2025 Industry-ARS Meeting Breakout Sessions

Table of Contents

Cercospora & Abiotic Stresses Breakout Session **2**

Agenda 2

Supplemental Graphs 3

Notes 4

Root Diseases Breakout Session **6**

Agenda 6

Supplemental Graphs 7

Notes 10

Viral Diseases Breakout Session **14**

Agenda 14

Supplemental Graphs 15

Notes 18

Storage Breakout Session **20**

Agenda 20

Supplemental Graphs 21

Notes 22

Processing Breakout Session **24**

Notes 24

Agenda
2025 Industry – ARS Meeting
Cercospora & Abiotic Stresses Breakout Session, 10:20-11:00am: Beacon A
Moderator: Dr. Linda Hanson (USDA-ARS E. Lansing); Note-taker: Dr. Mike Metzger (MDFC)

Focus Questions

A. Are industry needs aligned with USDA-ARS research? Gaps?
B. What tools/technologies/solutions can be utilized to address these issues?

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1. **Overview of Cercospora since 2023 (25 min.)**
    - Cooperatives:
        - Challenges/successes, CR+ genetics
    - ARS:
        - Discussion on current/future projects or research ideas.

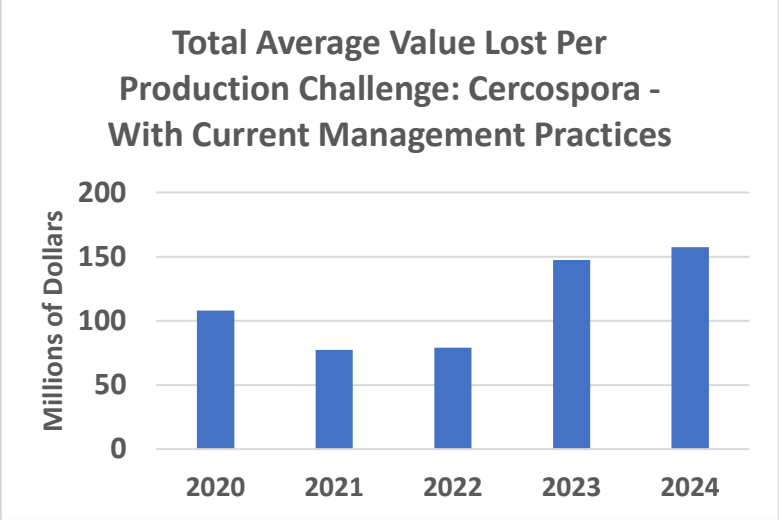
2. **Leaf spot pictures & symptoms**
    - L. Hanson – Provide a document with photos and a description of symptoms.
        - Cercospora, Anthracnose, Alternaria, CR+, etc.

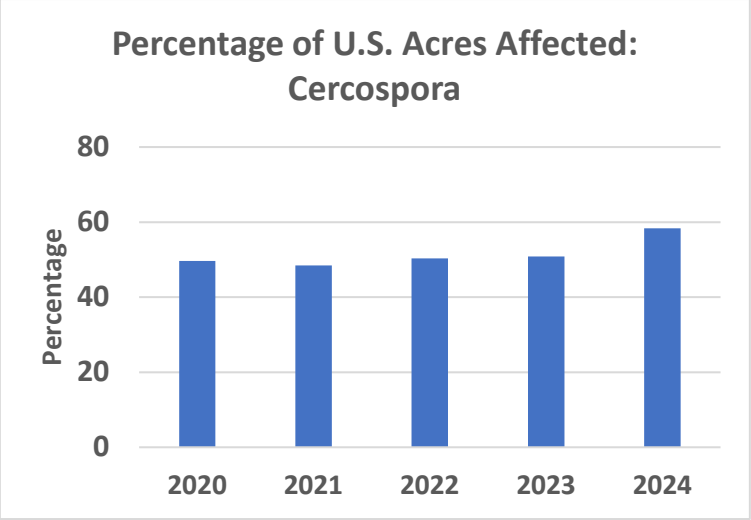
3. **Abiotic Stresses (10-15 min)**
    - Industry input/needs
        - Heat/Drought/Sand Syndrome
        - Frost/Excess Water
        - Nitrogen Use Efficiency (NUE)
        - Other?

4. **Additional (if time)**
    - Alternaria

BSDF Production Challenges Survey Data (5 yr.)
Cercospora & Abiotic Stresses

Cercospora





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Abiotic Stresses

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NOTES

Cercospora and Abiotic Stress Breakout Session

Each company went through the 'State of the Union' regarding CLS in their respective areas:

SMBSC – Plants roughly 70 CR+ / 30 traditional genetics. They need 5 fungicide applications to keep the fields green season-long. The 2024 season had a little 'slippage' towards the end. As a result, the 2025 season is anticipated to have a spray program with 'tighter' spray windows.

Amalgamated – Plants roughly 25% CR+ mainly concentrated in the western growing areas. They sometimes feel that they are their own worst enemy when it comes to irrigation and creating an environment conducive to disease development. It was noted that the CR+ genetics are seeing a lot of powdery mildew infection.

ACSC & MDFC – Growers are spraying earlier than they ever have. Both companies have programs with rotating modes of action. Everything is tank mixed and is generally a blend between systemic and protectant. Each company's 2025 program will focus on tighter spray intervals. 70% of the acres are CR+ at ACSC and 100% of the acres are CR+ at MDFC.

Question – What are the research needs of the industry? What are the gaps?

Dr. Secor noted that he believes the industry needs to take a look at the model we utilize for disease forecasting, as the current model is outdated. Once an 'industry-wide' base model is established, you will need to optimize the parameters for each individual growing region. Secor also commented on the intense collaboration in the Red River Valley between the USDA, industry, and university personnel – There is a group that meets at the 'Bison Turf' in Fargo, ND, each Wednesday for "Beer and Beets."

Questions – What type of modeling does each area use? First spots? Sporulation? Environmental factors?

Michigan is doing field valuations with their Beet Cast System and uses this model extensively.

Coops in the Red River Valley continue to use the NDAWN-based forecast system. Drs. Wyatt and Branch will be looking a re-evaluation of the economic thresholds used in the NDAWN forecasting model.

Are growers looking at alternatives to tillage?

Michigan is looking at the heat treatment on strip till acres (their thought is that would be close to/or as effective as burying spores). A propane-fueled leaf burner is being used as their heat source for the project.

The USDA-ARS in Fargo is experimenting with treating the residue with hot water (50 degrees C is enough to kill the pathogen).

Are there any good methods for quantifying inoculum in the soil?

All agreed that most of the research has been on the residue itself and then extrapolated to the amount/survivability in the soil…

SMBSC has tried copper as a 'layby fungicide application' with varying levels of success. Dr. Chanda (UMN) thought it could delay disease development by two weeks based on their research.

Discussion ensued surrounding the use of a "Top Saver" to remove the infected residue that would overwinter and if there is or would be a correlation to disease reduction? It was pointed out that this practice isn't as common as it used to be since EBDC-treated material cannot be fed to dairy cattle.

There is a little work being done by Dr. Secor's lab to evaluate the stromata survivability in the soil with respect to light. They have determined that light promotes sporulation (i.e., snow melting in the spring exposing soil). It was noted that research has been done on wavelength of light that promotes sporulation. It was also noted that their spore traps have 'caught' CLS spores as early as February during an open winter. This begs the question of what temps CLS sporulates AND at what temperature in the field can they cause infection. It has been found to sporulate at 4 degrees C in the fridge…it takes longer but it does happen.

Discussion ensued as to whether or not the 'local' CLS isolates adapt to their regional environment.

