WERA1007 - Curly Top virus Biology, Transmission, Ecology, and Management

Annual Meeting Dates: 06/18 - 6/19/2019

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**Participants:**

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Plant Pathology and Weed Science

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Jennifer Willems (Jennifer.willems@cdfa.ca.gov) - California Dept of Food and Ag/BCTV Control Program

Bill Wintermantel (bill.wintermantel@ars.usda.gov) - USDA-ARS, Salinas, CA

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**Summary of Meeting Minutes**:

 Jennifer Willems welcomed the group to the CDFA office in Clovis, CA. Rebecca Creamer explained a bit about the group and its purpose. Introductions were made, and the agenda was discussed.

Bill Wintermantel gave an overview of curly top in California. He reported on the curly top strains in tomatoes and sugarbeets in California and Idaho. He noted that new BCTV variants are emerging in California and displacing traditional forms of BCTV and suggested that the change could be due to the virtual elimination of sugarbeet cultivation in the Central Valley of CA. Since sugarbeet is a favored host of the beet leafhopper, then BCTV strains that do best on sugarbeet are found in low frequency, if at all. BCTV-Svr replicates better on sugarbeet than BCTV-Mld; while the reverse is true for tomato. BCTV mild replicates significantly better on bean and Shepherds purse than BCTV-Svr. The movement on the beet leafhopper in California can be separated into two components – long distance movement from the foothills (up to 400 miles has been reported) and localized in field movement. Mitigating factors for BCTV epidemiology in CA are the wide host range of virus and vector, the relatively high leafhopper populations most years, the abundance of uncultivated lands, and the poor stands of crops providing open areas. Disease management in sugarbeets has been improved by elimination of volunteer beets, the use of insecticides, and the use of resistant varieties.

 Jennifer Willems gave an update on the curly top problem in California and the control board management efforts. For updates on BCTV control in California, subscribe to BCTV at <http://www.cdfa.ca.gov/subscriptions/>. Plantago > peppergrass > filaree are the preferred overwintering hosts for the beet leafhopper, in that order. January and February 2019 were very rainy and thus germinated abundant grasses. There was a small BLH hatch in March and more of a drydown of the weeds in April, which led to spring spraying. Spraying is generally timed for a local population consisting of around 85% nymphs and 15% adults. Most of the spraying is done with fixed wing aircraft, with spot treatments done with a ground rig. In 2019 there was spraying of 9,815 acres out of a possible 30,000 acres, so a very minor curly top year and small acreage sprayed.

Carl Strausbaugh showed symptoms used in rating BCTV losses in sugarbeet. He presented results on the use of the neonicitinoid seed treatment for sugarbeets. Since there is currently a low to intermediate level of plant resistance to curly top, the ability to grow sugarbeets is highly reliant on neonicitinoid seed treatments. He finds good control against BCTV for 77 days using Poncho Beta, Cruise, or NipsIt. He finds a 17-20% yield increase if BCTV is present and 5% yield increase if BCTV is not present (early season control of leafminers and aphids, along with reduction of root maggots, thrips, and cutworms). Treated roots store better than untreated roots. A foliar pyrethroid treatment such as Mustang or Asana will provide at least 2 more weeks of leafhopper control and can be tank mixed with herbicides. Foliar applied pyrethroids were tested using 6 hoppers/plant with plants at 8 leaf stage for sugarbeets without any resistance. Plants were sprayed one week before leafhoppers were introduced. Truvia (stevia sugar substitute) was effective against black bean aphids. He also discussed the identification of curly top strains from Idaho and how those have changed over time. For example, in 2014, 2015, and 2016 mostly BCTV-Wor-like isolates were found infecting sugarbeets, while in 2017 around 17% CFH and CA/Logan isolates were identified and in 2018, around 50% were infected with BCTV-Wor-like and 50% with Ca/Logan. He suggested that the change in isolates could be due to the treatment of all sugarbeets with Poncho, so that the leafhoppers would likely be moving BCTV from dry beans or weeds.

 Tesneem Nusayr reported on her research that characterized the GroEL homologue produced by the beet leafhopper. The GroEl sequence can be used to separate among the former Homopteran groups. She showed through bacterial 2-hybrid and beta galactosidase production and PCR capture that the beet leafhopper GroEL binds to the curly top capsid protein, stronger than to begomovirus CP. The specificity appears to be associated with the viral capsid so that each viral capsid binds slightly differently to GroEL and other HSPs. Expressed purified GroELs from both sources had the correct structure as visualized by TEM. The GroEL and CP were found by confocal to be localized in the head at the salivary glands.

