

# Equipment sanitation to reduce spread of broomrape and other soil borne pests

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# AKA Team Clean Machine



# Soil-borne pathogens and other pests spread on field equipment to new fields

## Broomrape



G. Miyao

## Southern blight



## Verticillium



## Fusarium wilt and rot diseases



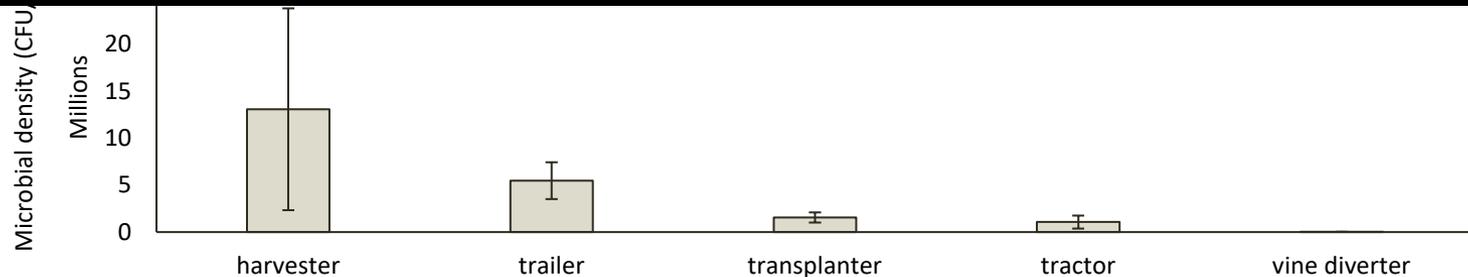
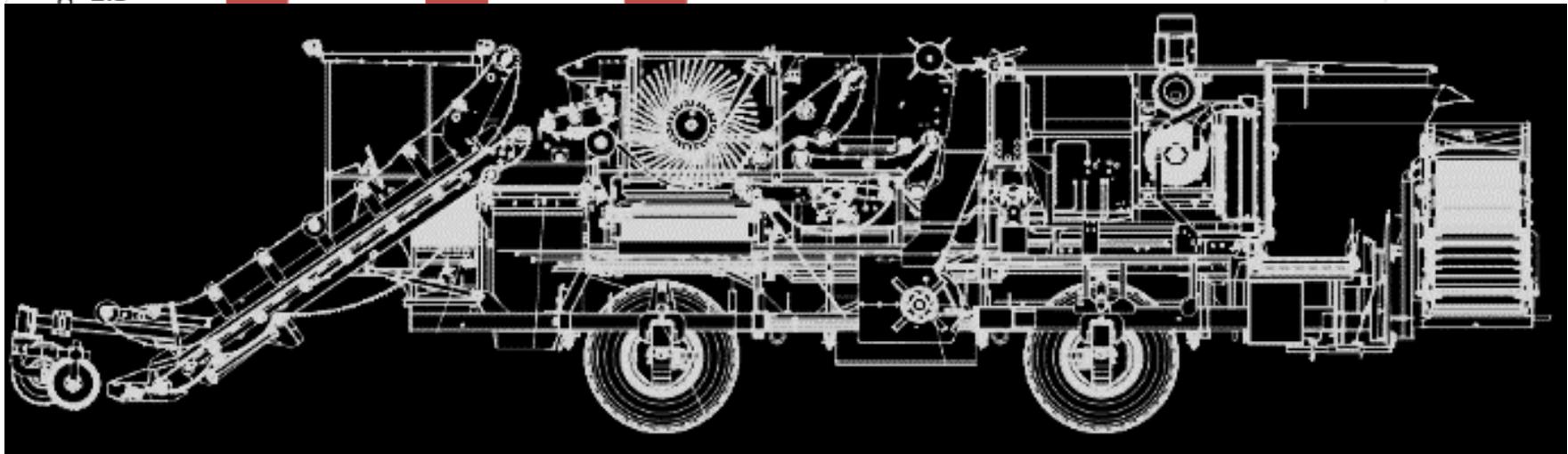
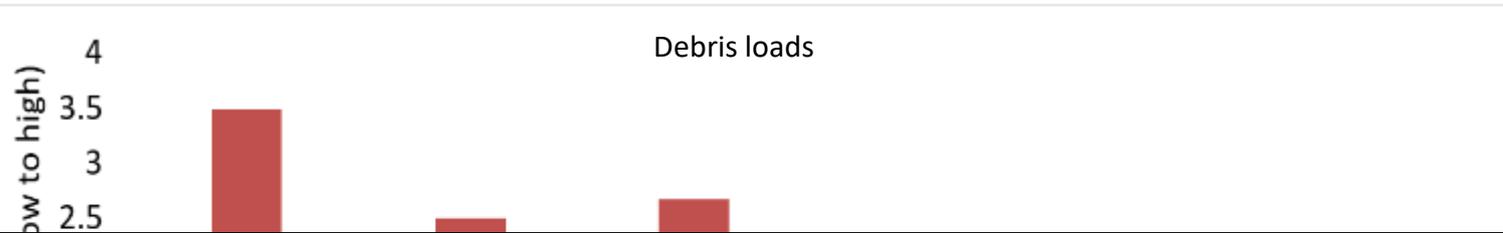
## Clavibacter (bac canker)