Dr. Hanson reported that they are seeing some different shapes/sizes of CLS on leaves in Michigan….up to ¾" in diameter.

There wasn't any time to discuss Abiotic Stress. Dr. Naegle is looking at various aspects of nutrient use / cold tolerance / etc. during periods where the sugarbeet is experiencing during different forms of abiotic stress.

Agenda
2025 Industry – ARS Meeting
Root Diseases Breakout, 9:20-10:00am: Beacon B

Rhizoctonia, Aphanomyces, Nematodes
Mark Bloomquist (moderator) & Kevin Dorn (note-taker)

Focus Questions

A. Are Industry needs aligned with USDA-ARS research? Gaps?
B. What tools/technologies/solutions can be utilized to address these issues?

Total time: 40 min.

1. **Rhizoctonia (20 min)**
   - **Current USDA-ARS Research Overview (~3-4 min.)**
     High-level station overview
     - Rhizoctonia research objectives, disease nurseries (CWR screening), technologies and tools utilized
   - **Industry Comments**
     - BSDF Production Challenges Survey
     - Cooperatives: Do we have a handle on Rhizoctonia? Gaps? Future focus?
   - **Other**

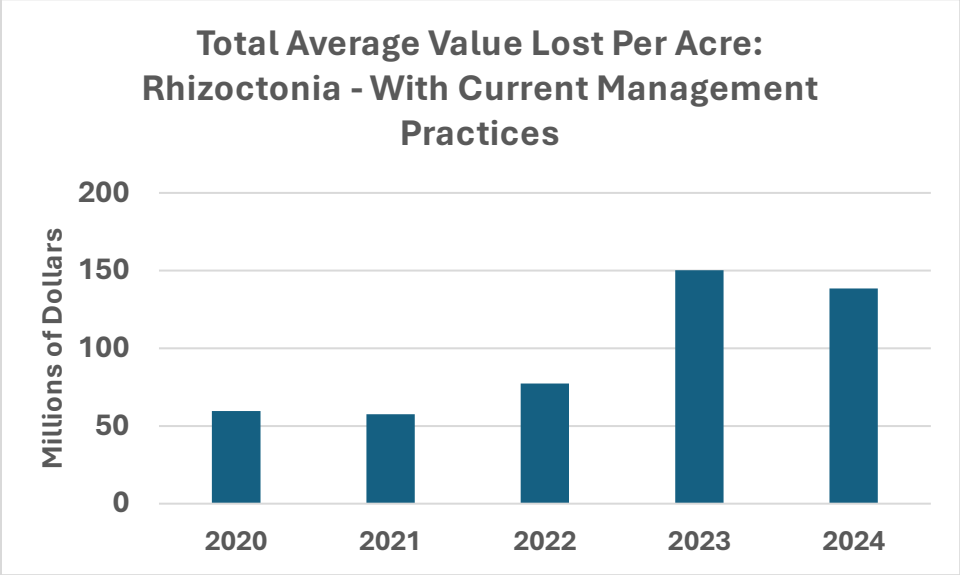
2. **Aphanomyces (10 min…could go longer if good discussion)**
   - **USDA-ARS perspective**
     - Current collaborations with USDA-ARS on Aphanomyces.
   - **Industry perspective**
     - Production Challenges Survey
     - Cooperatives: Do we have a handle on Aphanomyces? Gaps? Future focus?
   - **Seed company perspective**
     - Are industry needs aligned with ARS portfolio? Does ARS need to scale up CWR screening for Aph resistance or other biotech approaches?
   - **Other**

3. **Nematodes (10 min)**
   - **Industry perspective**
     - Cooperatives: Do we have a handle on SBCN? What about others (e.g., stubby root)? Areas of focus, e.g., greenhouse screens (CWR), continue working on resistance gene, understanding the pathology of nematodes, etc.
   - **USDA-ARS**
     - Currently, there is no active USDA-ARS program work. Does there need to be further efforts on NT research?
       - Fort Collins, Fargo, Beltsville, other?
   - **Other**

BSDF Production Challenges Survey Data (5 yr.)

Rhizoctonia, Aphanomyces, and Nematodes

Rhizoctonia



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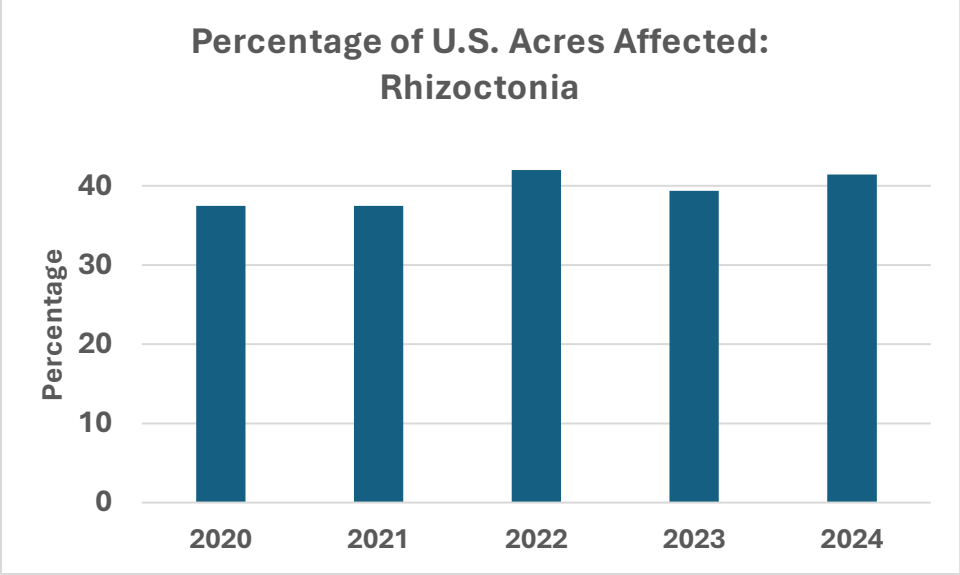
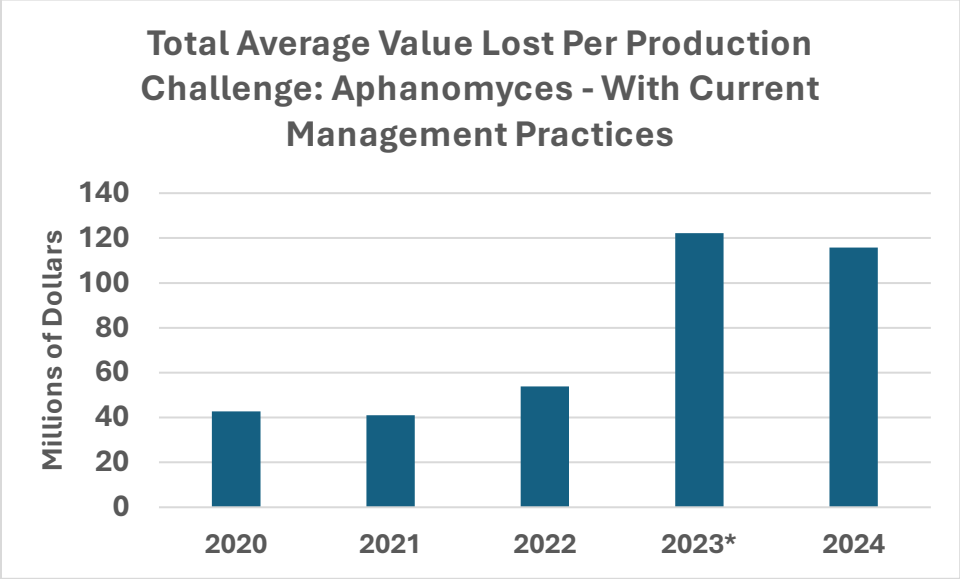


