23. Fungal Resistant Sunflower

Sunflower production in the U. S. in 2000 was worth over $240 million. The vast majority was used for sunflower oil, a major source of vegetable oil nationally and internationally. In North Dakota, South Dakota, Kansas and Minnesota, states whose combined sunflower production constitutes approximately 85% of U. S. production, Sclerotinia is the number one disease problem in sunflower. The soil-borne fungus causes Sclerotinia wilt when it infects roots. Root and stem tissues decay, depriving the infected plant of water and nutrients so that it wilts and dies. Plants that survive with Sclerotinia wilt have severely reduced yield and seed quality and are susceptible to lodging in high winds. When Sclerotinia infects plants above ground, it causes Sclerotinia head and stalk rots, which cause significant losses by reducing plant yield by up to 33% and by reducing the quality of seed that is produced.

An estimated 8% of sunflower production, on average, is lost to Sclerotinia diseases annually, although losses in individual fields with high incidence may be as much as 80% in epidemic years.

There are no fungicides registered for control of Sclerotinia in sunflower and there are no sunflower cultivars with resistance to the fungus. Although some varieties have more tolerance than others, none will stand up to a heavy infection. Sclerotinia resistance has been a goal of sunflower breeders for decades, but the complexity of breeding resistance to a disease with multiple forms, and the close linkage of resistance traits with other undesirable traits have prevented attainment of that goal. Currently, the only partially effective way for Sclerotinia management in sunflower is rotating to unsusceptible crops such as grains. The number of years a field should be rotated out of sunflower varies with the level of Sclerotinia in the soil, but is generally between three and eight years. However, since fungal spores can be carried by wind from infected fields, sunflower plants can become infected even in fields with long rotations.

Crops with natural Sclerotinia resistance, such as wheat and barley, produce an enzyme, oxalate oxidase, which breaks down and detoxifies the phytotoxins produced by Sclerotinia. A wheat gene for oxalate oxidase has been transferred to sunflower and the resulting transgenic sunflower plants show resistance to Sclerotinia wilt, head and stalk rot.

Potential Impacts of Fungal Resistant Transgenic Sunflower
Change in Production: 260 million pounds per year increase (+ $17.2 million)
Changes in Production Costs: $4.8 million/yr. increase

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