Chapter 25

Prediction of Single-Cross Performance

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INTRODUCTION

Maize (Zea mays L.) production in the U.S. has increased dramatically since the 1930s, as scientific knowledge in agronomy, genetics and plant breeding accumulated and this technology started to have a large effect. The change in production has been estimated by Duvick (1977), Russell (1974), and others to be roughly half due to increased inputs and agronomic practices and half due to genetic changes that allow modern hybrids to fully utilize increase inputs, i.e., chemical fertilizers, etc.

Maize breeding has also changed dramatically since the 1930s. During this period better maize hybrids have been developed, in terms of their grain production and agronomic performance. As superior hybrids have been developed, increased efforts have been needed to maintain the rate of genetic improvement. One of the results of this is that research funding associated with commercial breeding programs has increased almost logarithmically during this 60-year period. The increased research funding has supported larger and larger breeding programs that have been developed to identify new hybrids. Along with the development of larger breeding programs have come incentives for breeders to develop more efficient methods of identifying potential commercial hybrids.

The type of commercial hybrids grown has also changed during this 60-year period and has progressed from the use of open-pollinated varieties, or landraces, to double cross hybrids in the 1930s, and finally, single cross hybrids that have been used since the 1960s. The large amount of non-additive genetic variance associated with single cross hybrids and the amount of genotype by environmental interaction has made it difficult to identify high yielding hybrids without testing large numbers of potential hybrids over a relatively large sample of environments. Recently, Bernardo (1994,1995) has published on the adaptation of methods developed by animal breeders to predict single cross hybrids. Similar work has been done at Pioneer, and in this chapter I will present some of the objectives and details of this system.

EFFORT NEEDED TO DEVELOP A NEW HYBRID

Fig. 25–1 is a reminder of the gains in maize production in the U.S. since about the 1930s, when enough scientific knowledge had accumulated that technology could start to have a major effect on maize production. The following section lists some of these technologies that have allowed breeders to develop the highly productive hybrids farmers grow today.