

# The Rise and Fall of Overdominance

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*Nature tells us, in the most emphatic manner, that she abhors perpetual self-fertilization.* Darwin (1862)

*The first and most important conclusion which may be drawn from the observations given in this volume, is that cross-fertilization is generally beneficial and self-fertilization injurious.* Darwin (1876)

\*I should like to dedicate this review to George Sprague, a leader in the field for many years, who has so often been right. His death on November 24, 1998, ended an outstanding career. His wisdom, along with a large measure of common sense, will be missed. An earlier draft of this paper was read by Charles Stuber, Howie Smith, Donald Duvick, Kendall Lamkey, Wyman Nyquist, Arnel Hallauer, Jerry Kermicle, and Oliver Nelson. I am indebted to all of them for catching errors and for useful comments. I also want to thank Forest Troyer and Charles Gardner for supplying data for Figs. 5.1 and 5.2, respectively.

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## I. INTRODUCTION

Hybrid maize (*Zea mays* L.) is one of the greatest triumphs in agriculture. Since the introduction of hybrid seed in the 1930s, the yield in the United States has increased about 5-fold. Data compiled by A. F. Troyer (Fig. 5.1) show that, after a long plateau from 1866 until about 1935, the introduction of double-cross corn led to an annual increase of 1.04 bushel per acre ( $65 \text{ kg ha}^{-1}$ ). Then, after single crosses became practical, the increase was considerably faster, 1.71 bushels per acre ( $107 \text{ kg ha}^{-1}$ ), with no apparent slowing of the rate of improvement in recent years. Some of this increase was due to improved management and environment; for example, synthetic nitrogen fertilizer also increased during much of this period. Yet the major improvement was in genetic quality. By saving seed from an earlier period and growing plants from these seeds in a later environment, the environmental changes during that time interval could be assessed. Numerous studies indicate that the

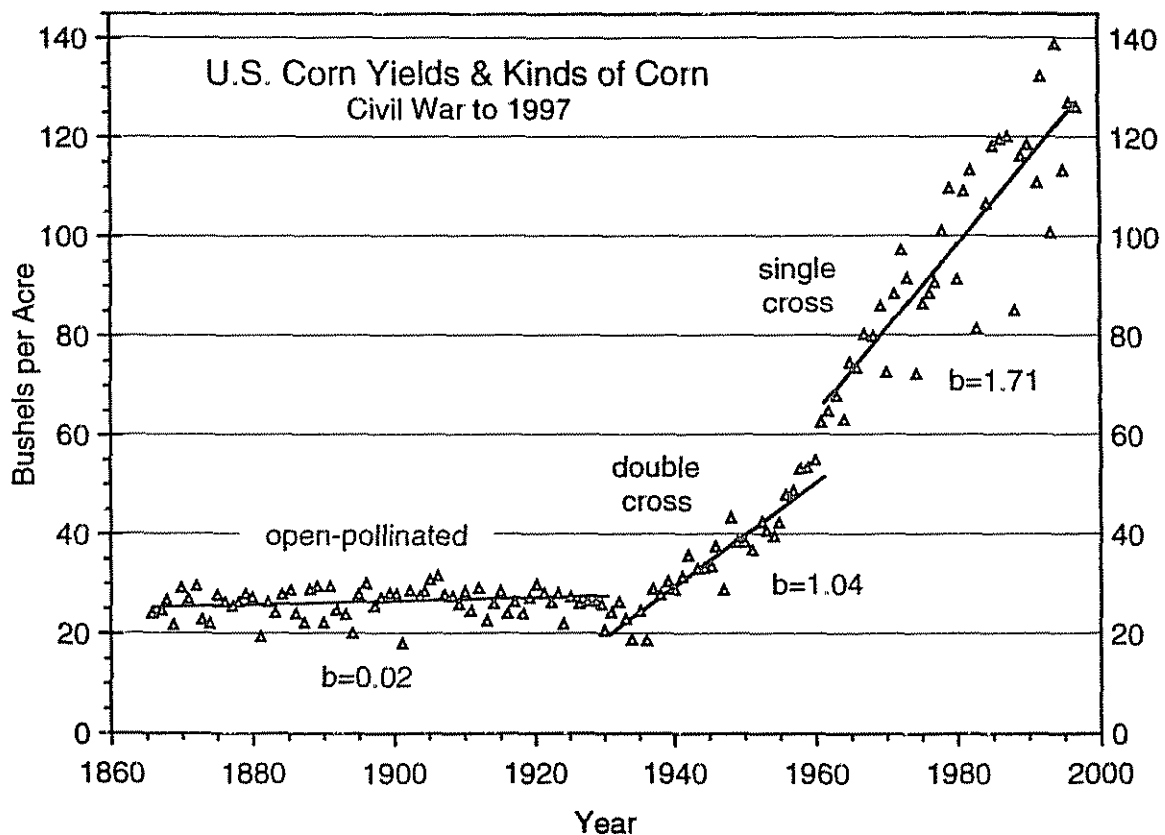


Fig. 5.1. Maize yield in bushels per acre in the United States. The periods dominated by open-pollinated, double-crosses, and single-crosses are indicated, along with regression coefficients (bu./acre). Redrawn with permission of A. Forest Troyer, from data compiled by USDA. Reprinted from Genetics.