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Combining ability of white grain popcorn populations

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ABSTRACT – *The objectives of this study were to indicate the best improvement strategy and select parents to begin an improvement program of white grain popcorn based on the combining ability and heterosis of eight populations selected in experiments in the northwestern region of Paraná. The traits plant and ear height, grain yield and popping expansion were evaluated. The base populations, the F_1 and five controls were evaluated in Maringá, state of Paraná, over the course of two years. Heterosis for popping expansion was very low and the best improvement strategy is to raise the values of popping expansion up to commercial levels through intrapopulation improvement of the populations BRS Angela and SC 002. Intense selection must be applied to reduce plant and ear height; interpopulation selection must not be initiated at this moment.*

Key words: *Zea mays*, yield, popping expansion.

INTRODUCTION

In 2004, according to estimates of the packaging industry, the annual demand for popcorn in Brazil was 65 to 70 thousand tons, of which 15 to 20 thousand tons were imported. Over the last five years this market has gone through several changes. The first was the introduction of a producer – distributor partnership system. The producers supply seed and warrant the sale of the product, as far as it meets quality standards (Scapim et al. 2006).

From this year on, the release of hybrid IAC-112 developed by the Instituto Agronômico de Campinas (IAC), began to reduce the dependence of the country on imported seed notably, according to data obtained from packaging industries (Yoki and Hikari). Formerly, most farmers used to sow their own seed, derived from local varieties or advanced generations of American hybrids (Sawazaki 1995, Sawazaki et al. 2000). In spite of the advances, the scope of Brazilian research is restricted to the work of a few researchers of public institutions and some private seed producer companies. Nation-wide, only a few varieties and hybrid lines have been developed (Matta and Viana 2001).

On this background, new improvement programs ought to be set up. One of the genetic-statistically most interesting techniques is the analysis of diallel crosses in view of the huge amount of genetic information it can provide breeders with (Cruz and Regazzi 1994).

There are few reports on diallel analysis in popcorn. Zanette (1989) analyzed diallels of seven popcorn populations and inferred the existence of intermediate heterosis for popping expansion. Later,

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other diallel studies indicated low (Andrade et al. 2002) or even negative specific heteroses (Larish and Brewbaker 1999, Scapim et al. 2002)

Scapim et al. (2002) evaluated nine yellow grain popcorn populations in the state of Paraná in diallel crosses and recommended the populations Beija-Flower and RS-20 for a reciprocal recurrent selection program. The two are complementary regarding grain yield and popping expansion, aside from the possibility of developing composites among populations of high general combining ability. Miranda et al. (2003) indicated the pair Beija-Flower and RS-20 as genetically most distant by means of the evaluation of the genetic diversity through multivariate analysis.

In view of the lack of reports in Brazil on diallel analysis with the populations PR 038, PR 079, RR 046, SC 016, PR 017, RS Angela, SC 002, and PR 009 this study was conducted with the following objectives: to propose an indication of the best improvement strategy and the selection of parents for an improvement program, based on information of combining ability and heterosis for white popcorn populations.

MATERIAL AND METHODS

Eight popcorn populations were crossed in a diallel mating design (PR 038, PR 079, RR 046, SC 016, PR 017, BRS Angela, SC 002, and PR 009). These populations are advanced generations of American and Argentinean hybrids, with exception of BRS Angela, released by the EMBRAPA-CNPMS. The populations were chosen based on regional results of yield and popping expansion in the northwestern region of Paraná.

For the establishment of the F1 plants, the populations were sown in four 10 m long rows in all possible pair combinations. In the flowering period, all possible crosses between the populations were performed manually with pollen mixture, with approximately 70 crosses; twenty-five to 30 healthy ears were harvested per intervarietal cross. The populations were multiplied on a separate area, using the same procedure with pollen mixture.

The trials were developed in the growing seasons (2000/2001 and 2001/2002) on an experimental field of the Universidade Estadual de Maringá, in Iguatemi-PR, in a randomized block design in three replicates, with 41 treatments that consisted in eight populations, the 28 intervarietal hybrids and five controls (Zélia, IAC 112, UEM J1, PR 023, and SE 013). Each plot consisted of four rows of 5.0 m, spaced 0.9 m apart. In the plots, two seeds were sown at every 0.2 m in a planting hole. After thinning out 20-25 days after emergence, one plant per spot was left over, so that in the useful area of each plot, 50 plants were left to grow.