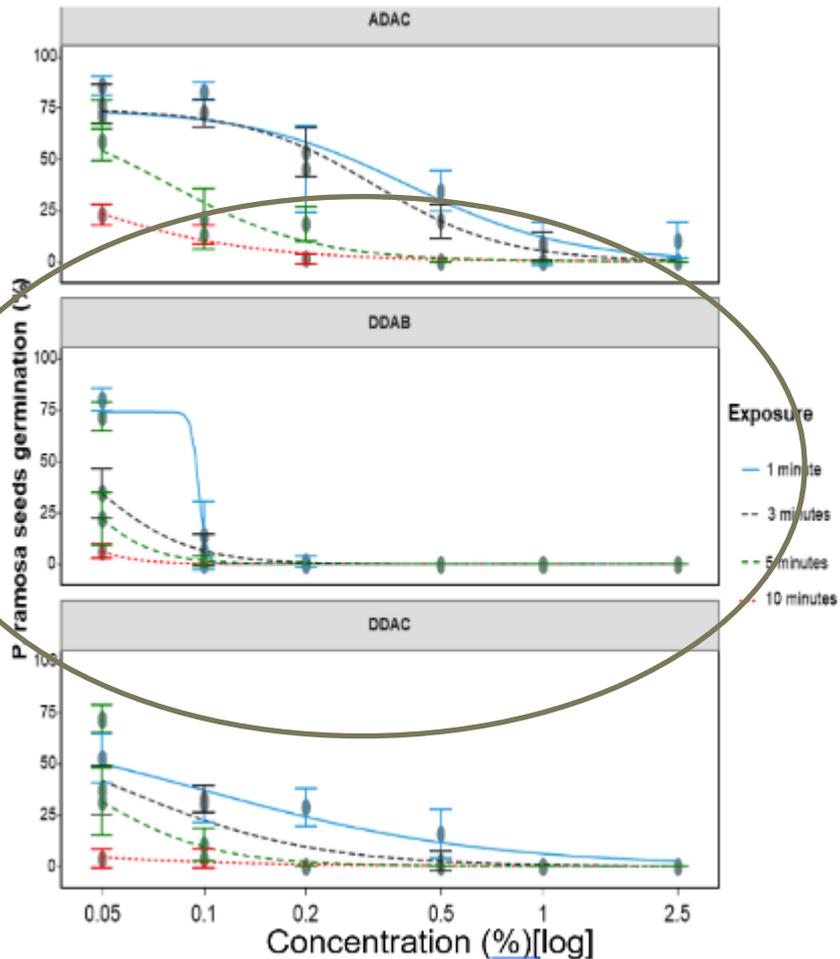
## Root knot nematode



# Harvesters represent the primary risk to spread



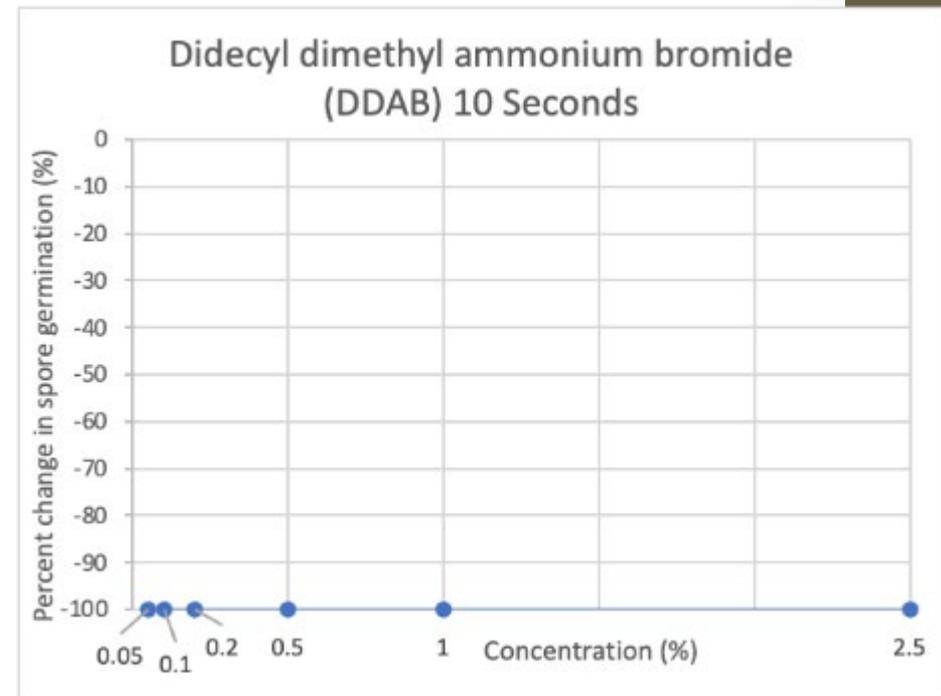
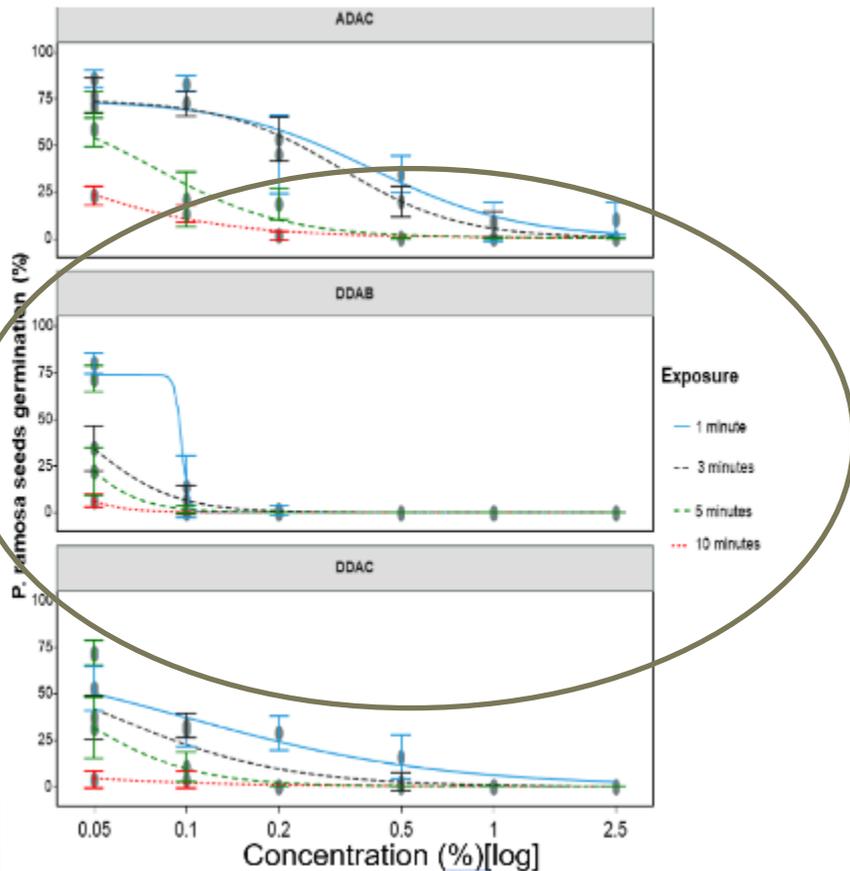
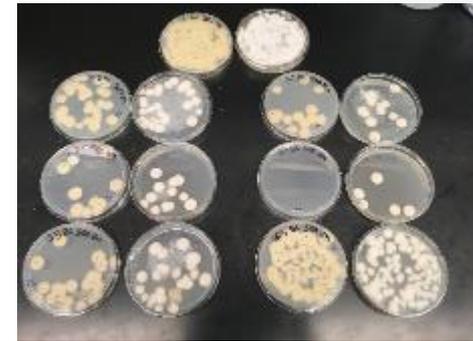
# Quaternary ammonium sanitizer efficacy against broomrape



