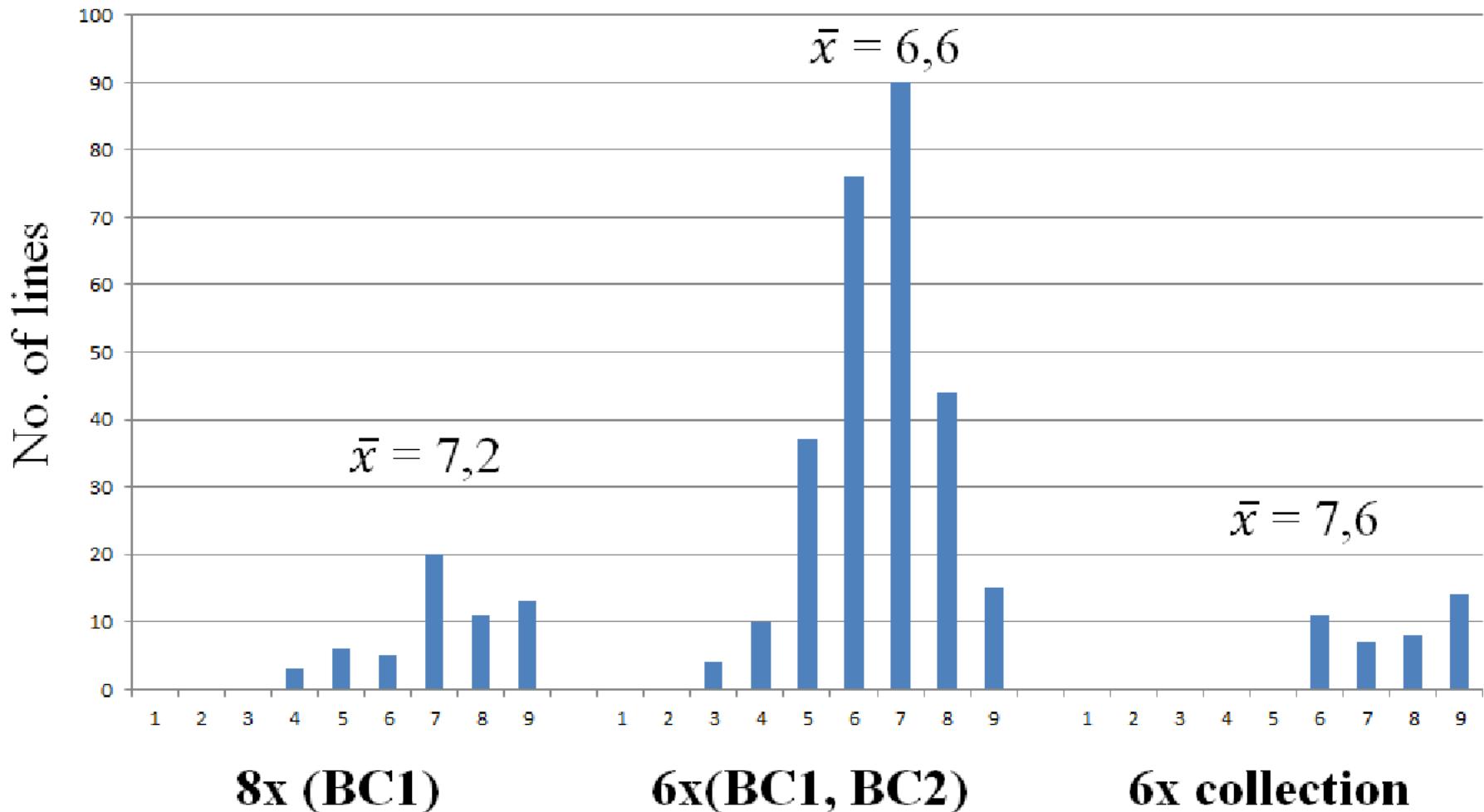
5T8 (6x)

5Q5 (6x)

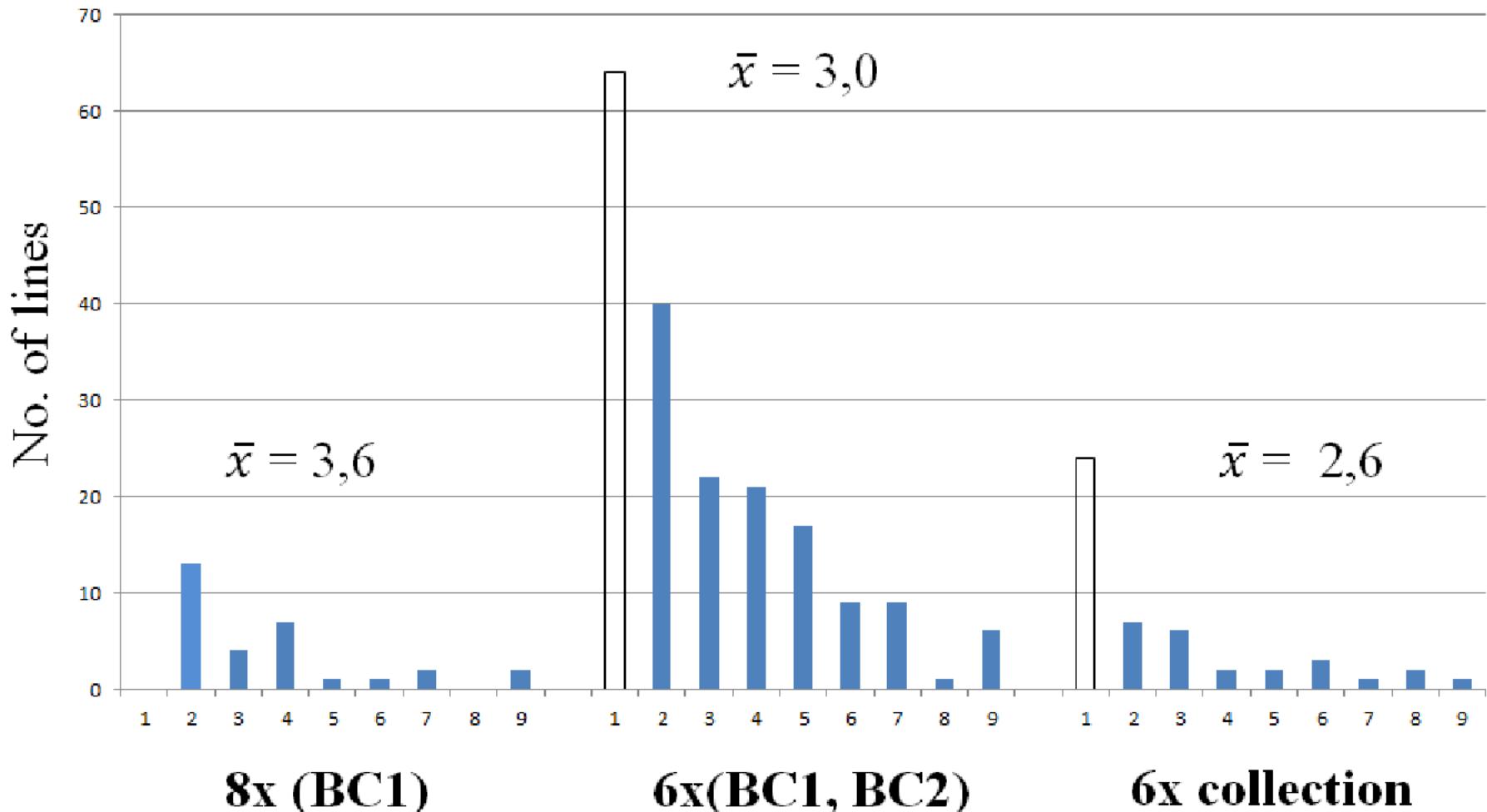
Winterhardiness score distributions for three groups of winter oat grown in Radzików in the 2008/2009 season



