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Reciprocal influence of durum and soft wheat in inter-specific cross-breeding

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Abstract

Durum and soft wheat cultivars constitute an important source of genetic variation that can be used by plant breeders to create new durum wheat genotypes with higher yielding capacity and grain quality. For that reason we have studied some effects inter-specific crosses among durum and soft wheat genotypes might have upon the efficiency of durum wheat breeding. We have realized four crosses among one durum and two soft wheat cultivars. Significant results have been obtained for the crossing ability and germination ability of the hybrid seeds as well as for the segregation ratios among different morphological types of wheat in F-2 generation.

Key words: inter-specific crosses, crossing ability, germination ability, segregation ratio.

Introduction

Many researchers are of the opinion that soft wheat should be used as female plant (pollen receptor) in the process of hybridization between durum and soft wheat, and only **a few others support the idea of using durum wheat as female plant (pollen receptor).** In our study we tried to clarify several questions related to the amount of seeds obtained during hybridization (crossing ability), germination ability of hybrid seeds, and inheritance of morphological traits, as well as the segregation ratio among different forms of progenies in F-2 generation. The conclusions that can be drawn might be useful to fine-tune the breeding strategies and methodologies in classical plant breeding.

Materials and methods

Four inter-specific crosses among one durum and two wheat cultivars (table 4) are studied for three consecutive years. Crossing ability was determined by counting the number of seeds obtained by different crosses. Germination ability was defined in F-1 as a ratio between the germinated seeds over the total number of hybrid seeds obtained by each cross. Segregation ratios among different morphological wheat types were defined in F-2. The selection for the best genotypes based on phenotypic traits started in F-2. The experiments were carried out at the former Research Institute of Lushnja, Albania. Each variant was made of rows 1m long, with 20 cm inter-row distance, and 5 cm distance among seeds within the same row. The pollen was removed from the female plants (pollen receptors) during the hybridization process. The isolation was provided by covering the castrated spikes with paper envelopes after performing the pollination according to the crossing schemes. 10 spikes were castrated and pollinated for each variant.

Results and discussion

According to the analysis of variance for the crossing ability, there are not significant differences among four crosses. The only significant difference is evident among years (table 1). That implies that different weather conditions in different years might influence the results of the hybridization process.

Table 1: Analysis of variance for the crossing ability

Nr	Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F
1	Years	2	436.2	218.1	(*) 6.7
2	Crosses	3	406.9	135.6	(ns) 4.2
3	Error	6	195.8	32.6	
4	Total	11	1038.9		

Note: (*) Significant at p = 0.05
(ns) Not significant

The analysis of variance for the germination ability shows several significant effects at probability level 0.01 caused by generations (F), hybrids (H), and F x H interaction (table 2).

Table 2: Analysis of variance for the germination ability in F-1 and F-2 generations

Nr	Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F
1	Years	2	20.1	10.1	(ns) 0.8
2	Generations (F)	1	1300.4	1300.4	(**) 103.6
3	Hybrids (H)	6	10113.9	1685.7	(**) 134.4
4	Interaction F x H	6	1834.1	305.7	(**) 24.4
5	Error	26	326.2	12.5	
6	Total	41	13594.6		

Note: (**) Significant at p = 0.01
(ns) Not significant

According to data in table 3 the germination ability was lower in F-1 for hybrids where durum wheat was used as female plant. No differences in germination ability were seen in F-2.

Table 3: Germination ability of the parents and hybrids in F-1 and F-2 generations

Nr	Hybrids & Parents	F-1	F-2
1	Mec x Appio (soft x durum wheat)	66.8	73.9
2	Appio x Mec (durum x soft wheat)	(**) 44.5	74.1
3	Ç-22 x Appio (soft x durum wheat)	62.2	77.3
4	Appio x Ç-22 (durum x soft wheat)	(**) 46.4	76.9
5	Mec (soft wheat)	97.3	94.3
6	Ç-22 (soft wheat)	96.0	96.3
7	Appio (durum wheat)	96.0	94.3

Note: (**) Significant at p = 0.01

The data for the segregation ratios based on spikes morphological traits are presented in table 4.

Table 4: Segregation in F-2 according to spike morphology

Nr	Hybrids & Parents	Morphological segregation in F-2 (%)				
		Triticum aestivum	*Triticum durum*	Intermediate forms	*Triticum spelta*	*Triticum polonicum*
1	Mec x Appio (soft x durum wheat)	49.7	24.5	18.4	2.1	5.3
2	Appio x Mec (durum x soft wheat)	47.1	22.9	19.5	6.0	4.5
3	Ç-22 x Appio (soft x durum wheat)	33.4	35.8	19.4	5.7	5.7
4	Appio x Ç-22 (durum x soft wheat)	42.8	16.7	36.1	4.4	---

Conclusions

- Our results show that there is no significant difference in the amount of the hybrid seeds obtained in both cases when soft wheat was used as pollen receptor and vice versa (p= 0.01). Nevertheless there is a tendency to obtain more hybrid seeds when soft wheat is used as pollen receptor.
- Germination ability of hybrid seeds obtained by having durum wheat as female plants was clearly lower in F-1 than in F-2 (p= 0.01 %). This difference was less evident for the hybrid seeds obtained by using soft wheat as female plants, although there is some tendency to see higher germination ability in F-2 compared to F-1 seeds (Table 3).
- The morphological segregation of spike forms in F-2 were as follows: soft wheat and durum wheat constituted 33.4 % - 49.7 % and 16.7 % - 35.8 % respectively, intermediate spike forms 18.4 % - 36.1 %, *Tr. spelta* spike forms 2.1 % - 6.0 %, *Tr. polonicum* spike forms 4.5 % - 5.7 %.

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