Plant Path

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7. Title

Molecular Biology of Bacterial Panicle Blight of Rice and Rice Defense Systems for This Disease

12. Investigator Name(s) (Last Name and Initials)

Ham, J. H.

20. Termination Date 05/31/2013

40. Period Covered (mo/da/year): 01/01/2011 TO 12/31/2011

Outputs:

Progress from this project was presented at the 2011 Annual Meeting of American Phytopathological Society (Honolulu, Hawaii) American Phytopathological Society Southern Division Meeting (Corpus Christi, Texas), and the Louisiana Rice Research Board Meeting (Rayne, Louisiana). New patentable techniques for controlling bacterial panicle blight were filed for disclosure. Findings from this project also were disseminated through the publication of one peer-reviewed article, seven abstracts, one book chapter, and one magazine article.

Outcomes/Impacts:

Novel regulatory genes, pidS and pidR encoding a two-component regulatory system, were found to control the virulence of the causal agent of bacterial panicle blight Burkholderia glumae. In addition, presence of new regulatory pathways that globally control the virulence of B. glumae was validated. These novel findings may have significant impacts on the study of Burkholderia species, which also include important human and animal pathogens, by changing a current paradigm for the central regulatory systems involved in the pathogenic functions of the bacteria in this genus. Ultimately, innovative strategies for controlling diseases caused by Burkholderia species could be developed from this new information. Several bacterial strains isolated from rice plants in the rice fields showed substantial antifungal and antibacterial activities against the sheath blight pathogen of rice, Rhizoctonia solani, and the bacterial panicle blight pathogen, B. glumae, respectively. Likewise, several B. glumae strains showing natural avirulence to rice demonstrated strong antifungal activities against R. solani. These rice-inhabiting non-pathogenic bacteria could be useful biological control agents for rice diseases. Pretreatment of ascorbic acid or culture filtrate of B. glumae to rice suppressed the development of bacterial panicle blight symptoms caused by subsequent infection with B. glumae. Extended tests are under way to investigate the broader disease control effects of these pretreatments on other plant diseases. On the basis of these research outcomes, a new approach to control bacterial panicle blight of rice, as well as other important plant diseases could be developed. Four mapping populations of the F4 generation were established via crosses between disease resistant and susceptible rice lines/varieties. These mapping populations are a very valuable resource for genetic studies to understand the disease resistance to bacterial panicle blight and sheath blight. In addition, up to 30 new rice lines that show promising disease resistance traits against both bacterial panicle blight and sheath blight were screened breeding populations this year. These breeding lines are useful materials for the development of new rice varieties that are highly tolerant to these two economically important rice diseases.

Publications:

Ham, J. H., R. A. Melanson, and M. C. Rush. 2011. Burkholderia glumae: Next major pathogen of rice? Mol. Plant Pathol. 12 (4): 329-339.

Subudhi, P.K., J. Ham, C. A. Kimbeng, J.W. Hoy, and N. Baisakh. 2011. Marker-assisted breeding to enhance disease resistance in corn, rice, and sugarcane. USDA-NIFA Agriculture and Food Research Initiative, Plant Genome, Genetics, and breeding Programs Project Directors Meeting, San Diego, CA, Jan 14, 2011. Annual Report, pp. 152-154.

Ham, J. H. and D. E. Groth. 2011. Bacterial panicle blight: an Emerging rice disease. Louisiana Agriculture 54(3): 16-17.

Karki, H. S., I. K. Barphagha, and J. H. Ham. 2011. Functional characterization of the PidS/PidR two-component regulatory system of Burkholderia glumae. Phytopathology 101:S88.

Shrestha, B. K., H. S. Karki, D. E. Groth, M. C. Rush, and J. H. Ham. 2011. Suppression of bacterial panicle blight of rice by

pretreatment with various chemical compounds. Phytopathology 101:S166.

Chen, R., I. Barphagha, and J. H. Ham. 2011. A genomics study of Burkholderia glumae genes regulated by quorum-sensing. Phytopathology 101:S264.

J. Ham, H. S. Karki, B. Shrestha, I. K. Barphagha, R. A. Melanson, R. Chen, D. E. Groth, X. Sha, H. Utomo, P. Subudhi, and M. C. Rush. 2011. Molecular genetic and genomic studies on bacterial panicle blight of rice and its causative agent Burkholderia glumae. Phytopathology 101:S266.

Karki, H. S., I. Kaur, and J. H. Ham. 2011. Role of melanin-like pigments in the virulence of Burkholderia glumae. Phytopathology 101:S266.

Melanson, R. A., R. S. Sanderlin, and J. H. Ham. 2011. Classification of strains of Xylella fastidiosa isolated from pecan in Louisiana as Xylella fastidiosa subsp. multiplex. Phytopathology 101:S267.

Shrestha, B. K., R. Nandakumar, M. C. Rush, and J. Ham. 2011. Expression of NAC-like transcription factor is involved in bacterial panicle blight resistance in rice. Phytopathology 101:S268.

Participants:

J.H. Ham (PI), I. Kauer, B. Shrestha, H.S. Karki, R. Chen, R. Melanson, F. Francis, R. Keawwan, M.C. Rush, D. Groth, X. Sha, LSU AgCenter; R. Keawwan, Kasetsart University, Bangkok, Thailand; J. Kim, Louisiana State University; Beom-Seok Kim, Korea University.

Target Audiences:

Plant pathologists, undergraduate and graduate students, other plant scientists at universities and industries, and rice growers.

Project Modifications:

Nothing significant to report during this reporting period.

Approved (Signature)	Title	Date