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Optical Detection of Two-Spotted Spider Mite Infestation in Cucumber Using Vegetation Indices

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Abstract

The two-spotted spider mite (*Tetranychus urticae* Koch) feeds on the underside of plant leaves by penetrating the chloroplast-containing cells. This primarily leads to yellowing in limited areas, which is visible as spots on the upper side of leaves. Spider mite infestation can lead to yield loss. In the case of cucumbers, heavy infestation even leads to complete loss of the assimilation surface on the leaves and, as a result, to the death of the plants. Therefore, it is necessary to detect a spider mite infestation as early as possible. Objective of the present work was to investigate the possibility of identifying spider mite infestation of cucumber by using a hyperspectral camera. An image capturing unit was built, which consisted of a Cubert UHD185 Firefly camera, a halogen light source and a camera mounting platform. Cucumber plants were infected with 50 spider mites each and kept under controlled conditions for two weeks. Subsequently, the leaves with spider mite damage were cut at their base and placed on the platform under the camera's objective. During image acquisition, the distance between objective and leaf was adjusted at 43 cm. As control, the same procedure was performed with healthy leaves. After image acquisition, infected and healthy leaves were compared by applying different vegetation indices (VI) such as: GNDVI, NRENDVI, REIP and TGI. The performance of the VIs was analysed in R program. The analysis indicated that it is possible to differentiate between healthy and infested leaves, as three of four investigated VIs showed significant difference within the compared data. Hence, VIs obtained with hyperspectral imaging can be used to detect damage on cucumber leaves caused by spider mites.

Keywords: Hyperspectral imaging, two-spotted spider mite, vegetation indices