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Mosaics of plant disease resistance genes are a more versatile means of achieving disease control than pyramids in most agricultural landscapes

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The breakdown of plant virus resistance genes is a major issue in agriculture. We investigated whether a set of resistance genes would last longer when stacked into a single plant cultivar (pyramiding) or when deployed individually in regional mosaics (mosaic strategy).

We modeled the genetic and epidemiological processes shaping the demo-genetic dynamics of viruses under a multi-locus gene-for-gene system, from the plant to landscape scales. The landscape consisted of many fields, was subject to seasonality, and of a reservoir hosting viruses year-round.

Strategy performance depended principally on the fitness costs of adaptive mutations, epidemic intensity before resistance deployment and landscape connectivity. Mosaics were at least as good as pyramiding strategies in most production situations tested. Pyramiding strategies performed better only with slowly changing virus reservoir dynamics. Mosaics are more versatile than pyramiding strategies, and we found that deploying a mosaic of three to five resistance genes generally provided effective disease control, unless the epidemics were driven mostly by within-field infections.

We considered the epidemiological and evolutionary mechanisms underlying the greater versatility of mosaics in our case study, with a view to providing breeders and growers with guidance as to the most appropriate deployment strategy.

Keywords: Durable disease resistance, Pyramids of plant resistance, Mosaic of plant resistance, Landscape epidemiology, Regional deployment strategy