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Nematode resistance genetics should boost tomato health

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Root-knot nematodes are one-of-a-kind endoparasites that infect the roots of a wide range of cultivated crops. As the name suggests, galling or swelling of the roots typically characterizes this group of nematodes.

Nematode feeding in crop roots prevents the normal uptake of water and nutrients, resulting in large yield losses of tomatoes and other susceptible host crops. Host resistance to the root-knot nematode is the primary strategy for controlling the problem in infested fields.

GALLING SYMPTOMS APPEAR ON TOMATO ROOTS WITH MI GENE INFECTED WITH VIRULENT ROOT-KNOT NEMATODES.

The *Mi* gene, which was transferred into cultivated tomato from the wild tomato species *Lycopersicon peruvianum* in the 1940s, confers all resistance to root-knot nematodes in tomatoes.

Unlike many other forms of single gene resistance, *Mi* has been a durable source of root-knot nematode resistance. This gene gives effective field resistance to three species of the nematode.

In recent years, there has been an increased reliance on the *Mi* gene due to restrictions on chemical control with soil fumigants and the high cost of their application. Currently, the majority of tomato hybrids used in California contain *Mi*. However, its use has limitations.

Resistance is not effective at temperatures above 28 °C (about 82 °F), thus failing in areas such as Florida and under enclosed production.

In addition, virulent populations of these nematodes that can parasitize plants with the *Mi* gene have been reported in several areas of the world, including

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tomato fields in California. It is likely that this virulence will become more widespread as producers intensify their use of *Mi*.

Novel Resistance Genes

With support from USDA's National Research Initiative (NRI), scientists at the University of California at Riverside have identified a number of novel root-knot nematode resistance genes in wild tomato, *L. peruvianum.*

These novel genes either confer resistance to root-knot nematodes that can parasitize tomatoes with the *Mi* gene, or enable resistance at high temperatures. The researchers aim to develop DNA markers linked to these genes to assist in mapping them on the tomato genetic map and to understand their relationship to each other.

LEFT TO RIGHT, WILD RELATIVE OF THE TOMATO, SOURCE OF NEMATODE RESISTANCE, AND A CULTIVATED TOMATO.

DNA markers accelerate the incorporation of desirable traits into crops. Since nematode resistance assays require mature plants and take about 2 to 3 months' time, the DNA markers developed in this research will make it easier and faster to incorporate these novel genes into tomato breeding programs. The next step will be to clone these novel resistance genes and move them directly into desirable tomato varieties.

Impact

Due to the cost and restrictions on the use of effective nematicides arising from health and environmental concerns, identifying and incorporating naturally occurring host resistance genes into crops is an increasingly favored alternative for nematode control.

Identifying new sources of root-knot nematode resistance in wild tomato germplasm is the first step towards this goal. Developing markers linked to these resistance genes will accelerate the introduction of novel resistance traits into cultivated tomatoes.

The outcome should be the ability to protect tomatoes from nematodes in high-temperature growing conditions and regions, and to develop varieties with different gene combinations that provide durable resistance to these important plant pathogens.

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