USDA ARS United States Department Of Agriculture Agricultural Research Service

Research Project: GENETIC AND GENOMIC APPROACHES TO IMPROVE INSECT RESISTANCE AND OTHER VALUE-ADDED TRAITS IN WHEAT, BARLEY, AND SORGHUM

Location: Wheat, Peanut and Other Field Crops Research

Title: Understanding mechanisms of host resistance against greenbug in cereal crops - an interdisciplinary, collaborative approach

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Technical Abstract: At Texas AgriLife Research - Amarillo, we have an ongoing research program focusing on elucidating the mechanisms of interactions between the phloem-feeding aphid pests and cereal crop hosts using the wheat-greenbug as a model system. During this workshop, recent results from our research on the following projects will be presented: (1) Map-based cloning of greenbug resistance gene in wheat. This NRI-supported project aims to clone the Aegilops tauschii-derived greenbug resistance gene Gb3 from wheat. So far, over 30 SSR, AFLP-, EST- or RFLP-converted STS markers were placed on a high-resolution map in the Gb3, two of which are being used to screen an Ae. tauschii BAC library to initiate chromosome walking. The Gb3-linked markers have been successfully applied in marker-assisted selection for greenbug resistance in the Texas Wheat Improvement Program. (2) Molecular mapping of greenbug resistance genes Gb1, Gb2, Gb6 in wheat, and Rsg1, Rsg2 in barley. We plan to identify molecular markers for these genes that can be used in marker-assisted selection and development of wheat/barley germplasm with multiple resistance. (3) Exploring Brachypodium distachyon as a new model species to study molecular mechanisms of plant-aphid interactions in the grass genome. Diploid accessions with distinct greenbug-feeding responses were identified. SSR markers were developed and phylogenetic relationships of B. distachyon with rice, wheat and ryegrass were evaluated. (4) Expression profiling of host defense responses against greenbug feeding. Molecular defense responses of near isogenic wheat lines of Gb3 were investigated with Affymetrix GeneChips providing new insights in host defense mechanisms. (5) Physiological basis of Gb3-mediated host resistance against the greenbug in wheat. Free amino acid dynamics were examined in the greenbug and two near isogenic wheat lines of Gb3 in a 12-day time frame after infestation using an optimized SPME-GC-FID (solid phase micro-extraction/gas chromatography-flame ionization detection). (6) Development of cross-species transferable microsatellite markers for evaluation of biotypic diversity in the greenbug. Over 120 SSR markers were developed through database mining of the pea aphid and green peach aphid EST and genomic resources. Cross species transferability of these markers was evaluated. Thirty seven SSRs were used to evaluate genetic diversities among forty greenbug biotypes. Host-associated genotypic variation and geographical differentiation among these clones were revealed.