Screening commercial cucumber cultivars for resistance to anthracnose using image analysis

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INTRODUCTION

Guam’s most common and most severe cucumber disease is anthracnose (Fig. 1). Colletotrichum on cucumber was reported in 1867 in the United States and Guam in 1979 and confirmed as C. orbiculare strain CBS 570.97+LARS73 by Dr. Cheryl Blomquist at CDFA-Plant Pest Diagnostics Center in 2017. Based on a yield loss value of 15%, the estimated loss to Guam’s growers in a single year is $178,000 based on a market value of $890,775. The aim of this study was to devise a means by which a large number of cucumber cultivars could be quickly screened and from which the best could be selected for field evaluation.

MATERIALS/METHODS

Four replications of 22 commercial cultivars were grown in pots, at the fourth leaf stage, they were spray inoculated to point of runoff with a 1x10⁴ conidia/ml suspension, then afterwards placed under a plastic tent at 100% RH for 24 hrs. A conidial suspension was prepared by vortexing (15 sec) a distilled water suspension of anthracnose lesions collected from an infected field. On the fifth day, the third leaf was removed and pressed between sheets of paper towel. This flattened the leaf and arrested further disease development. Leaves were scanned (Fig. 2) and images were evaluated using Adobe Photoshop and ImageJ software. Image analysis resulted in the color of healthy leaf tissue appearing red; thereby, creating a sharp contrast between disease and healthy tissue (Fig. 3). On each leaf, a circular area of 20 cm was analyzed in order to reduce errors in the image analysis associated with coalescing of lesions and distortion of leaf margins on highly susceptible cultivars. An additional study where conidia spore concentrations were varied (Fig. 4) was conducted by University of Guam students enrolled in AL 101: Introduction to Agriculture (Fig. 5).

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DISCLAIMER

Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the USDA National Institute of Food and Agriculture.

RESULTS

Statistical analyses consisted of one independent variable (cultivars) and four dependent variables: VR (Visual Rating) (Thompson and Jenkins 1985 Visual Rating scale), TL (Total Leaf area), PerDis (Percent Diseased area within a 20 cm circular area), and LC (Lesions per cm², in the circular area). The F-test was significant (<0.001), leading to significant Tukey’s studentized range (HSD) pairwise tests, for all dependent variables. Controlling for experiment-wise error rates at 0.05, HSD revealed the following significant pairs: 26 among 231 for VR, 7 among 231 for PerDis, and 19 among 231 for LC. Both Fig. 6 and 7 display the ordering of VR and PerDis cultivar means, respectively, using LSD lines to highlight separation. Based on visual inspection of cultivar groupings across VR, PerDis, plus LC (not shown), it was determined that cultivars Sinews, Tasty King, Speedway, and Early Triumph are among the most susceptible to anthracnose, while Olympia, Olympia trd (treated) and Poinsett76 are among the most resistant.

DISCUSSION

The use of digital image analysis software like ImageJ and Adobe Photoshop allowed for an easy means to evaluate a large number of cucumber cultivars to anthracnose susceptibility. It was determined that among the cultivars currently grown by Guam growers, Blessing, Soarer, and Summer Top offer the most resistance. To further evaluate the usefulness of this technique, the same cultivars should be tested under field conditions.