Kragujevac J. Sci. 28 (2006) 153-157.

GENETIC ANALYSIS OF NUMBER OF KERNELS PER SPIKE IN WHEAT (*Triticum aestivum* L.)

Desimir Knežević[1], Veselinka Zečević[2], Danica Mićanović[2], Milomirka Madić[3], Aleksandar Paunović[3], Nevena Đukić[4], Dušan Urošević[2], Biljana Dimitrijević[2], Srđan Jordačijević[5]

[1]*Agricultural faculty Lešak, University of Priština, Serbia and Montenegro,*
e-mail: desko@ptt.yu
[2]*Agricultural Research Institute SERBIA, Center for Small Grains Kragujevac, Save Kovačevića 31, Kragujevac, Serbia and Montenegro,*
[3]*Faculty of Agronomy Čačak, University of Kragujevac, Cara Dušana 34, Čačak, Serbia and Montenegro;*
[4]*Faculty of Science and Mathematics, Department of Biology & Ecology, R. Domanovića 12, Kragujevac, Serbia and Montenegro*
[5]*High Agricultural school of Prokuplje, Serbia and Montenegro*

(Received April 3, 2006)

ABSTRACT. In diallel cross excluding reciprocals of four divergent wheat cultivars (Ana Morava, Gruža, Beograđanka and Pobeda) was derived F_2 hybrids. Those four cultivars and F_2 hybrids were investigated to estimate the mode of inheritance, gene effects and combining abilities for number of kernels per spike in wheat plants. By analysis was established different mode of inheritance for number of kernels per spike (intermediate, partial dominance, dominance and overdominance). Analysis of variance of combining abilities indicated significant differences for this trait. Obtained results showed that this trait determined by additive and non-additive gene effects. Significant high value of specific combining ability (SCG) in F_2 hybrids indicated preponderance of non-additive gene effect. The highest value of general combining ability (GCA) expressed cultivar Ana Morava while the best specific combination was cross of Ana Morava x Beograđanka for number of kernels per spike.

INTRODUCTION

Number of kernel per spike is very important components of yield in wheat. This component depends from genetics and environmental factors. During plant ontology, regime of temperature and moisture is very important for developing spikelets per spike, efficiency of pollination and fertilization what is direct connection with kernel development. Increasing of yield is based on the increasing value of yield components (for example: height of plant, productive tillering, length and mass of spike, number of kernel

per spike, mass of grain per spike). All of these yield components are genetically determined. In diallel cross analyses is possible to investigate genetical control of yield components and it have been reported by Gupta *et al.* (1988), Dimitrijević and Kraljević-Balalić (1992) Knežević and Kraljević-Balalić (1993), Menon and Sharma (1994), Petrović *et al.*, (1995), Dimitrijević *et al.* (2002) Zečević *et al.* (2005). Results of expressed mode of inheritance and gene effects mainly depend from parents used for diallel crosses. Because of this reason is very important the choice of parents for the breeding program. Combining ability of investigations carried out by breeders to select parents with efficient transferring desirable genes to the progenies (Joshi *et al.* 2002; Gorjanović and Kraljević- Balalić, 2004; Madić *et al.* 2005). The aim of breeders is developing new cultivars with high yield and quality. During breeding time, it is necessary to select pure line and to estimates general combining ability (GCA) which is indicating prevalence of additive gene effects, as well specific combining ability that is indicating non-additive gene effect and on the base of that predict progenies and make choice of cross combinations and genotypes.

The objective of present investigation was study of combining abilities, mode of inheritance, gene effects for number of kernels per spike in F_2 hybrids derived by diallel crosses of four wheat cultivars.

MATERIALS AND METHODS

For this investigation were used four divergent wheat cultivars (Ana Morava, Gruža, Beogradanka and Pobeda) which were created in different breeding centers. Diallel crosses without reciprocals were performed and developed six hybrids combination. The experiment was carried out at the experimental field of the Center for Small Grains in Kragujevac during the period of 2001/02. For this study, seed materials of parents and 6 crosses combination was sown in 1.0 m long rows, with 20 cm space between rows and 10 cm distance between single seeds in the row. Number of kernels per spike was analyzed at the full maturity stage by analysis of 120 plants per genotypes (40 plants per replication) for parents and F_2 hybrids. Combining ability was analyzed according to Griffing (1956) by using method 2, model I.

