

Plant Pathology Seminar Series



“Gene pyramiding and cultivar mixtures for disease management”

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Resistance to crop diseases is an important foundation of agriculture. Plant breeders, pathologists and farmers must be on their toes to stay ahead in the co-evolutionary arms race between plant pathogen populations and resistant cultivars. Disease resistance of a cultivar is durable if the resistance is effective for several years while being cultivated in large areas under environmental conditions favorable for disease development [1]. Durability of resistance may depend on spatial and temporal variation in resistance gene deployment. Four strategies have been used to improve durability of resistance: i) pyramiding multiple resistance genes in a cultivar, ii) mixtures of several lines or released cultivars with different resistance genes, iii) rotational or sequential use over time of cultivars with different resistance genes, and iv) cultivation of cultivars with different resistance genes in different fields [2]. In this talk, I will focus on the first two strategies.

Pyramiding of resistance genes is attractive because a single cultivar is easy for breeders to market and farmers to use. Theoretically, there is low probability of a virulent race of pathogen emerging as it would require virulence against multiple resistance genes to emerge at the same time [3, 4]. While gene pyramiding utilizes diverse sources of resistance genes, it does not reduce genetic homogeneity in production systems. It might even encourage it. On the other hand, use of cultivar mixtures is attractive because it increases within-species genetic diversity on farm that may reduce risk not only from disease damage but also from unpredictable weather conditions [5, 6]. However, variability in the end-product can make marketing difficult for commodities with strict quality requirements. Concerns have also been expressed that components with different resistance genes may provide an environment for stepwise evolution of a pathogen race virulent to all resistance genes [3], although no super race of pathogen have been reported in mixtures yet. Advancement in modern plant breeding is resulting in cultivars with multiple resistance genes. Therefore, farmers in developed countries with easy access to new varieties and pesticides will find single cultivars with resistance gene pyramids to be the preferred solution. Disease control by cultivar mixtures may be more suitable in smallholder systems with limited research to support a continuing stream of new resistant cultivars [7].

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