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THE EFFECT OF A HIGH SELECTION INTENSITY ON THE CHANGE OF MAIZE YIELD COMPONENTS' ADDITIVE VARIANCE

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A set of 31 SSD lines from *ZP-Syn-1* C_0 and 37 from *ZP-Syn-1* C_3 maize population was studied in this paper. After line selection and seed multiplication in 2000, the trials were carried out in 2001-2002, at Krusevac and Zemun Polje, in RCB design. After three cycles of recurrent selection we observed a significant decrease of homozygous progenies' means of root and stalk lodged plants percent, plant and ear height, but also of row number per ear. The means of grain number per ear and 1000 grain mass were increased, and the differences in ear length and grain yield were not significant. After three cycles, a significant narrowing of additive variance happened for root and stalk lodged plant percent, ear length, and row number per ear, but this narrowing was not significant for the other traits. We also found significant values of narrow-sense herutability.

Key words: maize, yield components, additive variance, selection intensity

INTRODUCTION

The crucial question of recurrent breeding is how to get a selection progress with a simultaneous conservation of genetic variability and avoiding of de-

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sired alels loss. As those processes are opposite each other, the solution is reaching a compromise between them, which, of course, has a harmful effect on both of them. In order to reach the best level of that compromise, it would be ideal to study every new populations quantitative-genetically parameters, and to observe them during selection process, for choosing selection method and intensity, because genetic composition of a population, selection goals and conditions differ from case to case (DELETIĆ, 1999; DELETIĆ *et al*., 2000; DELETIĆ, 2003). As nothing ideal is able to implement, every study on that subject gives a contribution to establishing of general rules, that could be applied in a lack of exact data. This is particularly significant for additive variance, because it has the greatest influence on the most important traits, and can be covered by the dominant and epistatic effect (TRIFUNOVIĆ *et al*. 1998).

MATERIAL AND METHODS

The ZP Syn 1 maize population was used for the study. After line recombination and forming of ZP-Syn1-C_0 population, the three cycles of half-sib recurrent selection were done, with selection intensity of 5%, and line A-632 was used as a narrow-base tester (former version of B-14 line from BSSS).

After 150 randomly chosen plants per each selection cycle (C_0 and C_3) were selfed, selfing continued according to SSD method to a practically complete homozigousness (12-14 generations). Number of lines decreased during selfing process, mostly because of random factors related with the applied method, and, in some extent, because of the lethal effect of some recessive alels, so the final number of the studied lines was 31 in C_0 cycle and 37 in C_3 cycle. After seed multiplication, the comparative trials were set in Kruševac and Zemun Polje, in RCB design, with three replications.

RESULTS AND DISCUSSION

Grain yield was a little greater in the third cycle lines but this difference was not significant (Table 1 and 2).

Tab. 1. Mean values of the studied traits of ZP-Syn-1 C_0 population lines

	Kruševac			Zemun Polje			
Traits	2001	2002	mean	2001	2002	mean	$\overline{X} \pm SE_{\overline{X}}$
Grain yield	3498.1	4114.8	3806.5	3985.4	4216.0	4100.7	3953.6 ± 85.0
% of lodged	13.98	9.92	11.95	9.01	30.93	19.97	15.96 ± 1.30
Ear height	87.71	75.63	81.67	76.73	74.19	75.46	78.57 ± 0.89
Plant height	206.20	188.19	197.20	184.15	175.88	180.02	188.61 ± 1.33
Ear length	14.08	12.78	13.43	15.14	14.83	14.99	14.21 ± 0.12
Grain rows No	13.24	13.30	13.27	13.24	13.37	13.30	13.29 ± 0.11
Grains per row	22.88	24.44	23.66	22.40	27.97	25.18	24.42 ± 0.33
1000 grain mass	266.35	246.99	256.67	268.63	243.12	255.87	256.27 ± 2.37

The third cycle lines had lower percent of root and stalk lodged plants, which was statistically significant at the level of P<0.01, and that difference was also followed by high-significantly lower plant height and upper ear height. Grain row number was higher in the zero cycle lines, and grain number per row and 1000 grain mass were higher in the third cycle lines.

Tab. 2. Mean values of the studied traits of ZP-Syn-1 C_3 population lines

	Kruševac			Zemun Polje			
Traits	2001	2002	mean	2001	2002	mean	$\overline{X} \pm SE_{\overline{X}}$
Grain yield	3260.6	4231.7	3746.2	4576.6	5227.7	4902.1	4324.1 ± 74.9
% of lodged	3.81	2.13	2.97	5.77	7.72	6.75	4.86 ± 0.51
Ear height	78.09	61.30	69.69	74.77	67.46	71.12	70.41 ± 0.69
Plant height	193.82	175.85	184.83	183.72	163.62	173.67	179.25 ± 1.05
Ear length	13.67	13.81	13.74	14.73	14.79	14.76	14.25 ± 0.08
Grain rows No	12.65	12.49	12.57	12.75	12.85	12.80	12.69 ± 0.08
Grains per row	22.16	25.41	23.78	28.87	28.58	28.72	26.25 ± 0.29
1000 grain mass	276.38	271.86	274.12	270.53	264.68	267.61	270.86 ± 2.22

The all studied traits of the both cycles lines had significant additive variance, because the observed values were more than two-fold higher regarding respective standard error, which is, according to FALCONER (1989), a criterion for variance and heritability significance. Phenotypic variance followed the same tendency, so the all calculated values were significant (Table 3 and 4).

