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Protection against common bean rust conferred by a gene silencing method

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Rust disease of the dry bean plant, *Phaseolus vulgaris*, is caused by the fungus *Uromyces appendiculatus*. The fungus acquires its nutrients and energy from bean leaves using a specialized cell structure, the haustorium, through which it secretes effector proteins that contribute to pathogenicity by defeating the plant immune system. Candidate effectors have been identified by DNA sequencing and motif analysis, and some candidates have been observed in infected leaves by mass spectrometry. To assess their roles in pathogenicity, we have inserted small fragments of genes for five candidates into bean pod mottle virus. Plants were infected with recombinant virus and then challenged with *U. appendiculatus.* Virus-infected plants expressing gene fragments for four of five candidate effectors accumulated lower amounts of rust and had dramatically less rust disease. By contrast, controls that included a fungal gene fragment for a septin protein not expressed in the haustorium died from a synergistic reaction between the virus and the fungus. The results imply that RNA generated in the plant moved across the fungal haustorium to silence effector genes important to fungal pathogenicity. This study shows that four bean rust fungal genes encode pathogenicity determinants and that the expression of fungal RNA in the plant can be an effective method for protecting beans from rust. This method may be useful for soybean. We have observed similar effector soybean rust fungus proteins in infected soybean leaves. These candidate effectors can be tested with the same virus.