- QACs vary in efficacy
- Optimal compound: DDAB
  - effective with 1 min exposure
  - effective at 0.1% AI



# The most effective QAC against broomrape is also most effective for Fusarium

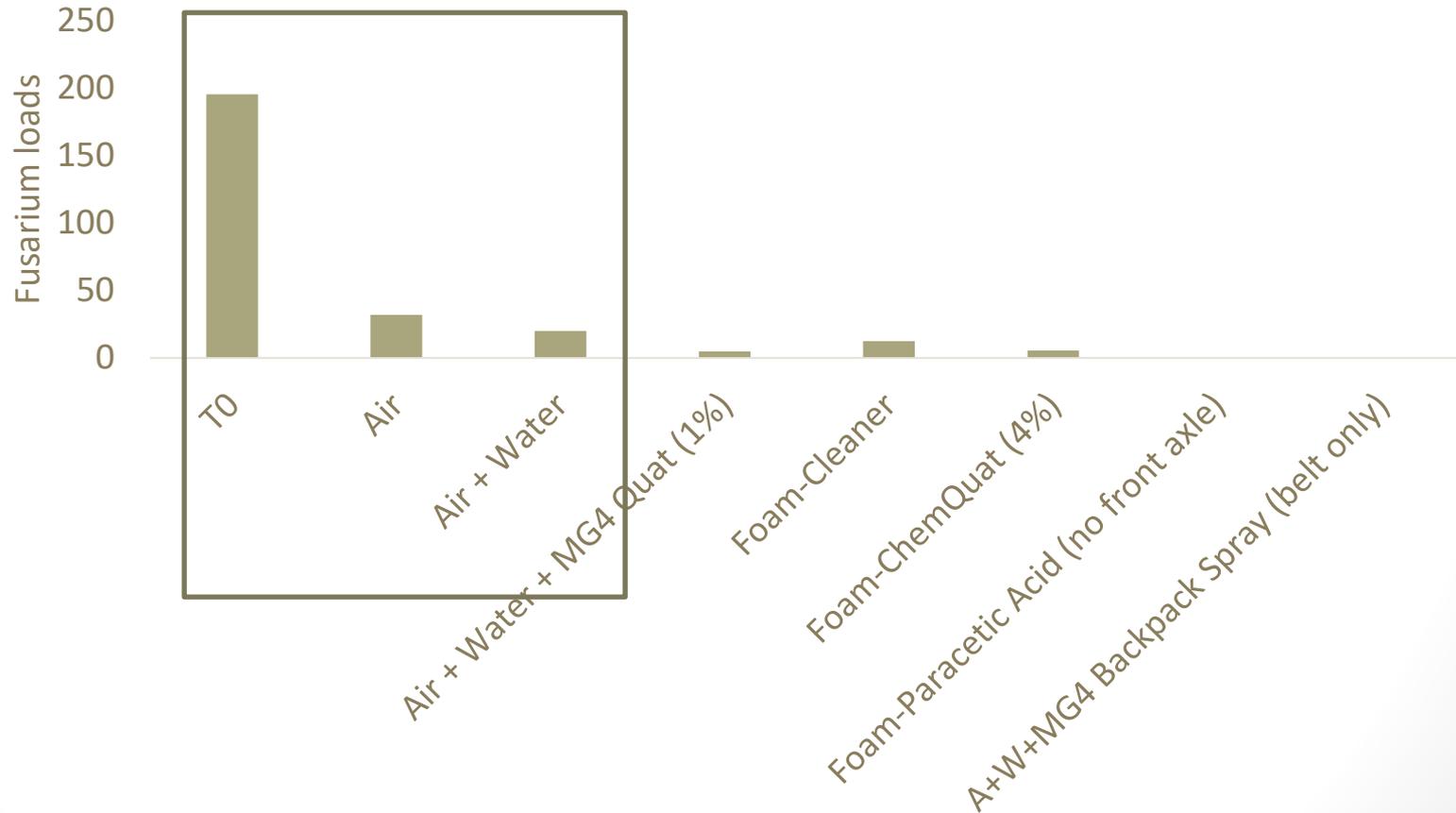


# 2022 project: develop BMP draft 1 for harvester sanitation using controlled trial and in-situ surveys



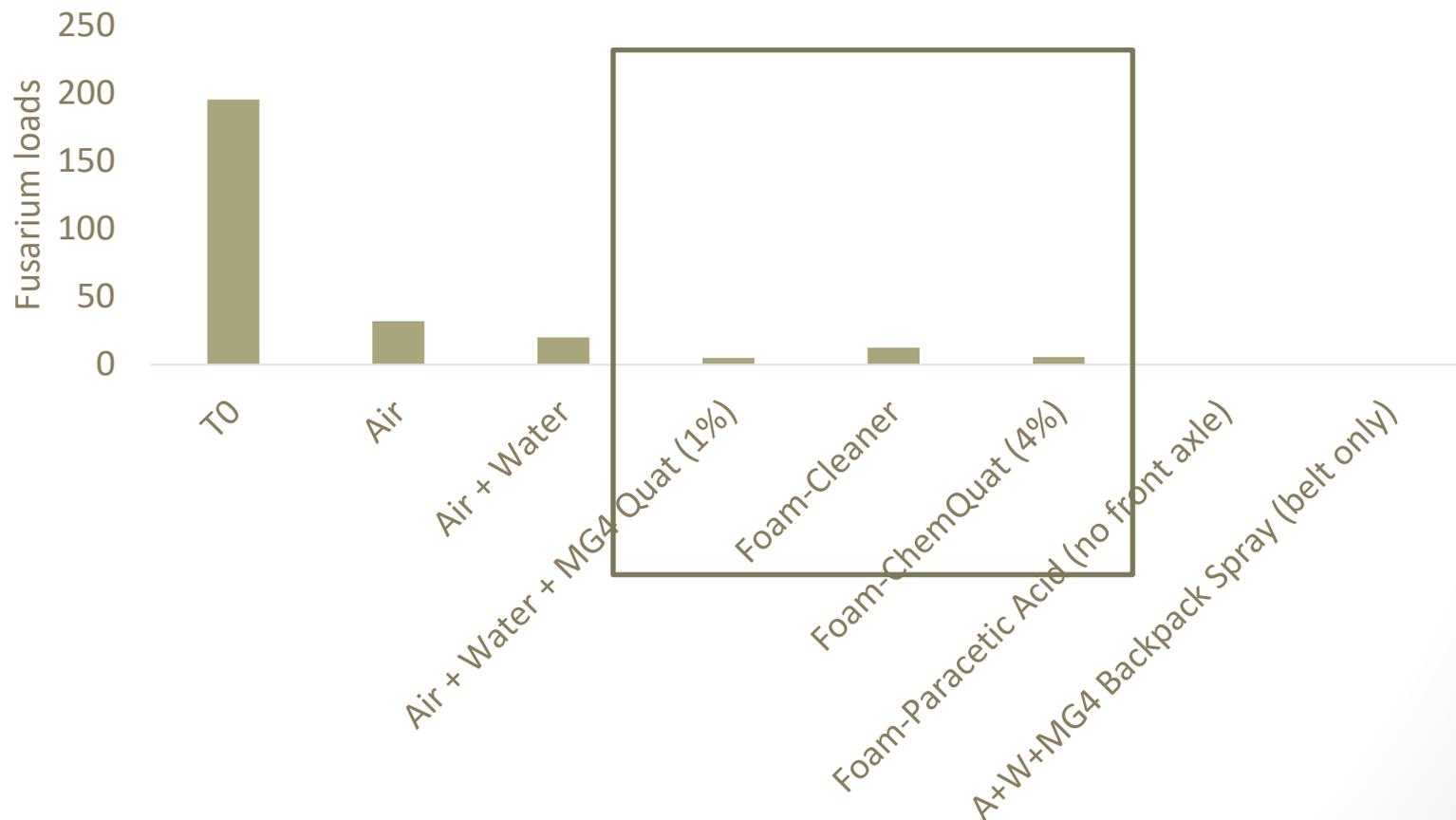
# Take home #1: Air alone reduce loads by ~83%; Pressure wash increased to 90%

All harvester areas combined (with exceptions noted)