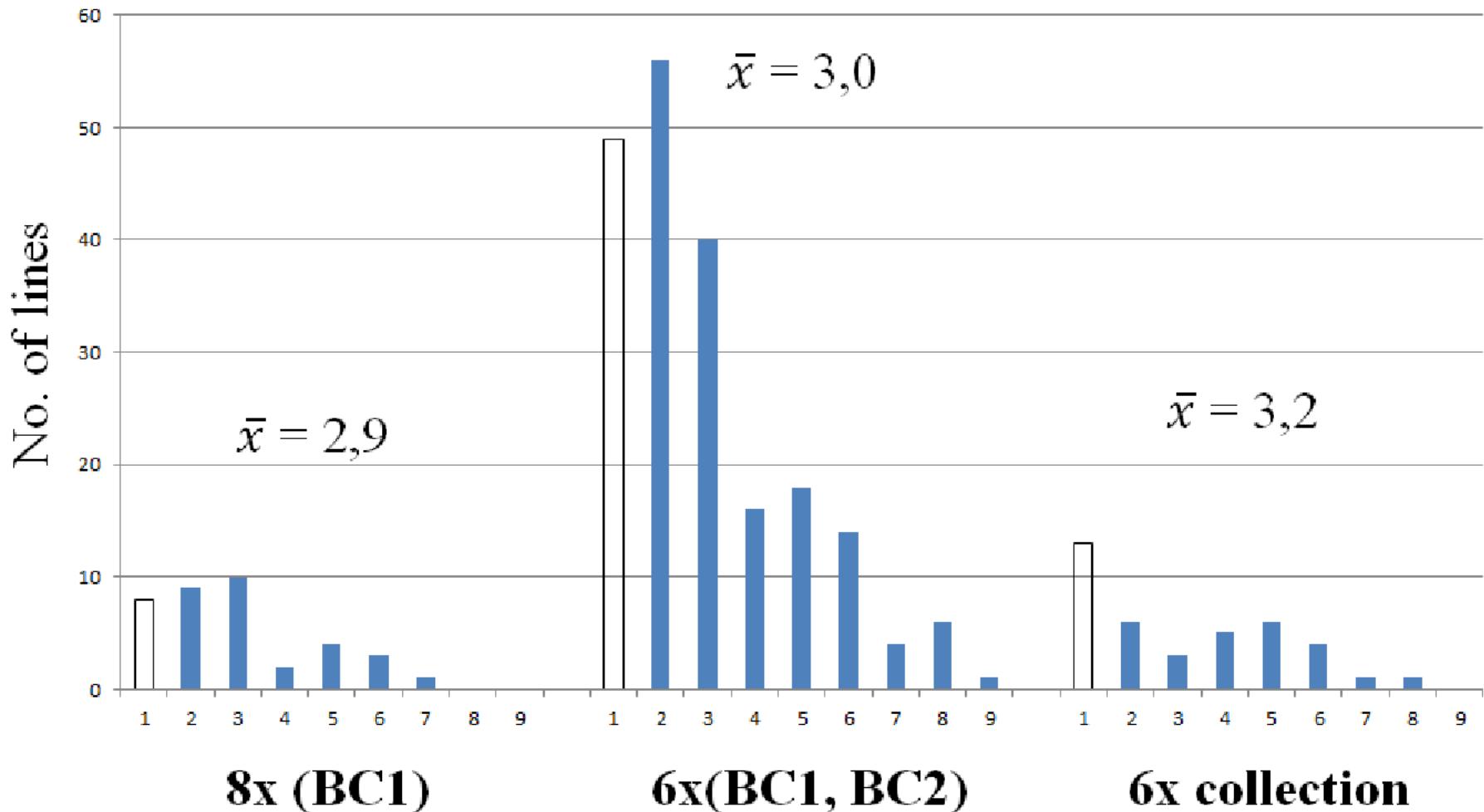
Winterhardiness score distributions for three groups of winter oat grown in Radzików in the 2009/2010 season

