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

Annual Meeting Dates: 07/14/20

Report Date 07/29/2020

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**Summary of Meeting Minutes**:

Carl Strausbaugh, WERA1007 Chair, welcomed the group to the virtual meeting. Rebecca Creamer, WERA1007 Secretary, explained a bit about the group and its purpose. Introductions were made, and the agenda was discussed.

Steve Loring, NMSU ACES, gave the Administrative Advisor report. He reminded us that meeting reports are due 60 days after the meeting. He also told the group that he will be stepping out of the group and all similar advisory roles by September 1 and plans to retire at the end of the year. The new Administrative Advisor will be Sreekala Bajwa, Dean of the College of Agriculture and Agricultural Experiment Station Director at Montana State University (agdean@montana.edu).

Rebecca Creamer presented background information on curly top and the beet leafhopper with emphasis on the disease in New Mexico in chile. She discussed the history of the disease in the state, the renaming of the virus and conversion to strains. She mentioned surveys of virus strains in sugarbeets and the frequency of recombinants and host specificity of certain strains. The most common weed hosts for the beet leafhopper in New Mexico are London rocket, which serves as an overwintering host, and Kochia, which serves as an oversummering host. She discussed the problems encountered in 2019 with very high levels of leafhoppers and high incidence of curly top, and the management strategies that were successful despite the severe leafhopper/disease pressure.

Athena Kvamme presented her research on BCTV strains identified from New Mexico chile and leafhoppers (swept from Kochia) in 2019. She found more than 40% of samples were infected with BCTV-Wor or BCTV-PeCT (or mixed infections of the two strains) and smaller amounts (10%) with BCTV-PeYD, (2%) with BCTV-CO or BCTV-LH71. The leafhoppers contained only the strains found with more than 10 % infection.

Alex Karasev presented on a collaborative research on BCTV infection on potato. They inoculated Yukon Gold potatoes with cloned BCTV strains using agroinoculation. They found that primary inoculation (agroinoculation) of Cal-Logan (75%) or CFH/Severe (63%) caused symptoms on potato after 4-5 weeks, but not yield losses, while Worland and Mexican Mild did not infect or show symptoms. He found that the plants resulting from secondary infection (plants that resulted from infected tubers) showed much higher levels of infection of Cal-Logan (90%) and CFH/severe (67%) and much stronger symptoms (stunted and curled leaves) and tuber yield losses (weight of tubers/plant).

Punya Nachappa presented data on curly top infection of hemp in Colorado in 2019. Disease was identified from 11/12 counties in Colorado. Symptoms of curly top on hemp include chlorosis, curled leaves, leaf scorch, mild leaf curl, flat leaf lamina, and significant yield losses. BCTV-CO, BCTV-Mild, and BCTV-Wor or mixed infections of the strains were most prevalent in the samples and symptoms were not associated with a specific BCTV strain. Some asymptomatic plants also were infected with BCTV. Other viruses were also found infecting the plants. The beet leafhopper does not appear to be reproducing on hemp.

Akash Bajagain presented his research on the effects of mustard cover crops on disease and weeds in chile. He also monitored the effect of mustard cover crop termination on leafhopper flights. Highest biomass of mustard was found with the latest termination date (April 4), and leafhopper numbers did not increase until May. The second and third termination dates (March 17 and April 4) were effective in decreasing number of weeds.

Carl Strausbaugh reported on foliar insecticide treatments for management of curly top on sugar beets. None of the foliar insecticides tested were any better than the untreated checks. He also reported on their research to sample leafhoppers trapped from yellow sticky traps from sugarbeet and bean fields and desert areas from eight sites. Leafhoppers were highest (423) in desert areas in Elmore County in August. Leafhoppers were highest (9) in sugarbeets in Elmore County in July. Leafhoppers were highest in beans (23 and 56) in Elmore County in July and September and Canyon County (42) in August. 51% of the leafhoppers collected in July and August were BCTV positive, with 83% of the positives from Treasure Valley. 70% of the positives contained BCTV-Wor or BCTV-CO, 11% Cal-Logan, and 6% CFH (Severe). BCTV-Mild-containing leafhoppers were equally found in all three test areas (sugarbeets, beans, desert), while the 3 BCTV-Svr samples came from beans and sugarbeet, and the 6 BCTV-Cal-Logan samples came from sugarbeets. Comparing the mtCoi from the leafhoppers showed that there are two different biotypes of leafhoppers from Idaho, one of which matched the sequence from New Mexico.

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 the exact angle and lighting is very important. He requested beet leafhoppers collected by sweep net from specific plant hosts, put into 70% ethanol and sent to him. He would like to test field-collected hoppers in his system noted with location, date, and host plant.

Hyoseok Lee spoke about his research on predicting spring migration time of the beet leafhopper using satellite imagery in California. In California, overwintered beet leafhoppers migrate from the foothills to crop fields in the spring. We hypothesized vegetation conditions in the foothills trigger the spring migration. Since 2019, the spring migration of the leafhoppers was monitored at three different foothills using yellow sticky cards. For measuring the vegetation conditions, NDVI (Normalized difference vegetation index) and EVI (Enhanced vegetation index) of the foothills were calculated using satellite imagery. Field observation data were normalized and then correlated with NDVI and EVI using a Jackknife method. Weibull function was used to build a simulation model. The simulation model with EVI showed better performance than the model with NDVI. The spring migration was started when EVI values reached about 0.3. Almost all field observation data were observed within the 95% confidence interval of the simulation model output. The simulation model will be used to build a leafhopper migration alert system.