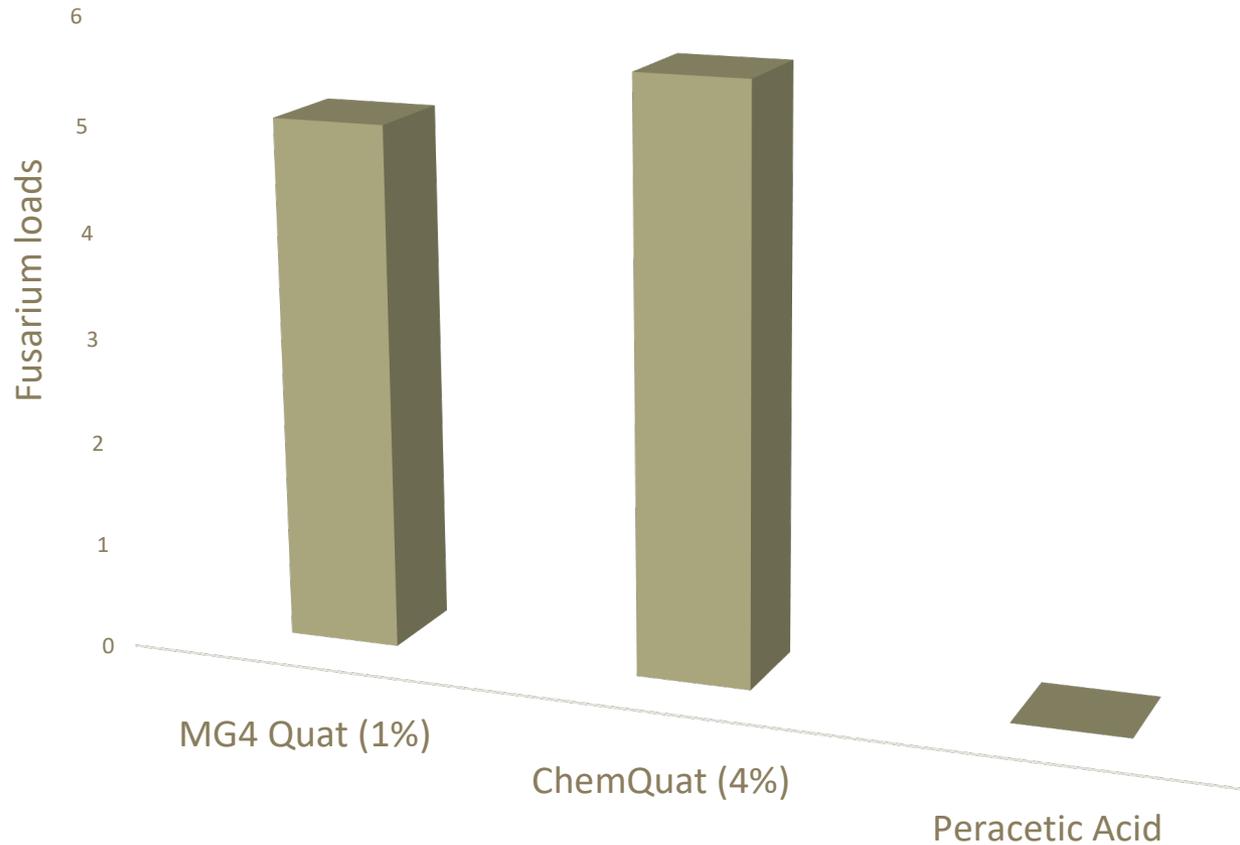


# Take home #2: QAC compounds reduced loads by 97%

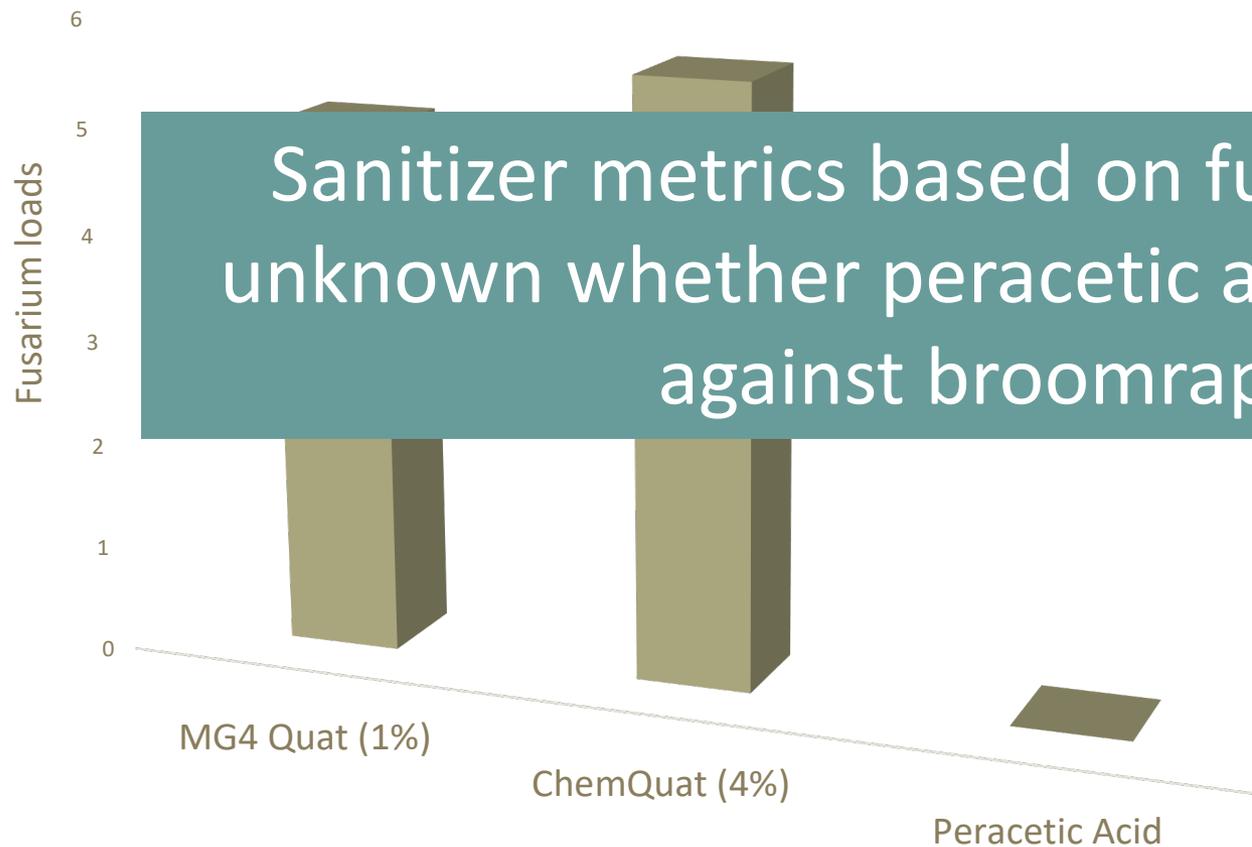