Aphanomyces



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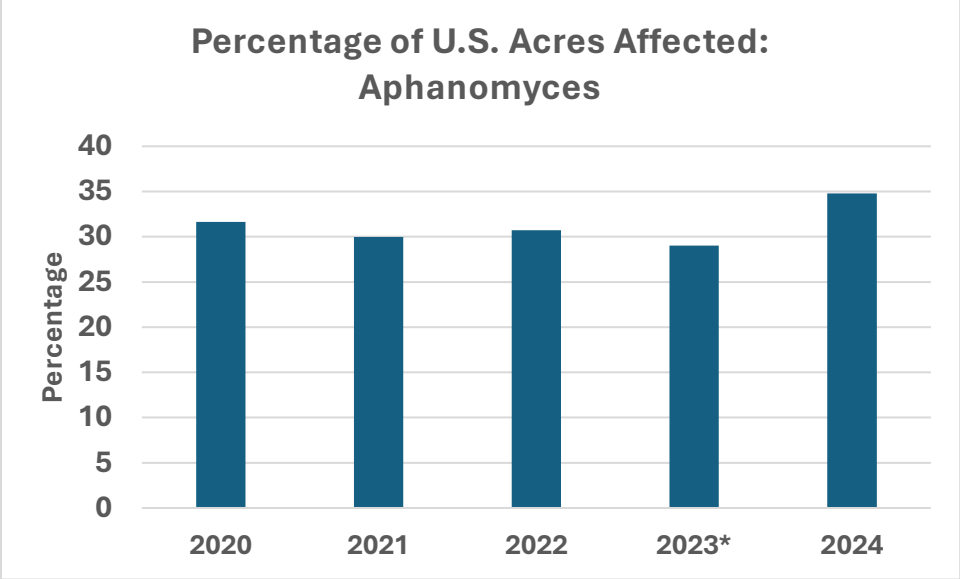
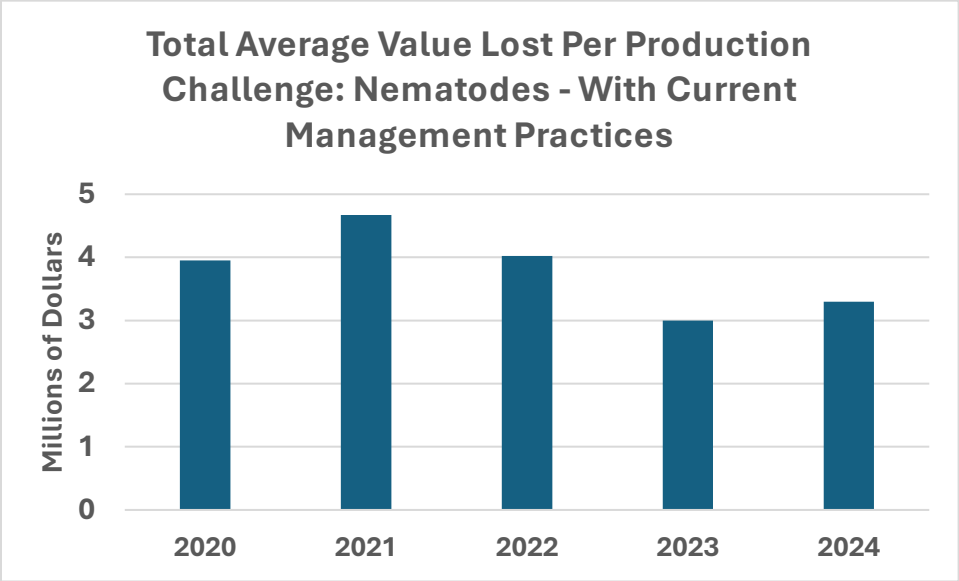


Nematodes



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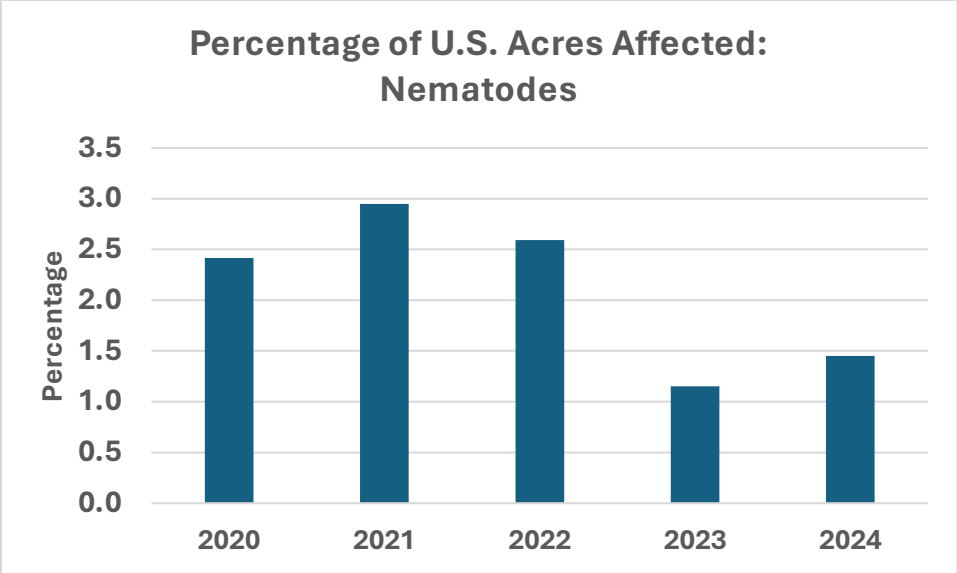


NOTES

Root Diseases Breakout Session

1. **Rhizoctonia**
   - **Current USDA-ARS Research Overview** – Rhizoctonia research objectives, disease nurseries (CWR screening), technologies and tools utilized:
     - Kevin Dorn (USDA-ARS, Colorado): Discussed Fort Collins, Colorado pre-breeding program, with renewed focus on identifying and introgressing Rhizoctonia resistance from secondary and tertiary crop wild relatives (CWRs). Discussed genetic mapping projects of Rhizoctonia resistance from 'old' Fort Collins germplasm releases (ex. FC709-2), which is needed to differentiate between 'old' and 'new' resistance. Finally, discussed a project focusing on the development of hyperspectral phenotyping for above ground high throughput Rhizoctonia rating.
     - Raj Majumdar (USDA-ARS, Idaho): Discussed project utilizing seed treatment to provide protection against Rhizoctonia. Seed treatment product is a pigment with antimicrobial properties (derived from bacteria). Currently working with a startup company (via SBIR program) that can produce this chemical inexpensively. Seed treatment drops infection by 29% at seedling phase. Also discussed stable transformation pipeline to generate CRISPRi to test gene function. Currently testing CRISPRi lines in the F2 stage.
     - Eric Vincill (USDA-ARS, Idaho): *B. maritima* accessions with good resistance have been back crossed those into high sucrose lines for future germplasm release. Discussed impact of Carl Strausbaugh's retirement from USDA-ARS. The status of the traditional Rhizoctonia nursery in Idaho is currently unclear due to recent layoffs
     - Linda Hanson (USDA-ARS, Michigan): Discussed genetic diversity of Rhizoctonia (Example: subgroups AG2-2IIB and AG4 not genetically supported and has recently paper submitted on this topic). Discussed the Rhizoctonia disease nursery (commercial, wild, breeding) in East Lansing. Currently, non-Roundup-ready nursery has limited capacity due to staffing shortages. Also working on Rhizoctonia as a seedling pathogen, as adult plant versus seedling resistance is genetically different. USDA-ARS East Lansing has released germplasm with resistance to seedling Rhizoctonia.
     - Rachel Naegele (USDA-ARS, Michigan): Explained overarching goals of genomic selection project funded through the Sustainable Sugar Beet Research Initiative (SSBRI).
   - **Industry Comments**
     - BSDF Production Challenges Survey – Rhizoc
       - Mark Bloomquist explained the production challenges survey handout.
     - Cooperatives: Do we have a handle on Rhizoctonia? Gaps? Future focus?
       - Mike Metzger (Minn-Dak): Discussed that Rhizoctonia wasn't a big issue 25 years ago, and pressure was restricted to small pockets. After the introduction of Roundup-Ready genetics, Minn-Dak started noticing