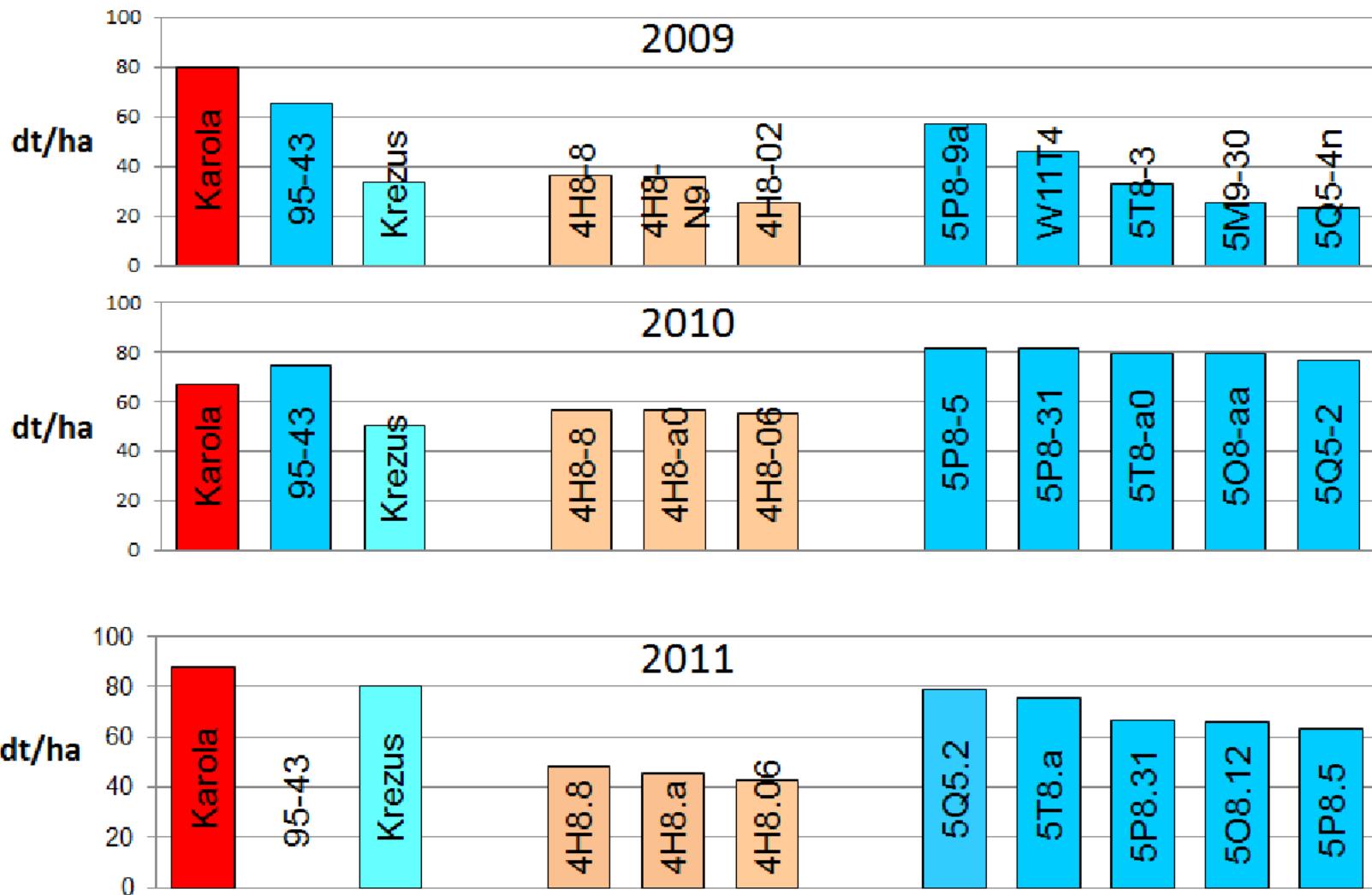


Winterhardiness score distributions for three groups of winter oat grown in Radzików in the 2010/2011 season

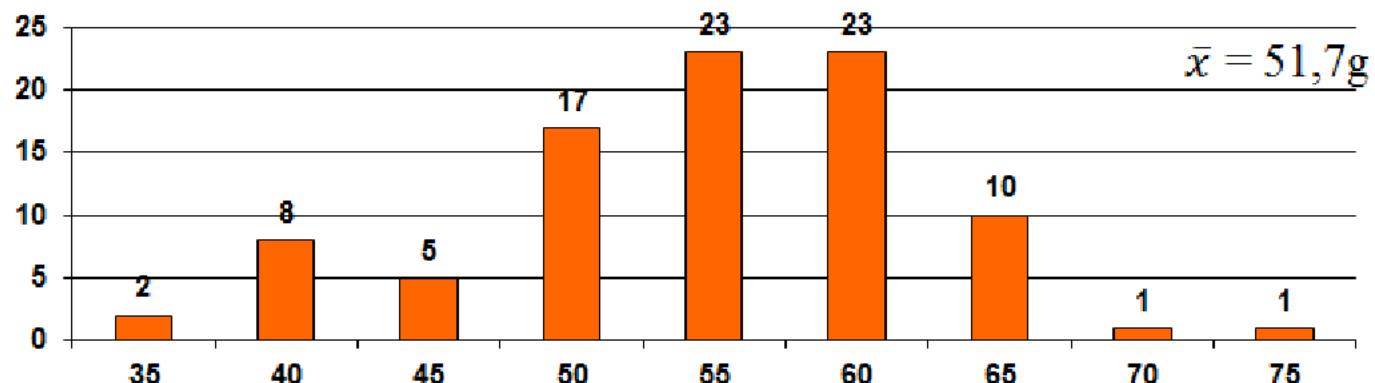


Winterhardiness score distributions for three groups of winter oat grown in Radzików in the 2011/2012 season

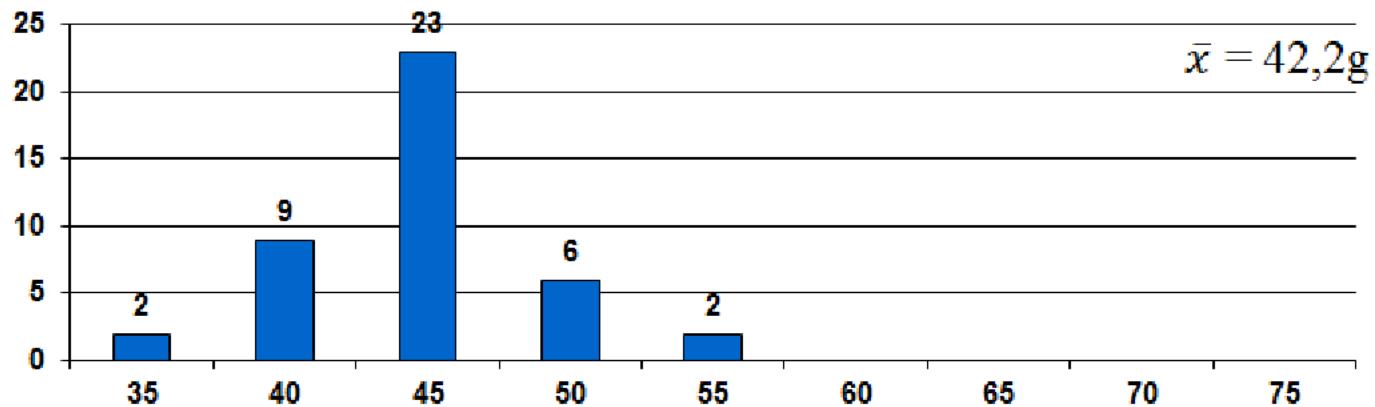




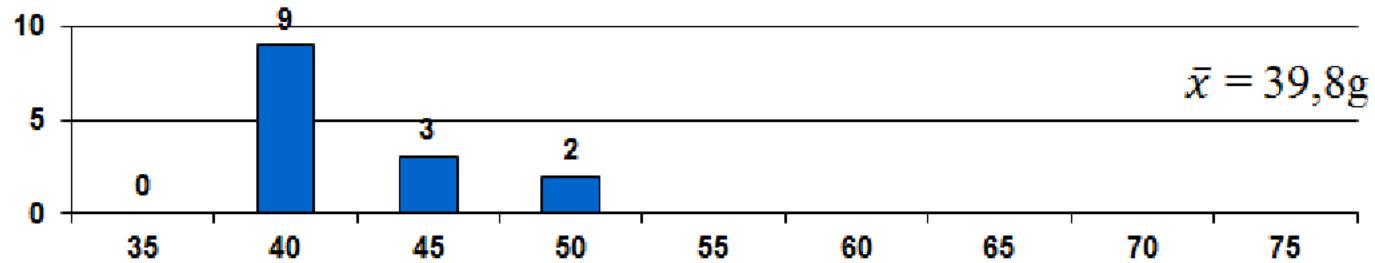
B1F1 8x:



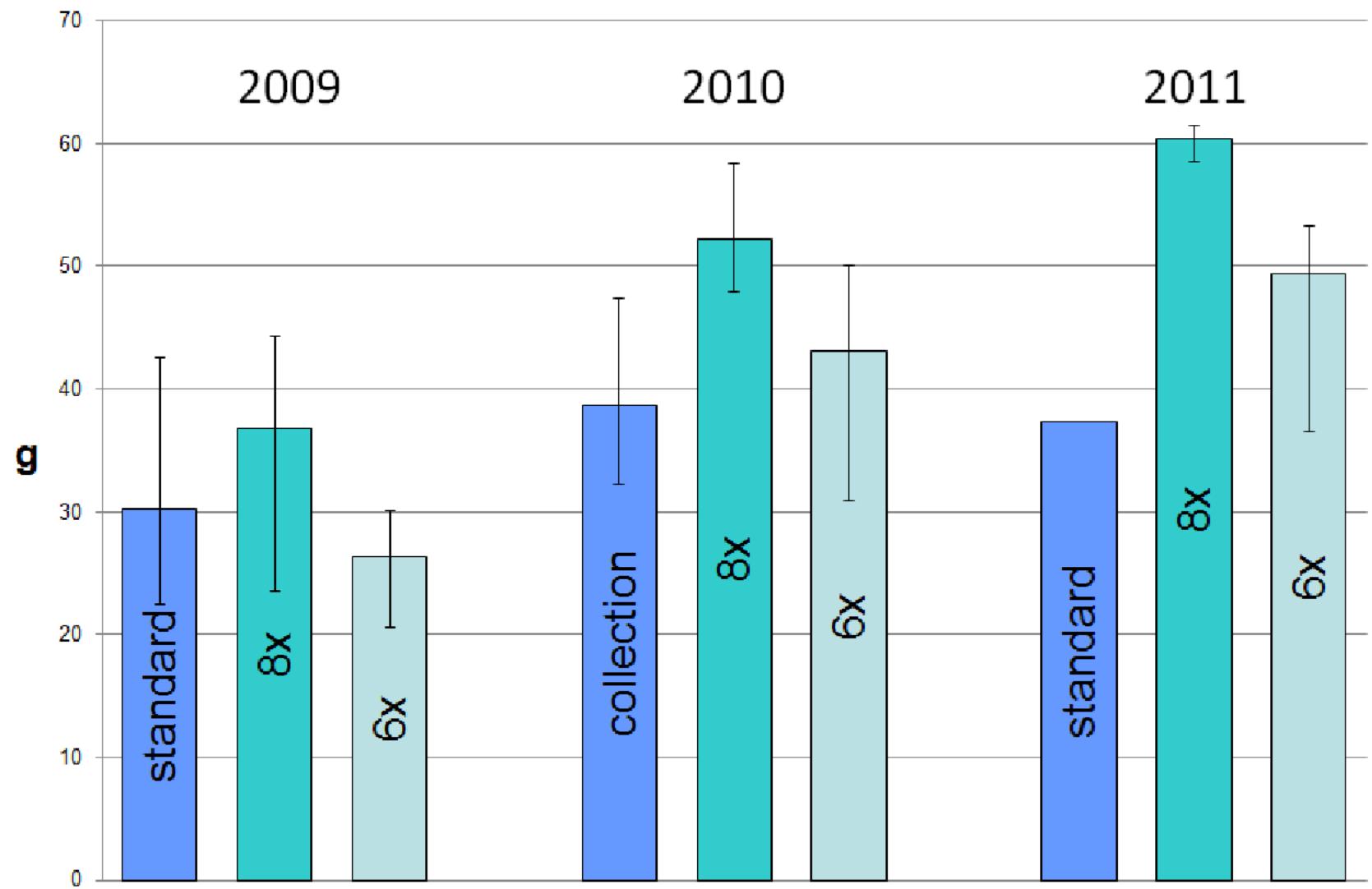
B1F1 6x:



6x collection:



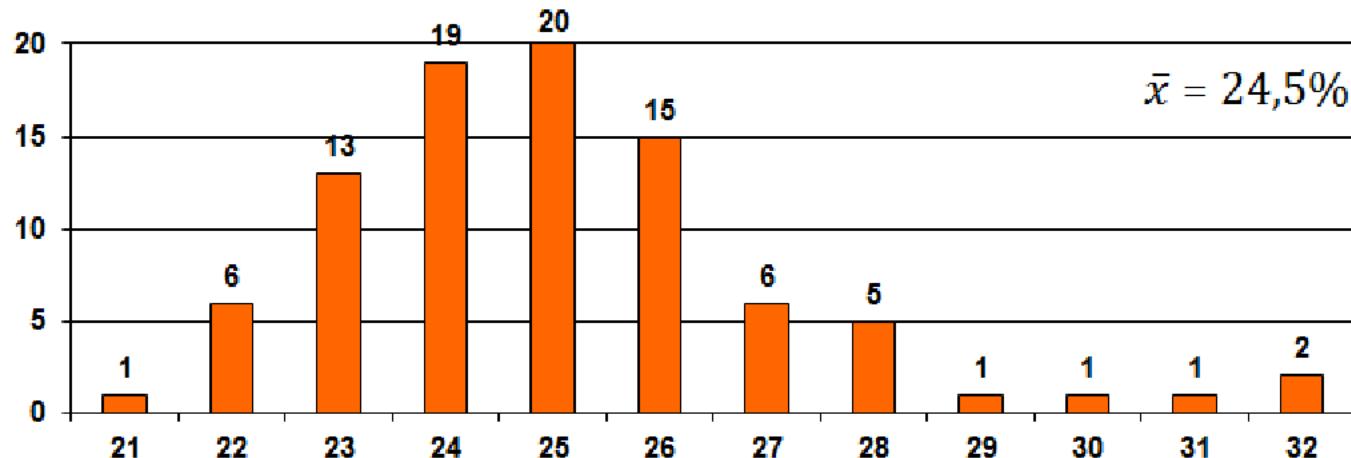
Radzików, 2008



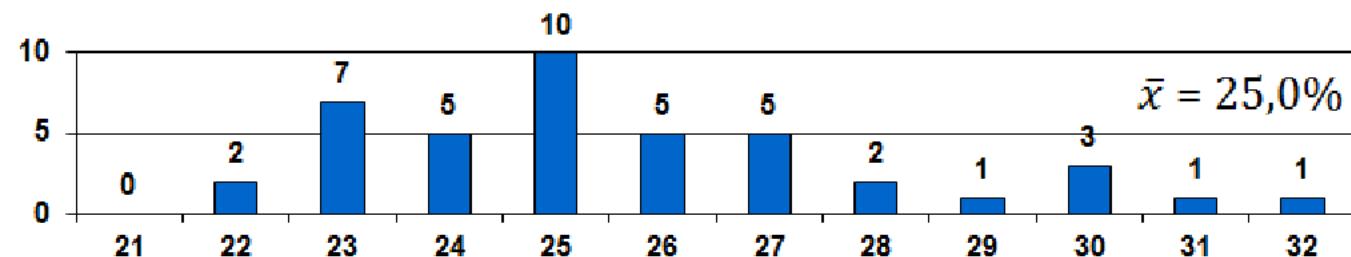




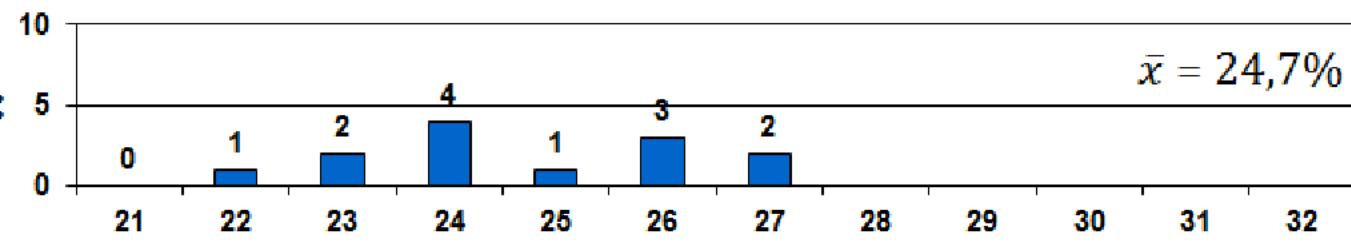
B1F1 8x:



B1F1 6x:



6x collection:



Radzików, 2008

object	yield kg	TKW g	% of husk	protein %	oil %	β-glucan
Krezus (spring oat)	8,02	37,4	21,8	14,56	5,17	4,00
heksaploids	5Q5.2	7,93	36,5	23,6	16,25	7,03
	5T8.a	7,58	53,3	26,3	17,11	5,11
	5P8.31	6,7	51,5	24,4	17,08	6,81
	5P8.5	6,33	47,8	24,7	16,3	4,9
	5P8.9a	6,25	51,7	27,5	16,5	6,91
octoploids	BH8 (bulk)	5,03	61	24,9	18,64	6,28
	4H8.8	4,85	61,5	25	19,77	5,9
	4H8.06	4,25	58,5	25,6	16,92	5,23

Comparison of octoploid and hexaploid wide hybrids

	octoploids	hexaploids
Winterhardiness		\geq
Yield	-	+
TKW	+	-
Husk content		=
Earliness		\leq
Protein content	+	-
β -glucan content	-	+
response to drought and weak soils	Not recognized	

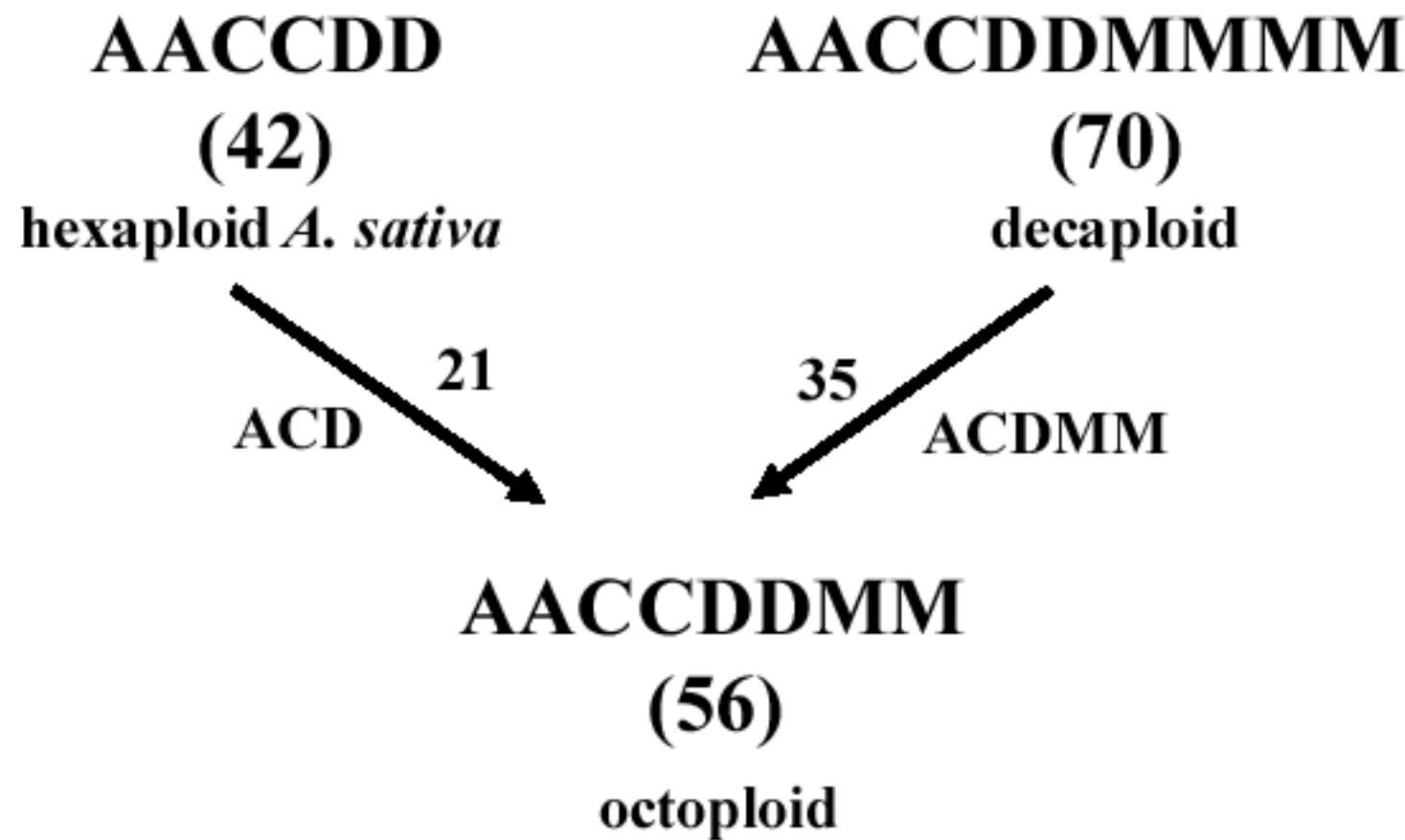
A photograph of a dense field of green oat plants. The plants are tall and have long, thin leaves. The sky above is clear and blue.

