March 2019

Vegetable Crops Newsletter

University of California
Agriculture and Natural Resources
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UCCE

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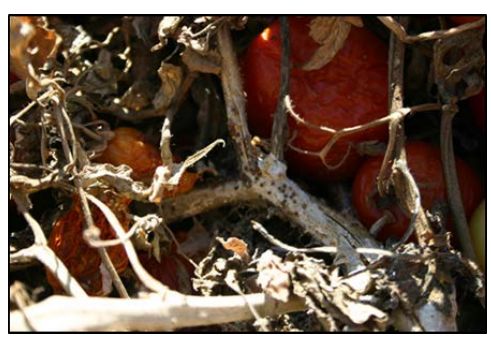
2018 Research Progress and Results

Multisite demonstration of conservation management practices for soil health and greenhouse gas emissions reduction

UCCE Agronomy Advisor, Sarah Light, and myself wrapped up the first year of a 3-year statewide Healthy Soils Demonstration Project supported by CDFA. This project includes a cover crop demonstration and research site on a farm in Sutter County in addition to two other sites statewide (San Joaquin and Merced County). We are evaluating the impact of cover crops to soil health and annual production in the region. We have taken baseline soil samples at our site in Meridian, CA, which was previously planted to wheat. After compost application, the grower planted a purple vetch cover crop in early winter. Our plots consist of a control (no cover crop), a low seed rate of the vetch, and a high seed rate of the vetch. The next two years of the project will include a tomato, vetch, and corn rotation. We will take soil samples each year in addition to looking at weed pressure, cover crop biomass, and % residue cover at cash crop planting. Greenhouse gas emissions are also being evaluated throughout the project, specifically before and after "events" such as rainfall, irrigations, fertilizations and tillage operations. Sample analysis is ongoing.

The 2017 Healthy Soils Demonstration Project is funded by Greenhouse Gas Reduction Funds and is part of California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work reducing GHG emissions, strengthening the economy, and improving public health and the environment.

Monitoring southern blight prevalence in Colusa County



Southern blight, *Sclerotium rolfsii*, is a destructive crown rot disease that rapidly kills tomato plants. The combination of late planting dates and record high temperatures in 2017 created unusually favorable conditions for the pathogen in the Sacramento Valley (C. Swett). The objective of this research was to quantify southern blight spread and impact in annual rotations in the region. To do this, we collected soil to look for southern blight sclerotia, as seen in photo on right (Photo credit: J. Nunez).

We sampled soil from nine fields, five of which were known to have southern blight in 2016 or 2017. All fields were in tomato in 2017, except one that was in tomato in 2016 and wheat in 2017, and another that was planted with canary bean in 2017. We sampled the soil in May 2018 to get baseline

data on early season southern blight sclerotia levels. The rotational crops in 2018 included sunflower and corn. Soil was collected again from the same spots in the fields in August/September 2018 to determine if there were any changes to southern blight sclerotia levels in the field. Cassandra Swett's lab analyzed the soil samples using the methanol method (Rodriguez-Kabana et al 1980). Methanol kills most microbes, except for southern blight. Trays of soil were sealed in plastic bags so the moisture could stimulate germination of the southern blight sclerotia. The germination of sclerotia (see photo above) was evaluated at 3 and 7 days (Photo credit: C. Swett).

Sclerotia were recovered from 3 fields in May 2018, possibly 5 fields but identification was unclear for 2 of the fields. The end-of-season samples from August and September 2018 contained much higher volumes of soil than the May samples, and we recovered sclerotia from 7 of the 9 fields. Five fields had increased sclerotia levels, two fields decreased, and one field had the same number of sclerotia in both the May and September samples. Southern blight increased in all three of the sunflower fields, which was expected since sunflower is a host crop. Corn fields were spread between increases, decreases, and no changes. It is worth noting though, that the only fields with decreased levels were corn fields. Also, fields where no sclerotia were recovered may contain southern blight that was not captured among our samples.

