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CRIS Projects

Project #	Title	Start Date	End Date
FLA-BRA-04196	Breeding and Genetics of Fresh Market Tomatoes	10/1/2004	10/1/2009
FLA-BRA-04565	Introgression of Silverleaf Whitefly (*Bemisia argentifolii*) Resistance Genes From *Lycopersicon hirsutum* to Tomato	9/15/2006	9/14/2008
FLA-BRA-004649	GIS-Based Spatial Analysis of Movement of Silverleaf Whitefly and Begomovirus	5/1/2007	4/30/2012
FLA-BRA-004700	Biology and Management of Arthropod Pests of Vegetables	10/1/2007	9/30/2012
FLA-BRA-004659	Fine Mapping of a Begomovirus Resistance Gene	8/15/2007	8/14/2010

FLA-BRA-004700 - Biology and Management of Arthropod Pests of Vegetables

Progress Report

OUTPUTS: The following research areas were emphasized: 1) Laboratory bioassays were used to estimate susceptibility of silverleaf whitefly (SLWF) adults reared from nymphs on field-collected tomato foliage to the neonicotinoids imidacloprid, thiamethoxam, acetamiprid and dinotefuran; the pyrethroid bifenthrin and the organochlorine endosulfan. F1 nymphs were bioassayed with the insect growth regulator buprofezin. The field populations were bioassayed with the estimated LC50 and LC95 values of the respective insecticides for a susceptible lab colony. Mortality for the neonicotinoids at the LC50 value of the lab colony ranged from 4 to 14% for field populations, representing declines of 65 and 70% for acetamiprid and thiamethoxam respectively. Mortality at the lab LC95 were about 50% for imidacloprid and thiamethoxam, but were about 70% for acetamiprid and dinotefuran. Field populations were susceptible to buprofezin and endosulfan, but were tolerant to bifenthrin. 2) Greenhouse choice and no-choice bioassays identified some products that were toxic to SLWF adults, and that reduced oviposition and TYLCV transmission but were not as effective as the imidacloprid and pymetrozine standards. 3) Selected formulations of microencapsulated materials were evaluated in greenhouse trials for effects on SLWF adult survival, oviposition and nymph survival. Some formulations were identified that resulted in higher adult and nymphal mortality as well as reduced oviposition compared to the azadirachtin, pyriproxyfen, pyrethrum and novaluron standards. 4) Insecticides, insecticide combinations, miticides, and biopesticides were evaluated in field trials on squash, tomato and pepper for control of the SLWF, melonworm, pickleworm, armyworms, leafminers, broad mites and the pepper weevil. 5) Sound trapping for adult mole crickets and a tachinid parasite was continued. 6) Tomato germplasm from the breeding program at Cornell University were evaluated in a field trial for effects on whiteflies and TYLCV incidence. Some breeding lines were observed to have fewer whiteflies and a lower incidence of TYLCV than other lines. PARTICIPANTS: **Dr. David Schuster (University of Florida, Gulf Coast Research & Education Center) planned and organized the projects and provided entomological direction in the reported output and outcome.** TARGET AUDIENCES: People involved in the production of field grown vegetables in southern Florida were the target audience of the project. Targeted persons included in field vegetable producers as well as upper level management personnel, agricultural consultants and scouts, and agricultural distributors. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Monitoring of field populations of the silverleaf whitefly for susceptibility to insecticides is an essential part

of a resistance management program and will help ensure the continued availability and sustainability of these indispensable management tools for whitefly control. The use of adult repellents, especially for protecting tomato seedlings in transplant production houses, could improve management of whitefly-vectored viruses with reduced adverse environmental impact. The development of tomato germplasm resistant to the SLWF could result in fewer applications of insecticides and improved control. The identification of pesticides and pesticidal rotations will help ensure the continued management of key arthropod pests of vegetable crops grown in Florida and elsewhere.

