GENERAL AND SPECIFIC COMBINING ABILITY IN FORAGE MAIZE APTITUDE PART 2: LAND RACES

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ABSTRACT
Eight argentine land races of maize (1 to 8) were evaluated in a diallel mating scheme for ear, stover and total digestible dry matter yield. For the average of four environments, the crosses 1x2 and 1x4 do not show significant differences with the best check (Cargill Semiden 5) for total digestible dry matter yield. Using the Gardner and Eberhart diallel analysis only the sum of squares of cultivars for stover digestible dry matter yield was significant, suggesting that additive effects are very important in controlling this trait, while for ear digestible dry matter yield both additive and non-additive effects are important. This conclusion implies that if the parent populations are improved, the breeding strategies will need to be different depending on the plant characteristic to be selected.

KEYWORDS
Maize land races, diallel analysis, heterosis

INTRODUCTION

In the Argentine Republic, the milk industry has experienced a high growth, principally due to the increasing export of its products. The dairy production is based on the intake of pastures, silage and grain supplements. With the increase in cereal prices, conserved forage represents an important alternative due to the seasonal forage production. Maize is the principal crop used as conserved forage, however there are no hybrids or cultivars improved for silage production. The land races of the germplasm banks offer an alternative to begin the selection of cultivars with aptitude for forage production.

MATERIALS AND METHODS

Eight maize land races (1 to 8) belonging to the INTA Germplasm Bank collection, were evaluated in a diallel mating scheme in four environments jointly with four checks (Dekalb 4F37, Cargill Semiden 5, Morgan 369 and Funkís Tilcara). The variables evaluated were: Ear Digestible Dry Matter Yield (EDDMY), Stover Digestible Dry Matter Yield (SDDMY) and Total Digestible Dry Matter Yield (TDDMY). The experimental design was a randomized complete block design with three replications. The experimental unit consisted of two rows 5 meters long and 0.7 m between rows. The genotype sum of squares (populations and crosses) for EDDMY and SDDMY were partitioned using the Gardner and Eberhart model II (Gardner and Eberhart,1966; Gardner,1967). An LSD test was utilized for mean separation. In all cases an error probability of $p<0.05$ was used.

RESULTS AND DISCUSSION

Significant differences were observed among genotypes and genotype by environment interactions were present in the combined analysis of variance for EDDMY, SDDMY and TDDMY (Table 1).

TDDMY: 12 crosses and populations 2 and 4 do not show significant differences with the best commercial hybrid (Cargill Semiden 5) in the average of four environments. The crosses 1x2 (12.2 t ha-1) and 1x4 (11.9 t ha-1) reached yields significantly different to those of hybrids Dekalb 4F37 and Funkís Tilcara.

In the Gardner and Eberhart analysis for EDDMY and SDDMY, genotypes and cultivar (Vj) effects show significance differences in the combined analysis (Table 1) as well as in each environment.

EDDMY: The heterosis (Hij) and average heterosis effects were significant in environments 1, 3 and 4, and non significant in the environment 2. Cultivar heterosis was significant only in environment 1.

In the combined analysis, heterosis and average heterosis were significant. Populations 2, 4, 6 and 7 presented positive (Vj) effects. The sum of squares due to heterosis (Hij) represented 56% of the variation among genotypes, indicating that additive and non-additive effects are important in controlling EDDMY.

Dekalb 4F37 (6.47 t ha-1), Cargill Semiden 5 (6.24 t ha-1) and Funkís Tilcara (5.93 t ha-1) showed the highest yields over environments. The crosses 2x7 (5.71 t ha-1) and 4x7 (5.62 t ha-1) do not differ significantly from Cargill Semiden 5 and Funkís Tilcara but show differences with Morgan 369.

Crosses 1x2, 1x4, 1x5, 1x6, 1x7, 1x8, 2x5, 2x6, 2x7, 2x8, 3x5, 3x6, 3x7, 4x7, 5x6, 5x7, 6x7 and 6x8 presented significant mean parent heterosis of about 20%.

SDDMY: Heterosis was significant only in environments 2 and 4. In the analysis over environments the heterosis effect were not significant suggesting that additive effects are very important in the control of SDDMY. Populations 1, 2, 3, and 4 show positive cultivar (Vj) effects. The highest yield (mean over environments) was observed in the cross 1x2 (6.98 t ha^{-1}) but was not show significantly different than crosses 1x3, 2x3, 1x4, 4x5, 4x7, 2x5, 2x4, 1x5 and 3x5, population 1 and 2 and Morgan 369. Cargill Semiden 5, Funkís Tilcara and Dekalb 4F37 showed low SDDMY.

TDDMY reached by some crosses and the heterosis values observed indicate that the populations 1, 2, 3, 4 and 7 have potential to be used in the beginning of breeding programs. Depending on the component chosen to be improved, the strategies will be different. An intrapopulation recurrent selection should be effective in improving SDDMY due to the importance of additive effects while for EDDMY a selection scheme that takes into account both additive and non additive effects is necessary.

REFERENCES

Gardner C.O., S.A. Eberhart. 1966: Analysis and interpretation of the variety cross diallel and related populations. Biometrics **22:** 439-452.

Gardner C.O., 1967: Simplified methods for estimating constants and computing sums of squares for a diallel cross analysis. Fitotec. Latinoamer. **4:** 14-22.

Table 1
Anova table for EDDMY, SDDMY and TDDMY.

		Mean Squares		
Source of Variation	G.L.	EDDMY	SDDMY	TDDMY
Genotype (G)	35	*	*	*
Variety (Vj)	7	*	*	————
Heterosis (Hij)	28	*	n.s.	————
Average heterosis (H)	1	*	n.s.	————
Variety heterosis (Hj)	7	n.s.	n.s.	————
Specific heterosis (Sij)	20	n.s.	n.s.	————
G x Environment	105	*	*	*
Error	312			

* : Significantly different at 5%.
n.s.: Non significant.