Sunflower is not recommended as a rotational crop because it is a southern blight host. Corn may be a decent choice for rotation. We were able to recover southern blight sclerotia in fields throughout Colusa County and demonstrate southern blight increases over the growing season with rotational crops. Southern blight requires specific conditions for development to occur. In 2018, southern blight was not a large issue for tomato growers, and remains a disease that is a problem in our area only when environmental conditions are ideal for development, especially for certain fields.

Cassandra Swett-Field and Vegetable Crop Pathology Extension Specialist, and Sarah Light-Agronomy Advisor, were collaborators on this project. We would like to thank our grower and pest control adviser cooperators on this project. We would also like to thank the California Tomato Research Institute for funding this project.

Rodriguez-Kabana, R., Beute, M. K., & Backman, P. A. 1980. A method for estimating numbers of viable sclerotia of Sclerotium rolfsii in soil. Phytopathology, 70(9), 917-919.

2019 Projects

<u>Evaluation of weed control in tomatoes comparing finger weeders to standard cultivation</u>

In 2018, a local organic farmer achieved success with a finger weeder (KULT Kress) compared to a double disc opener in tomatoes, corn and beans. Standard cultivators leave a band of soil untouched in the seed line, but finger weeders run in the seed line and are able to uproot small weed seedlings that standard cultivation would have missed (Smith 2017). In 2019, we will be comparing these two pieces of equipment in tomatoes by measuring percent weed cover before and after a tractor pass, length of weed kill, the need for more than one pass, timing/speed of equipment, and yield.

This project is funded by the California Tomato Research Institute.

Smith, R. 2017. "Labor, Efficiency, and the Future of Weed Control". Growing Produce: Why we need growing innovations.

<u>Evaluation of Fusarium wilt survival in the Sacramento Valley as influenced by rotational crops of flooded rice and dry-farmed crops</u>

In 2018, over half of the farm calls in Colusa and Sutter counties involved Fusarium wilt of tomato (see photo on right). Fusarium wilt, Race 3 (Fol), *Fusarium oxysporum* f. sp. *lycopersici*, is a soilborne fungal pathogen damaging to tomato crops in the Sacramento Valley. When a susceptible tomato host is planted, Fol spore levels increase by season's end. Growers rely on resistant varieties to control this disease. Sanitation is also a key management tool to prevent further spread throughout the field by infested soil or tomato plant material. Though this disease is specific to tomatoes, little is known of the role rotational crops play in harboring Fol in non-tomato years, especially rice. The Sacramento Valley, especially the Sutter Basin, provides a unique opportunity to evaluate Fusarium wilt survival in rotations with flooded rice and dryland crops such as wheat and non-irrigated melons. Do these different irrigation practices (flooding vs dryland) have an impact on Fusarium wilt severity in years with tomato rotations? To test this, we will bury mesh bags filled with Fol-infected tomato stem pieces in a rice field with a history of Fusarium wilt of tomato at the beginning of the season and collect them at multiple times throughout the season. The level of Fusarium in the plant material will be determined prior to burying the bags and assessed again after bag collection.

Cassandra Swett-Field and Vegetable Crop Pathology Extension Specialist, Whitney Brim-DeForest-Rice Advisor, and Gene Miyao-Retired Farm Advisor, will be working with me on this project. The California Tomato Research Institute is funding this research.

<u>Management of spotted and striped cucumber beetle in melon production</u>

The western striped cucumber beetle and the western spotted cucumber beetle are serious pests of fresh-market melons in the Central Valley. Adult striped cucumber beetles feed on the bottom surface of fruit causing scarring on the rind, which leads to cosmetic damage and unmarketable fruit. They are difficult to control with insecticides because they are protected underneath the fruit. Spotted cucumber beetles feed on the foliage, flowers, and fruit, but remain in the plant canopy, so they are easier to control. Both beetles can also be very damaging to seedling stands (see photo to left). (Photo Credit: UC-IPM, P. Goodell).

