To wilt or not to wilt: MicroRNAs determine tomato susceptibility to Fusarium fungus

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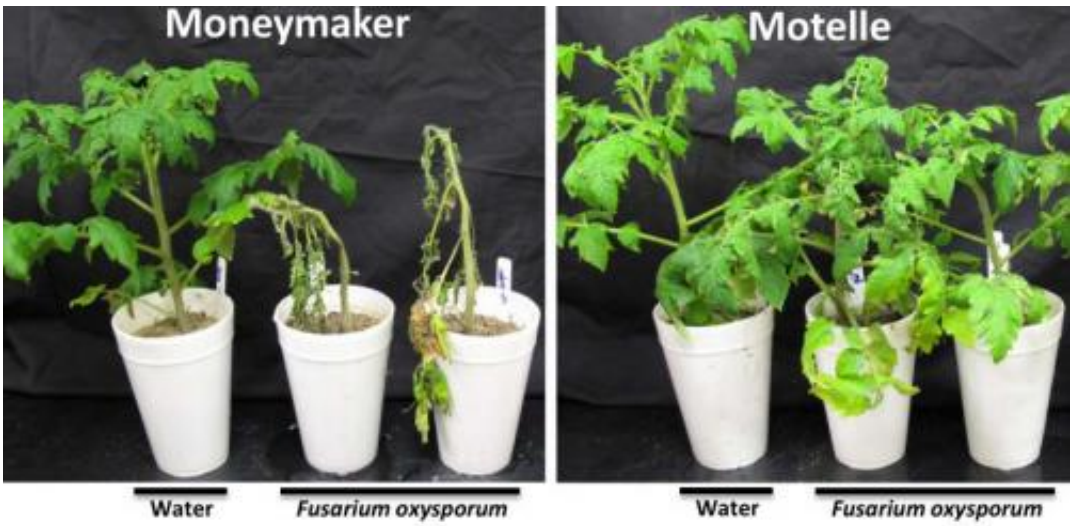

This image shows tomato plant varieties that are sensitive (Moneymaker; left panel) or resistant (Motelle; right panel) to the fungal pathogen *Fusarium oxysporum*. Each panel shows a water-treated control plant on the left and two *F. oxysporum*-treated plants on the right. Exposure of Moneymaker to *F. oxysporum* results in severe wilting, while Motelle is resistant. Credit: Shouqiang Ouyang, University of California, Riverside.

Plant breeders have long identified and cultivated disease-resistant varieties. A study published on October 16th in *PLOS Pathogens* reveals the molecular basis for resistance and susceptibility to a common fungus that causes wilt in susceptible tomato plants.

Katherine Borkovich, from the University of California at Riverside, USA, and colleagues started with two closely related tomato cultivars: "Moneymaker" is susceptible to the wilting fungus *Fusarium oxysporum* whereas "Motelle" is resistant. In their search for what makes the two different, the researchers focused on microRNAs, small molecules that act by regulating the expression of a variety of genes, including genes involved in plant immunity.

They treated roots from the two cultivars with water or with a solution containing *F. oxysporum* and looked for microRNAs that were increased in response to the fungus in Moneymaker (where they would inhibit resistance genes) or decreased in Motelle (where they would allow expression of resistance genes). They identified two candidate microRNAs whose levels went down in Motelle after treatment with the fungus.

Because microRNAs inhibit their targets by binding to them, computer searches can find target genes with complementary sequences. Such an "in silico" search for targets of the two microRNAs identified four candidates in the tomato genome, and all four resembled known plant resistance genes. When the researchers compared the levels of the four potential targets in the two cultivars after exposure to fungus, they found that all four were up-regulated in response to F. oxysporum—but only in Motelle; the levels in Moneymarker were unchanged.

To test whether up-regulation of the target genes was indeed what made Motelle resistant, the researchers employed a virus-induced gene silencing (VIGS) system that can down-regulate specific genes in tomato. After exposure to *F. oxysporum*, disease symptoms, including leaf wilting, were seen in VIGS Motelle plants that silenced any one of the four genes. Although the symptoms were not as severe as in Moneymaker plants, this suggested that all four targets contribute to resistance.

"Taken together", the authors conclude, "our findings suggest that Moneymaker is highly susceptible, because its potential resistance is insufficiently expressed due to the action of microRNAs." Moreover, "because the four identified targets are different from the only known resistance gene for *F. oxysporum* in tomato", they say, "there is much to learn about the immune response to an important pathogen family that infects numerous crop plants."

More information: *PLoS Pathog* 10(10): e1004464. DOI: 10.1371/journal.ppat.1004464

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