Opinion

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Brown Rot Infections in Potatoes

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Description

The Dutch potato production chain faces a significant threat from brown rot, which is caused by *Rastonia solanacearum*. Due to a lack of understanding of the relative importance of possible risk factors in relation to brown rot prevalence and dispersal throughout the potato production chain, the disease has not yet been eradicated. We evaluated two epidemiological models a compartmental state-variable model and a spatial Individual-Based Model (IBM) to investigate the connection between potato brown rot infections and potential risk factors. Our methods focus on disease epidemiology within the industrially defined dynamics of the brown rot pathogen in the potato production chain, which sets them apart from the majority of ecological applications of the two modeling techniques currently in use. The state-variable model demonstrated valuable for getting knowledge into the essential standards of earthy colored decay dispersal. It demonstrated that the fundamental to a comprehensive comprehension of brown rot epidemics is the dynamic nature of the proportion of infected seed lots in the total population of potato lots. However, the large variation in annual infection rates that is characteristic of brown rot epidemics was not captured by this model. A conceptual IBM was created to provide a representation of the proportion of infected seed lots that was both more specific and more realistic. Since each potato lot in this IBM is located in a specific location, it is simple to include spatial heterogeneities based on specific data about the potato production industry. The IBM, in contrast to the state-variable model, enables us to investigate the effects of particular brown rot control policies in geographically distinct regions. In addition, the IBM's inherent high level of detail makes it suitable for policy application. The IBM will be improved and made into a bio economic model for use in the analysis of brown rot control strategies.

Vegetative Propagation System

Infectious disease transmission relies heavily on plant production chains. Long-distance travel and international agricultural product trade are making it easier for pathogens to spread to previously unaffected regions, increasing the likelihood of disease outbreaks in these chains. Production chains with multiple production cycles and a vegetative propagation system face a particularly high risk of disease transmission. Once pathogens are introduced into these chains, they can persist from one production cycle to the next in the tissue or on the surface of propagation material. As a result, they have a chance to spread and multiply, which could eventually lead to an epidemic. When infected individuals are capable of transmitting the disease while remaining asymptomatic, this presents a significant challenge for disease control in production chains. Pathogen transmission and dispersal risks within chains are frequently quantified. The development or optimization of control strategies would greatly benefit from gaining a deeper understanding of how infectious diseases behave in plant production chains. An Individual-Based Modeling (IBM) method is used to develop a modeling concept for simulating disease dynamics at the plant production chain level. The application of the IBM idea to disease propagation in plant production chains is novel because most models of plant diseases only cover one growing season or production cycle and focus on epidemics at the plant or field level. The recognition and explicit representation of the principle that each individual is distinct in its characteristics and interactions with other individuals is what sets IBMs apart. Instead of using aggregated state-variables to describe population dynamics, an IBM typically defines each organism as the logical basic modeling unit. In contrast to the concrete individuals that make up traditional IBM entities, the commercial production entities that make up the production chain are defined as the modeling units in our application. Not only do these things reflect their biological state, but also how they are managed and where they are in the chain.

Physical Management through Resistance Cultivars

Potato (*Solanum tuberosum* L.), the fourth most important food crop in the world after wheat, rice, and maize, is one of the most important sources of food for humans. China topped the world in both planting area and total production when it came to potato production in 2020, reaching 359.07 million tons on 16.49 million hectares. Carbohydrates, proteins, and a variety of vitamins and minerals are all found in potatoes, which are high in nutrients. Potato yield, quality, and market value are significantly impacted by field and storage diseases like late blight, early blight, black scurf, powdery scab, wilt disease, dry rot, silver scurf, and others. One of them is dry rot, which is one of the most important post-harvest diseases that affect potatoes. It causes a loss of 6%-25% in yield per year and up to 60% when the potato is damaged, which results in significant economic losses around the world. *Fusarium* spp. are the primary agents responsible for dry rot, *F. sambucinum*, *F. solani* and *F. oxysporum* are the most prevalent and infectious strains. Potato dry rot can be prevented and controlled in a number of ways. In 2001, Stevenson proposed avoiding tuber damage during harvest and growing disease-free seed potatoes to prevent dry rot. Additionally, controlling the pulp temperature of harvested tubers between 10 and 18 °C prevents dry rot in part. However, the disease cannot be completely controlled through management alone. Some researchers tried to control the disease by selecting potato varieties that were resistant to dry rot, but selection takes a long time and is often difficult. Integrated control is a method that combines chemical control with physical management through resistance cultivars. Chemical fungicides such as thiobendazole, 2-aminobutane (2-AB), flusilazole, and others are the most important and efficient methods for controlling dry rot. However, the use of chemical fungicides can quickly result in the development of pathogen resistance; for instance, TBZ was utilized extensively in the United States in the 1970s, but the resistant strains of TBZ did not appear until approximately a decade after its use. In addition, if chemical fungicides are applied in large quantities for extended periods of time, toxic residues, pollution of the environment, carcinogenicity, teratogenicity, and mutagenicity are all likely to occur.