22. Bacterial Resistant Apple

Fire blight is the most devastating bacterial disease to affect apples worldwide. Epidemics throughout the 1990s have cost apple producers millions of dollars in lost yields and lost trees across the U. S. The most recent outbreak in Southwest Michigan in 2000 devastated the region's apple industry, with losses estimated to total $42 million, including $10 million in crop losses, $9 million in tree losses, and $23 million in crop losses expected until new plantings become established.

Fire blight can affect all parts of the tree, including blossoms and fruit, twigs and leaves, trunk and rootstock. Infected plant tissue has a scorched appearance, and exudes bacterial ooze. Fire blight bacteria are microscopic and are spread by wind, rain and insects. An infected tree may die rapidly, or may survive with varying levels of yield loss until it is removed.

Several factors contribute to the increasing severity of fire blight epidemics in the U. S. The 1990s brought a shift in production practices, away from low-density plantings of varieties, such as Red Delicious, which exhibit tolerance to fire blight infections. Market preferences have moved away from Red Delicious, so new plantings use a greater diversity of scion cultivars, such as Gala and Fuji, which are commercially popular but are more susceptible to fire blight. Modern orchards are also high density, which means trees are smaller and more closely planted, making spread of disease between trees easier. High-density plantings are facilitated by use of dwarf rootstocks, which are highly susceptible to fire blight. Infection of a tree planted on susceptible rootstock, regardless of the scion variety, can be fatal.

Fire blight management includes monitoring trees and pruning out infected wood in order to prevent infections from spreading to the rootstock, combined with carefully timed applications of the antibiotics streptomycin and oxytetracycline to prevent new blossom infections. Increased plantings of cultivars susceptible to fire blight has led to an increase in antibiotic applications for disease protection. Antibiotic-resistant fire blight strains have been detected in several apple-producing regions, including in California, Washington, Oregon, and Michigan, further contributing to outbreaks.

Researchers at Cornell University have successfully transformed apples with the insertion of genetic material from the pupae of the giant silkworm moth. The transformed apples express a lytic protein, which damages and inhibits the functions of bacterial cell membranes. Transgenic lines of Royal Gala were produced and exhibited significant resistance to fire blight. Fruit of the transgenic Gala lines are indistinguishable from fruit of non-transformed lines.

Potential Impacts of Bacterial Resistant Transgenic Apple

| Changes in Production: | prevent loss of 251 million pounds per year |
| Changes in Pesticide Use: | 21,800 pound per year reduction in antibiotic use |
| Changes in Production Costs/ Value: | $38.4 million per year gain |

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