EFFECTS OF RECURRENT SELECTION FOR GRAIN YIELD ON PLANT AND EAR TRAITS OF FIVE MAIZE POPULATIONS

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SUMMARY

Maize (Zea mays L.) breeders are interested in the effects of recurrent selection for grain yield on other plant and ear traits. Changes in plant traits could alter agronomic acceptability of the populations under selection, and observed improvements in grain yield could be explained by changes in ear traits. We evaluated changes in combining ability for plant and ear traits of BS10(FR), BS11(FR), BSSS(R), BSCBl(R), and Lancaster Surecrop associated with recurrent selection for grain yield.

Recurrent selection procedures generally did not change plant and ear heights or date of silking of testcrosses of populations or of the population crosses, BS10(FR) x BS11(FR) and BSSS(R) x BSCBl(R). Grain yield improvements, however, were associated with increases in ear-sink size.

INTRODUCTION

Maize (Zea mays L.) breeders are interested in the effects of recurrent selection for grain yield on other plant and ear traits. Changes in plant traits could alter agronomic acceptability of populations and observed improvements in grain yield could be explained by changes in ear traits. RUSSELL et al. (1973) reported that recurrent selection for specific combining ability for grain yield resulted in increased number of ears/100 plants in two maize populations and testcrosses of the populations. Their data suggested that number of harvestable ears may have limited grain yield of unimproved populations and that this trait was changed by indirect selection. RUSSELL et al. (1973) also found that testcrosses of improved populations exhibited earlier silk emergence, higher grain moisture at harvest, higher plant and ear heights, and less lodging than testcrosses of unimproved populations.

Eberhart et al. (1973) reported that five cycles of reciprocal recurrent selection for grain yield in BSSS(R) and BSCBl(R) and seven cycles of half-sib selection in BSSS(HT) did not change ear height or maturity, but selection did reduce stalk lodging. Ears/100 plants increased in BSSS(R), BSCBl(R), and their population crosses, but changes were not detected in crosses to a broad-based tester. Fakorede & Mock (1978) later evaluated variety hybrids of unimproved (C0) and improved (C7)
populations of BSSS(R) and BSCBl(R) and found that most grain-yield components, plant traits, and leaf-area-related traits did not change significantly with recurrent selection for grain yield. Improved variety hybrids, however, exhibited shorter pollenshed-to-silking intervals, longer grain-filling periods, and smaller tassels than did unimproved hybrids.

Five cycles of half-sib selection with an inbred tester in Kolkmeier and Lancaster maize populations resulted in a decrease in kernel-row number for populations per se, population crosses, and testcrosses of populations (WALEJKO & RUSSELL, 1977). These authors suggested that changes in number of kernel rows likely were caused by visual selection among S0 plants that were selfed and testcrossed. Three cycles of reciprocal full-sib selection reduced stalk lodging of BS10(FR) × BS11(FR), but selection did not significantly reduce grain moisture at harvest or root lodging (OBILANA et al., 1980).

The purpose of this research was to evaluate changes in plant and ear traits of testcrosses of BS10(FR), BS11(FR), BSSS(R), BSCBl(R), and Lancaster Surecrop and of the population crosses, BS10(FR) × BS11(FR) and BSSS(R) × BSCBl(R).

MATERIALS AND METHODS

Procedures used to develop plant materials for this study were described by CROSBIE & MOCK (1979). Testcrosses of unimproved (C0) and improved (CN) populations of BS10(FR), BS11(FR), BSSS(R), BSCBl(R), and Lancaster Surecrop, plus population crosses of BS10(FR) × BS11(FR) and BSSS(R) × BSCBl(R) were evaluated in three environments (i.e., Agronomy and Agricultural Engineering Research Center near Ames, Iowa, in 1976; Martinsburg, Iowa, in 1976; and Ankeny, Iowa, in 1977) at 39.5, 59.3 and 79.0 x 10^3 plants/ha. Maize inbreds Mo17, B73, B77, and B79 were used as testers, and cycle CN was C3 for BS10(FR) and BS11(FR), C7 for BSSS(R) and BSCBl(R), and C5 for Lancaster. The experiments were arranged in split-plot field designs with two replications. Plant densities were main plots, and the 44 crosses were randomized within densitics as subplots. We used four-row subplots with rows, 4.06 m long, spaced 76 cm apart at Ames and Ankeny and 96 cm apart at Martinsburg. Subplots were overplanted and later thinned to the proper density. Approximately 170 kg N/ha (preplant application) and 90 kg P and K/ha (autumn application) were applied to each experiment, and 60 kg N/ha was sidedressed at Ames in mid-June.

Ears were hand-harvested from plants in the left-center row of each subplot, but subplots were not gleaned for dropped ears. In each experiment, one hill at each end of a subplot was not harvested, and two hills at each end of subplots within 59.3 and 79.0 x 10^3 plants/ha were not harvested at Ames and Martinsburg. First and second ears were harvested separately, and ears with less than 25% of their surface covered with kernels were considered barren and discarded. Number of harvested ears (i.e., both first and second ears) was divided by number of plants per subplot (minus end-hill plants) to give number of ears/plant. Also, number of second ears was divided by number of plants per subplot and multiplied by 100 to calculate number of second ears/100 plants.

Ears were dried to a uniform moisture content, and ear length (cm), ear diameter (cm), and cob diameter (cm) were recorded for five randomly selected first ears per subplot. Kernel depth (cm) was determined by subtracting cob diameter from ear