

Lechosław Grochowski

“Plant Breeding Smolice” Ltd., Smolice 146. 63 — 740 Kobylin. Poland.

## SOME PROPERTIES OF DOUBLE CROSS HYBRIDS OF RYE

### ABSTRACT

The study presents a formula of producing double cross hybrids of rye. The aim of the research was a generation of double and three way cross hybrids by using the same female parents and comparing chosen properties of them. The subject of the research were ten double cross hybrids, ten three way cross hybrids, two male parents and three standard varieties. The field trials were conducted in two places (Smolice, Rogoźewo). A statistical analysis showed that grain yield of double cross hybrids was significantly higher than grain yield of three way cross hybrids. Both types of the hybrids did not differ in plant height and lodging resistance indeed.

*Key words:* double cross hybrids, quantitative traits, rye

### INTRODUCTION

The hybrid varieties of rye grown at present are the three way cross hybrids of formula  $(A \times B) \text{ CMS} \times C$ . The male parent C is mostly a synthetic, strain or a population variety characterized by high fertility restoration ability and good combining ability (Geiger, 1982). In the years 1993–1998 Grochowski and associates elaborated a method of generation the xemc hybrids of rye. The combination of both methods, mentioned above, enabled a production of double cross hybrids of rye of formula  $(A \times B) \text{ CMS} \times (C \times D) \times H$ , which were the effect of crossing of 4 inbred lines with varied genetic origin.

The aim of undertaken researches was:

- the generation of double cross and three way cross hybrids of rye by using the same female parents
- the comparison of chosen properties of produced hybrids.

### MATERIAL AND METHODS

The first double cross hybrids of rye were produced at Smolice in 1999. The female parents were 10 hybrids CMS–SC from Radzików.

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The male parent was xenic hybrid SMH–XH–1. Simultaneously the same female parents were crossed with the strain SMH– 117 and three way cross hybrids were obtained.

The field trials were conducted in 1999/2000 in two locations (Smolice, Rogozewo). 10 double cross hybrids, 10 three way cross hybrids, 2 male parents, 3 standards: WARKO, ESPRIT and DANKOWSKIE ZLOTE participated in the trials. They were conducted by the method of incomplete blocks in 4 replications. Sowing density was 320 kernels/m<sup>2</sup>. The size of plot to harvest was 5m<sup>2</sup>. Five traits: grain yield per plot, 1000 grains weight, test weight, plant height and lodging resistance were analyzed in detail.

## RESULTS

The analysis of variance (Table 1) showed the essential differentiation of locations and researched genotypes in terms of evaluated traits. Significant interaction between genotypes and locations was not ascertained, what can testify to gene stability in different environments. The mean values of analysed traits were put together in Table 2.

Table 1  
The mean squares of variability for investigated traits. Smolice, Rogozewo, 2000

Source of variation	D.F.	Grain yield [dt/ha]	1000–grain weight [g]	Test weight [kg]	Plant height [cm]	Lodging score of 9° (1° – the best)
Locations L	1	5085.41**	354.31**	218.63**	3528.00**	0.018
Replications × Locations	6	509.46	23.37	148.67	148.67	0.002
Genotypes G	24	67.65*	27.92**	215.18**	215.18**	0.028**
Interaction L × G	24	34.87	5.69	29.46	29.46	0.015
Error	144	53.62	5.88	36.40	36.40	0.019

\* – significant at  $\alpha = 0.05$

\*\* – significant at  $\alpha = 0.01$

From the comparison of both types of hybrids ensue that grain yield of double cross hybrids was significantly higher than grain yields of three way cross hybrids.

The best double cross hybrid (TO<sub>2</sub>8722 × SMH–XH–1) yielded better than the best standard ESPRIT above 8%. The three way cross hybrids had higher 1000 grain weight, but the higher test weight was determined in the double cross hybrids. Types of the hybrids did not differ in plant height indeed, but within both groups differentiation of height was essential. In terms of lodging resistance no essential differentiation between groups of the hybrids was ascertained.