Thank you for the attention



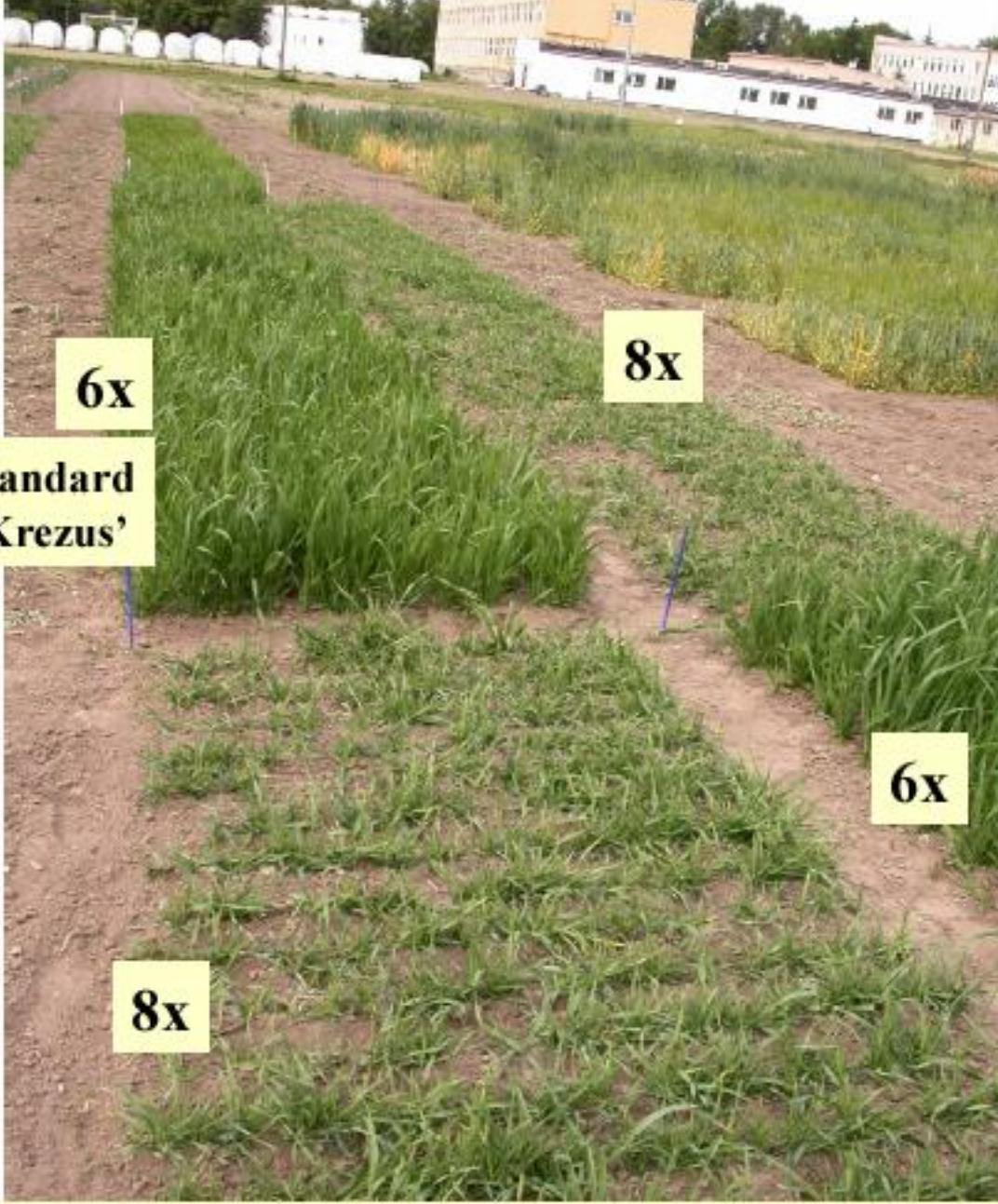
Octoploid lines, the 4H8 cross, 23.06.2008