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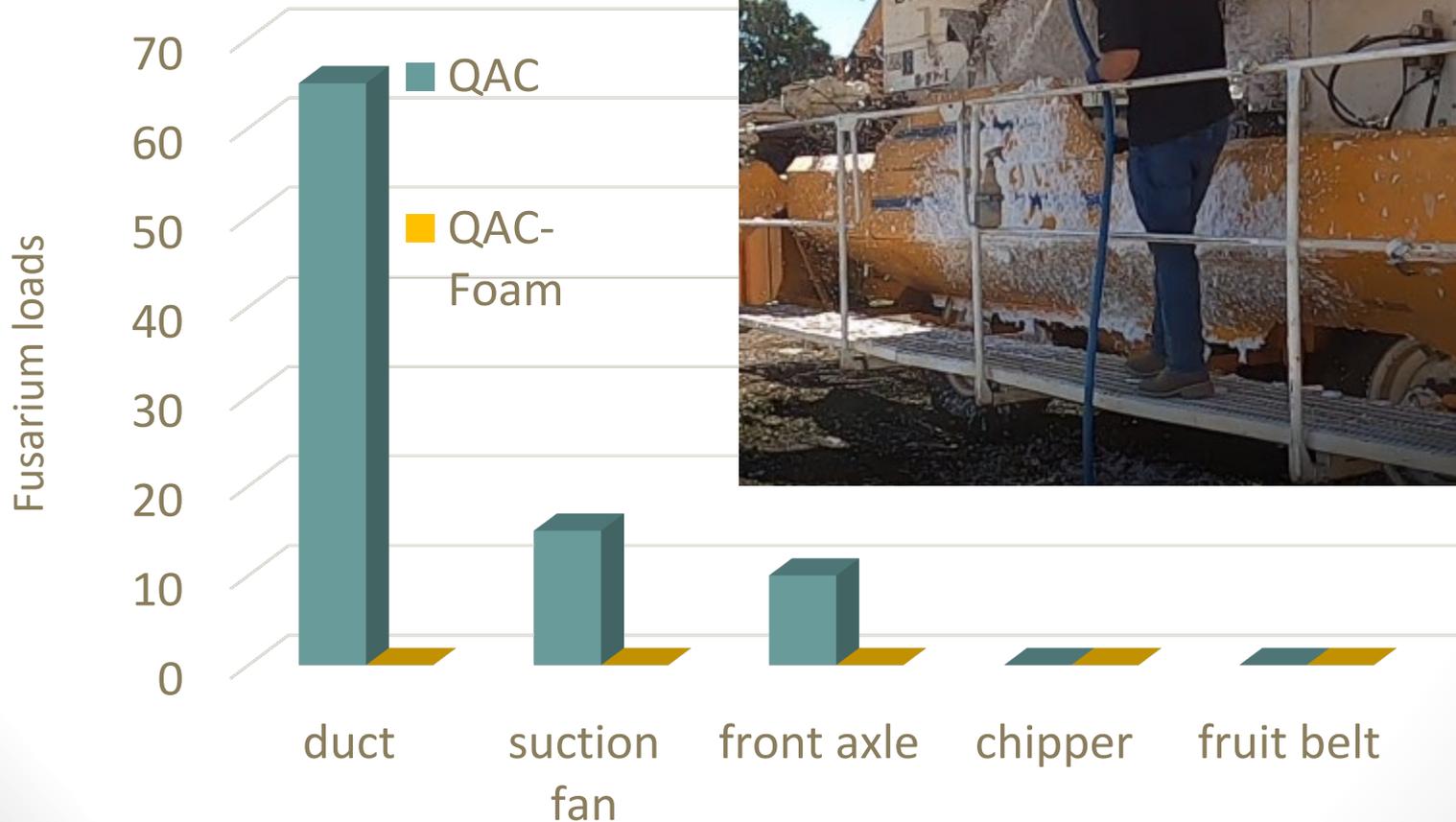
# Take home #3: Only the non-QAC sanitizer peracetic acid killed all propagules