Rhizoctonia pressures across the Minn-Dak acreage. Speculation that varieties with the Roundup-Ready trait didn't have Rhizoctonia resistance package at that point. Currently, Rhizoctonia negatively affects yield on 2/3 of acres. Minn-Dak increased the resistance ratings required to approve a variety.

- Clay Altepeter (American Crystal): 78% of acres treated with fungicide. In 2016, Rhizoctonia pressure was quite severe due to environmental conditions. Currently, Rhizoctonia pressure is well managed with a combination of fungicides and planting of resistant varieties. Noted that Rhizoctonia symptoms are generally root rot, but not crown rot. Noted that disease pressure is most severe in Moorhead, Minnesota, and reduces going north, as the soil types transition to higher clay content.
- Corey Guza (Michigan Sugar): Noted similar concerns and comments as previous companies. Rhizoctonia has not been a huge issue in past few years with use of fungicides and resistant varieties currently available. Noted that research on plant/disease interactions is a critical need.
- Craig Spencer (Western Sugar): Discussed current management strategy revolving around use of Rhizoctonia resistant varieties and encouraging use of the appropriate fungicides. Noted that management is fairly good with current protections.
- Greg Dean (Amalgamated Sugar): Noted that Rhizoctonia is present, and that severity of disease pressure seems to be driven by favorable environmental conditions for the pathogen. Acreage is irrigated, so moisture is usually sufficient for increased disease pressure. Discussed that timing of fungicide application is critical for disease management (early vs. row closure).
- Jacob Bullinger (Wyoming Sugar), answers read by Mark Bloomquist: Present on 100% of acreage. Most growers apply Quadris at 4-6 leaf stage. Largest concern regarding Rhizoctonia is the storability of diseased roots and its impact on pile and downstream processing.
- Mark Bloomquist (Southern Minnesota): 100% of acres planted with seed treatment. Growers applying furrow or post emerge. ½ acres planted to 'Rhizoctonia resistant specialty variety'. Almost always follow corn in rotation, which continues to build Rhizoctonia pressure over time.

2. **Aphanomyces**
   - **USDA-ARS perspective** – Current collaborations with USDA-ARS on Aphanomyces.
     - Ashok Chanda (University of Minnesota): Discussed Aphanomyces resistance mapping project by PhD student Samantha Rude in collaboration with Cory Hirsch (University of Minnesota and Kevin Dorn (USDA-ARS, Colorado)). Project consisted of screening 106 pre-breeding lines to identify resistance, followed by extreme phenotype pooling and sequencing. Also discussed diagnostics for identifying Aphanomyces from soil or plant samples. Chanda Lab also maintains collection of Aphanomyces samples dating to the 1980s, is examining genetic

diversity for 50 different isolates and also developed an Aphanomyces reference genome. His program also runs an Aphanomyces nursery for cooperatives.
    - Linda Hanson (USDA-ARS, Michigan): Noted that no Aphanomyces research is taking place in East Lansing, at either USDA-ARS or Michigan State University.
- **Industry perspective**
    - Cooperatives: Do we have a handle on Aphanomyces? Gaps? Future focus?
        - Amalgamated Sugar: Disease pressure in some years is significant, some years the pathogen is "just there" with little impact.
        - Western Sugar: Pressure exists in different areas across regions and seems to be environmentally dependent. If it is a very wet year, disease pressure is substantial.
        - Michigan Sugar: Currently seeing a reduction in seedling loss due to Aphanomyces compared to past years. Aphanomyces was a severe issue 15 years ago, but less so now.
        - American Crystal: Pressure is falling in Red River Valley. Noted that where there is Rhizoctonia pressure, there is also Aphanomyces pressure. Currently managing Aphamomyces pressure using seed treatments and resistant genetics. Moving the variety resistance requirement to demand stronger plant resistance. Also noted that the application of spent lime is used to help control pressure.
        - Minn-Dak: Noted similar trends as other regions. Less than 5% of acreage is planted to seed treated with Tachigaren. Aphanomyces is not as serious of an issue compared to prior years.
        - Wyoming: Aphanomyces pressure is usually not present, however, if there is pressure that land had had some sort of previous event.
        - Southern Minnesota: Utilizes Tachigaren application. Noted that excessive moisture does cause notably heavy Aphanomyces pressure.

- **Seed company perspective**
    - Are industry needs aligned with ARS portfolio? Does ARS need to scale up CWR screening for Aph resistance or other biotech approaches?
        - Jens Lein (KWS): Noted that company has both Aphanomyces and Rhizoctonia specific breeding programs for each disease.
        - Patrick O'Boyle (Betaseed): Noted company has Aphanomyces nursery in Shakopee, Minnesota and Rhizoctonia nursery in Kimberly, Idaho.
    - The use of rotation to control Aphanomyces was discussed, noting that a longer rotation between land being planted to beets is better for controlling Aphanomyces pressure.

3. **Nematodes**
    - **Industry perspective**
        - Cooperatives: Do we have a handle on SBCN? What about others (e.g., stubby root)? Areas of focus, e.g., greenhouse screens (CWR), continue working on resistance gene, understanding the pathology of nematodes, etc.

    - Southern Minnesota: No nematode issue
    - Michigan Sugar: 60-70% impacted by nematodes. In some fields, nematode pressure is so severe growers cannot even grow beets. Seed treatments and cover crops are used for management.
    - Speckels: SBCN is not a major pressure, noting that crop rotation is critical for controlling SBCN
    - Amalgamated: SBCN main issue, root knot nematode is also a concern. Currently expanding testing program. SBCN tolerant varieties are working well.
    - Western: Varieties for last 10 years seem to be controlling nematode issue.
    - American Crystal: Nematode pressure currently not present. Some other nematodes also present that can cause some minor issues.
- **USDA-ARS**
  - Currently, there is no active USDA-ARS program work. Does there need to be further efforts on NT research?
    - Vincent Klink (USDA-ARS, Maryland): Discussed his previous work on laser dissection transcriptomics (in soybean), as well as his previous work using transgenic methods to test candidate genes.