The evaluated traits were: plant height – measured from the ground level to the point of insertion of the flag leaf, of six healthy plants per plot after tasseling; ear height - measure from the ground level to the insertion of the highest ear in the stem, in the same six plants per plot; grain moisture - obtained in a sample of grains from each plot; grain yield – obtained by weighing the threshed grains in the plot and transformed into kg ha^{-1}, adjusted to a moisture of 15.5%; and popping expansion - obtained as the ratio of the popped popcorn volume and the raw grain mass. Two grain samples of 30g per plot, measured on a precision scale, were popped at a temperature of 280 ^{o}C for 2 min in an electrical popper with automatic temperature control developed by the EMBRAPA-CNPDIA. The volume of the popped popcorn was measured in a graduated cylinder of 1000 mL. The grain mass for popping was taken from the mid-basal part of the ears. Before evaluating the popping expansion, the grain samples and a pilot sample of 1.0kg for moisture monitoring were stored in a cold and dry chamber. The evaluated of the trait popping expansion only started from the day on when the pilot sample had attained a moisture content of about 12% (Hoseney et al. 1983).

Firstly, the analysis of variance of each year was performed. The homogeneity of the residual variances of the years was tested by means of the F maximum test, at 5% probability. In the joint analysis, the effects of treatments and years were considered as fixed. The analyses of variance and the test of Scott and Knott (1974) were performed using SAEG software (Gomes and Braga 1992). Heterosis was evaluated by the methodology of Gardner and Eberhart (1966), analysis II (Vencovsky and Barriga 1992) together with the methodology of Griffing (1956); the Genes software (Cruz 1997) was used for the diallel analysis.

RESULTS AND DISCUSSION

Since the F test at 5% probability did not show heterogeneity in the mean squares of the residue of the individual analyses in any trait, it was possible to perform the joint analyses of variance. According to the classification proposed by Scapim et al. (1995), the coefficients of variation are considered low for plant and ear height and mean for grain yield, demonstrating good local control (Table 1). The trait popping expansion (PE) did not present classification of its own, but was classified as within the acceptable limits for agricultural experimentation (c.v=13%) compared with some other authors (Pacheco et al. 1998, Simon et al. 2004, Vendruscolo et al. 2001) and high compared with Sawazaki et al. (2000).

The mean squares of years were significant at 5% probability for plant height and grain yield, indicating the differences between means of years for these traits. Only the trait grain yield did not present significance regarding the populations x years interaction, which shows that the populations did not perform differently in the two years (Table 2).

The formation of four groups and five groups was observed for plant and ear height, respectively (Table 1). In the overall mean, the treatments presented high values of plant height (2.45m) and ear height (1.57m). Such tall populations can cause problems in the harvests. The population RR 046 (2.59m and 1.62m) is somewhat sensitive to lodging. Improvement programs must focus on a reduction of plant and ear heights.

Several intervarietal hybrids presented a productivity of over of 4000 kg ha^{-1} (Table 1). These values outmatch, statistically, all controls, including the triple hybrid Zélia, the only one available on the market for those farmers that do not belong to the partnership system with the packagers. This hybrid is susceptible to corn stunt, attack of fall armyworm on the ears and ear rots (Sawazaki 2001).

For popping expansion, seven groups were formed in 2001 and six in 2002. The hybrids IAC 112 (32mL g^{-1}) and Zélia (33mL g^{-1}) presented the best expansion means. The population BRS Angela (28mL g^{-1}) ranked as second group in expansion. Among the intervarietal hybrids, PR 079 x BRS Angela (23mL g^{-1}) and PR 009 x BRS Angela (26mL g^{-1}) stood out, forming the third group in expansion. The population means of popping expansion varied from 8.2mL g^{-1} of RR 046 to 28mL g^{-1} of BRS-Angela. For the intervarietal hybrids the means of popping expansion varied from 6.8mL g^{-1} for hybrid PR 038 x RR 046 to 26mL g^{-1} for hybrid BRS-Angela x PR 009.

Popping expansion is a limiting factor for commercial planting of the intervarietal hybrids tested here. This seems to be a common limitation for Brazilian popcorn genotypes, with rare exceptions, such as Zélia which is a triple hybrid; IAC-112, a modified simple hybrid, and the population BRS Angela that was improved with CMS-43 (Pacheco et al. 1998). Regarding the quality of traded grain in the country, the mean popping expansion of popcorn of the trademarks Yoki and Hikari reached 39 mL g^{-1} and 34 mL g^{-1}, respectively, in a hot air popper (Matta and Viana 2001). Based on these results the conclusion can be drawn that hybrids and varieties in Brazil must reach values of popping expansion over 30mL g^{-1}.