Production of secondary octoploids

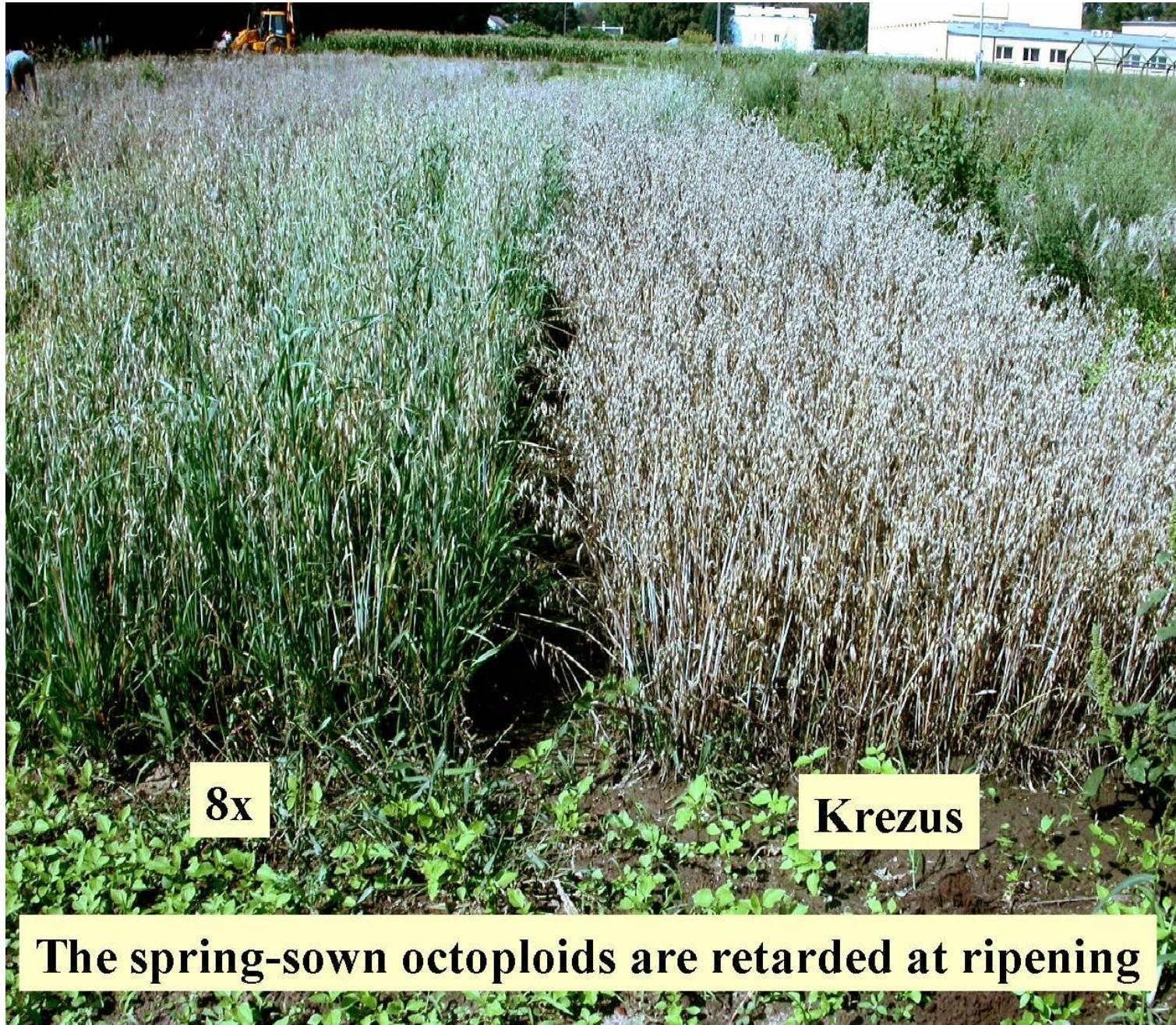




Disease resistance differences among octoploids



The octoploids are not suitable for spring sowing

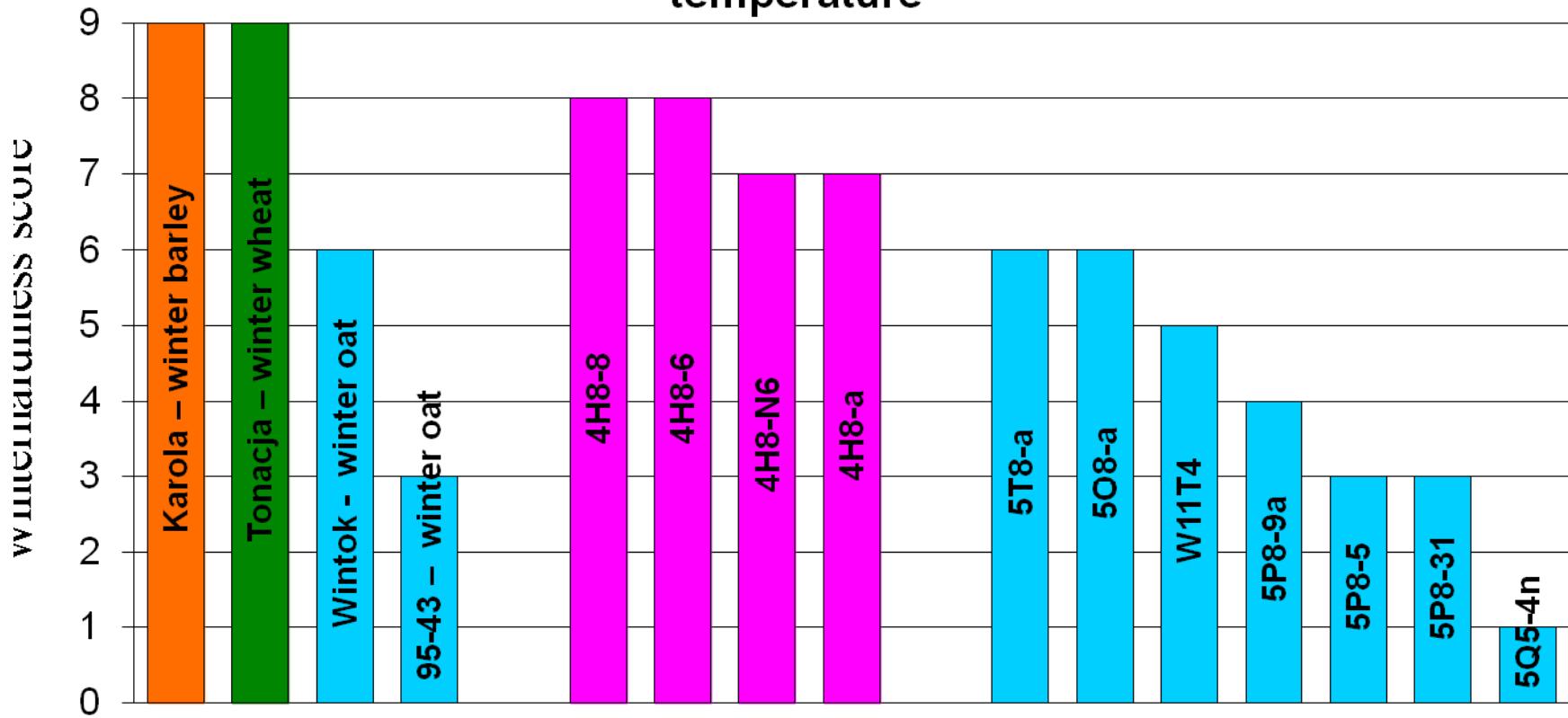


8x

Kreuzus

The spring-sown octoploids are retarded at ripening

The cold season was interrupted with temporary rise of temperature



Conclusions:

The octoploid oats derived from crosses with *A. macrostachya* show:

Advantages:

- ✓ winterhardiness
- ✓ high resistance to diseases causing leaf spots and lesions,
- ✓ large grain
- ✓ nutritive and technological properties of grain and green matter,

Faults:

- asynchronous flowering and ripening,
- yield ca. 30% lower than for the best hexaploids,
- large size and elongated shape of seed may require reconstruction of plot drills.

Not recognized:

- response to drought and weak soils.

Tabela 2: Rozkłady zmienności dla zimotrwałości różnych materiałów szkolkowych owsa
ozimego w 2009 r.
(*A. sativa* x *A. macrostachya*) x *A. sativa*

Bonitacja *	6x (<i>A. sativa</i> a))	6x BC3	6x BC2	6x BC1	8x BC1	x CW57	A.s+A. m 10x	raze m
1-1,9	14		18	4	9		4	49
2-2,9	5	4	2	24	7	1	4	47
3-3,9	7	3	1	23	5	1	2	42
4-4,9	7		2	35	8	1	1	54
5-5,9	10	2	2	17	16			47
6-6,9	3	3		26	10	2		44
7-7,9	9	3		33	15	2	1	63
8-9	35	1		51	41	13	1	142
liczebność								
średnia	5,6	4,7	1,7	5,5	6,0	7,3	2,8	5,4

*) 1 - najsłabsze, 9 - najlepsze

Plonowanie owsa ozimego w dwóch miejscowościach, sezon 2008/2009 (średnie z 3 powtórzeń, poletka 4m²) oraz niektóre cechy związane z plonem.

Miejscowość:	Radzików - plony		Małyszyn - plony		Radzików, cechy:		
Obiekt	q/ha	%wz. j.oz	q/ha	%wz j.oz	cięż. obj.	CTN (g)	zimo- trw.
a) wzorce:							
Karola, jęczm.oz.	79,8	100	86,5	100	62,4	42,6	9
43Cn4, owies oz.	65,8	82,4	49,5	57,2	44,5	30,4	8,0
Krezus,owies jary	33,8	42,4	52,3	60,4	39,8	25,5	-
Wintok, owies oz.	22,0	27,6	19,3	22,3	47,9	22,4	8,7
b) oktoploidy (A. sativa Wintok x A. macrostachya) x A. sativa 43Cn4							
4H8.8.8	36,3	45,5	44,3	51,2	nb	42,5	9
4H8.N9.01	36,0	45,1	38,8	44,8	49,6	23,5	7,2
4H8.0.2	25,5	32,0	33,8	39,0	40,5	44,3	5,0
c) heksaploidy (A. sativa W9 x A. macrostachya) x A. sativa (mix.)							
5P8.9a	57,5	72,1	43,0	49,7	45,5	27,7	7,7
W11T4.A8	46,0	57,7	39,5	45,7	49,4	24,9	7,8
5T8.3	33,0	41,4	29,0	33,5	59,7	25,8	4,3
5M9.30	25,5	32,0	18,8	21,7	57,9	20,6	5,2
5Q5.41n	23	28,8					

Tabela 4. Rozkłady zmienności dla udziału łuski w plonie, w różnych grupach materiałów owsa ozimego (ze zbioru 2008 r.).