Melon fields are regularly scouted for cucumber beetles and other pests. Current control methods in conventional fields consist of insecticide sprays (carbamates, pyrethroids, neonicotinoids) when beetles are detected in the field. We will be evaluating 10 different insecticides for their efficacy against cucumber beetles on a research farm at UC-Davis. Additionally, we will test 3 trap designs (all with a floral-lure attached) to find the one that works best for catching cucumber beetles. We will compare trap captures and beetle counts on plants to assess how effective the different trap types are with regards to detection sensitivity.

Ian Grettenberger, Field and Vegetable Crops Entomology Extension Specialist is a principal investigator on this project. Rachael Long-Field Crops and Pest Management Farm Advisor, and Margaret Lloyd-Small Farms Advisor are collaborators on this project. This research is funded by the California Melon Research Board.

Pest Management Strategic Plan for Processing Tomatoes

A Pest Management Strategic Plan (PMSP) is a planning document that details pest-management issues and management practices in a particular crop. There is currently no PMSP for processing tomatoes. Processing tomato growers from across California, commodity boards, UCCE Advisors and Specialists, and others will gather this spring to discuss the priority research, regulatory, and education needs for California processing tomato. The final PMSP will likely be divided by region since many of the main issues for processing tomato vary by location.

Principal investigators on this project include myself, Cassandra Swett-Field and Vegetable Crop Pathology Extension Specialist, and Tunyalee Martin-UC-IPM Associate Director for Communications. Collaborators include all UCCE Vegetable Crop Advisors working on processing tomatoes and the California Tomato Research Institute. This project is funded by the Western Integrated Pest Management Center.

Fusarium wilt and crop rotation

Cryptic hosts can pose hidden challenges for managing Fusarium wilt in tomato and other California crops

Rino Oguchi and Cassandra Swett, Dept. of Plant Pathology, UC Davis / UCCE

Diverse *Fusarium oxysporum* strains cause Fusarium wilts in various crops in California, including cantaloupe, celery, cilantro, cotton, lettuce, spinach, strawberry, tomato and watermelon. Each Fusarium wilt strain is specific to a certain host or hosts. Among the most devastating in California are Fusarium wilt of tomato, strawberry and lettuce. As these are soil-borne pathogens, management of pathogen loads in soil is critical to effective control. In the past, soil fumigation strategies effectively killed off the pathogen in the soil. However, with the loss of effective fumigants, management must rely heavily on a combination of soil treatment alternatives (eg. anerobic soil disinfestation) and cultural practices (eg. crop rotation).

Since each Fusarium wilt pathogen strain only causes disease in a limited range of hosts (eg. *Fusarium oxysporum* f. sp. *lycopersici* only causes disease in tomato) and populations can decline relatively quickly in soils (1-3 years), crop rotation is a commonly recommended management strategy to reduce pathogen loads. However, the efficacy of this approach is compromised by the fact that some rotation crops can be cryptic hosts. Cryptic hosts, sometimes referred to as symptomless or reservoir hosts, are plant species/varieties that are colonized by the pathogen but do not show symptoms. Historically, the contribution of these cryptic hosts to inoculum build up was not significant due to use of effective fumigants; with the loss of such fumigants, our attention has turned to better understanding this hidden stage of the pathogen's life.

Cash crops, cover crops and weeds can all be symptomless carriers, allowing the pathogen to colonize the tissue and accumulate in soil. Most if not all *Fusarium oxysporum* strains can establish localized root infections—the small amount of infested root tissue is not likely to make a significant contribution to pathogen persistence. However, studies have shown that some cryptic hosts can be systemically colonized—infected throughout the root system and canopy. These systemic hosts have great potential to cause harm since they allow the pathogen to accumulate in large amounts of plant tissue; following crop incorporation into soil, the fungus can survive on this tissue in the soil for at least another year. By evaluating which rotation crops are and are not systemically colonized, we can develop crop rotation recommendations that more effectively reduce pathogen loads in the soil.