Erik Lehnhoff discussed a recently published prediction model for beet leafhopper populations based on November and December rainfall for southern New Mexico. The best correlation was for April 16-30, May 16-31, and June 1-15. The leafhopper numbers for the end of April and May were very good for predicting the total numbers of leafhoppers for the entire system.

Bill Wintermantel gave a brief overview of his collaborative research with Bob Gilbertson, UC Davis, to sequence the genome of the beet leafhopper. He has also acquired transcriptome information as it relates to transmission, including different hosts and different time points, and gene pathways. They are developing a draft genome sequence using Oxford Nanopore and are now doing a PacBio long read sequence for a female beet leafhopper because the females are more likely to migrate.

Various participants presented field perspectives from different states.

Lauren Murphy briefly talked about the CDFA Curly top Control survey and spray efforts for 2020. Spraying of the foothills began early this year in late February in Kings Co. and continued to Fresno in early March, and later than usual in Kern Co. in end of April. There has not been a lot of curly top this year. The late rains may have played a role in the low virus overall.

Carl Strausbaugh commented on the unusual weather in Idaho, which included a much wetter and windier May and June, and very focused rainfall. The desert is still quite green and few grasses have even begun to dry down and hopper flights are late.

Punya Nachappa talked about collecting leafhoppers from the western slope of Colorado and around Fort Collins. Judith Chiginsky has not found curly top in kochia, but has found it in sugarbeets and hemp. Ana Christina Fulladolsa expects to see symptoms on hemp in late July and August based on last year’s experience. She has not found any correlation of virus symptoms with hemp variety.

Carrie Wohleb operates an area-wide insect monitoring system for potatoes in the Coumbia Basin of Washington. In 2020 she found peaks in the beet leafhopper populations June 5 and June 19 in the Hanford Reach National Monument area of south central Washington. She mentioned that curly top has been seen in pinto bean and specialty seed crops such as coriander. Her previous largest leafhopper year was in 2013. 2020 was also an early year for leafhoppers. She had a large number of leafhoppers in August 2019 and a large amount of Russian thistle. She guessed that 2020 will be a moderately bad curly top year.

Can we predict leafhoppers populations based on spikes in late fall leafhopper numbers? What factors influence a large fall leafhopper population? Carl found a large number of leafhoppers in Idaho in fall 2019 that correlated with dry down of weeds. However, Idaho had a strong cold snap that likely killed everything in October and little rain afterwards.

Research Priorities and Ideas

-Alternatives to neonicitinoid seed treatments

-Novel sources of disease resistance

-Need centralized database for leafhopper trapping results. Sweeps or sticky traps? Include the size of sticky card? What height or placement and direction of card? Dates and locations? Host plants for sweeps?

-Silvia Rondon suggested looking at green bridge, what are the overwintering sources, beet leafhopper movement in the landscape.

-Imad Eujayl wants colonies of leafhoppers that carry single virus strains to use for strain specific resistance testing.

-Christian would like to have a shared leafhopper resource information database. It would include who has colonies, whether the colonies are carrying curly top or not and what strain(s) are present.

- Christian has healthy and BCTV-Svr-infected leafhopper colonies.

- Imad and Carl have infected colonies with mixtures of 3 strains. BCTV-Svr (CFH), Cal-Logan, and smaller amounts of BCTV-Wor and BCTV-CO.

- Punya Nachappa has a matched set of Idaho leafhopper colonies with and without BCTV-Svr virus and field collected hoppers from Colorado that are likely virus-free.

There were several suggestions as to the host plants that would allow multiple virus strains to remain in a population. Rebecca suggested adding weeds such as Kochia or London rocket to colonies. Tesneem Nusayr suggested using spinach.

Punya Nachappa suggested that the WERA1007 group should apply for an SCRI (Specialty Crop Research Initiative) CAP (Coordinated Agriculture Projects) grant for one of the crops that is a problem for curly top, such as peppers, tomatoes, beans or other specialty crops. Christian was supportive of the idea.

Hyoseok Lee would like historical data or field observation data on leafhopper data, sticky cards and sweeps data, GPS location, date, and numbers of leafhoppers collected.

Tesneem Nusayr and Imad Eujayl are looking for uninfected beet leafhoppers that are growing on sugarbeets.

Zach Bagley offered a support letter for anyone writing a SCBG on tomatoes from the California Tomato Research Institute.

There was a brief discussion as to the 2021 meeting location. Carl Strausbaugh agreed to host the meeting in Kimberly, ID. The meeting date will tentatively be set for a hybrid meeting (online/in person) on Tuesday July 13, 2021 with July 14 as a field day/nursery tour.

WERA1007 will need to be renewed. The renewal is due by January 15. These projects run for 5 years. Carl Strausbaugh, Christian Nansen, and Punya Nachappa will help with the renewal process.

Carl Strausbaugh will serve for another year as chairman of the group. Rebecca Creamer will serve as secretary for the next year.