Even with low values of popping expansion, the studies of improvement indicate a promising outlook on intrapopulation improvement regarding this trait, by using different populations and improvement methods, as those described by Pacheco et al. (1998), Larish and Brewbaker (1999), Pereira and Amaral Júnior (2001), Scapim et al. (2002), Simon et al. (2004), and Scapim et al. (2006). These articles indicate the predominance of additive effects and high narrow-sense heritability for this trait. In the present study, in agreement with the literature, the relation between mean square of the general and specific combining ability was twelve-fold. This ratio was used by Vencovsky and Barriga (1992).

All most productive intervarietal hybrids did not perform particularly well regarding expansion. The intervarietal hybrids BRS Angela x PR 079 (22mL g^{-1} and 3948kg ha^{-1}) and BRS Angela x PR 009 (26mL g^{-1} and 3315kg ha^{-1}) are the only ones with a considerable popping expansion ($\geq$ 22mL g^{-1}) and good yield ($\geq$ 3000kg ha^{-1}) requiring new evaluations to verify the stability of these two hybrids in relation to these traits.

The mean squares of the general combining ability (GCA) were significant (P<0.05) for both traits (Table 2), evidencing the genetic variability among the evaluated populations and the manifestation of additive gene action, a favorable situation for improvement. The estimates of the GCA ($\hat{g}_i$) population effects are shown in Table 3. A low$_i$, value indicates that the hybrid means

Table 1. Means of the traits plant height (PH), ear height (EH), grain yield (GY) and popping expansion (PE) in popcorn parent populations of the hybrids F_1 and controls, in Maringá and Iguatemi-PR, in the growing seasons 2000/01 and 2001/02

