

II.13 Genetic Transformation in *Tulipa* Species (Tulips)

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1 Cultivation and Breeding of Tulips

Tulip (*Tulipa* L.) is the most important bulbous ornamental crop in the Netherlands, with a production in 1992 of one billion flowers and three billion bulbs. The Dutch production accounts for about 85% of the world bulb production.

The tulip originated from Central Asia and the Middle East, and was introduced into Europe via Turkey in the second half of the 16th century. Since then it has been an object for breeding. The cultivated tulips, bred for their ornamental value, are members of the species *Tulipa gesneriana* L. A survey of the extensive literature on tulip research has been published recently by Le Nard and De Hertogh (1993).

Serious threats to the tulip industry are fungi (*Fusarium*, *Botrytis*, *Pythium*, *Rhizoctonia*, and others), viruses (Tobacco Etching Virus, Tobacco Rattle Virus), and nematodes (*Trichodorus*) (Van Eijk et al. 1978, 1979, 1983; Van Eijk and Eikelboom 1990, Romanov et al. 1992). Control of diseases and pests takes about 10% of the production costs of the crop. Especially the control of soil-borne pathogens requires crop-protecting chemicals, which can cause severe environmental pollution. In tulip, as in many other crops, there is a strong need for genetic resources of resistance to pathogens. In addition, breeders need novel genetic variation to improve characteristics like forcing ability, flower longevity and flower quality, and to broaden the assortment, by introducing new flower colors and forms.

Breeding of tulips has a long history. During the last 25 years considerable enrichment of the cultivated tulip with foreign genetic material has been accomplished using interspecific hybridization (Van Eijk et al. 1991), but further transfer of germplasm from interesting related species into the crop now is hampered by strong crossing barriers, which can be overcome only by special fertilization and embryo rescue techniques (Van Creij et al. 1992). The main drawback in breeding tulip by hybridization, however, is the long juvenile period of the species. From seed to a flowering bulb takes 4 to 6 years. Then it takes about 10 years to evaluate the value of a promising hybrid. Due to the low

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