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## Linkage disequilibrium in a maize F2 population of B73 x Mo17

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The average level of dominance ($\bar{d}$) of genes conditioning quantitative traits is an important indicator of the genetic expression of heterosis in maize. Previous studies suggested that linkage disequilibrium causes overestimation of $\bar{d}$, sometimes designated as pseudooverdominance. Estimates of $\bar{d}$ within F2 populations intermated to reduce linkage disequilibrium have suggested that partial to complete dominance of genes is of greater importance to expression of heterosis in maize. F2 populations of elite, widely used hybrids, however, have not been extensively studied. The contribution of overdominant loci and linkage disequilibrium to the expression of heterosis in the hybrid B73 x Mo17 were studied in the (B73 x Mo17)F2 and (B73 x Mo17)F2 Syn. 10 (250 plants of the F2 population intermated for 10 generations) populations with the use of the North Carolina Design III mating design. It seems the sample of 250 individuals intermated for each of the 10 generations was adequate because the trait means of the backcrosses of F2 plants to each parental line were very similar (no significant differences) for the F2 and the F2 Syn. 10 populations for each trait (Table 1).

Differences of the estimates of additive genetic ($\sigma^2_A$) and dominance ($\sigma^2_D$) variances for the F2 and F2 Syn. 10 populations were not significant (confidence intervals are not included) for the nine traits studied (Table 2). Estimates of dominance variances were generally lower in the F2 Syn. 10 population compared with the F2 population. For grain yield, estimate of $\sigma^2_D$ decreased 60% in the F2 Syn. 10 population compared with the F2 population. The direction of change for the estimates of $\sigma^2_A$ for the two popula- tions was not consistent among traits; e.g., estimates of $\sigma^2_A$ decreased 16% from F2 to F2 Syn. 10 and increased 67% for plant height from F2 to F2 Syn. 10 population. The estimate of $\bar{d}$ for grain yield decreased from 1.17 in the F2 to 0.80 in the F2 Syn. 10 population, but neither estimate deviated significantly from 1.0. Estimates of $\bar{d}$ were not greater than 1.0 for the other traits in either population before and after intermating. But estimates of $\bar{d}$ decreased for all traits where $\bar{d}$ was estimable, suggesting that linkage disequilibrium caused overestimation of $\sigma^2_D$ in the F2 population. Evidence for the presence of significant overdominant effects for grain yield were no greater in B73 x Mo17 populations than estimates reported previously in other populations derived from crosses of inbred lines (Hallauer and Miranda, Quantitative Genetics in Maize Breeding, p. 122, 1988).

Table 1. Means of 100 males of (B73 x Mo17)F2 and (B73 x Mo17)F2 Syn. 10 populations backcrossed to B73 and Mo17 for nine traits averaged across the three Iowa environments.

| Male plants of population | Inbred parent | Grain Yield | Grain Moisture | Days planting to Anthesis | Days planting to Silk emergence | Height Plant | Height Ear | Lodging Root | Lodging Stalk | Dropped ears |
|---|---|---|---|---|---|---|---|---|---|---|
| | | t/ha | % | ---------------no.--------------- | | -------cm------- | | ---------%--------- | | % |
| F2 | B73 | 4.56 | 23.2 | 87.4 | 89.0 | 228 | 113 | 0.4 | 10.2 | 5.5 |
| F2 | Mo17 | 3.31 | 22.3 | 86.4 | 89.5 | 215 | 100 | 0.2 | 13.1 | 6.7 |
| F2 Syn. 10 | B73 | 4.30 | 22.8 | 87.3 | 88.8 | 227 | 112 | 0.4 | 10.7 | 5.8 |
| F2 Syn. 10 | Mo17 | 3.22 | 22.3 | 86.6 | 89.1 | 218 | 104 | 0.2 | 16.2 | 7.3 |

Table 2. Estimates of additive genetic ($\sigma^2_A$) and dominance ($\sigma^2_D$) variances, average level of dominance ($\bar{d}$), and heritability ($h^2$) for nine traits of the (B73 x Mo17)F2 and (B73 x Mo17)F2 Syn. 10 populations obtained from analysis combined across three environments.

| Trait | Population | $\sigma^2_A$ | $\sigma^2_D$ | $\bar{d}$ | $h^2$ |
|---|---|---|---|---|---|
| Grain yield (t/ha) | F2 | 60.4 | 41.7 | 1.17 | 0.48 ± 0.11 |
| | F2 Syn. 10 | 50.5 | 16.2 | 0.80 | 0.57 ± 0.14 |
| Grain moisture (%) | F2 | 1.0 | -0.1 | ‡ | 0.33 ± 0.15 |
| | F2 Syn. 10 | 3.0 | 0.2 | 0.41 | 0.82 ± 0.14 |
| Days to anthesis (no.)† | F2 | 2.2 | 0.4 | 0.61 | 0.78 ± 0.19 |
| | F2 Syn. 10 | 2.4 | 0.2 | 0.42 | 0.85 ± 0.20 |
| Days to silking (no.)† | F2 | 3.0 | 0.8 | 0.71 | 0.73 ± 0.18 |
| | F2 Syn. 10 | 2.8 | 0.2 | 0.35 | 0.84 ± 0.21 |
| Plant height (cm) | F2 | 151.3 | 20.7 | 0.52 | 0.80 ± 0.13 |
| | F2 Syn. 10 | 226.6 | 14.9 | 0.36 | 0.89 ± 0.14 |
| Ear height (cm) | F2 | 136.8 | 9.5 | 0.37 | 0.87 ± 0.14 |
| | F2 Syn. 10 | 169.8 | 6.1 | 0.27 | 0.92 ± 0.14 |
| Root lodging (%) | F2 | -0.1 | 0.1 | ‡ | ‡ |
| | F2 Syn. 10 | 0.3 | 0.1 | 0.87 | 0.41 ± 0.20 |
| Stalk lodging (%) | F2 | 68.8 | 4.6 | 0.37 | 0.78 ± 0.15 |
| | F2 Syn. 10 | 45.5 | 5.9 | 0.51 | 0.64 ± 0.15 |
| Dropped ears (%) | F2 | 13.4 | 0.8 | 0.36 | 0.64 ± 0.17 |
| | F2 Syn. 10 | 11.9 | -0.1 | ‡ | 0.56 ± 0.18 |

†Data collected at only one environment.
‡Average level of dominance was not estimable because of negative estimates of variance.