A Case Study: Fusarium wilt of Tomato

Fusarium wilt of tomato is caused by *F. oxysporum* f. sp. *lycopercisi* (Fol); race 3 is the current problem race in California. Studies are ongoing in the Vegetable and Field Crop Pathology program at UC Davis to examine systemic cryptic hosts in common rotation crops representing a range of plant families. Evaluating extent of colonization allows us to determine the potential for each crop to contribute to soil inoculum. Crops that are colonized to an extent lower than tomato include grasses (rice, corn and wheat) as well as legumes (green beans and garbanzos), pepper, lettuce and a brassica (arugula)—these are all potentially low risk rotations. Sunflowers and onions are colonized at intermediate levels, and may pose a more moderate risk. Crops that are colonized at an extent similar to tomatoes (potentially high-risk crops) include cotton and cucurbit crops (pumpkin, muskmelon). Based on these results, tomato growers suffering from Fusarium wilt may perpetuate inoculum loads if they immediately rotate with cotton or cucurbits like muskmelon. Rotation with lower risk crops such as corn, pepper, and bean may be better at reducing pathogen loads.

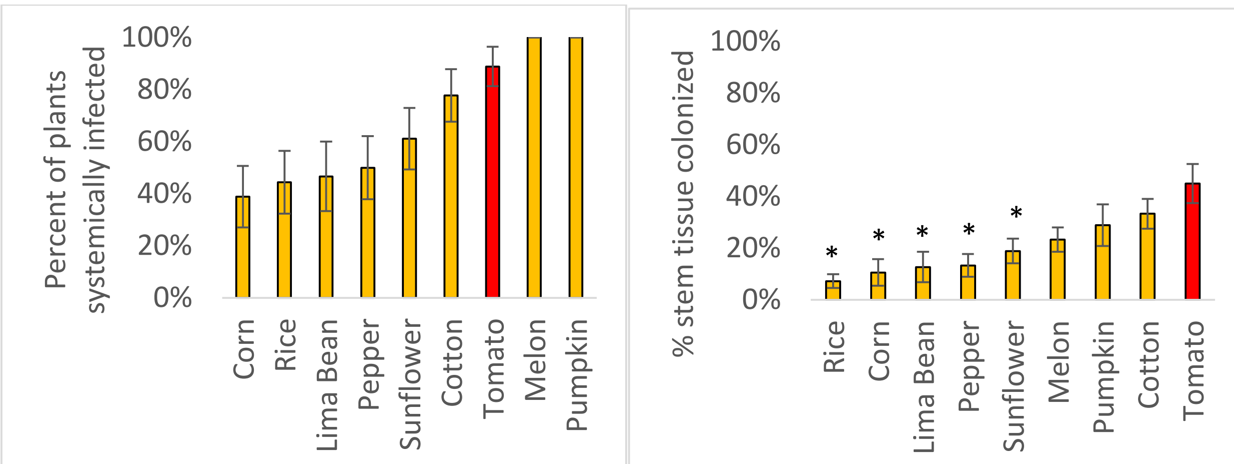


Figure 1. Warm season crops: Fol race 3 systemic colonization abilities as evaluated based on (L) percent of plants that Fol R3 colonized systemically and (R) extent of stem colonization in infected plants. *Indicates significantly less colonization than tomato.