Populations	**PH** (m)	**PH** (m)	**EH** (m)	**EH** (m)	**GY** (kg ha^{-1})	**PE** (mL g^{-1})	**PE** (mL g^{-1})
	2000/01	**2001/02**	**2000/01**	**2001/02**	**Mean**	**2000/2001**	**2001/2002**
PR 038	2.15 D	2.33 C	1.40 D	1.58 B	2442 D	17.0 D	13.7 E
PR 079	2.10 D	2.61 B	1.38 D	1.71 A	2123 D	13.1 F	11.3 F
RR 046	2.68 A	2.50 C	1.83 A	1.41 C	2361 D	8.2 G	9.2 F
SC 016	2.30 C	2.28 C	1.53 C	1.71 A	3234 C	17.4 D	15.0 E
PR 017	2.35 C	2.83 A	1.60 B	1.83 A	2859 C	12.3 F	10.4 F
BRS Angela	2.56 B	2.60 B	1.38 D	1.71 A	3556 B	28.0 B	28.0 B
SC 002	2.40 C	2.23 C	1.33 D	1.35 D	2138 D	23.5 C	26.5 C
PR 009	2.18 D	2.30 C	1.58 B	1.73 A	1300 E	19.0 D	26.1 C
Hybrid population means	2.34	2.46	1.50	1.63	2501	17.3	17.5
PR 038 x PR 079	2.60 B	2.66 A	1.61 B	1.60 B	3752 B	14.7 E	15.5 E
PR 038 x RR 046	2.35 C	2.73 A	1.65 B	1.76 A	4482 A	8.3 G	6.8 F
PR 038 x SC 016	2.36 C	2.60 B	1.76 A	1.66 B	3496 B	12.1 F	10.6 F
PR 038 x PR 017	2.46 B	2.46 C	1.86 A	1.86 A	3306 C	14.5 E	14.5 E
PR 038 x BRS Angela	2.23 D	2.23 C	1.36 D	1.36 D	3518 B	17.6 D	17.6 E
PR 038 x SC 002	2.21 D	2.63 A	1.30 D	1.68 B	3584 B	14.6 E	14.2 E
PR 038 x PR 009	2.60 B	2.51 B	1.86 A	1.76 A	3420 B	18.7 D	14.0 E
PR 079 x RR 046	2.80 A	2.71 A	1.68 B	1.63 B	3881 B	12.6 F	13.2 E
PR 079 x SC 016	2.60 B	2.70 A	1.73 B	1.78 A	4263 A	10.4 G	15.0 E
PR 079 x PR 017	2.75 B	2.68 A	1.80 A	1.81 A	3591 B	13.1 F	11.5 F
PR 079 x BRS Angela	2.68 A	2.76 A	1.80 A	1.58 B	3948 B	22.1 C	24.1 C
PR 079 x SC 002	2.41 C	2.71 A	1.35 D	1.70 A	3343 C	14.0 E	16.7 E
PR 079 x PR 009	2.73 A	2.68 A	1.91 A	1.71 A	4459 A	22.7 C	20.8 D
RR 046 x SC 016	2.48 B	2.73 A	1.63 B	1.81 A	4259 A	13.7 F	15.5 E
RR 046 x PR 017	2.68 A	2.65 A	1.91 A	1.61 B	3718 B	9.6 G	9.5 F
RR 046 x BRS Angela	2.68 A	2.76 A	1.76 A	1.73 A	4362 A	18.4 D	16.1 E
RR 046 x SC 002	2.60 B	2.60 B	1.66 B	1.60 B	2972 C	16.6 D	14.8 E
RR 046 x PR 009	2.46 B	2.78 A	1.85 A	1.90 A	2822 C	19.4 C	14.3 E
SC 016 x PR 017	2.66 A	2.66 A	1.91 A	1.65 B	4455 A	14.8 E	13.4 E
SC 016 x BRS Angela	2.60 B	2.63 A	1.60 B	1.66 B	4424 A	20.8 C	20.0 D
SC 016 x SC 002	2.25 D	2.48 B	1.63 B	1.73 A	3046 C	23.0 C	23.4 D
SC 016 x PR 009	2.73 A	2.55 B	2.01 A	1.75 A	2714 C	22.9 C	18.4 E
PR 017 x BRS Angela	2.56 B	2.51 B	1.71 B	1.60 B	4290 A	20.4 C	21.3 D
PR 017 x SC 002	2.35 C	2.65 A	1.56 B	1.76 A	3299 C	10.5 G	12.7 F
PR 017 x PR 009	2.80 A	2.31 C	1.88 A	1.53 C	3259 C	17.6 D	14.4 E
BRS Angela x SC 002	2.56 B	2.48 B	1.65 C	1.55 C	4143 A	22.9 C	22.7 D
BRS Angela x PR 009	2.78 A	2.75 A	1.85 A	1.73 A	3315 C	25.0 C	26.0 C
SC 002 x PR 009	2.60 B	2.61 B	1.80 A	1.53 C	3211 C	21.0 C	23.1 D
Hybrid means	2.55	2.61	1.72	1.68	3744	17.0	16.4
Controls							
Zélia	2.05 D	1.97 D	1.18 E	1.08 E	2881 C	31.5 A	34.5 A
IAC 112	2.34 C	2.26 C	1.13 E	1.28 D	2695 C	32.0 A	31.5 A
UEM J1	2.70 A	2.38 C	1.78 A	1.46 C	3823 B	15.0 E	14.5 E
PR 023	2.81 A	2.48 B	1.90 A	1.55 C	3828 B	18.5 D	17.5 E
SE 013	2.50 B	2.37 C	1.55 C	1.55 C	3017 C	14.5 E	12.5 F
Control mean	2.48	2.29	1.51	1.38	3249	22.3	22.1
CV (%)	3.81	3.23	6.86	5.93	18.7	13.2	12.8

Means followed by the same letter in the same column belong to the same group, according to the clustering of Scott and Knott (1974)

Table 2. Analysis of variance for the traits grain yield (GY) and popping expansion (PE) in eight populations and their intervarietal F_1 popcorn hybrids, according to the diallel analysis proposed by Gardner and Eberhart (1966), associated to that of Griffing (1956)

Sources of variation	df	MS	
		GY (kg ha^{-1})	**PE** (mL g^{-1})
Populations	35	3645399.7 *	156.1155*
Parentals	75	826048.0 *	648.4708*
Heterosis	(28)	3100237.7 *	33.0267*
Mean heterosis	1	57703104.0 *	22.4130*
Parental heterosis	77	28612.5	35.4687*
Specific heterosis	20	1200163.2 *	32.7026*
Years	17	5924165.3 *	4.2000
Populations x Years	35	414811.8	9.8494*
Parentais x Years	73	42879.5	8.7865
Heterosis x Years	28	432794.9	10.1152*
Mean heterosis x Years	11	545787.4	4.1141
Parental heterosis x Years	73	80017.2	23.6222*
Specific heterosis x Years	20	395617.5	5.6878
GCA	73	538066.2 *	391.1270*
GCA x Years	76	26634.2	14.5161*
Residue	160	408194.8	4.85.245