Agenda
2025 Industry – ARS Meeting
Viral Diseases Breakout Session, 9:20-10:00am: Beacon A

Moderator: Dr. Vanitha Ramachandran (USDA-ARS, Fargo, ND)
Note taker: Isaac Courneya (USDA-ARS, Fargo, ND)

Discussion focus:

1) Current management & future concerns/needs

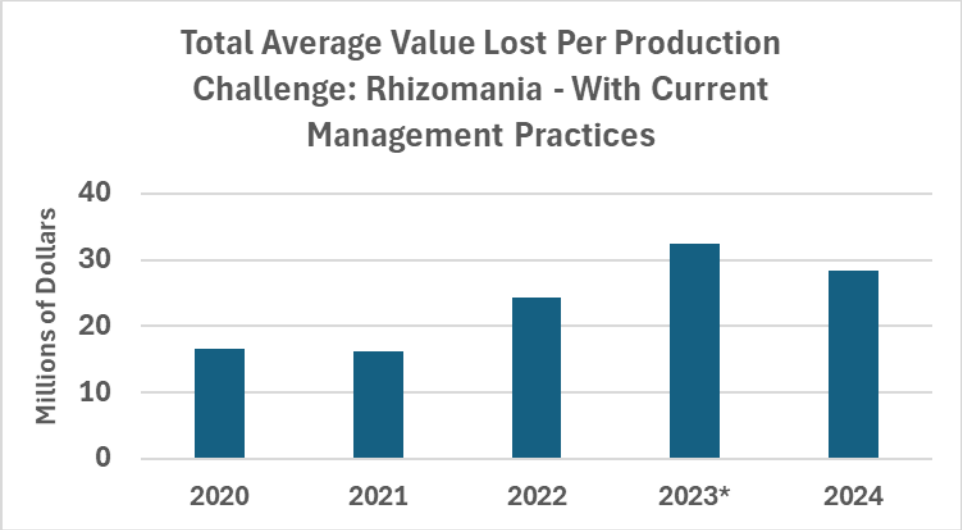
Presenters: 2-3 mins for each. Total time = 40 mins max

1. **Virus Yellows**
    - **European Perspective**
        - Britt-Louise Lennefors (United Beet Seeds, Sweden, Europe)
    - **U.S. Perspective**
        - Oliver Neher (Amalgamated Sugar Company, USA)
2. **Rhizomania**
    - **European Perspective**
        - Britt-Louise Lennefors (United Beet Seeds, Sweden, Europe)
    - **U.S. Perspective**
        - Joe Hastings (American Crystal Sugar Company, USA)
        - David Mettler (Southern MN Beet Sugar Cooperative, USA)
        - Mark Bjornstead (Western Sugar Cooperative, USA)
        - Oliver Neher (Amalgamated Sugar Company, USA)
    - **USDA-ARS Research**
        - Vanitha Ramachandran (USDA-ARS, Fargo, USA)
            - Resistance-breaking
            - Management strategies (RNAi & gene editing)
3. **Curly Top**
    - **U.S. Perspective**
        - Oliver Neher (Amalgamated Sugar Company, USA)
    - **USDA-ARS Research**
        - Vanitha Ramachandran, BCTV Research at Fargo
        - Rajtilak Majumdar, BCTV Research at Kimberly
4. **Emerging Viruses:** Vanitha Ramachandran, USDA-ARS, Fargo, USA

BSDF Production Challenges Survey Data:

Rhizomania, Curly Top, Aphids (Root & Black Bean)

Rhizomania



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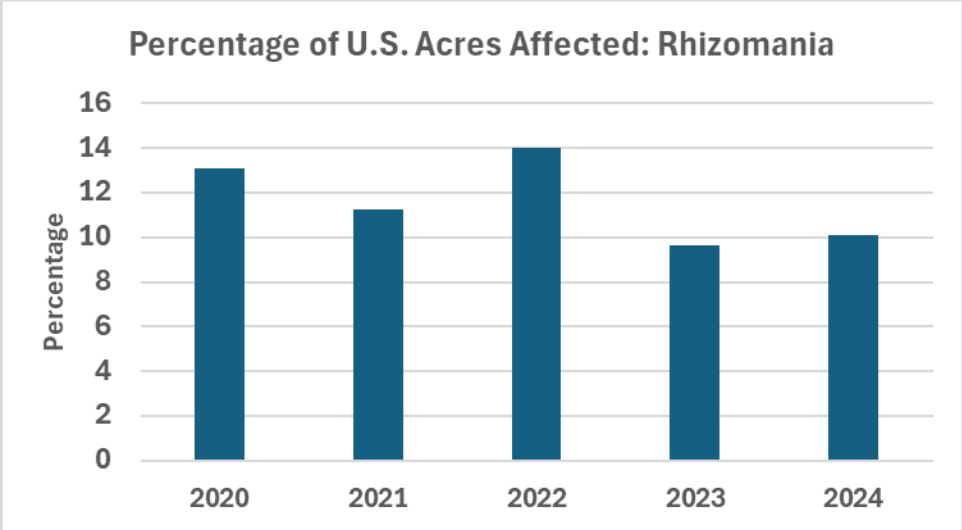
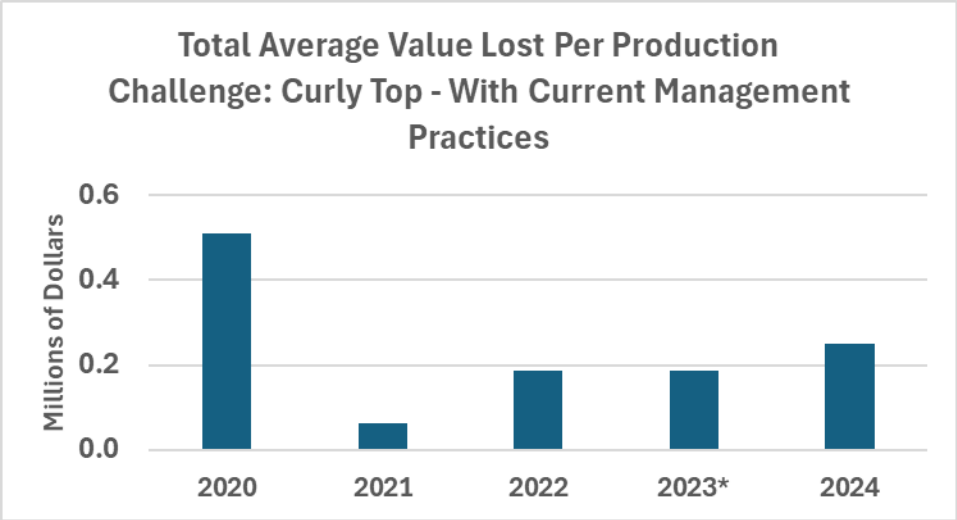


