

Identifying trichomes on digital images of soy leaves

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Motivation and Aim: Trichomes are extensions of the aforementioned epidermal cells in plants [1]. Soybean leaf trichome plays an important biological role in resisting pests and adapting to the environment and exhibits a wide range of phenotypic variation. Currently, the typical method used to collect trichome data is qualitative visual counting using lenses, which is labor- and time-intensive [2], another method is the use of scanning electron microscope (SEM), which is costly, time-consuming and not conducive to high-throughput analysis [3]. As more and more plant and trait parameters need to be measured quickly and accurately, various types of computer vision algorithms, image processing and machine learning classification methods are increasingly used in plant phenomics data analysis [4–6]. In this work, we suggest method for an automated identification of trichomes on the surface of soybean leaves through machine vision segmentation algorithms.

Methods and Algorithms: With the use of computer technology for analysis of microscopic images of transverse fold of leaf blades has been proposed for quantitative evaluation of leaf trichomes [7]. Typical image contains green leaf fold with darker trichomes located outside on the black background. Additionally, part of image contain image of ruler and labelling data. We developed an algorithm, which enables automatic segmentation of image into four parts: background, leaf, trichomes and ruler/label.

Three algorithms was used for image segmentation: (1) using pixel intensity in the RGB color space; (2) using pixel ExG, ExR, ExGR indices [8]; (3) using thresholds in H (HSV color space) and a (Lab color space). The performance of pixel classification was estimated using TP, TN, FP, FN, F1 measures. The algorithms implemented using OpenCV library.

Results: With the help of pre-segmentation data, segmentation of pixel points of different classes is performed for automatic calculation of threshold value. After completing the automatic segmentation algorithm, the results are evaluated using the confusion matrix for the multicategorization task.

Conclusion: By analyzing the number, length and other characteristic of trichomes, we will explore the association between these microstructures and the function and growth status of soybean leaves, and further reveal the important role of trichomes in plant adaptation and growth and development. By combining machine vision counting and plant phenomics research, we expect to provide important data support for geneticists to study soybean growth and development.

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