FLA-BRA-004659 - Fine mapping of a begomovirus resistance gene

Progress Report

OUTPUTS: Forty homozygous recombinant inbred lines (RILs) containing varied lengths of *Solanum chilense* introgressed segments in the Ty-3 target region were tested for resistance to *Tomato yellow leaf curl virus* (TYLCV). Thirty of these lines were produced from F2 recombinants, while the remaining ten were identified from advanced breeding lines previously genotyped with molecular markers. In fall 2007 these RILs were inoculated at seedling stage for two weeks with sweet potato whiteflies viruliferous for TYLCV and were then transplanted to the field. A randomized complete block design with 12-plant plots and 3 blocks was used, and disease severity was evaluated three times at three week intervals. An average of the three ratings was used for analysis, and means were separated by Duncan's multiple range test. The experiment was repeated in spring 2008. Results suggest that Ty-3 maps to the interval between markers T0774 (18 cM) and PG-25 (~25 cM). The introgression segments in fifteen of twenty-seven resistant RILs spanned this entire region, while recombination events between these two markers resulted in part of this region being present in eleven of the other resistant lines. It was noted that the remaining resistant line, whose introgression did not span any part of this region, also had a lower level of resistance than the others. All thirteen susceptible lines were deficient for this interval. This indicates that there was no detectable resistance at the Ty-1 locus in this germplasm derived from LA2779. According to the map positions provided by SGN for T0774 and the BAC from which PG-25 was designed, the interval between these two markers is approximately 7 cM. However, only six of 717 F2 plants initially screened showed recombination within this interval. Thus, the realized distance between these two markers was estimated to be 0.84 cM in our material. To more finely map the Ty3 gene, two resistant RILs were selected from the spring 2008 trial and crossed to the TYLCV-susceptible breeding line, Fla. 7776. The first RIL contains a ~20 cM introgression spanning markers C2 At2g39690 (5.3 cM) to PG-25, while the ~14 cM introgression in the second RIL spans markers T0774 to T0834 (32 cM). F1 plants from each of these crosses will be self-pollinated in fall 08, and F2 seed will be harvested. In spring 2009, approximately six thousand F2 plants from these crosses will be screened with the molecular markers T0774 and PG-25. Given the realized distance between the two markers of 0.84 cM, we estimate that approximately 50 recombinants will be identified. These F2 recombinants will be evaluated in spring 2009, and their derived F4 RILs will be tested in fall 2009. PARTICIPANTS: J.W. Scott Professor of Horticulture is the tomato breeder who introgressed the resistance into tomato and oversaw the molecular marker work over 10 years that got this project started. Yuanfu Ji is the Post-Doctoral scientist who conducted most of the work; developing and screening molecular markers on the germplasm, rating plants for disease severity, analyzing data, and developing recombinant populations. **D.J. Schuster, Professor of Entomology, maintained the viruliferous whitefly colony used for disease screening, assisted with the inoculation procedure and he provided 1/2 the field space used to grow the plants.** Jose Diaz and Dolly Cummings worked half time in the lab assisting with molecular marker screening procedures. TARGET AUDIENCES: Tomato breeders from the public sector, seed companies, and processing tomato companies around the world are the main target audience. Scientists working in cytogenetics or molecular analysis would be interested in our data on reduced recombination in the introgressed chromosome segments. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Advanced breeding lines highly resistant to begomoviruses released from our research project have been

utilized in tomato breeding programs worldwide. In addition, molecular markers developed from this project have also been widely applied in tomato breeding programs for marker-assisted selection. Commercial hybrids utilizing our released breeding lines and marker information (such as Carmencita in Spain and Llanero in Guatemala), have been released by seed companies.

FLA-BRA-004649 - GIS-Based Spatial Analysis of Movement of Silverleaf Whitefly and Begomovirus

Progress Report

OUTPUTS: The silverleaf whitefly, *Bemisia argentifolii* (also known as biotype B of the sweetpotato whitefly, *B. tabaci*), is the key insect pest of tomato in southern Florida. Most damage associated with the whitefly is due to the transmission of plant viruses, the most damaging of which is *Tomato yellow leaf curl virus* (TYLCV). In the spring and fall of 2008, about 900 and 750 acres, respectively, of tomatoes spread over about 20 square miles in Hillsborough Co. FL were used as a study site for monitoring silverleaf whiteflies and TYLCV. Whitefly adult and nymph density data and percent incidence of plants with symptoms of TYLCV data were collected twice weekly for every 2.5 acres. Each sampling site remained fixed and was geo-referenced with global positioning system (GPS) coordinates. The Geographical Information System (GIS) was used to analyze the data. Maps were created using ArcMap with inverse distance weighting (IDW), which estimates predicted values based on the distance they are away from a sampled point. The data indicated that the production system is very complex. Whitefly density and TYLCV incidence were low in both seasons of 2008. Nevertheless, whitefly densities suggested origination within the study site, perhaps from adjacent weeds. The information gained in the study was shared with growers and other clientele in a formal information exchange and in informal discussions. The information was also shared with the scientific peer community in a formal presentation at the 2008 annual meeting of the Florida Entomological Society. PARTICIPANTS: **Dr. David Schuster (University of Florida, Gulf Coast Research & Education Center) organized the project, established contacts with cooperating growers, and provided entomological direction.** Drs. Craig Stanley (University of Florida, Gulf Coast Research & Education Center) and Sabine Grunwald (University of Florida, Soil and Water Science Department) provided direction of the GIS analyses. Graduate student Mr. James Taylor (University of Florida, Gulf Coast Research & Education Center) supervised the temporary personnel in collecting whitefly density and TYLCV incidence data. He conducted the GIS analyses under the direction of Drs. Grunwald and Stanley. TARGET AUDIENCES: People involved in the production of field grown tomatoes in southern Florida were the target audience of the project. Targeted persons included in field tomato producers as well as upper level management personnel, agricultural consultants and scouts, and agricultural distributors. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Growers have altered their management practices of fallow fields and weedy field perimeters to reduce potential reservoirs of whiteflies and virus. Fallow fields are disked frequently, treated with herbicides, or seeded to sudangrass to reduce potential weed hosts.

