36. Fungal Resistant Barley

Since 1993, Fusarium head blight, or scab, has become the most serious fungal disease in North Dakota small grain. As a result of recent scab epidemics, North Dakota barley acreage has declined by one third, production has declined by 25%, and value by 40%. Losses to scab infection include reduced yields, reduced seed weight and quality, but severe economic losses from scab result from contamination by a mycotoxin it produces. The mycotoxin is commonly known as vomitoxin because it induces vomiting when consumed at high levels. Its chemical name is deoxynivalenol, or DON.

The majority of barley grown in North Dakota is malting barley, the basic ingredient in beer. DON contamination of malting barley causes excessive amounts of foam in beer, reducing the amount of beer produced and reducing consumer appeal. Maltsters and brewers, the primary buyers of North Dakota barley, apply pricing schedules based on DON contamination levels, with severe discounts for contaminated grain. Before 1993, approximately 65% of the annual North Dakota barley crop went to premium malting markets, defined as having DON levels of 0.5 ppm or less; from 1993 to 2000, the annual average was 26%. Consequently, U. S. barley imports doubled, with U. S. consumption of Canadian malting barley going from 5% of total U. S. consumption before 1993 to 25% in 1997.

Two anti-toxin genes, one from a fungus closely related to scab and the other from yeast, have been transferred to barley and are being tested for expression and performance. Both genes code for proteins that deactivate DON. Barley is also being transformed to produce proteins that will attack the scab fungus itself when it first tries to infect kernels. Maltsters only accept certain elite barley cultivars based on enzymatic and other properties that affect brewing performance. Future goals include endowing the elite commercial cultivars accepted by maltsters with DON and/or scab resistance by crossing them with transgenic barley varieties.

Potential Impacts of Fungal Resistant Transgenic Barley

Changes in Production: prevent loss of 30 million bushels per year (1.44 billion pounds)
Changes in Production Value: prevent loss of $100 million per year
Changes in Pesticide Use: 4,500 pound per year reduction in fungicide use

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