Screening commercial cucumber cultivars for resistance to anthracnose using image analysis

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Western SARE Sustainable Agriculture Research & Education

USDA United States Department of Agriculture National Institute of Food and Agriculture

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.

Fig 1. Guam anthracnose severity commonly seen on the cucumber cultivar Fountain

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 1x10^4 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)**.

ACKNOWLEDGMENTS
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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 U.S. Department of Agriculture.

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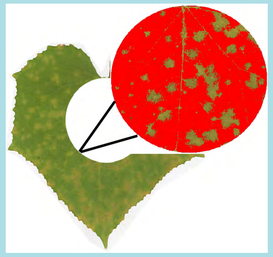
Fig 2. Scanned images of pressed cucumber leaves of Fountain: non-inoculated (left) and inoculated (right)



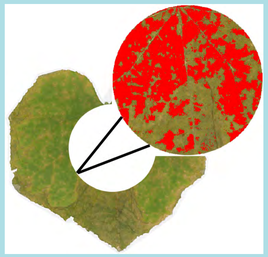


Fig 3. Scanned and transformed image of inoculated cucumber cultivar Summer Top (left) and Fountain (right). Note that the healthy tissue appears red and that the circular area used to determine LC and PerDis is shown enlarged

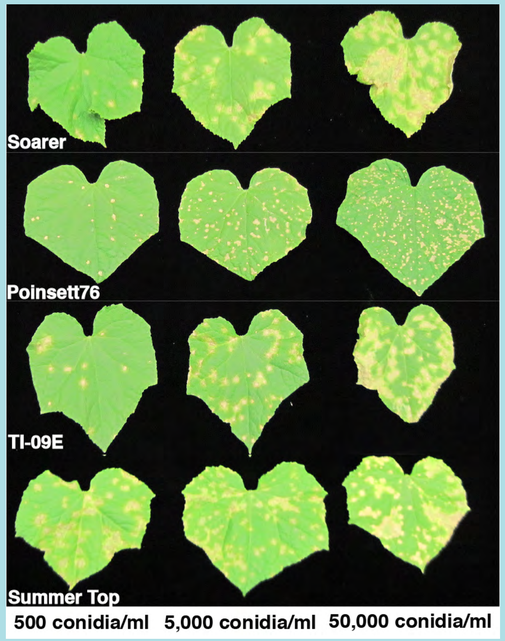


Fig 4. Lesion development of four test cultivars inoculated at three different conidial concentrations

Fig 5. Students, instructor and supporting staff of AL 101: Introduction to Agriculture. Left to right: Mariel Villaluz, Joseph Afaisen Jr., Karen Bacalia, Searsyleen Saimon, Fidel Palacios, Angelia San Agustin, Dr. Robert L. Schlub, Ysa Pablo, Eugene Bondoc, Brian Capindo, Ryo Suzuki, Johnny Parke, James Castro

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 cm^2, 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.

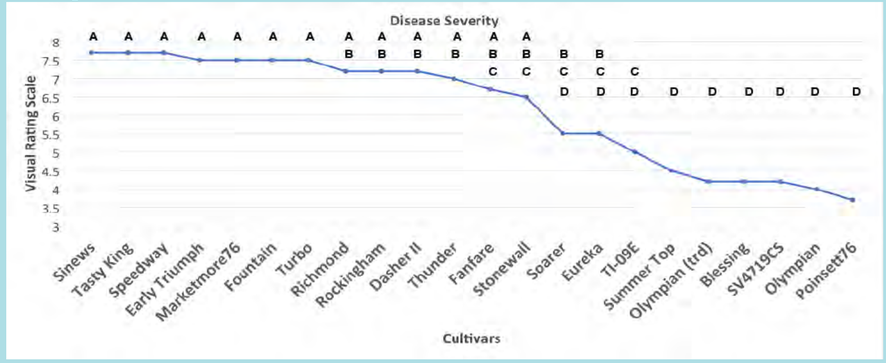


Fig 6. Disease severity ranking of 22 cucumber cultivars based on visual rating (VR) from high to low susceptibility, with corresponding LSD, t statistical groupings (A-D)

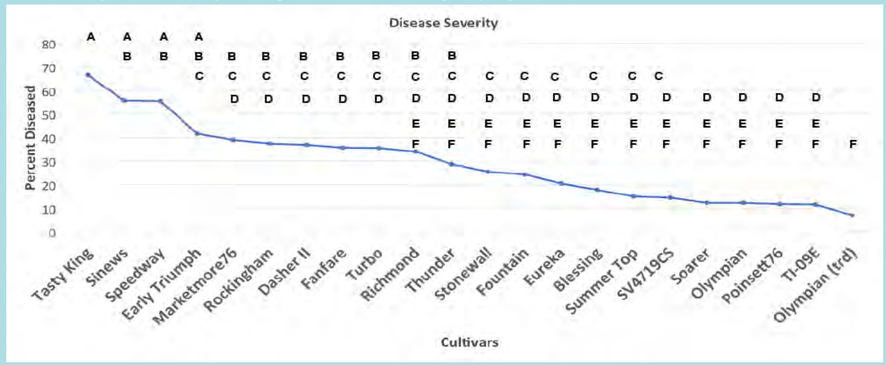


Fig 7. Disease severity ranking of 22 cucumber cultivars based on percent disease (PerDis), with corresponding LSD, t statistical groupings (A-F)

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.