Tracking Soybean Rust Susceptible Kudzu in Mississippi


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ABSTRACT

It is estimated that Mississippi contains over 101,000 hectares of kudzu. Based on extensive surveys, conducted since soybean rust (SBR) was first detected in Mississippi, we have determined that 80 counties contain kudzu. Following a recent publication on kudzu reactions to greenhouse challenge with three geographically distinct isolates of Phakopsora pachyrhizi, it was determined that 7.8% of the MS kudzu sites screened exhibited an immune response. An immune response was defined as a red-brown lesion type without the characteristic raised pustules. During October 2009, surveys were conducted to determine the response of the 51 screened kudzu sites and over 100 additional sites to natural infection from P. pachyrhizi. The information gathered will help us more carefully focus our kudzu scouting efforts in the future and potentially allow us to determine the extent of immune kudzu. In all, greater than 80% of the sites surveyed exhibited symptoms and signs of SBR. Additionally, it appears that there may be morphological differences between kudzu plants with different responses to P. pachyrhizi. Moreover, based on observational and greenhouse data there are several different types of susceptible responses within the kudzu population to P. pachyrhizi. Additionally, kudzu sites previously identified as being immune to the fungus in the greenhouse and not currently exhibiting symptoms or signs of SBR can likely serve as differentials in the future should P. pachyrhizi make a molecular shift.

KUDZU SCOUTING AND SEED COLLECTION

Mississippi is reported to contain over 101,000 hectares of kudzu in 80 of its 82 counties (see Figure 1). As opposed to some of the other states in the region, more specifically AL, AR, and LA, MS has some counties with extensive areas covered by kudzu. In some counties the invasive plant was used as a means to prevent erosion and can be found covering entire hillsides (Figure 2). In addition to kudzu having a widespread nature across the state there is tremendous morphological variability within the entire kudzu population. Since the initial detection of soybean rust (SBR) in the continental U.S. in 2004, MS soybean producers have been aware of the potential threat that kudzu poses since it is an additional host of the SBR fungus. However, initial field observations suggested there were differences in the overall level of susceptibility of kudzu to Phakopsora pachyrhizi (Pp). For example, some kudzu sites would become infected by the fungus and produce sporulating pustules while other kudzu sites immediately adjacent would not produce visible symptoms.

Beginning in 2005, and again in 2006, kudzu seed were collected from random sites throughout the state. A total of 51 sites with seed that germinated in the greenhouse were utilized for experiments. Challenge studies with three geographically distinct isolates of Pp were conducted in the greenhouse in Frederic, MS to determine the range and type of reaction that could be associated with infection from the SBR fungus. Four unique responses to the fungus were detected with an immune response, characterized by no apparent symptoms on kudzu leaves; a reddish-brown response (resistant), indicative of little or no sporulation; a tan response (susceptible), characterized by sporulating pustules; and a mixed reaction, characterized by the leaves containing both reddish-brown and tan lesion types.

To follow up on the greenhouse reactions, and determine the overall field reaction to natural infection within MS, field scouting was conducted with a 20-30 hand lens during October and November on 24 of the 51 locations. In addition, 183 kudzu sites in 26 counties in the northern 1/3 of the state were observed for whether or not they were infected with SBR and the overall type of reaction encountered at each location was compared with sites that had a known reaction type to Pp as outlined above. Kudzu sites were observed for their reaction type and intensity of the reaction by observing green leaves. All kudzu sites, including those from the Bonde et al. (2009) study were rated on a 0-5 scale where 0=negative (judged to be immune), 1-light (judged to be red-brown due to the overall low numbers of pustules in most cases a single, sporulating pustule), 2-light-moderate, 3-moderate (judged to be a mixed reaction with sparse sporulating pustules), 4-moderate-heavy, 5-heavy (judged to be a tan reaction with heavily sporulating pustules).

KUDZU RESPONSE

Bonde et al. (2009) was the first map study of its kind to determine the response of different kudzu accessions to Pp. From those studies it was determined that 7.8% of the kudzu screened produced an immune response while 58.8% of the kudzu produced sporulating lesions, either a mixed reaction or a tan (susceptible) reaction, in response to fungal infection. The other 33.4% of the kudzu sites responded with a resistant, red-brown reaction. Additionally, the most important finding related to whether or not there were geographical clusters of reactions (Figure 3). Based on the initial greenhouse research geographical clusters of kudzu with a like-response were not detected.

Follow-up surveys conducted using coordinates from the locations where seed originated were used to return to those sites and monitor the response in 2009. Judged to be a year when severe soybean rust had occurred throughout MS and a tremendous amount of inoculum was present in a widespread nature. In all, 234 total kudzu sites were rated for the presence or absence of SBR, and the severity of the infection. Overall, 8.5% of the kudzu sites rated were found to not have a reaction and were thus judged to be immune/negative (Figure 5). All other reactions were considered to be positive reactions since sporulating pustules were visible. The light reaction accounted for 21.4% of the sites. However, both the light reaction and the light-moderate, moderate, and the moderate-heavy reactions, 52.6% of those sites were judged to produce pustules and sporulation was evident. The heavy reaction (tan response) accounted for 38.9% of the sites. In addition, as was stated in Bonde et al. (2009) there appeared to be no pattern to the geography of kudzu reactions.

Two locations appeared to have a different response at the field level than what was recorded in the greenhouse. One of those locations had originally been identified as immune, thus no localized/hypersensitive response type lesion nor sporulation would be judged to occur. However, the field survey detected sporulating pustules at this particular kudzu site as well as a site across the road. Both sites were observed due to possible coordinate overlap. Additional seed was collected from the site in question.

CONCLUSIONS

The response of kudzu to infection from the SBR fungus is highly variable.

In MS, greater than 60% of the kudzu surveyed in 2009 could contribute to an SBR epidemic (if infected at any time during the soybean growing season) due to the production of sporulating pustules.

Even over a larger area there does not appear to be a geographical response to infection so that all kudzu within an area does not have the same response.

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REFERENCES