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Rapid Identification of Strawberry Runners Using AI Techniques

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Abstract

Strawberry runners, also known as "stolons", are long, horizontal stems that extend from the main strawberry plant, or mother plant. They can be used for vegetative propagation, which is a cost-effective and efficient method for expanding strawberry production. However, runners can also cause overcrowding in the patch, which can reduce overall strawberry yield and make it difficult to manage and harvest the fruit. Additionally, runners take energy away from the mother plant, which can reduce the size and quality of the fruit produced. Therefore, a balance between runner production and fruiting is necessary for optimal plant growth and yield. Visually identifying runners in the field is a time-consuming, labor-intensive, and costly process. Overcoming this challenge requires an automated and accurate technique. Through a preliminary study in the 2022-2023 strawberry season in Central Florida, high-resolution RGB images of 2,000 advanced-stage strawberry breeding selections were collected by a ground-based imaging platform. We adopted a state-of-the-art AI-based method, Mask R-CNN, to quickly identify and localize strawberry runners. Trained by a small amount of image samples collected on different dates, the AI-powered machine vision model test showed that larger training data led to better performance, as evidenced by higher precision and recall rates of 84% and 86%, and an F1 score of 73%. By contrast, smaller training datasets resulted in lower precision and recall rates, with the maximum values of 76% and 58%, and an F1 score of 60%. This approach will streamline the selection of runner-related traits for breeding and pave the way for automated runner management for growers.

Keywords: artificial intelligence, object detection, ground-based imaging