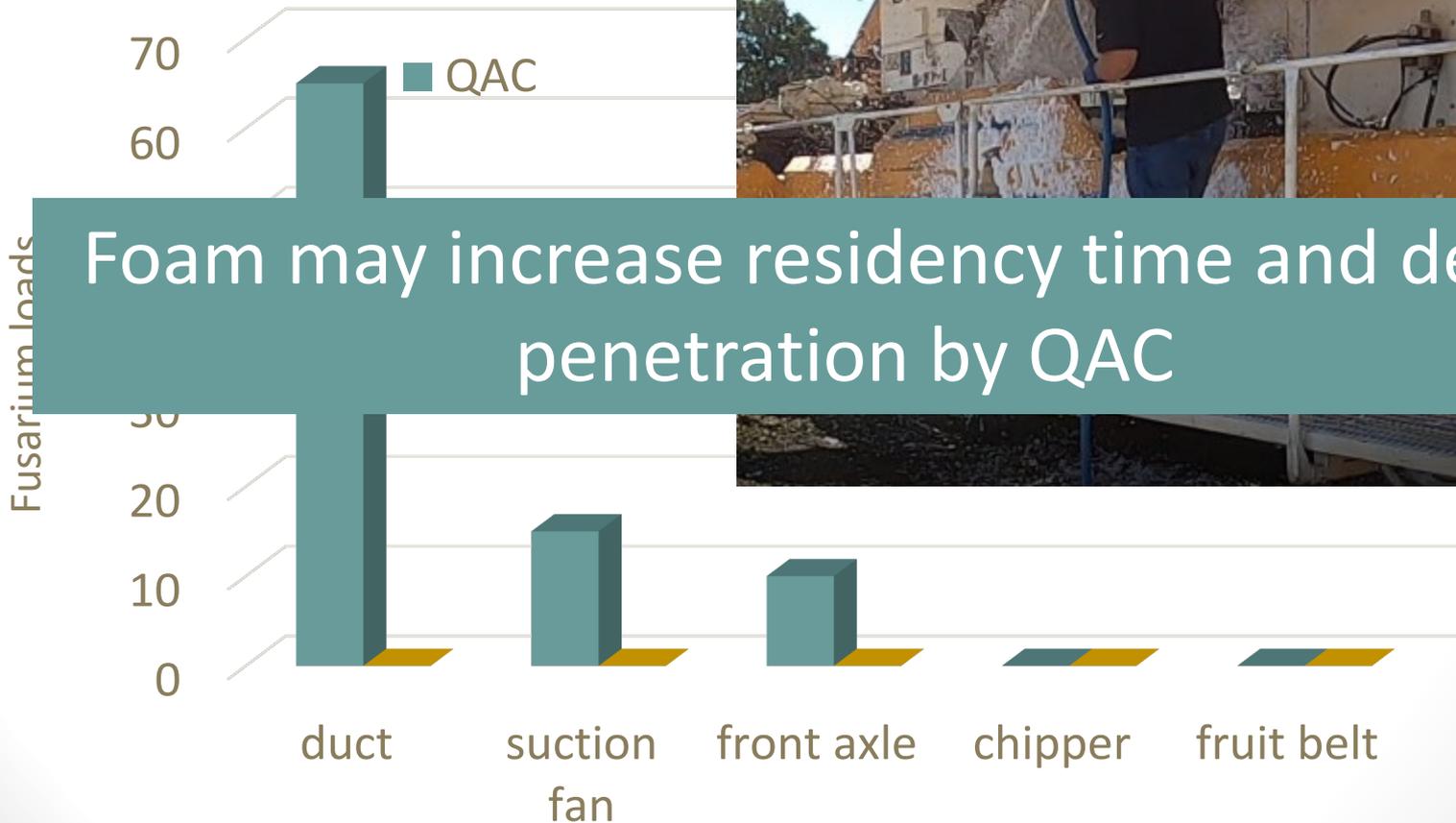
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# Take home #4: Across comparable locations, sanitizer in foam was more effective