Udział łuski (%)	6x (A. sativa)	6x (A. sativa x A.macrostachya)	8x (A.sativa + A. macrostachya)	razem
20-20,9			1	1
21-21,9	1	2	6	9
22-22,9	2	7	13	22
23-23,9	4	5	19	28
24-24,9	1	10	20	31
25-25,9	3	5	15	23
26-26,9	2	5	6	13
27-27,9		2	5	7
28-28,9		1	1	2
29-29,9		3	1	4
30-30,9		1	1	2
31-31,9		1	2	3
32-36,9				
37-37,9			1	1
liczebność	14	42	91	147
średnia	24,7	25,0	24,6	24,8

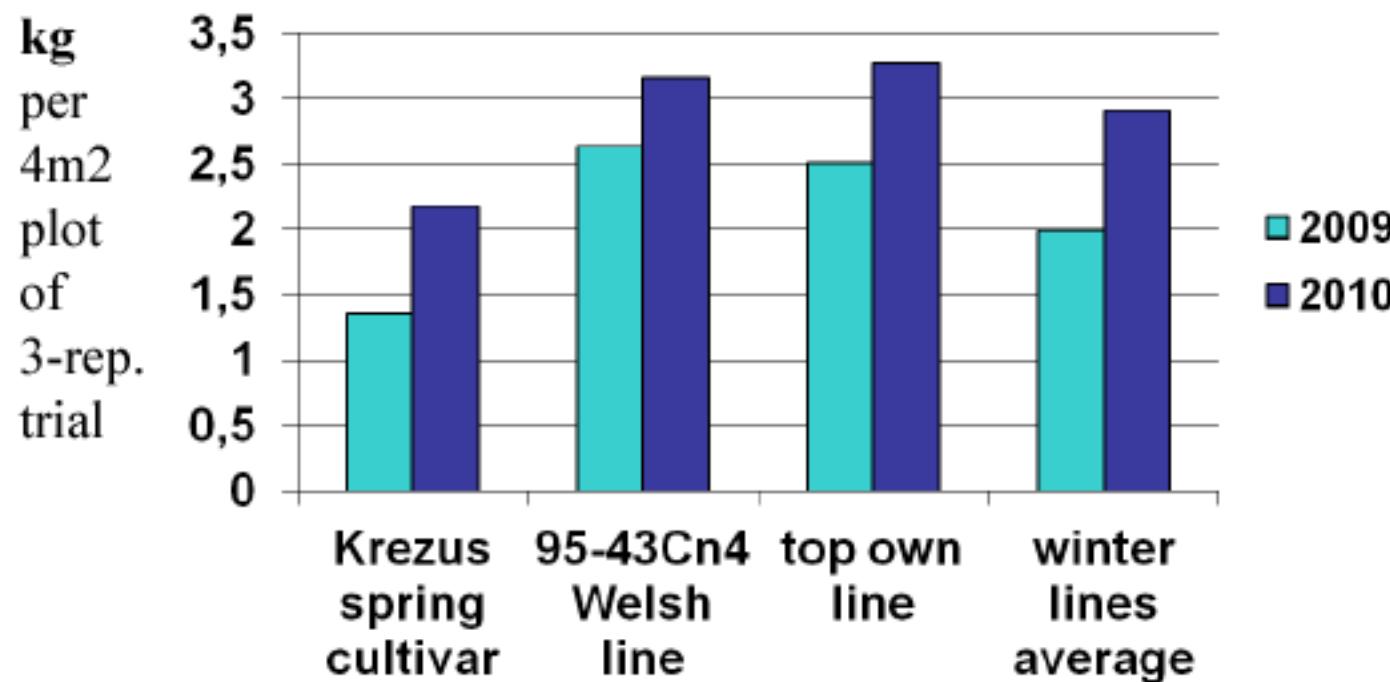
Tabela 5: Rozkłady zmienności dla ciężaru ziemiaka owsa ozimego (ze zbioru 2008 r.).

Ciężar 1000 nasion (g)	6x (<i>A. sativa</i>)	6x (<i>A. sativa</i> x <i>A.macrostachya</i>)	8x (<i>A. sativa</i> x <i>A.macrostachya</i>)	razem
15-19,9			1	1
30-34,9		2	2	4
35-39,9	9	9	8	26
40-44,9	3	23	5	31
45-49,9	2	6	17	25
50-54,9		2	23	25
55-59,9			23	23
60-64,9			10	10
65-69,9			1	1
70-74,9			1	1
liczebność	14	42	91	147
średnia	39,8	42,2	51,7	47,7

**Grain mass and percentage of husk
for the octoploid synthetic hybrid (Wintok+AmB6)
compared to the maternal form and the spring oat
check cultivar. Radzików, 2006.**

		1000 kernels mass (g)			% of husk
		with husk	without husk	large aver. small	
W+AmB6	(8x)	44,0	40,6-30,4-11,2		31,0
Wintok	(6x)	36,9	38,2-29,7-18,0		20,6
Chwat (check,6x)		31,3	31,2-23,8-10,4		24,9

Yielding of hexaploid winter oat, in relation to spring oat standard in Radzików, Poland, in the years 2009 and 2010.



yield of spring oat = 51,3% of best winter oat in 2009
= 66,4% in 2010
= 67,8% of winter oat mean in 2009
= 74,6% in 2010

The results of crossing *Avena sativa* with *A. macrostachya*, 2002.

Series	forms		crosses	Number of		obtained	
	<i>A.s.</i>	<i>A.m.</i>		pollinated	flowers	seeds	F1 plants
Spring A.s. x A.m.	10	6	11	42	779	10	0
Winter A.s. x A.m.	10	9	33	165	2271	27	3
A.m x spring A.s.	2	1	2	4	38	0	0
A.m. x winter A.s.	4	4	5	22	147	0	0

**Propagation of the colchicine treated clones
of the *Avena sativa* x *A. macrostachya* F1 hybrids,
at access of the *A. sativa* pollen. 2003.**

F1	Number of:				
	plants	panicles	spikelets	seeds	progeny
Ax264	969	2 053	22 951	19	3
Ax265	2 073	9 837	190 033	120	54
Ax330	6	16	81	0	0
Sum	3 048	11 906	213 065	139	57

Three F1 hybrids between winter oat and the wild species *Avena macrostachya* were obtained as a result of crosses performed in 2002. The hybrids were cloned intensely, treated with colchicine and propagated generatively at access of the *A. sativa* pollen. Seed set and genomic structure of the progeny were dependent on F1 genotype. Both primary synthetics and back-cross products were derived from two clones. Only three back-crossed plants had the most expected number of chromosomes – 56. The remained 26 ones had 40-49 chromosomes and majority of them were weak or highly sterile. However, they gave rise to several families of stable and fertile hexaploid lines (now F7), some of them expressed a high level of resistance to mildew and soil-borne diseases. Frequent introgression of the *A. macrostachya* genetic material was confirmed with the use of the AFLP markers.

In 2005, the forms with 56 or ca. 70 chromosomes produced uniform and fertile progeny with chromosome numbers close to the parental ones. Thus, new synthetic species were created, not described yet in botanical literature. The allopoloids survived moderate winter of the 2005/2006 season without damages, showed also resistance to mildew and soil-borne diseases. Only the octoploid form shows sufficient growth dynamism and fertility to be prospective for future applications in agriculture.