Severity Assessment for Soybean Rust*

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Abstract

The accurate assessment of soybean rust, *Phakopsora pachyrhizi*, is needed by both fungicide efficacy and germplasm evaluation programs. The small size of soybean rust lesions makes them difficult to count or measure in field evaluations. An evaluation of individual leaflets should provide an accurate assessment of the difference among treatments or genotypes. To ensure repeatable evaluation, a set of images representing the range of soybean rust severity was developed with a combination of APS Assess[3] and Adobe® Photoshop®. A hand-drawn leaf outline with points the size of soybean rust lesions was scanned and imported into Adobe® Photoshop®, where the color and number of points were edited. These images were then evaluated in APS Assess to obtain the percent of the leaf area covered and the number of points present. Images were reworked in Photoshop® to add or decrease the number of lesions to obtain the desired percent coverage and lesion number. Several cycles of evaluation and editing were needed to develop an accurate representation of each severity level. Images were developed for 30 lesions (0.1% surface coverage), 75 lesions (0.25% surface coverage), 150 lesions (0.5% surface coverage), 300 lesions (1.0% surface coverage), 750 lesions (2.5% surface coverage), 1,500 lesions (5% surface coverage) and 3,000 lesions (10% surface coverage). Images with 20, 30, 40 and 50% of the surface covered were also produced, but lesions were not counted.

Introduction

Soybean rust, caused by *Phakopsora pachyrhizi*, has caused significant yield losses in most areas where it occurs. The disease now threatens the soybean production in the United States following the first report from Louisiana in November 2004 (Schneider et al, 2005).

The pathogen can infect soybean plants at any time after germination (Bromfield, 1984). In the early season, rust pustules are found on the lower leaves in the canopy. As plants flower and spore production increases, pustule development moves up the plant and disease severity increases. Fields develop a bronze to yellow color and may rapidly defoliate. Yield losses occur due to increases in pod abortion and decreases in seed size and seeds per pod. The symptoms of soybean rust are small, tan or reddish brown, polygonal lesions that have from one to several erumpent globose uredinia. The lesions are 2 to 5 mm^2 in size, with individual uredinia measuring 85 x 300-365 µm (Kitani and Inoue, 1960).

Fungicide efficacy, germplasm evaluation and yield loss studies require an accurate assessment of soybean rust severity to ensure repeatability of results. An evaluation of individual leaflets should provide an accurate assessment of the differences among treatments or genotypes. However, the small size of soybean rust pustules makes it difficult to obtain accurate counts or measurements in field evaluations. It was recognized that a severity assessment scale with visual representation of each severity would be useful to overcome this difficulty. Ideally, each image in the scale would have a known severity, as a percent of area covered and as a count of the individual lesions. Our objective was to develop a set of images to enable a rapid and accurate assessment of soybean rust severity.

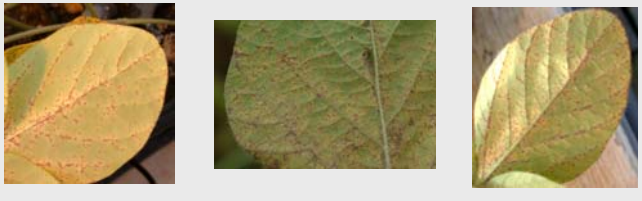


Fig. 3. Photos used to develop soybean rust severity images

Methods

A hand-drawn leaf outline with points the size of soybean rust lesions was scanned and imported into Adobe® Photoshop®, where the color and number of points were edited. Soybean rust lesions were colored red to be more visible on the green background of the leaf. The images were then evaluated in APS Assess to obtain the percent leaf area covered and the number of points present. Images were reworked in Photoshop® to add or decrease the number of lesions to adjust the desired percent coverage and lesion number. This cycle of analysis and editing was repeated several times until an accurate representation of each severity level was obtained. Images were developed for 30 lesions (0.1% surface coverage), 75 lesions (0.25% surface coverage), 150 lesions (0.5% surface coverage), 300 lesions (1.0% surface coverage), 750 lesions (2.5% surface coverage), 1,500 lesions (5% surface coverage) and 3,000 lesions (10% surface coverage). Images with 20, 30, 40 and 50% of the surface covered were also produced, but lesions were not counted (Fig. 1 and Fig. 2).

*Names are necessary to report factually on available data; however, the USDA neither guarantees nor warrants the standard of the product, and the use of the name by the USDA implies no approval of the product to the exclusion of others that may also be suitable.

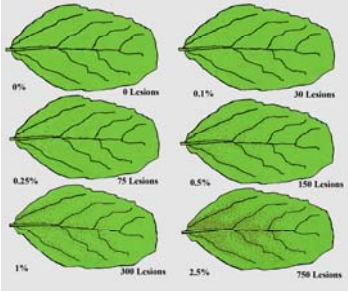
Discussion and Conclusions

Accurate depictions of soybean rust infected leaves are difficult to obtain. Photos of infected leaves from the field have different aged lesions ranging in size and color or can contain a mixed reaction with both tan and red-brown reactions. They may also show symptoms of diseases that are easily confused with soybean rust, such as bacterial pustule or brown spot. A graphic representation should avoid both of these problems.

Our representations were developed using photos of infected plants from the field and greenhouse as examples (Fig. 3). We aimed to represent one of the characteristic tendencies of soybean rust which is to cluster lesions along the veins and mid rip of the leaf. This is most readily seen in heavy infections and is represented in images showing above 10% surface area covered. Above 10% coverage, lesions overlapped and accuracy of counts was reduced, so lesion counts were not done.

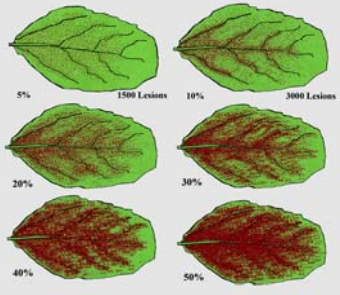
These images may serve as a tool to support research on soybean rust, to allow for the development of assessment scales that will provide repeatable data without the need to count lesions or pustules. We plan to use the images in germplasm evaluation experiments this winter. Individual cards will be used in both field and net-house trials to evaluate soybean rust severity on leaflets of different genotypes.

Fig. 1. Images representing low soybean rust severities



available at http://www.soydiseases.uiuc.edu

Fig. 2. Images representing high soybean rust severities



available at http://www.soydiseases.uiuc.edu

Use the assessment images to evaluate the soybean rust severity in these photos

Bibliography

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