Chapter 22

Recurrent Selection and Heterosis

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INTRODUCTION

Recurrent selection methods were designed to improve the agronomic value of populations by gradually increasing the frequency of favorable alleles, while maintaining genetic variability. To realize these objectives, progenies are developed, evaluated, selected, and recombined in a repetitive manner. Populations improved by recurrent selection are expected to be agronomically superior to unimproved versions and have enough genetic variability for the traits under selection to allow these populations be used for medium or long-term selection.

The performance of hybrids is associated with the level of heterosis, i.e., to the superiority of hybrids over their inbred parents. To exploit heterosis efficiently, populations are grouped into heterotic groups, where population crosses within and among groups produce low and high levels of heterosis, respectively. Hybrids are then produced by crossing inbred lines from different heterotic groups.

Recurrent selection has been effective in gradually improving population performance (Smith, 1983; Hallauer et al., 1988), as well as the performance of the hybrids developed from the preceding cycles of selection in maize (Zea mays L.; Russell, 1985; Betran & Hallauer, 1996). Therefore, recurrent selection programs should be integrated with hybrid breeding programs so that improved populations can be used as sources of inbred lines not related to that ones developed from hybrid breeding programs. The objectives of this paper are: (i) to present the effects of recurrent selection on hybrid improvement programs; (ii) to present the changes in heterosis following recurrent selection; and (iii) to compare intra- and interpopulation selection schemes.

RECURRENT SELECTION AND HYBRID IMPROVEMENT

Recurrent selection will be useful only if the hybrids developed from improved populations are superior to those developed from unimproved versions. To evaluate the effects of recurrent selection on hybrid improvement, consider two genetically divergent populations ($P_1$ and $P_2$) under recurrent selection, and assume that single-cross selection is carried out in the original ($P_0$ and $P_2$) and in the populations improved by $n$ cycles of recurrent selection ($P_{1n}$ and $P_{2n}$). The expected