Non-Invasive Live Phenotyping of Pathogens Colonizing Plants

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Bioluminescence is used as marker e.g., in genetic or plant pathological studies. We developed a method to monitor bioluminescence at the whole plant level combined with phenotypic analysis of the plant. Using a CCD camera mounted in a cabinet shielding all external light we can image weak luminescence emissions from samples and map these to RGB images. Image processing delivers temporal and spatial data on the distribution of the luminescence together with phenotypic features of the plants. With this technology, microbial colonization of plants can be monitored. Arabidopsis plants were inoculated with *Pseudomonas* and *Xanthomonas* plant-pathogenic bacteria labelled with gene cassette for autonomous luminescence and disease progression was monitored over time. Luminescence imaging revealed accumulation of the bacteria in different plant tissues while the RGB images served to monitor plant growth and occurrence of disease symptoms. Applying this method, resistant plants could be selected from a mutant population. Disease responses of susceptible plants were compared to the responses of resistant plants. In the case of *Pseudomonas*, bacterial abundance reached its maximum during two to four days after inoculation, at a time when water soaking of the leaves could be observed as well with the RGB camera. At later stages – five to seven days after inoculation, disease symptoms in terms of leaf yellowing and tissue collapse occurred while bacterial populations appeared to decrease. With this method it was possible to monitor pathogen development and disease progression non-invasively at whole-plant level over time.