Curly Top



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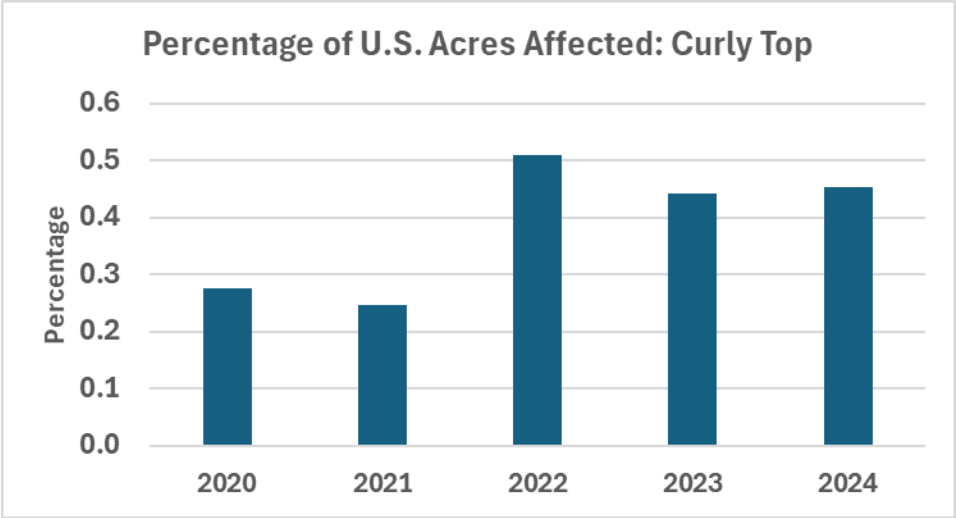
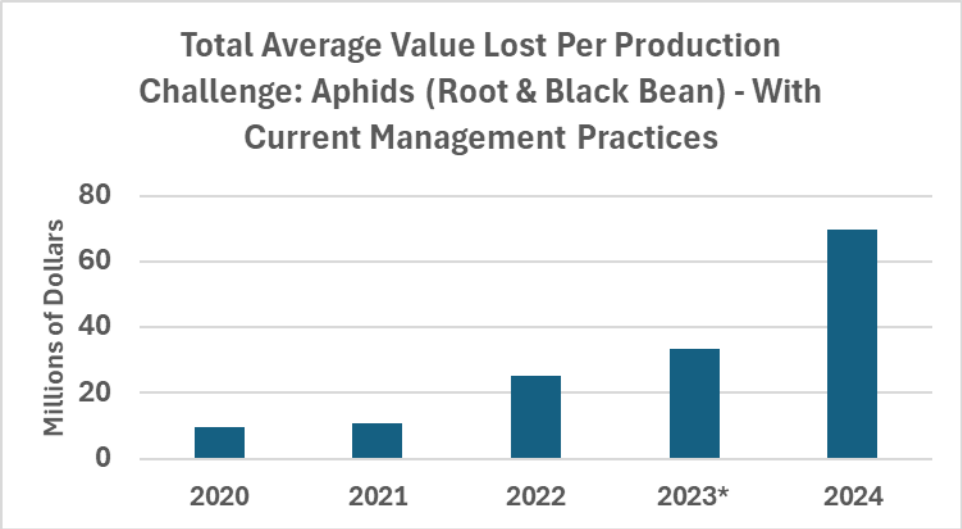


Aphids (Root & Black Bean)



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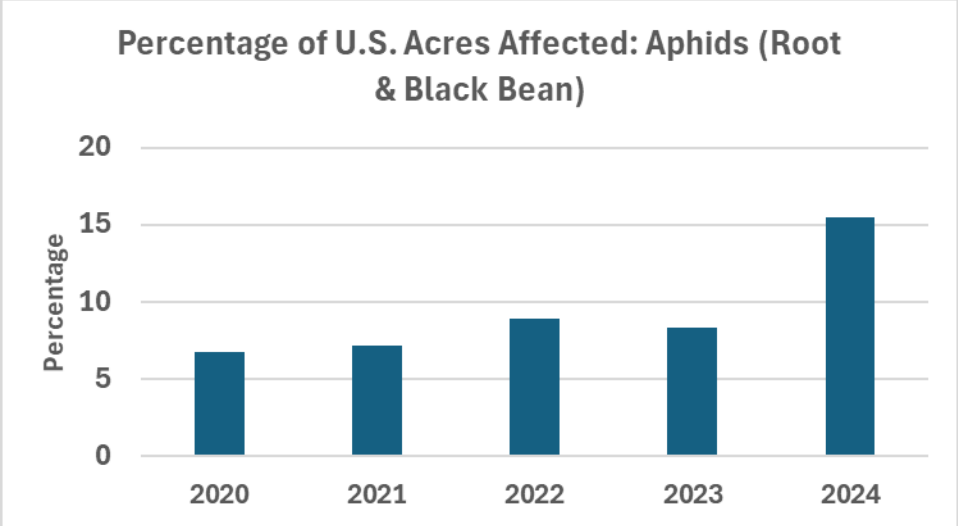


NOTES

Viral Diseases Breakout Session

Discussion focus: Current management & future concerns/needs

In this section, we have discussed three major viral diseases of sugarbeet have an impact on sugarbeet productivity: Rhizomania, Curly top, and Virus Yellows Complex. We have covered European and U.S. perspectives of each one the diseases. In the previous ASSBT meeting (2023), there was a discussion that stakeholders can bring in real needs if they were informed in advance. Hence, for the 2025 session, we beforehand reached out to stakeholders, so that they have time to prepare and represent their needs at the Viral Diseases breakout session.

Virus Yellows Disease:

European Perspective (Britt-Louise Lennefors, United Beet Seeds, Sweden).
In Europe, the virus yellows disease is caused by a mix of viruses (Beet Yellows Complex). Minor outbreaks of virus yellows last year, unlike in 2020. With the loss of neonicotinoids new products and strategies are tested, however, nothing can be equivalent to Neonics. Possibly new chemicals are coming for the future.
U.S. Perspective (Oliver Neher, Amalgamated Sugar Company, Idaho)
In Idaho, virus yellows cause minor damage. Worried about losing neonics.

Rhizomania Disease:

European Perspective (Britt-Louise Lennefors)
Rhizomania exists in most countries in Europe. Resistant strains are not spreading too much, under control by variety.
U.S. Perspective
Joe Hastings (American Crystal Sugar Company): Varietal resistance is keeping up. Keep watching for blinkers and Rz1-breaking about 33% in 2024 samples that were suspected for rhizomania.
David Mettler (Southern MN Beet Sugar Cooperative): Symptoms of rhizomania are being observed as scattered patches of rhizomania but not spreading. Worried about spreading in the future. Continuing to monitor.
Mark Bjornstead (Western Sugar Cooperative): Very little problem. Only seen occasional blinkers. Rz1 minimum requirement for planting.
Oliver Neher (Amalgamated Sugar Company): Strong rhizomania, varieties with Rz1+Rz2 or Rz1+helper genes are required for approval and planting. Areas with excessive irrigation can be problematic. Seeing more symptoms of rhizomania potentially due to the reduction of nitrogen fertilizers.

USDA-ARS Research (Vanitha Ramachandran, USDA-ARS, Fargo): Appearance of rhizomania symptoms indicates the appearance of resistance-breaking strains of beet necrotic yellow vein virus. USDA-ARS has initiated research on RNAi and gene editing to develop new management strategies to manage rhizomania. Rhizomania resistance-breaking is evaluated in soil-baiting assays using susceptible, Rz1, and Rz1+Rz2 genotypes, and potential resistance-breaking samples are subjected to next generation sequencing. As of now, we have rhizomania data for about four years across various sugarbeet growing areas of the U.S.

Curly Top Disease:

U.S. Perspective (Oliver Neher, Amalgamated Sugar Company)

About 200,000 to 220,000 acres are being threatened in ID, OR, CO and WY by curly top. Early season infection can lead to increased disease severity, but neonics still provide control. Mid-to-late season infection is of minor concern since plants are protected by genetic tolerance. Infection rates depend on virus load and leafhopper incidence. In collaboration with USDA-ARS Fargo, will be conducting a disease survey. Also, will be testing potato leafhoppers. Further, we have the plan for testing phytoplasma presence in 2025 samples, since leafhoppers can transmit phytoplasma in addition to viruses.

USDA-ARS Research

Vanitha Ramachandran, BCTV Research at Fargo

Conducting thorough survey to monitor curly top disease occurrence in sugarbeet, beet leafhopper incidences, and analyses of potato leafhoppers as well testing for beet curly top virus (BCTV) in Idaho in collaboration with Oliver Neher. Curly top survey and monitoring for BCTV strains has been started in the sugarbeet growing fields of the Imperial Vally of California in collaboration with Mark Bloomquist. Identification of strains of BCTV is important for exerting RNAi and CRISPRi-based technologies to specifically target the virus.

