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Imaging Maize Lesions

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Abstract

The maize disease lesion mimic mutants spontaneously form lesions on leaf blades and sheaths that strongly resemble the plant's responses to pathogen infection. Variations in lesion morphology, spatiotemporal distribution, and sensitivity to genetic background and weather make them ideal candidates to develop high throughput and high resolution phenotyping methods for individual plants and their organs in unstructured fields. We present three approaches to imaging lesions at different phenotyping scales and image resolution. Each strategy has distinct advantages and poses unique collection and computational challenges. The first is imaging individual leaves ex situ before sexual maturity using reflected light. The challenge is to identify leaves while the lesions are sufficiently separated for easier segmentation, yet numerous enough for good sample size and mature enough to display the range of lesion developmental stages. This is a moderate throughput, moderate resolution strategy. The second is to image plants using UAVs in situ. The challenges are to fly low enough for good lesion resolution while minimizing extraneous movement and to register individual plants and their leaves during the growing season. This is a high throughput, lower to moderate resolution strategy. The third is to image lesions using after-market lenses on cell phones in situ. The challenges are to capture the same region of the leaves over time without interfering with lesion formation and to mosaic the imagery of highly repetitive surface features into a summary view for registration. This is a low throughput, high resolution strategy.

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