# A demo-genetic model of root-knot nematod dynamics with applications to the deployment of plant resistance

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Root-knot nematodes (RKN) are soil-borne, little mobile, polyphagous pests which threaten important sheltered crops such as vegetables or small fruits. They attack plant roots to feed and reproduce and have a major impact on crop yield. Most modern eco-friendly plant protection strategies against RKN are based on the use of resistant crops. The emergence of virulent RKN variants, which are adapted to crop resistance, challenges the durability of such methods. Because virulent RKN exhibit reduced fitness on non-resistant crops, combining both resistant and non-resistant plants can help increase the efficacy and sustainability of resistance-based nematode control. Indeed, if resistant crops select virulent nematodes, non-resistant crops counter-select these less fit nematodes. Furthermore, since nematodes have poor intrinsic dispersal ability, the association between resistant and non-resistant plants should rely on crop rotation over cropping seasons, rather than on spatial arrangements. We proposed a semi-discrete model describing the population dynamics of plant roots infection by nematodes within and over cropping seasons. This model, rooted in epidemiological concepts, was fitted to literature data on within-season dynamics of non-resistant plants and avirulent nematodes, and further extended to account for resistant plants and virulent parasites. The model was used to compute optimal crop rotation strategies with respect to a proxy of crop yield over several cropping seasons, for different epidemiological scenarios. In many instances, crop rotation remarkably enhanced crop yield. Robustness of the results to parameter uncertainty was also assessed.

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