Rajtilak Majumdar, BCTV Research at Kimberly

Genetics, new double haploid lines, and mapping QTL-based new sources will be released. Targeting the beet leafhoppers and virus using CRISPRi has potential. Looking at the microbiome can be another source. Dry beans are a new source for tolerance genes. Testing of foliar application of jasmonic acid and nanoparticles for the control of BCTV.

Emerging Viruses: Vanitha Ramachandran, USDA-ARS, Fargo, USA

We perform high-throughput sequencing to identify virome of plants that have symptoms resembling virus diseases.

Agenda
2025 Industry – ARS Meeting
Storage Breakout Session, 10:20-11:00am: Beacon B

Moderator: Dr. Karen Fugate (USDA-ARS Fargo); Note-taker: Spencer Roth (ACSC)

Focus Questions

1) Are Industry needs aligned with USDA-ARS research? Gaps?
2) What tools/technologies/solutions can be utilized to address these issues?

Discussion of Different Aspects of Storage

Genetics

- Research on genetics associated with improved storage?

Harvest Damage

- Cell wall thickness/turgor
    - Creating a "tougher" beet to resist harvest damages.
- Beet Handling

Soil

- Continue research into soilborne influences on beets?

Respiration impacts of different harvesters.

- Tested in Europe, results unknown.

Can the balance of scalping benefits be pinpointed?

- Stand establishment?
- Varietal differences?
- Size, shape, height out of ground all impact consistency.

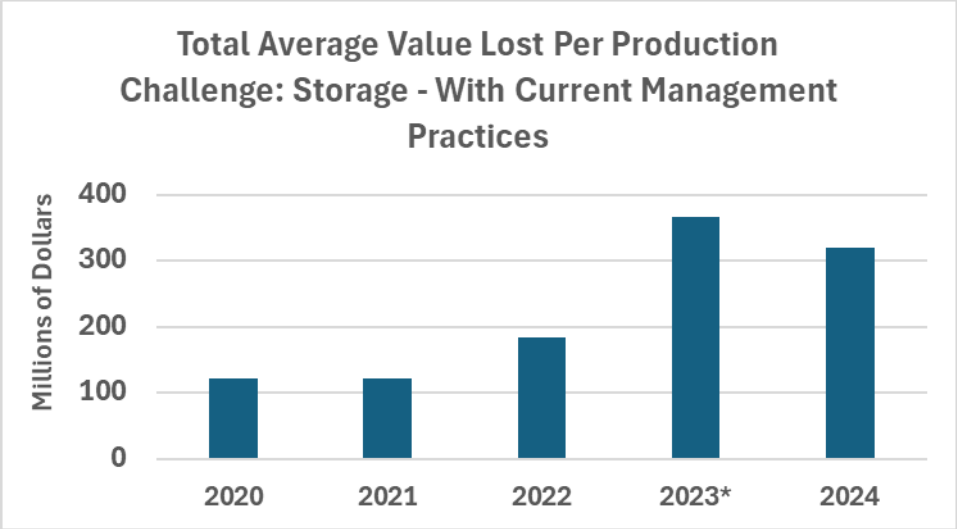
Post-harvest application opportunity

- Propulse (Bayer)
- Stadium (Syngenta)
- Other products in the pipeline?

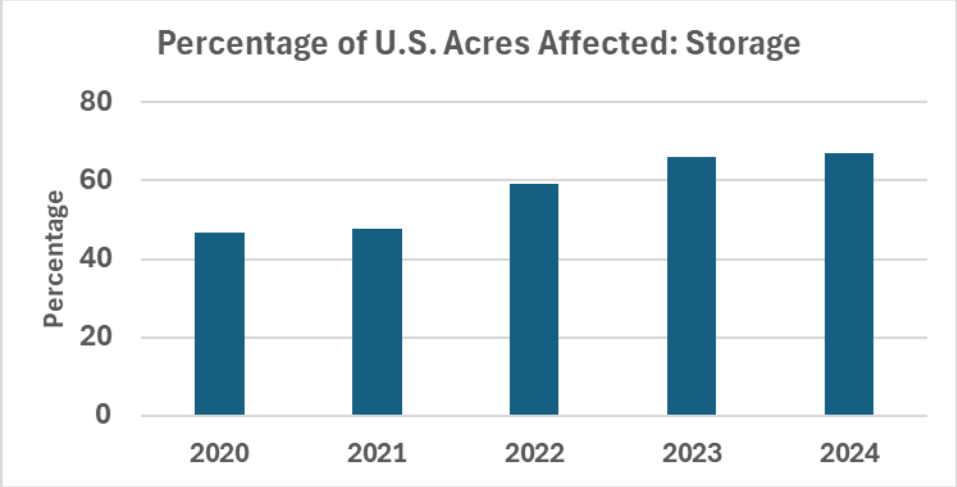
Other/Additional?

BSDF Production Challenges Survey Data: Storage

Storage



*Note: The criteria for measuring the economic value lost per acre changed in 2023 from a standard tons/acre and payment/ton to a calculation based on each cooperative.



NOTES
Storage Breakout Session

Focus Questions

1) Are Industry needs aligned with USDA-ARS research? Gaps?
2) What tools/technologies/solutions can be utilized to address these issues?

Genetics

- Continued/more research into storability would be good. Changing grower habits/equipment would be difficult to implement.

Harvest Damage

- **Cell wall thickness/turgor**
    - Fargo ARS is working to create a "tougher" beet to resist harvest damages, creating a more stable cell wall structure. Thoughts are it may also lower respiration in the process (70% of storage losses come from respiration, so this would be very beneficial).
        - They're looking to identify specific germplasm to accomplish this, 330 lines have been tested at least once. The test takes 10-14 days per round.
        - General idea is higher marc = less damage = better storage
        - Some genotypes have proven to have lower respiration
        - Potential negative = High sucrose beets tend to have less cellular wall
- **Beet Handling**
    - Everyone agrees that we are very rough in the handling process. Would like to treat them more like potatoes (gently).
    - Need to get the tops off (that is a violent process), but if we don't then beets may try to regrow, burning more sugar in the process
        - More tops = less ventilation in the piles
    - Scalping - Industry is divided on the benefits
        - Scalped - no tops but leaves a wound
            - Past studies suggest no pathogens entered the wound if properly scalped but did impact excessively scalped
        - Non-scalped - no wound for disease to enter, higher impurities
        - Industry is curious about the respiration of scalped vs non scalped beets
        - Industry standards
            - Amalgamated: scalps - silver dollar
            - Michigan: scalps heady, adjustable as needed
            - ACSC: no standard
        - Respiration is higher at the crown
    - Temperatures
        - Controlling harvest temps can be a challenge.
            - Too warm to harvest
                - Michigan - 53 degrees

        - ACSC - 55 degrees (sometimes slightly more if policy allows)
    - The possibility of freezing in if harvest takes too long is a serious concern.
  - Beet size is a factor
    - "BBs and bowling balls" (significantly different sized roots piled together) are poor for ventilation
    - Small beets = higher respiration
- Disease and drought both factors in lowering storability
- Dr. Kandel has been looking into post-harvest pathogens
  - Too many to mention
    - Penicillium one of the main
  - Genetics may help
- General agreements from industry
  - Cooling piles quickly is another key to storability
    - Ventilation is important
  - Developing new sensors to detect pile off gassing may be beneficial
  - Dollars lost in storage is HUGE
    - Focus appreciated in this area
  - Cool harvest weather is important, but not waiting so long that beets can freeze out

NOTES

Processing Breakout Brainstorming Session

Introductions

- **USDA-ARS, SRRC, New Orleans, LA**
  - Thomas Klasson, *Research Leader/Chemical Engineer*
  - Evan Terrell, *Research Ag Engineer*
  - Gillian Bruni, *Research Microbiologist*
  - Isabel Lima, *Research Chemist*
  - Sanjay Joshi, Postdoctoral researcher
- **USDA-ARS Fargo, ND**
  - Shyam Kandel, *Research Plant Pathologist (Post-harvest)*
  - Malik Bill, Postdoctoral researcher
- **USDA-ARS Kimberly, ID**
  - Dave Bjorneberg, *Research Leader*
  - David Tarkalson, *Soil Scientist/Systems Agronomist*
- **Industry introductions**
  - Greg Martin, Southern Minnesota Beet Sugar
  - David Groom, American Crystal Sugar Company
  - Brodie Griffin, Amalgamated Sugar
  - Alan Van Der Kooi, Lantic Inc.
  - Gerry Buck, Lantic Inc.