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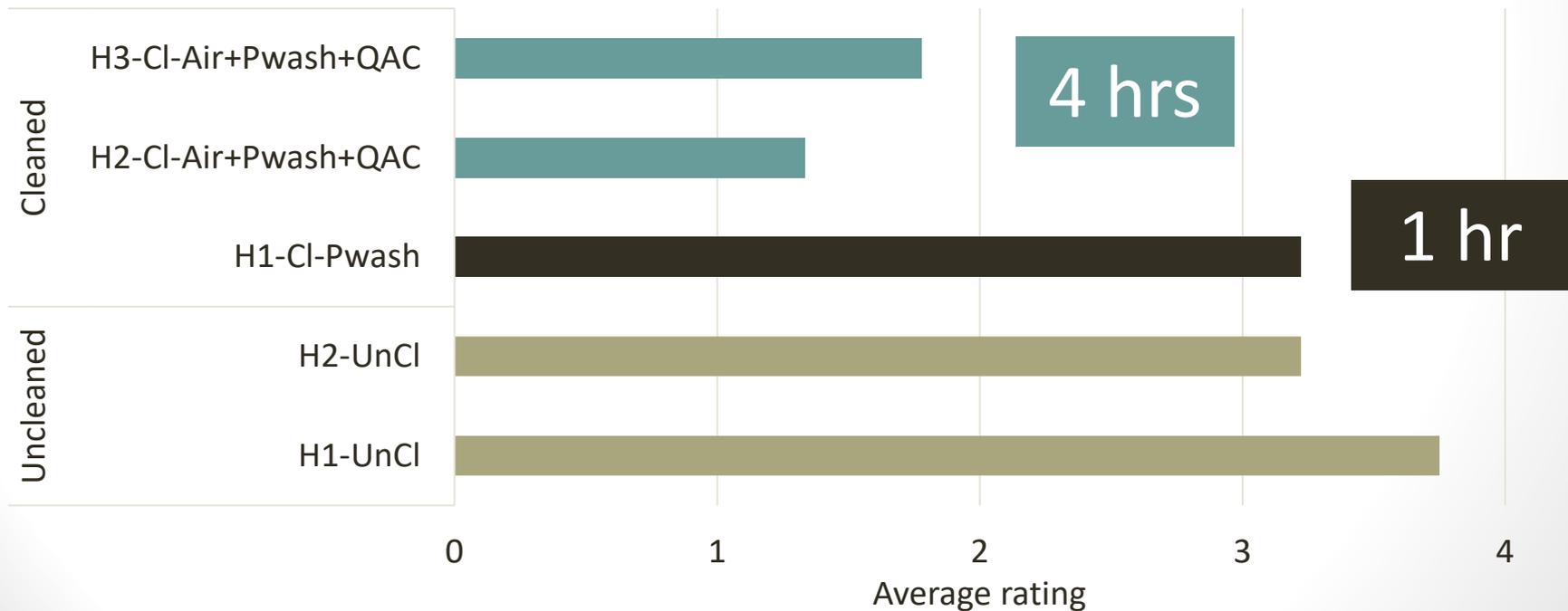
Foam may increase residency time and debris penetration by QAC

# Take home #5: sanitizer efficacy varied by location



# Take home #6: Time is a critical barrier to effective cleaning

- Most operations were unable to spend more than 1-2 hrs cleaning their machines
- The most exhaustive cleaning took 4 hrs



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- Most operations were unable to spend more than 1-2 hrs cleaning their machines
- The most exhaustive cleaning took 4 hrs

How can we overcome this barrier?  
Surveys indicate increased labor will not help

Innovation in wash method to streamline debris removal and sanitizer application

More information on debris load thresholds (how clean it needs to be) may reduce time needed for cleaning

Average rating

# Harvester Sanitation Best Management Guidelines (version 1.2)

## WHERE TO CLEAN?

- A designated area for equipment cleaning, within the field perimeter, should be assigned and solely utilized.
- This area will be an at-risk location for future broomrape emergence if there was seed in the debris removed from the equipment and should be monitored carefully in future crops.

## TIME TO CLEAN?

- The time needed for effective cleaning may require restructuring of harvest schedules.
  - Effective cleaning requires removing ALL debris and THEN applying a sanitizer—a process which typically takes 3-4 hours with a standard crew.
  - 1-2 hours of cleaning, no matter how efficient your crew is, is not likely to effectively reduce your risk of pest spread.