Values of narrow-sense heritability in the zero-cycle lines were from 0.352-0.457, and from 0.342-0.476 in the third cycle lines, and the all values were significant. Broad-sense heritability was double, because $\sigma_g^2 = 2\sigma_a^2$. So high heritability values are a direct consequence of the applied design, which exclude the two main groups of environmental factors (location and year) from the phenotypic variance, so that it includes, besides genotypic variance, just interactions between genotype and some environmental factors. These results are comparable with the previous reports (DELETIĆ, 1999; NASTASIĆ, 2001; BURAK and BROCCOLI, 2001).

Tab. 3. Components of variance and genetical parameters of ZP-Syn-1 C_0 population lines

Traits	σ_a^{2*}	$SE_{\sigma_a^2}$	CV_a%	σ_f^{2*}	$SE_{\sigma_f^2}$	CV_f%	h^{2*}	SE_{h^2}
Grain yield	670385	121744	20.71	1901875	1152585	34.88	0.353	0.064
% of lodged	73.212	14.090	53.61	207.989	137.108	90.36	0.352	0.068
Ear height	85.711	15.400	11.78	193.846	140.789	17.72	0.442	0.080
Plant height	187.544	33.406	7.26	410.226	304.115	10.74	0.457	0.082
Ear length	1.273	0.229	7.94	3.180	2.122	12.55	0.400	0.072
Grain rows No	1.757	0.313	9.97	3.886	2.853	14.83	0.452	0.081
Grains per row	10.835	1.945	13.48	27.201	17.989	21.36	0.399	0.072
1000 grain mass	600.90	108.38	9.57	1452.28	997.98	14.87	0.414	0.075

* - σ_g^2, σ_f^2 and h^2 are significant when are double or more than their standard error

Tab. 4. Components of variance and genetic parameters of ZP-Syn-1 C_3 population lines

Traits	σ_a^{2*}	$SE_{\sigma_a^2}$	CV_a%	σ_f^{2*}	$SE_{\sigma_f^2}$	CV_f%	h^{2*}	SE_{h^2}
Grain yield	572313	103707	17.50	1423853	192224	27.60	0.402	0.073
% of lodged	17.266	3.611	85.50	50.524	7.415	146.26	0.342	0.072
Ear height	57.553	10.379	10.77	121.068	18.917	15.63	0.476	0.086
Plant height	126.395	22.741	6.27	268.424	41.459	9.14	0.471	0.085
Ear length	0.716	0.134	5.94	1.567	0.247	8.78	0.457	0.086
Grain rows No	0.747	0.137	6.81	1.654	0.253	10.14	0.452	0.083
Grains per row	8.462	1.550	11.08	19.522	2.861	16.83	0.434	0.080
1000 grain mass	804.08	143.21	10.47	1726.37	260.65	15.34	0.466	0.083

* - σ_g^2, σ_f^2 and h^2 are significant when are double or more than their standard error

However, we were interested for possible narrowing of the yield components additive variance after three cycles of recurrent selection, with the intensity of 5%. Hartley tests showed that differences between additive and phenotypic variances were significant only for ear length, and highly significant for grain row number and root and stalk lodged plants percent. It means that in only these three traits happened a significant narrowing of additive and phenotypic variance, and the other traits variance did not change under selection.

CONCLUSION

After three cycles of recurrent selection we observed a significant decrease of homozigous progenies mean value for root and stalk lodged plants percent, plant and ear height, but also for grain row number. Values of grain number per row and 1000 grain mass were increased. Differences in ear length and grain yield were not significant.

Three cycles of recurrent selection induced a significant narrowing of additive variability for root and stalk lodged plants percent, ear length, and grain row number. Variance narrowing for the other studied traits was not significant.

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UTICAJ VISOKOG INTENZITETA SELEKCIJE NA PROMENU ADITIVNE VARIJANSE KOMPONENTI PRINOSA KUKURUZA

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Izvod

U radu je ispitivana 31 SSD linija iz *ZP-Syn-1* C_0 i 37 iz *ZP-Syn-1* C_3 populacije kukuruza. Nakon odabira i umnožavanja semena linija u 2000, ogledi su obavljeni u periodu 2001-2002 u Kruševcu i Zemun Polju, po RCBD metodi sa tri ponavljanja. Nakon tri ciklusa rekurentne selekcije došlo je do značajnog sniženja srednje vrednosti homozigotnih potomstava za procenat poleglih i slomljenih biljaka, visinu biljke i klipa, ali i za broj redova zrna. Povećane su srednje vrednosti za broj zrna u redu i masu 1000 zrna. Razlike u dužini klipa i prinosu zrna nisu bile značajne. Nakon tri ciklusa je došlo do značajnog suženja aditivne varijabilnosti za procenat poleglih i slomljenih biljaka, dužinu klipa i broj redova zrna.Smanjenje vrednosti za ostala svojstva nije bilo statistički značajno. Utvrđene su i značajne vrednosti heritabilnosti u užem smislu.

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