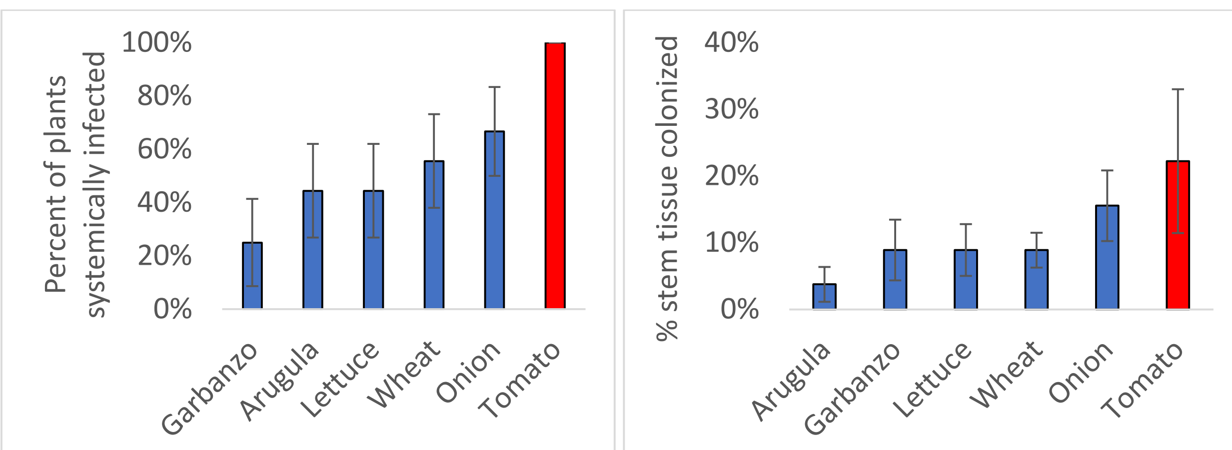


Figure 2. Cool season crops: Fol race 3 colonization abilities as evaluated based on (L) percent of plants that Fol R3 colonized systemically and (R) extent of stem colonization in infected plants.

To confirm these inferences, studies are underway to translate colonization results into resulting inoculum loads in soil. While it is important to understand which crops can host the fungus, good hosts do not necessarily lead to high pathogen loads in soil. For instance, some crops, such as those in the mustard family, are known to exude chemicals that kill fungi when incorporated into soil. There is increasing interest in using mustards such as broccoli for their bio fumigant effects; studies in Verticillium wilt of cauliflower suggest that incorporation of broccoli residue can reduce *Verticillium* microsclerotia in soil.

Figure 3. Warm season field trials evaluating Fusarium wilt of tomato pathogen loads following incorporation of infected rotation crops.

In addition to crops, previous studies of the tomato Fusarium wilt pathogen in Israel have shown that several weeds, including *Amanthus, Chenopodium, Digitaria, Malva and Oryzopsis spp.* can host the pathogen. Knowing which weeds host the pathogen can be helpful in identifying weeds to target for management, especially in organic production where weed control is often a significant challenge and economic cost.

Consistency in cryptic hosts across Fusarium wilt pathogens?

One question that is thus far unaddressed is whether there are any generalizations we can make about cryptic host ranges across Fusarium wilt pathogens. Perhaps there are some plant species or even families that are consistently poor hosts for all or most Fusarium wilt pathogens. One example is grasses—there are very few Fusarium wilt pathogens that affect grass crops; perhaps grasses are poor hosts for Fusarium wilt pathogens in general. Perhaps there are some that are consistently good hosts. It is also unclear whether systemic host status applies across all species in a given family. Although you would think so, work in tomato suggests not, since jalapeño pepper, in the same family at tomato, was a poor host. Addressing these and other questions would provide a significant asset to addressing management challenges of diverse Fusarium wilt pathogens as we enter the post-methyl bromide era of agriculture in California.

Take homes:

- With the loss of effective fumigation, rotation with non-host crops is an important component to integrated management of Fusarium wilts in various crops.
- While crop rotations can work to control Fusarium wilts, management efforts need to consider whether a given rotation crop is a cryptic (symptomless) host.
- There are many different (host specific) Fusarium wilt pathogen strains; it is not clear whether rotation crop recommendations for one Fusarium wilt pathogen are generalizable across pathogen strains.

Please feel free to contact me with any vegetable crop issues in the field, questions or comments, or to subscribe to this newsletter electronically. **<u>In 2019, crown rot, Tomato Spotted Wilt Virus, and Alfalfa Mosaic Virus plant samples are of special interest.</u>**

Amber can be contacted at the Colusa UCCE office at 530-458-0575,
by cell phone at 508-254-4490, or at acvinchesi@ucanr.edu.

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