Chapter 41

Hybrid Rye and Heterosis

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INTRODUCTION

Rye (Secale cereale L.) is the only cross-pollinated species among the small grain cereals. Selfing is prevented by an effective gametophytic self-incompatibility mechanism (Lundqvist, 1956). Yet, self-fertile forms have been found in several breeding populations and are being routinely used for developing inbred lines in hybrid breeding programs. As in maize (Zea mays L.) and other cross-pollinated crops, selfing results in severe inbreeding depression and hybrids display strong heterosis. These phenomena have been known since the beginning of this century (Fruwirth, 1913), but it was not before the detection of a cytoplasmic-genic male sterility about 60 years later (Geiger & Schnell, 1970) that the use of heterosis in hybrid varieties became possible.

In this chapter, we want to (i) briefly indicate the worldwide distribution and production of rye, (ii) review the genetical and methodological basis of hybrid rye breeding and seed production, and (iii) demonstrate the progress due to hybrid breeding accomplished in Germany during the last two decades.

WORLDWIDE DISTRIBUTION AND PRODUCTION

Rye is a major cereal crop in the cool temperate zones of Europe with major growing areas in Russia, Belorussia, Poland, and Germany (Madej, 1996). Important regions also exist in Asia and North America (Table 41-1).

The European rye growing area decreased by more than one-half during the last three decades to about 9.1 million ha in the mid-1990s. In 1995, the world production amounted to 29.5 million t, 94% of which was harvested in Europe.

Russian rye breeders successfully used dominant dwarfing genes to improve the productivity of open-pollinated varieties. Hybrid breeding was started on a small scale in the seventies at St. Petersburg and later also at Nemchinovka near Moscow. But no hybrid cultivar has been released so far (Madej, 1996).

Poland has been famous for its diploid open-pollinated rye varieties throughout the world. It was second after Germany in initiating a hybrid breeding program. The first promising hybrids are presently being tested in the official trials. Some of them are crosses between Polish pollinator and German seed-parent lines.

In Belorussia, breeding work has concentrated on tetraploid ryes after a successful cultivar had been released at Zhodina in 1987. Presently, more than 90% of the Belorussian rye acreage is grown to tetraploid varieties. Hybrid breeding (at the diploid level) is in its infancy (Madej, 1996).