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In vitro ANDROGENESIS OF SOME WHEAT (*Triticum aestivum* L.) VARIETIES AND THEIR F_1, F_2 PROGENIES AND COMBINING ABILITY OF EMBRYOID PRODUCTION

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ABSTRACT

Six parental lines along with their F_1 and F_2 progenies were investigated for general combining ability (GCA) effects on embryo-like-structure (ELS) production in anther culture. Significant differences were found among the parents in respect to the ELS production. Evaluating the combining ability effects, among the female parents Alfold showed the best result in ELS production, while Palma was the best among the male lines. While comparing F_1 and F_2 generations, in most of the cases (except one) F_2 generation was superior in ELS production. Polygenic effect plays a key role in such type of superiority in the F_2 generation. The reason for such superiority may be due to the recombination of superior genes.

Key Words : Anther culture, Combining ability, ELS

INTRODUCTION

In vitro androgenesis is an efficient system of homozygous line (DH) production that is widely applicable in wheat and could make a significant contribution to the breeding of new varieties by saving time and increasing selection efficiency via DH lines (Snape, 1981; Baenziger *et al*., 1984). Conventional recombination breeding is time consuming and during selection there is considerable loss of precious variability (Barnabas *et al*., 2000).

The androgenic response is influenced by three genetic components: callus/embryoid induction, plant regeneration and green plant induction ability. During developing doubled haploid production into a routine technique, many problems have been solved (Schaeffer *et al*., 1979; Lazar *et al*., 1984; Barnabas *et al*., 2000). But still little information is available on the genetics of *in vitro* responses and on the combining ability of doubled haploids in their crosses (Cseuz *et al*., 1990). Therefore, the present study was designed to estimate combining ability of some cultivated Hungarian wheat varieties for microspore embryoid production and also to check the embryoid production responses of their F_1 and F_2 progenies.

MATERALS AND METHODS

Six parents and their nine F_1 and F_2 generations were used for androgenic wheat studies. The donor plants were grown in a greenhouse under standard growing conditions. Cold

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treatment of donor shoots for anther culture was carried out in a cool chamber (4^0C) for 14-16 days. Spikes containing early and mid-uninucleate stage microspores were surface sterilized with 2% NaOCl containing some drops of Tween-80 for 20 minutes and then rinsed with sterile distilled water. Excised anthers (150 each in 5 replications) were plated onto a modified P-4 inducton medium (Ouyang *et al*., 1983) in 60 mm plastic Petri dishes. The P-4 medium was improved in two important components. Instead of sucrose and agar, 8% maltose and 10% Ficoll were used, respectively. For plant regeneration, a modified 190-2 medium (Zhuang and Jia, 1983) was applied (190-2 Cu) increasing $CuSO_4$ x $7H_2O$ doses twenty times compared to the content in the original MS medium, following results of Purnhauser and Gyulai (1993). Floated anthers in Petri dishes were kept in a dark room at 32^oC (Ouyang *et al*., 1987) for 3 days and after that at 28^0C for embryoid induction. ELS of about 1.5-2 mm were transferred to regeneration medium. Parents and progenies embryo-like-structure (ELS) production was analyzed by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

In the present study, three male namely Palma, Csuros, Optima and three female Kompolti, Alfold and Kondor were tested. Their average embryoid production in anthers has been presented in Table 1.

Table 1. Average embryoid production of the parents

Genotypes	ELS number/culture
Palma	238.4a
Kompolti	79.0b
Alfold	85.8b
Kondor	18.0c
Csuros	15.6c
Optima	4.0c

Genotypic variability in response to anther culture

There were three different responsive groups among the tested varieties according to embryo-like-structure (ELS) production in anther culture (Table 1). Remarkable difference was found in anther culture response among the tested varieties. According to the Table 1, Palma had the highest ELS production per Petri dish, while Optima showed the poorest fooled by Csuros and Kondor.

Combining ability of ELS production of F_1s

The combining ability effect of the female and male parents of embryo production are summarized in Table 2. Among the female lines, Alfold showed significantly higher combining ability effects (22.0). Strong negative combining ability effects were found in Kondor (-37.3). Examining the group of males, Palma had good combining ability effect on ELS production (57.8), while the other two showed strong negative effect. Cseuz *et al.*

(1990) got some good genotypes with increased frequency of *in vitro* androgenesis regarding ELS production.

Table 2. ELS production of the studied 9 F_1 combinations and GCA effects of the parents

Males	Palma	Csuros	Optima	Family mean of F_1s	GCA effect
Females	Embryoid number/culture			ELS number/culture	
Kompolti	156.2	7.8	24.6	62.9	15.3
Alfold	138.6	34	36	69.5	22
Kondor	21.4	4.6	4.8	10.3	-37.3
F_1 means	105.4	15.5	21.8	47.6	
GCA effect	57.8	-32.1	-25.8		0.0

Comparison between F_1 and F_2 generation on the basis of their ELS production

Among the F_1s Kompolti x Palma crossing showed the highest ELS production followed by Alfold x Palma and Kondor x Palma (Table 3). None of the crossings had heterotic effect. Among the F_2s, Kompolti x Palma was the best followed by Alfold x Palma and Kompolti x Csuros. While comparing F_1 and F_2 generations, except in one case (Alfold x Optima), F_2s had better performance than F_1s. Recombination of superior genes in F_2 generation may be the reason of better performance of F_2 generation. Karsai *et al*. (1991) found similar results in F_2 generation.

Table 3. Comparison between F_1 and F_2 generation on the basis of their ELS production

Female parent	Male parent	Progenies	
Kompolti	Palma	F_1 generation	F_2 generation
79.0c	238.4ab	156.2bc	261.0a
Alfold	Palma	F_1 generation	F_2 generation
85.8b	238.4a	138.4b	165.4b
Kondor	Palma	F_1 generation	F_2 generation
18.0b	238.4a	21.4b	76.0b
Kompolti	Csuros	F_1 generation	F_2 generation
79.0b	15.6c	7.8c	152.0a
Alfold	Csuros	F_1 generation	F_2 generation
85.8a	15.6b	34.0b	84.2a
Kondor	Csuros	F_1 generation	F_2 generation
18.0ab	15.6b	4.6b	18.0a
Kompolti	Optima	F_1 generation	F_2 generation
79.0a	4.0c	24.6bc	36.8b
Alfold	Optima	F_1 generation	F_2 generation
85.8a	4.0c	36.0b	16.8c
Kondor	Optima	F_1 generation	F_2 generation
18.0ab	4.0b	4.8b	27.0a

CONCLUSION

Six parents and their 9 F_1 and F_2 generations were tested regarding their androgenic response. Significant differences were found in anther culture response among the tested varieties. When evaluating the combining ability effects for ELS production, among the female lines Alfold was the best, while among the male lines Palma had best performance. When F_1 and F_2 generations were compared, F_2 had better performance. It might be due to polygenic effect in the F_2 generation. The reason for such superiority may be due to the recombination of superior genes. Based upon all the results obtained from the experiments, it is advisable to cross wheat parents with good combining ability.

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