Field Equipment Sanitation BMPs (version 1.3 – May 2024)

WHY?

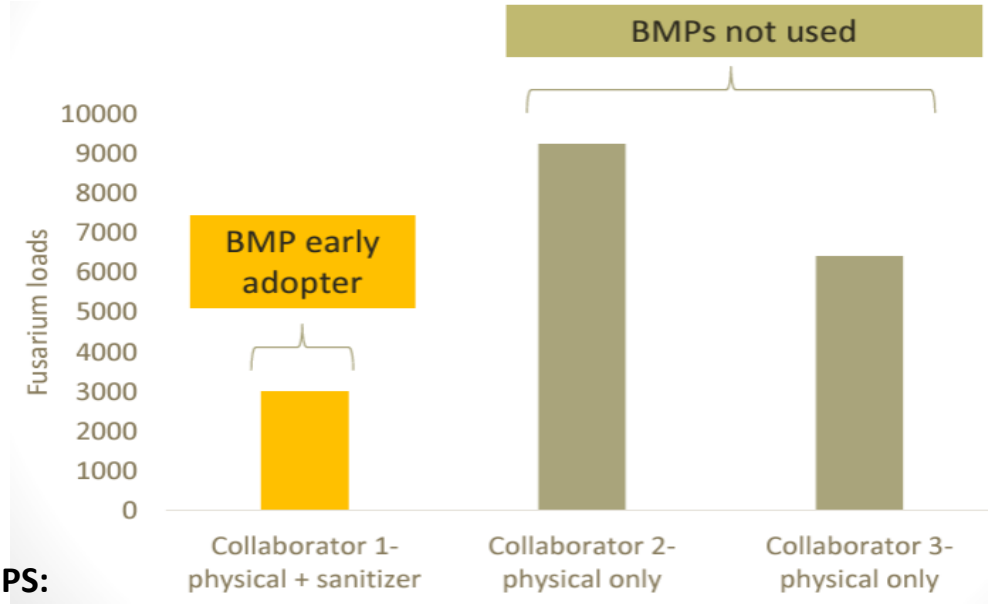
This short set of BMPs was created with the intent of sharing known best practices to slow down the spread of the parasitic weed, broomrape - between fields, operations, and production regions. The expectation is that lessons learned to date will allow operations that are currently implementing some level of sanitation to maximize the benefit from their program with science-backed tweaks AND to inform those operations who have not yet implemented sanitation programs but are interested in learning from others past lessons. Originally focused on tomato harvesters, this information is now being extended to field equipment generally. Although the particular target of this work is broomrape, the act of physical cleaning is also effective in reducing the risks of spread of other pests including weed seeds, fungal and bacterial pathogens, and root-knot nematode.

Figure 1. From left to right: Broomrape seeds the size of finely ground pepper, broomrape growing in a tomato field in California, broomrape debris on a harvester in Chile. Photo credits: Gene Miyao, Zach Bagley, Brad Hanson.

WHERE TO CLEAN?

- A designated area for equipment cleaning, within the field perimeter, should be assigned and solely utilized.
- Monitor this area carefully in future crops as it will be an at-risk location for future broomrape emergence.

WHAT TO CLEAN? Any equipment or personnel that move in or out of fields, especially those that accumulate a lot of soil and plant debris, can spread broomrape and/or other pests and pathogens.



CLEANING STEPS:

1. **Remove loose debris – this is the most important step in the cleaning process. At 1%, on a clean surface, QAC sanitizers can effectively kill broomrape and significantly reduce microbial loads. HOWEVER, QAC efficacy is greatly reduced in the presence of soil and plant debris due to sanitizer deactivation.**
    a. Soil and plant debris should be removed from all equipment using compressed air, scrapers, and pressure washers. Any visible plant or soil debris has some risk of containing broomrape seed and/or other weeds seeds or pathogens of concern.

b. Pay particular attention to the areas that accumulate a lot of debris and/or are difficult to access.
    - On harvesters, axles and frame members, suction fan, fan duct, and chipper are all areas that accumulate a lot of debris, are hard to clean, and are of high risk of moving seed or pathogens.
    - In high-risk fields, it may be necessary to remove the harvester fan duct for thorough cleaning.
    - On other equipment, hard to access areas (like axles and frames) and those locations that accumulate greater than 1 inch of soil and plant debris are those to focus on.

In recent UC studies, physically removing (with scrapers and compressed air) soil and plant debris reduced fusarium loads by 83%. Adding the step of pressure washing reduced these further, to 90%. Adding QACs reduced these further, to 97%.

2. **Pressure wash –**
    a. Remove fine debris, caked-on plant and soil materials, and greasy areas that can harbor seed and pathogens and also deactivate sanitizers.
3. **Sanitize –**
    a. AFTER removing loose debris with compressed air, scrapers, and pressure washing, apply chemical sanitizers which are proven to kill broomrape seed on contact.
    b. Quaternary ammonium (QAC), NOT BLEACH, is the sanitizer which is proven to kill broomrape seed.
        - Locally this can be bought under the labels: Clorox Pro Quaternary, Chem quat, Flo San or MG 4-Quat.
        - A solution of at least 1% is necessary for efficacy and should be used to spray down the equipment after soil and plant debris has been knocked off and pressure washing is completed.
    c. Apply sanitizers to surfaces that are still wet from pressure washing, or rewet the surfaces before sanitizing to increase contact time and improve efficacy.
    d. When measuring fusarium loads across comparable locations in recent studies, sanitizers in foam were more effective than the QACs alone, as the foam increased the residency time of the sanitizers.
4. **Do not rinse –** To provide maximum activity on seed or pathogens, washed and sanitized equipment should be left to dry, not rinsed with water or other cleaning agents.

BE ADVISED: Equipment with significant amounts of plant debris and soil will not be cleaned with the use of QACs at the rate of 1%. Although this rate is proven to kill broomrape seed, this is on contact. Soil and plant debris quickly deactivate this sanitizer. Recent studies have shown that in the presence of soil and plant debris efficacy is regained at much higher rates of QAC. Work to understand this continues. New information on rates and efficacy will be shared as it becomes available.

RESEARCH NEXT STEPS:

- Because debris removal is time intensive and cost prohibitive, our team is working on finding ways to improve QAC efficacy in the presence of soil and plant debris:
    - Effective concentrations of QAC under different debris loads.
    - QAC efficacy at varying application pressures and moisture saturation levels of the debris.
    - Value of utilizing foam or heated water with sanitizers.
- Development of self-assessment systems for farm staff training and sanitation efficacy evaluations.
- Identifying sanitizer alternatives to QACs.

References and additional information:

- Additional information on this pest in California processing tomatoes can be found at: www.tomatonet.org/grower-resources/broomrape-resources/
- January 2024 Equipment Sanitation Research Updates Presentation
- March 19, 2024 Post from UC Weed Specialist Brad Hanson on Findings from Chile

For more information, contact:

- Cassandra Swett, UC Davis: cswett@ucdavis.edu
- Brad Hanson, UC Davis: bhanson@ucdavis.edu
- Zach Bagley, CTRI: 530-405-9469, zach@tomatonet.org

Funding for this work has been provided by: CTRI, CLFP, CDFA, and USDA