RESULTS AND DISCUSSION

The analysis of variance for number of kernels per spike showed highly significant differences among genotypes. The highest number of kernels per spike had cultivar Pobeda (x=59.35) and similar values had cultivars Gruža (58.72) and Ana Morava (58.10) except cultivar Beogradanka (50.48) Table 1.

The mean value of number of kernels was different in F_2 hybrids. In comparison of mean values in F_2 hybrids with parents mean values was estimated mode of inheritance. Partial dominance as a mode of inheritance was at the combination (Pobeda x Beogradanka) while intermediate inheritance was in combination (Gruža x Beogradanka). The positive heterosis occurred at the two hybrids combinations (Ana Morava x Gruža; Ana Morava x Beogradanka) and at the remain two cross combinations (Ana Morava x Pobeda and Pobeda x Gruža) was occurred negative heterosis. Similar results concerning lack of dominance, also, have been reported by investigation (Mihaljev and Kraljević-

Balalić, 1981; Dimitrijević and Kraljević-Balalić, 1992; Kraljević-Balalić *et al.*, 2001; Gorjanović and Kraljević-Balalić, 2004).

Table 1. Average values and mode of inheritance of number of kernels per spike in F_2 hybrids analyzed by analysis of variance in diallel crosses of 4 cultivars

Parents	Ana Morava	Pobeda	Gruža	Beograđanka	LSD	
					0,05	0,01
Ana Morava	58.10	53.60-^{h}	61.86^{h}	65.15^{h}	5.78	7.94
Pobeda		59.35	48.10^{-h}	53.02^{-pd}		
Gruža			58.72	54.49^{i}		
Beograđanka				50.48		

i-intermediate; h-heterosis occurred; pd-partial dominance

Analysis of variance for combining ability showed that both, general (GCA) and specific (SCA) combining ability for number of kernels per spike were highly significant. This components controlled by additive and non-additive gene action with preponderance of non-additive gene effect. The GCA variance was less than SCA variance and computed ratio GCA/SCA was less from unit, that indicates preponderance of non-additive gene action (Table 1). Similar results of investigation of yield components was reported by Dimitrijević and Kraljević-Balalić (1992), Knežević and Kraljević-Balalić (1993), Kraljević-Balalić *et al.* (2001), Gorjanović and Kraljević-Balalić (2004) in wheat as well in barley analysis (Madić *et al.*, 2005). On the contrary some investigation reported that number of kernels per spike controlled by additive gene action (Gupta i sar., 1988),

Table 2. Analysis of variance for combining ability in F_2 hybrids for number of kernels per spike in wheat

Source of variation	Degree of Freedom	Sum of Squares	Mean of Squares	F	F- tabl.	
					0,05	0,01
GCA	3	68.01	22.67	5.96**	3,20	5,10
SCA	6	201.30	33.55	8.85**	2,70	4,00
E	18		3.79		GCA / SCA =0.675	

The best general combiner for number of kernels was cultivar Ana Morava which had the highest mean value of analyzed components. This cultivars can be use in the breeding programs for improving this traits (Table 3).

Table 3. Values of general combining ability for number of kernels per spike in F_2 hybrids of wheat

Parents	GCA	Range	SE	LSD	
				0,05	0,01
Ana Morava	2.73	1	1.14	2.39	3.32
Pobeda	-1.58	4			
Gruža	0.26	2			
Beograđanka	-1.38	3			

Computed values of specific combining ability for number of kernels per spike were significantly different (Table 4). The highest value of SCA for number of kernels per spike was found in F_2 hybrids combination (Ana Morava x Beograđanka). This cross combination was between the worst and the best parent for number of kernels per spike. This value of SCA indicates higher impact of genes with non-additive action in comparation to other F_2 hybrids combination. Similar values were obtained by investigation (Dimitrijević and Kraljević-Balalić, 1992; Kraljević-Balalić et. al., 2001; Joshi *et al.* 2002; Madić *et al.*, 2005), where found the best specific combining ability by crosses between the best and the worst parents.