Meeting started with introductions. Evan Terrell gave an overview of Sugar Crops Research at Southern Regional Research Center (SRRC). He mentioned that the number of available ARS personnel to carry out research is currently a fluid situation with possible effects to the productivity of ARS projects in general; however, scientists will continue doing their best under the circumstances. At ARS, project plans are five years in scope, with the current one at SRRC under current review and projected to start middle of 2025.

At our location in New Orleans, our Sugar Crops project covers both sugarcane and sugar beet, with about 50% directly supporting processing needs and the other 50% covering byproduct utilization. A big thrust of that for sugar beet is microbial degradation, microbial byproducts, dextran, etc.

If there are pressing research areas of concern to be learned with this meeting, we can try to do our best to incorporate those in the project plan. The project plan is funded with hard funding from Congress to do Ag research.

We also have some funding from the Beet Sugar Development Foundation (BSDF) and through the Sustainable Sugar Beet Research Initiative (SSBRI). We have a technician that is funded by BSDF and a post-doc funded by SSBRI. Gillian mentioned that we have been very blessed to have some people in the lab funded by the industry, so a lot of the work we've been doing the past couple of years would not be possible without industry support. Zianab Yassin has been hired through BSDF and has provided some stability in the lab over the past couple of years, particularly with the fluctuation of other staff. She started out doing microbial isolations from the factory juices of biofilms for about 18 factories across North America, and some of those present in the meeting have participated in that study. We also did some isolations on a project with Shyam Kandel (ARS Fargo, ND). The lab is also focusing on susceptibility testing. Dr. Sanjay Joshi was just hired with some funding through the SSBRI to study the role of exopolysaccharides and biofilm. We have a lot of isolates from those previous studies that can be worked on. Since the last ASSBT meeting in 2023, there has been significantly more collaborative efforts with the group in Fargo. We went to Fargo in January, and they have done a lot of microbiome work for bacterial loads in processing juices. We are addressing how to use that data for predictive modeling and trying to understand bacteria population dynamics throughout the season. We want to have forward-looking models to predict costs and report meaningful results to the industry. We are interested in factory trials and to grow the capability of doing industrial scale studies and want to continue working with industry to address their needs.

So, the question is “how can we (ARS scientists working on processing related sugar beet research from Louisiana, Idaho and North Dakota) leverage our expertise to the benefit of the industry”? There should be ways to build a network together amongst the ARS research groups working on sugar beet, to answer bigger or more entrenched problems.

Pressing industry needs:

- Variety of beets coming in and the corresponding changes in the bacteria on the beets and the resulting issues with sugar loss and EPS formation. It would be best to anticipate issues of the beets coming in so there is some anticipation of how to handle them. The ability to predict is desirable, so that modifications can be done to adjust (e.g. slicing, filtration, etc.).
    - Difficulty in tracking the quality of incoming beets to the factory. Is there a way to get more uniform beets out of storage?
    - One of the biggest long term research problems is not knowing the quality of beets coming in at any given time and what it means for processing.

- Microbial testing is slow, need more rapid testing like HPLC. It is difficult to make adjustments when results from microbial testing can take days (composite data from the lab is a week behind).
- How do we control microbes in storage?
- Bad outcomes arise when mixing a “good” stream with a “bad” stream; this always results in a bad stream!
- How do we handle differences between early August harvest beets, stockpile beets, frozen (poor quality) beets, different variety beets, and differences from year to year?
    - How do all the variables/conditions that happen between harvest, storage and transportation, affect processing?

SRRC (Evan Terrell) has been modeling microbiome data shared by industry with storage, time and factory location as inputs, over a two-year period, 2021-2022 and 2022-2023. When the model represented the average of the whole four years’ timeframe, the model was good; however, when the model was separated into two separate two-year models, the results were mixed. We are trying to incorporate weather parameters into these models. Incorporating weather data for early season beets makes sense, since we are not dealing with stored beets. However, it is a bit dubious to make inferences related to weather for late season beets when stored beets on a pile are used.
Gillian mentioned that her and Shyam have collected several isolates. They have done susceptibility testing to determine dosing of antimicrobial agents if they were to spray a certain biocide on a pile with the idea that this might help prevent sugar beet root rot. They also looked at temperature sensitivity for yeast and fungus and determined that they are killed off when heated to 42°C or higher. The DNA will still be in juice samples even if they're killed, and these DNA “signatures” will still be picked up by microbial profiling. But when they did isolations from the juice, for example, they didn't get hardly any of these isolates, suggesting that many fungal/yeast isolates are killed by higher temperatures in the processing streams.

In very complex systems with many variables, such as trying to manage incoming beets and predicting how to best process them, AI will be very important. If AI improves, in the future, it would be good to examine data sets in a way that we cannot. Need a data storage plan and AI to compile data related to weather, storage method, storage conditions, etc. One of the industry representatives mentioned involvement in a project where it was determined that higher temperatures in June (south of Wendell) correlated with lower sucrose levels.

Also, when measuring variables for input into any model, the strength of the variable is only good when the accuracy of the measurement is appropriate. For example, when measuring

weather humidity, it matters whether it is measured above or below the canopy in the field, as it can vary significantly.

Evan asked about the data management at the factories, what is measured in the factories, how is data stored.

Gillian asked about the ratios of glucose to fructose with higher raffinose levels? Answer is that it can be high or low, sometimes glucose disappears and sometimes the fructose disappears. There is no consistency. Also, Gillian mentioned that if one grows a strain that makes dextran, they always see a lot more fructose by HPLC. And when growing something that makes fructans, a lot of glucose is seen. Microbes that make fructans, use the enzyme levansucrase that synthesizes fructan polymers from both sucrose and raffinose as a substrate. This likely makes it all the more challenging to interpret sugar levels in the sugar beet factory processing streams.

Gillian asked David Groom about the "retention time" or time period of processing before processing streams are heated to kill microbes. David said it is about a 10-12 minute retention time until heating at American Crystal Sugar Company.

Some factories have been working on oxalate, succinate and formate detection with ANA additional detectors.

There was some discussion about the need for rapid microbial testing and how this could potentially help beet factories more rapidly adjust their processing. For instance, if someone was to develop a qPCR assay to rapidly identify microbes to help inform an antimicrobial strategy, beet factories in general would be interested.

There was discussion that they typically see a higher sugar invert load (glucose and fructose) from low quality beets, and this usually causes more color problems.

There is another concern about wastewater on the tail end of factories. Sometimes they are not able to discharge to the river immediately without first treating for *E. coli* coliforms. What is residual chlorine…? Ongoing cost and worry.

David Groom mentioned that across the industry there is typically less understanding or training in microbiology. When factories have to deal with processing problems, operators are more likely to only see the connection with the chemistry and mechanical aspects of the occurrence without considering or understanding the microbial component to the problems and how to deal with them operationally.