TEXAS A&M AGRILIFE RESEARCH

VEGETABLE-BREEDING PROGRAM

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RESEARCH

Growing vegetables in the subtropical climate of South Texas represents a real challenge due to its harsh environmental conditions and high pressure of endemic or new pests and diseases that severely limit production. The vegetable-breeding program is combining conventional breeding and modern molecular methods to develop high-yield, heat-tolerant, disease- and pest-resistant, high-quality tomato and spinach cultivars for the region.

DEVELOPMENT OF TOMATO YELLOW LEAF CURL VIRUS RESISTANT CULTIVARS

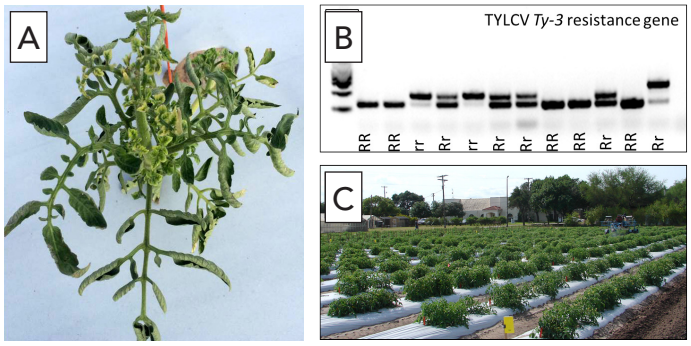

Figure 1. Breeding for TYLCV resistance.
(A) TYLCV symptoms, (B) Marker-assisted selection, (C) Field evaluation

The main disease affecting tomato production in South Texas is the tomato yellow leaf curl virus (TYLCV; **Fig. 1A**), which is vectored by whiteflies. Several major resistance genes for TYLCV have been identified, but they need to be introgressed and stacked into locally adapted cultivars to ensure long-lasting disease resistance. Current efforts of the breeding program are focused to introgress resistance genes into heat-tolerant breeding lines. Marker-assisted selection (**Fig. 1B**) is being used to increase selection efficiency by allowing us to only evaluate plants carrying the resistance gene(s) in the field (**Fig. 1C**).

IDENTIFICATION AND INTROGRESSION OF RESISTANCE AGAINST THE POTATO PSYLLID IN TOMATO

To date, no commercial tomato cultivar carries resistance to the potato psyllid (PP), the vector of "*Candidatus* Liberibacter solanacearum" (Lso) and the causal agent of tomato vein greening in tomato and other economically important diseases in solanaceous crops. As a result, farmers rely solely on chemical applications to control the insect. It is imperative to develop resistant cultivars in combination with management strategies to reduce yield losses. As a first step to develop resistant cultivars, the breeding program is screening wild tomato relative species to use as a resistance source. Identified resistant wild tomatoes are being crossed with advanced tomato breeding lines to develop resistant cultivars.

IDENTIFICATION AND CHARACTERIZATION OF PLANT DEFENSIVE OXYLIPINS INVOLVED IN RESISTANCE TO THE POTATO PSYLLID AND ITS TRANSMITTED BACTERIA

Figure 2. *In planta* and artificial diet oxylipin evaluation

Oxylipins represent a large, diverse group of fatty-acid-derived compounds primarily generated through enzymatic oxidation of linoleic and linolenic acid. Synthesis of plant oxylipins is regulated in response to plant stress, and resulting oxylipins participate in signaling and defense. The goal of this project is to identify oxylipins that contribute to plant defensive signaling and their regulatory network in response to PP-Lso infection as a first step to develop tomato and potato selection targets to enhance plant resistance. Antibiotic and insecticidal properties of phloem mobile oxylipins against the PP-Lso are being evaluated when applied directly to leaves or to artificial diets (**Fig. 2**). Parameters tested include insect survival/fecundity and bacterial load change in both insect and plant. Researchers expect that results from this project can be extrapolated to other pests and diseases of economical importance, such as citrus greening.

EVALUATION OF TOMATO PRODUCTION UNDER COVERED STRUCTURES

Protected structures such as high tunnels, net-houses, and greenhouses provide an alternative to tomato production in harsh environmental conditions by extending the growing season. The breeding program is currently leading a project to evaluate the agronomic and economic feasibility of covered structures as an alternative to open field production to reduce yield losses caused by insect-transmitted diseases and to extend tomato growing season (**Fig. 3**). The project will develop an extended information network to provide grower education on factors influencing profitable production practices specifically developed for locally and regionally produced fresh market tomatoes.

Figure 3. Evaluation of tomato cultivars under covered structures

DEVELOPMENT OF MOLECULAR TOOLS FOR WHITE RUST RESISTANCE SELECTION IN SPINACH

Figure 4. White rust evaluation

Breeding for spinach improvement requires new methods to speed up the development of cultivars with increased yield potential and disease and pest resistance. The major yield-limiting disease for spinach production in Texas is white rust (WR), caused by *Albugo occidentalis*. Since natural infection levels in the field varies year-to-year, conventional selection of resistant cultivars in the field is time consuming and unreliable. Therefore, in order to improve cultivar-development efficiency, the breeding program is evaluating spinach-breeding lines from the public and the private sectors and using genome-wide association analysis to develop molecular markers linked to WR resistance (**Fig. 4**). Currently, identified markers are being validated for their use in marker-assisted selection programs.

CURRENT CAPABILITIES AND EXPERTISE

The breeding program is located at the Vegetable Research and Education Center Building, a recently opened facility that includes a dedicated molecular biology laboratory, a greenhouse, and land field for conventional and molecular breeding. New cultivars are being developed by combining genomics, transcriptomics, and metabolomic tools.

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