Table 4. Specific combining ability values for number of kernels per spike in F_2 hybrids of wheat

Parents	Ana Morava	Pobeda	Gruža	Beograđanka	SE	LSD	
						0,05	0,01
Ana Morava	-	-4.12	3.86	7.41**	2.19	4.62	6.34
Pobeda			-7.16	-0.81			
Gruža				-0.42			
Beograđanka				-			

CONCLUSION

In diallel crosses of four divergent wheat cultivars were investigated: mode of inheritance, gene effects and combining abilities for number of kernels per spike in F_2 hybrids. The mode of inheritance of this component was different (intermediate, partial dominance and over dominance with occurrence of heterosis).

The analysis of variance of combining abilities showed that number of kernels per spike was under control of additive and non-additive gene action with preponderance of non-additive gene action. The best general combiner was cultivar Ana Morava for number of kernels/spike, while the best cross combination was Ana Morava x Beograđanka which is perspective for the further selection process.

The knowledge of genetic controls for number of kernels per spike as well as the other traits giving possibility for developing efficient concept for creation cultivars with higher yield and better quality. However, increasing of genetic potential of yield can realize through increasing of spike capacity. Basically, through increasing of number and fertility of spikelets will be increased number of kernels as well as yiled. Also, in the purpose of yield increasing, very important is to resolve genetics changes in increasing of assimilation acceptors capacity.

References

[1] GRIFFING, B. (1956): Concept of general and specific combining ability in relation to diallel crossing system. *Austr. J. Biol. Sci.*, **9,** 463-493.

[2] GUPTA, S., AHMAD, Z., GUPTA, R.B. (1988): A study of gene effects for some quantitative traits by different diallel models in wheat (Triticum aestivum L.). *Genetika*, **20**, 47-51.

[3] GORJANOVIĆ BILJANA, KRALJEVIĆ-BALALIĆ MARIJA (2004): Genetic analysis for grain weight per spike and harvest index in macaroni wheat. *Genetika*, **36**, 23-29.

[4] DIMITRIJEVIĆ, M., KRALJEVIĆ-BALALIĆ MARIJA (1992): Combining ability for number of kernels per spike in wheat. *Genetika*, **24**, 139-144.

[5] DIMITRIJEVIĆ, M., KNEŽEVIĆ, D., PETROVIĆ SOFIJA, ZEČEVIĆ VESELINKA (2002): Variability and stability of harvest index in wheat (*Triticum aestivum* L.). *Kragujevac J. Sci.* **24**, 91-96.

[6] JOSHI, S.K., SHARMA, S.N., SINGHANIA, D.L., SAIN, R.S. (2002): Genetic analysis of quantitative and quality traits under varying environmental conditions in bread wheat. *Wheat Information Service*, **95**, 5-10.

[7] KNEŽEVIĆ, D., KRALJEVIĆ-BALALIĆ MARIJA (1993): Genetic analysis for weight of kernels per spike in wheat (Triticum aestivum L.). *Genetika*, **25**, 71-75.

[8] KRALJEVIĆ-BALALIĆ, M., WORLAND, A. J., PORCEDDU, E., KUBUROVIĆ, M. (2001): Variability and gene effects in wheat. In: Quarrie, S. *et al.* (eds.) Monograph: *Genetics and Breeding of Small Grains*. pp. 9-49.

[9] MADIĆ MILOMIRKA, PAUNOVIĆ, A., ĐUROVIĆ, D., KRALJEVIĆ-BALALIĆ MARIJA, KNEŽEVIĆ, D. (2005): The analysis of gene effect in the inheritance of kernel number per spike in barley hybrid. *Genetika*, **37** 261-269.

[10] MENON, U., SHARMA, S.N. (1994): Combining ability analysis for yield and its components in bread wheat over environments. *Wheat Information Service*, **80**, 1-5.

[11] MIHALJEV, I., KRALJEVIĆ-BALALIĆ MARIJA (1981): Genetska analiza kvantitativnih svojstava pšenice. *Genetika*, **13**, 265-280.

[12] PETROVIĆ, S., KRALJEVIĆ-BALALIĆ MARIJA, DIMITRIJEVIĆ, M. (1995): The mode of inheritance and gene effects for plant height and harvest index in different wheat genotypes. *Genetika*, **27**, 169-180.

[13] ZEČEVIĆ VESELINKA, KNEŽEVIĆ, D., MIĆANOVIĆ DANICA, PAVLOVIĆ, M., UROŠEVIĆ, D. (2005): The inheritance of plant height in winter wheat (*Triticum aestivum* L.). *Genetika*, **37**, 173-179.