* significant. at 5% probability by the F test

Table 3. Estimates of effects of general combining ability ($\hat{g}_i$) of Griffing (1956) of the traits grain yield (GY in kg ha^{-1}) and popping expansion (PE in mL g^{-1}) in popcorn, in the growing seasons of 2000/01 and 2001/02

Populations	PE 2000/01	PE 2001/02	PE mean	GY mean
PR 038	-2.917	-3.636	-3.276	144.354
PR 079	-1.400	0.297	-0.551	170.604
RR 046	-3.233	-4.126	-3.680	47.104
SC 016	-0.050	0.198	0.074	3.854
PR 017	-2.917	-2.943	-2.930	75.271
BRS Angela	4.867	5.448	5.157	427.021
SC 002	0.767	2.098	1.432	-435.813
PR 009	4.883	2.664	3.774	-502.396

in which population i participates do not differ much from the general mean of the diallel. A high positive or negative value indicates that population i performs better or worse than the other populations considered in the diallel, regarding the hybrid means. The population that has higher frequencies of favorable alleles attains a higher$_i$ (Cruz and Vencovsky 1989).

The GCA x years interaction was significant (P<0.05) for popping expansion, indicating the need of selecting different parents to develop hybrids in specific years. These interactions are reported in the literature by different authors (Andrade et al. 2002, Pereira and Amaral Júnior 2001, Scapim et al. 2002). The effects of the general combining ability of the parent populations for grain yield were estimated in the mean of the two years (Table 3).

Population BRS Angela presented a positive$_i$ of high magnitude for grain yield and popping expansion. For popcorn improvement programs it matters to find populations that have favorable genes for both maximum yield and expansion. This population can therefore be identified as the most promising in methods of intrapopulation improvement. When analyzing only the popping expansion, the populations SC 002 and PR 009 presented positive$_i$ and deserve attention within an improvement program. Another favorable aspect is that BRS Angela and SC 002 presented negative$_i$ for plant and ear height indicating that they contribute to a reduced height in the hybrids they take part in, which is quite satisfactory for the improvement program.

The mean squares of the effects of populations and heterosis were significant, at 5% probability, for the two traits, indicating that the populations do not form a homogeneous group (they differ in GCA) and that the hybrids express heterosis.

In the partitioning of the sum of squares of treatments (parents and intervarietal hybrids) in the analysis of variance, for the trait grain yield, the population effect represented 32% and, consequently, 78% are due to the effect of heterosis. It was therefore concluded that the populations are contrasting for the variable grain yield. For popping expansion, the population effect represented 83% of the sum of squares for treatments and 27% are due to the effect of heterosis, opposite to the result for yield. This means that the populations are not very contrasting for popping expansion and that jointly they are not favorable for exploiting the heterosis effect in hybrids, in other words, the effect of dominance on this trait is lower than on grain yield. The low heterosis indicates that the prediction of means is a good criterion for choosing parents to be used in crosses. A similar result was obtained by Scapim et al. (2002).

It was possible to find with positive $\hat{V}_i$ values for yield and popping expansion in the population BRS Angela (Table 4). When analyzing only the popping expansion, as it was the case with $\hat{g}_i$, the populations SC 002 and PR 009 are auspicious for an improvement program.

It is known that the GCA effects of two populations estimated by the methodology of Griffing (1956) are partly due to the contrast between the population effects and partly to the contrast between the effects of varietal heterosis, estimated by the methodology of Gardner and Eberhart (1966) (Cruz and Vencosvky 1989) and complemented by Pacheco et al. (2002). The populations that presented the highest GCA effects in grain yield were BRS Angela and PR 079. Population BRS Angela presented a positive $\hat{V}_i$ (1054.75) and negative $\hat{h}_i$ (-100.354), while PR 079 presented a negative$_i$ (-378.75) and positive $\hat{V}_i$ (359.979). Population BRS Angela is therefore superior to PR 079, regarding the performance *per se,* while PR 079 determines a higher heterotic value in the hybrids it takes part in.

For popping expansion, the heterosis mean was significant with a negative estimate of -0.774mL g^{-1} (Table 5). This result demonstrates that for popping expansion these populations jointly are not favorable to exploit the effect of heterosis in hybrids. This ratifies the above-mentioned result in which 83% of the sum of squares of treatments was population effect.