FLA-BRA-04565 - Introgression of Silverleaf Whitefly (*Bemisia argentifolii*) Resistance Genes from *Lycopersicon hirsutum* to Tomato

Progress Report

OUTPUTS: An F2 population between tomato (*Solanum lycopersicum* L.) and *S. habrochaietes* accession LA1777 was made and 171 F2 plants were assayed for SLWF mortality and oviposition by confining 10 adult females in one clip cage per plant for 24 hours and the numbers of living and dead whiteflies and eggs deposited were counted. The lateral leaflet opposite to the one used for the insect

assay was used to count the numbers of type IV and type VI trichomes for each plant. Eleven plants from the population were selected as resistant based on their low oviposition (0-12 eggs), high adult mortality, and high number of type IV trichomes; ten susceptible plants were selected based on their low mortality, high oviposition, and 0 to very few type IV trichomes. Four hundred twenty-one molecular markers spanning the tomato genome were screened using a modified bulk segregant analysis (MBSA) of the resistant and susceptible selections. MBSA revealed five putative regions associated with resistance, designated R1, R2, R3, R4 and R5 on chromosomes 10, 9, 11, 11 and 8, respectively. To verify these results, a QTL analysis was done using 138 of the 171 F2 plants. Significant associations were found for oviposition and type IV trichomes for R1-R4 but not for R5. Resistance was only recovered in plants that had multiple regions present, but never in plants with only a single region. A manuscript is in preparation describing these results. Crosses were made primarily using recombinant inbred lines (RILs) to combine the four regions in all possible combinations to determine which combinations provide resistance. Some combinations were bioassayed and it was found that R1 plus R2 did not give resistance, but R2, R3, and R4 combined provided high resistance. To obtain a more complete set of genotypic combinations plants heterozygous for all four loci and plants heterozygous for three of the four loci were self-pollinated and sib-mated, and 823 progeny were recently genotyped. Select combinations will be bioassayed in late fall 2008. More genotyping will be done soon since recovery of particular genotypes does not appear to be random, and not all genotypic combinations were recovered. Results will be presented next year. PARTICIPANTS: J. W. Scott, Professor of Horticultural Sciences was the principal investigator, his role was in developing the overall design of the research; first using recombinant inbred lines (RILs) and then developing the interspecific F2 which was the population used in the MBSA and QTL studies when resistance was not found in the RILs. He is guiding the present research and breeding approach as resistance genes are verified and linkage drag is removed from each locus. Aliya Momotaz was the Post-Doctoral Scientist who carried out much of the work, from bioassays to molecular marker development and screening. She analyzed all the data and conducted the MBSA and QTL analyses. She also oversaw pollination and seed production activities. **D.J. Schuster, Professor of Entomology, oversaw the maintenance of the sweetpotato whitefly colony used in the bioassays and provided expertise in trichome morphology and the bioassay procedure. He provided labor to assist with the bioassays**. TARGET AUDIENCES: Target audiences for this work are scientists working in the area of (tomato) breeding and genetics. These are the people who may be able to take germplasm developed in the project to develop whitefly tolerant cultivars for tomato growers. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

This is a long-term project and there will be no economic impact for some time. If the project is successful savings to tomato growers in reduced pesticide costs, reduced geminivirus infection, and elimination of irregular ripening could be worth 30 million per year to Florida growers.

FLA-BRA-04196 - Breeding and Genetics of Fresh Market Tomatoes

Progress Report

OUTPUTS: A *Tomato yellow leaf curl virus* (TYLCV) resistance gene Ty-4 was mapped to chromosome 3. Combining this gene with the Ty-3 gene provides very good resistance and allows for marker assisted selection (MAS) to be used which will dramatically improve breeding efficiency. Five begomovirus resistant breeding lines with the Ty-3 gene and a linked molecular marker were released. One of the five breeding lines has Ty-4 and very soon will be available through a non-exclusive contract along with markers linked to these genes. PARTICIPANTS: J.W. Scott, Professor of Horticultural Science has worked on these projects for many years and oversees the University of Florida tomato breeding program. Jeremy Edwards is an Assistant Professor of Horticultural Science; he breeds tomatoes and started last year. He has gotten involved in most of the projects, making selections and designing experiments. **Dave Schuster is an Entomologist who maintains viruliferous whitefly colonies for TYLCV inoculation.** The Florida Tomato Committee provides monetary support. TARGET AUDIENCES: Seed companies and public breeders working on tomato improvement use germplasm from the breeding

program to develop new cultivars. The publications also help them understand how to efficiently work with several traits. New cultivars are beneficial to tomato growers in Florida and the southeastern US primarily.
PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Eventually the begomovirus resistant breeding lines and Ty-3/Ty-4 molecular markers could have a large impact on Florida tomato production where tomato yellow leaf curl virus is a serious problem. It will be several years in the future however.