Rebecca Creamer presented information on the relative levels of curly top strains in chile and weeds from 2001 through 2015. PeYDV was detected in 2001 and 2003 with higher levels compared to BCTV-mild or BCTV-Svr NM. PeCTV was discovered in 2005 and levels have increased such that 77% of the chile tested in 2015 had PeCTV. BCTV-CO was found for the first time in 2018 on sugarbeets, while BCTV-Wor and BCTV-PeCT were found on leafhoppers. 2019 has been a very high curly top and leafhopper year thus far in New Mexico. By mid April, yellow sticky trap catches had yielded more than 1100 leafhoppers on four traps and that increased to over 2000 leafhoppers at the beginning of May and over 2500 leafhoppers at the beginning of June. 2019 will likely be the year with the largest numbers of leafhoppers in southern New Mexico since 2001 when leafhopper trapping was initiated. Curly top incidence in some commercial chile fields was already at 40-50% in early June.

 Hyoseok Lee spoke about his research modeling beet leafhopper reproductive capacity on different hosts common to CA. Reproduction temperature optima were the same on different hosts, with sugarbeet providing the highest level of reproduction of the BLH, followed by plantago, and filaree, which provided lower reproductive potential. That matches the feeding preferences found in the field also. He also spoke briefly about the merits of various trap crops for use in CA.

Christian Nansen discussed the proximal remote sensing and how it works. He explained how reflectance was used to differentiate beet leafhoppers carrying BCTV-Svr from nonviruliferous hoppers. The hoppers bodies needed to be exposed, so wings and legs were removed and the exact angle and lighting was very important. This work was recently published in Plant Pathology in May 2019.

The group discussed the status of the disease, which research topics are important for a particular location and crop, and what our key research priorities would be. The list below is presented in no particular order.

Developing and improving predictive models for each state/system. Need long term prediction models also. Will test individual leafhoppers for virus and monitor leafhopper movement at each location to help fine tune models.

 What percentage of leafhoppers are carrying curly top and what BCTV strain(s) are they carrying? Can we use the spectral analysis method to determine infectivity status for field samples. Group will plant joint project to test field collected leafhoppers by spectral analysis, then by PCR. Could send the leafhoppers back and forth in 70% EtOH. This will also allow comparisons of the BLH populations.

 Trap crops – which crops would be effective to decrease leafhopper movement?

 CDFA would like a quick easy field test for infected leafhoppers.

 What are alternatives to the insecticides used for BLH control, particularly to malathion?

 Is sugarbeet resistance to BCTV strain specific?

 Sugarbeet industry would like high throughput phenotyping, durable resistance to BCTV and novel resistance with clear markers.

Bill Wintermantel invited the group to an international Geminivirus meeting, which he and Bob Gilbertson will be hosting in Davis, CA Nov. 9-13.

There was a discussion of officers for the WERA1007 group. Carl Strausbaugh agreed to serve for another year as chairman of the group. Rebecca Creamer agreed to serve as secretary for the next year.

There was a brief discussion as to the 2020 meeting location. Carl Strausbaugh agreed to host the meeting in Kimberly, ID. The meeting date will tentatively be set for July 14 with July 15 as a field day.

**Group Accomplishments**

Collaborative curly top projects for 2018-19 were carried out among Robert Gilbertson, Christian Nansen, and Bill Wintermantel. Cooperative projects were carried out between Carl Strausbaugh, and Bill Wintermantel and between Carl Strausbaugh and Alex Karasev. Carl Strausbaugh is also currently conducting two cooperative projects with Erik Wenninger. Rebecca Creamer is currently conducting a cooperative project with Stephanie Walker.

**Impact Statement**

Curly top is an economically important disease in many states in the western U.S. Members of the WERA1007 group increased the knowledge of the virus biology, its transmission, and the management of the disease. The range of virus strains was expanded in California, Idaho, Oregon, and Mexico. The resistance to curly top in sugarbeets was assessed, aspects of the curly top virus transmission were characterized, and the use of foliar insecticides for vector control was tested. These findings should help improve the management of curly top in sugar beet and other affected crops in the western U.S.

**Publications**

The group did not publish a report together. The following curly top related publications were published during the last year:

Martinez, S., Creamer, R. Thomas, S., and Schroeder, J. 2019. Assessment of Weed/pest complexes in southern New Mexico chile fields. NMSU AES Research Report – RR794.

Nansen, C., Stewart, A. N, Gutierrez, T.A.M., Wintermantel, W.M., McRoberts, N., and Gilbertson, R.L. 2019. Proximal remote sensing to differentiate nonviruliferous and viruliferous insect vectors – proof of concept and importance of input data robustness. Plant Pathology 68: 746-754.

Strausbaugh, C.A., and Hellier, B. 2019. Beet curly top resistance in USDA-ARS Plant Introductions Lines, 2018. *Plant Dis. Manag. Rep.* 13:CF050.

Strausbaugh, C.A., and Fenwick, A. 2019. Beet curly top resistance in USDA-ARS Ft. Collins germplasm, 2018. *Plant Dis. Manag. Rep.* 13:CF051.

Strausbaugh, C.A., and Wenninger, E. 2019. Foliar insecticides for the control of curly top in Idaho sugar beet, 2018. *Plant Dis. Manag. Rep.* 13:CF052.