Table 2  
**Mean values for analyzed traits of hybrids, male forms and standards**  
**(average over 2 locations). Smolice, Rogozewo, 2000)**

Traits	Grain yield [dt/ha]			1000-grain weight [g]			Test weight [kg]			Plant height [cm]			Lodging [1-9 scale]			
	D	T	M	D	T	M	D	T	M	D	T	M	D	T	M	
<b>♀</b>																
Objects																
TH 6123	489 × 399	64.0	58.9	61.4	36.1	35.9	36.0	71.90	70.15	71.03	113.9	111.9	112.9	1.5	1.1	1.3
TS 8760	399 × 4475	67.7	61.4	64.6	35.3	37.3	36.3	72.30	70.95	71.63	118.9	115.6	117.3	1.5	1.1	1.3
TO <sub>2</sub> 8727	482 × 2130	65.4	63.8	64.6	37.5	38.8	38.2	72.30	71.20	71.75	113.5	111.5	112.5	1.2	1.1	1.1
TO <sub>2</sub> 8657	4475 × 2130	63.5	64.8	64.2	37.0	39.5	38.3	71.40	71.10	71.25	114.6	114.7	114.7	1.1	1.1	1.1
TO <sub>2</sub> 8722	167 × 2130	71.9	65.0	68.5	37.9	39.6	38.8	72.85	71.00	71.93	117.2	111.9	114.6	1.5	1.1	1.3
TO <sub>1</sub> 8619	130 × 493	67.8	60.6	64.2	37.3	39.3	38.3	72.15	70.60	71.38	115.5	112.2	113.9	1.1	1.1	1.1
TO-2 8655	5491 × 2130	59.6	58.7	59.1	33.2	35.0	34.1	71.50	70.60	71.05	109.7	14.0	106.9	1.1	1.1	1.1
TO-2 8727	130 × 2130	65.0	61.3	63.1	34.3	37.5	35.9	70.10	69.20	69.65	108.4	106.2	107.3	1.2	1.1	1.1
T2 8807	130 × 5491	63.9	54.7	59.3	35.6	38.1	36.9	71.55	69.80	70.68	117.6	110.6	114.1	1.1	1.1	1.1
T2 8810	463 × 5491	67.9	56.5	62.2	33.1	36.8	34.9	70.45	69.30	69.88	113.5	110.4	111.9	1.1	1.1	1.1
Mean		65.7	60.6	63.1	35.7	37.8	36.8	71.65	70.39	71.02	114.3	110.9	112.6	1.2	1.1	1.2
<b>♂</b>																
C × D																
SMH-XH-1 L304N × L25484/97				58.3			34.6			72.70			121.1			2.5
SMH-117 Population				54.5			37.2			70.35			115.5			1.2
Mean				54.2			35.8			71.52			118.3			1.8
				Standards												
WARKO				62.8			37.3			71.75			123.2			1.0
ESPRIT				66.4			38.2			72.60			115.1			2.7
DANKOWSKIE ŻŁOTE				58.4			37.6			72.65			125.8			1.1
Mean				62.5			37.7			72.33			121.4			1.6
LSD0.05				3.70			2.00			1.25			5.90			0.11

## CONCLUSIONS

1. Grain yield of double cross hybrids was significantly higher than grain yield of three way cross hybrids. The best of them yielded better than ESPRIT variety above 8%.
2. The three way cross hybrids had higher 1000 grains weight.
3. The double cross hybrids had higher test weight.
4. Both groups did not differ in height of plant
5. All researched hybrids turned out to be more resistant for lodging than ESPRIT variety.

## REFERENCES

- Geiger H.H., 1982. Breeding methods in diploid rye (*Secale cereale* L.). Tag. Ber. Akad. Landwirtschaft.- Wiss.DDR Berlin 198:305-332
- Grochowski L. Kaczmarek J. Kadhibiec W. Bujak H. 1996. Characterization of xenic rye hybrids. Votr. Pflanzenzuchtg 35:66-67
- Grochowski L.,1998. Kseniczne mieszańce 2yta Zesz. Nauk. AR Wrocław. 337:1-82

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