For specific heteroses ($\hat{s}_{ij}$), the hybrids PR 079 x PR 009 (1045.30), SC 016 x PR 017 (561.39), BRS Angela

Table 4. Estimates of the effects of populations ($\hat{V}_i$) for grain yield (GY) and popping expansion (PE), in popcorn, in the growing seasons of 2000/01 and 2001/02

Populations	**GY** (kg ha^{-1})	**PE** (mL g^{-1})
	mean	**mean**
PR 038	-59.25	-2.068
PR 079	-378.75	-5.218
RR 046	-141.25	-8.718
SC 016	732.25	-1.218
PR 017	357.25	-6.068
BRS Angela	1054.75	10.581
SC 002	-363.25	7.581
PR 009	-1201.75	5.131
Var ($\hat{V}_i$)	119056.83	1.529
Var ($\hat{V}_i - \hat{V}_j$)	272130	3.496

Table 5. Estimates of heteroses of populations ($\hat{h}_i$) and mean ($\bar{\hat{h}}$) for grain yield (GY) and popping expansion (PE) in popcorn

Populations	**GY** (kg ha^{-1})	**PE** (mL g^{-1})
PR 038	173.979	-2.241
PR 079	359.979	2.058
RR 046	117.729	0.679
SC 016	-292.270	0.683
PR 017	-103.354	0.104
BRS Ângela	-100.354	-0.133
SC 002	-254.187	-2.358
PR 009	98.479	1.208
Var	49607.013	0.637
Var ($\hat{h}_i - \hat{h}_j$)	113387.458	1.456
($\bar{\hat{h}}$)	1243	-0.77
Var ($\bar{\hat{h}}$)	21867.581	0.280

x SC 002 (407.30), and RR 046 x SC 016 (393.55) in which one of the parent populations presented the highest general combining ability, were outstanding. Moreover, these are the hybrids of the first group in grain yield by the clustering criterion of Scott and Knott (1974) (Table 1). For specific heteroses, hybrid SC 016 x SC 002 (5.050) was auspicious. In this study it was not possible to identify any hybrid that had a high grain yield (over 4000kg ha^{-1}) as well as good popping expansion (over 30mL g^{-1}).

A strategy for the establishment of popcorn populations of high yield and with good popping expansion would be the synthesis of composites for intrapopulation improvement programs. The choice of populations for the formation of these composites must be based on the $\hat{V}_i$ and $\hat{g}_i$, values, which depend on additive effects. Population BRS Angela was the only one that presented positive $\hat{V}_i$ and $\hat{g}_i$, estimates for grain yield and popping expansion, which makes the formation of composites in this phase of the program with these evaluated populations difficult. Analyzing only popping expansion, the composites formed by the populations that presented positive $\hat{V}_i$ and $\hat{g}_i$, such as BRS Angela, SC 002 and PR 009, would have a predicted value of 24 mL g^{-1}. This estimate is inferior to the popping expansion of the three populations per se, considering the experiment of 2002. Based on this explanation, the best strategy is the intrapopulation improvement of the populations BRS Ângela and SC 002.

In this context, as heterosis for popping expansion is very low, the best improvement strategy is to raise the values of popping expansion through intrapopulation improvement, until reaching commercial values and then exploit heterosis for grain yield, by means of the formation of composites or even the development of inbred lines and hybrids.

CONCLUSIONS

1. Intrapopulation improvement of the populations BRS Angela and SC 002 is recommended.

2. Strong selection is required to reduce the plant and ear height of these populations.

3. No interpopulation selection should be initiated at this point.

Capacidade combinatória de populações de milho-pipoca de grãos brancos

RESUMO – *O objetivos deste trabalho foram de selecionar genitores e indicar a melhor estratégia de melhoramento para iniciar um programa de melhoramento de milho-pipoca de grãos brancos por meio das informações da capacidade combinatória e heterose de oito populações selecionadas em experimentos na região Noroeste do Paraná. As características analisadas foram altura de plantas e espigas, rendimento de grãos e capacidade de expansão. As populações, os F_1 e cinco testemunhas foram avaliadas em Maringá-PR em dois anos. A heterose para capacidade de expansão foi muito baixa e a melhor estratégia de melhoramento é a elevação dos valores de capacidade de expansão, até os níveis comerciais, por meio do melhoramento intrapopulacional das populações BRS Angela e SC 002. Forte seleção deve ser feita para reduzir altura de plantas e de espigas. A seleção interpopulacional não deve ser iniciada nesse momento.*

Palavras-chave: *Zea mays*, rendimento, capacidade de expansão.

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