## CLEANING STEPS:

### 1. Remove loose debris –

- 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 or fungal spores.
- b. Pay particular attention to the areas that accumulate a lot of debris or are difficult to access.
  - 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 fan duct for thorough cleaning.

### 2. Pressure wash –

- a. Remove fine debris, caked-on plant and soil materials, and greasy areas that can harbor seed and pathogens and also inactivate chemical sanitizers.
- b. This is the most important step in the cleaning process. Areas that contain debris when the sanitizer is applied will not be sanitized, since debris deactivates the sanitizer.

### 3. Sanitize –

- a. AFTER CLEANING, apply chemical sanitizers which can kill broomrape seed and fungal or bacterial pathogens.
- b. Quaternary ammonium, NOT BLEACH, is the sanitizing agent 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 still wet from pressure washing, or rewet the surfaces before sanitizing to increase contact time and improve efficacy.

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.

## REMEMBER:

- If seed is underneath or within soil or plant material no cleaning agent, including quaternary ammonium, will be completely effective in killing seed or pathogens.
- No amount, or % of active ingredient, will make up for poorly-cleaned equipment with significant amounts of plant debris and soil. Debris you can see is debris which can and will harbor pests and deactivate your sanitizer.

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## CLEANING STEPS:

Produced version 1.1 and revised 1.2 in 2022  
<https://swettlab.faculty.ucdavis.edu/extension/>  
Continuously update as more information comes in from studies

## Swett Lab

Fungal Pathogen Ecology in  
Vegetable and Field Crops

Lab members

Research

Extension

Join the lab!



## Equipment Sanitation working BMPs

[UCD\\_Harvester Sanitation Best Management GuidelinesV1](#)

## Power point presentations

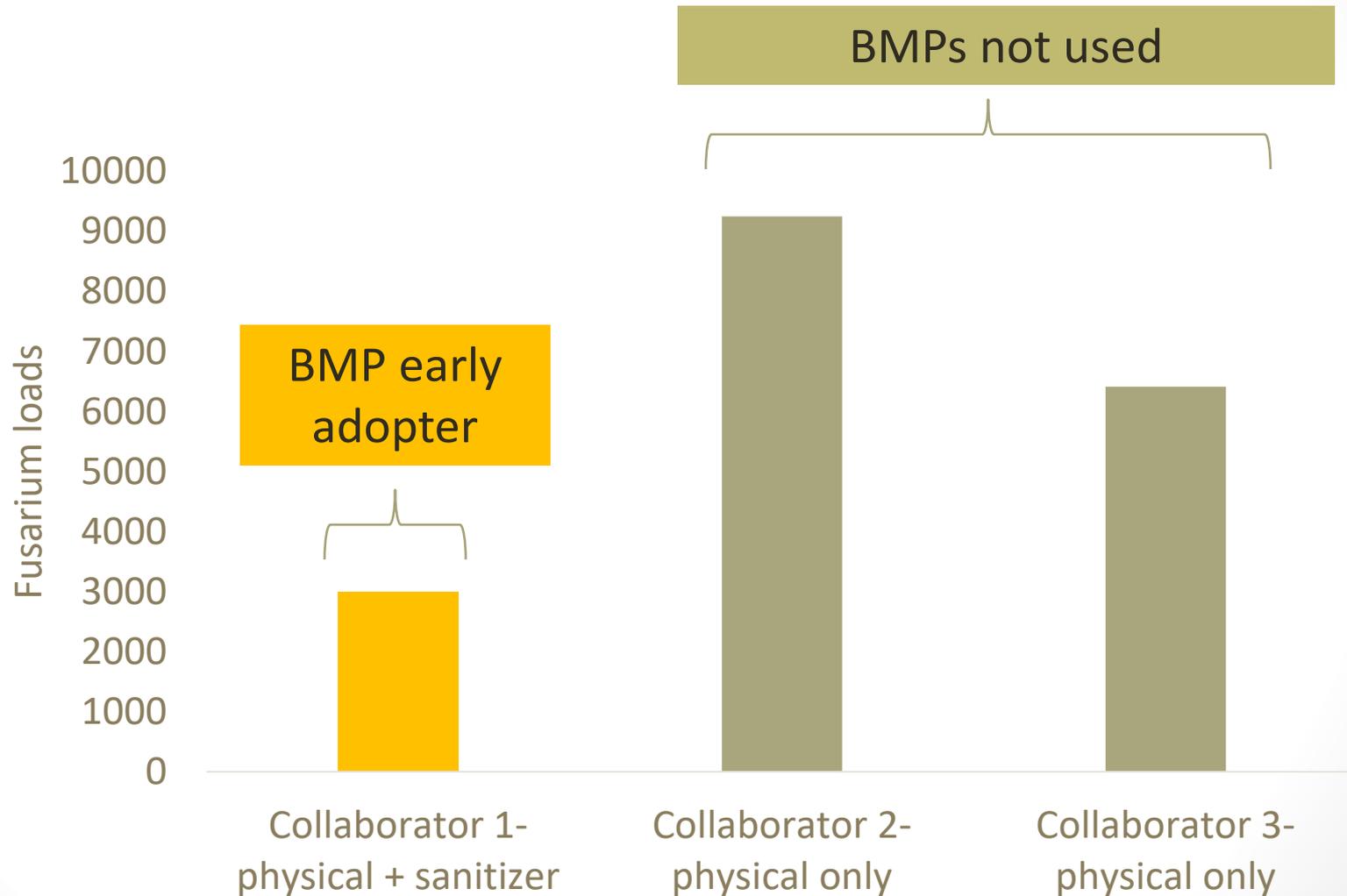
[Fusarium wilt race 3 in California processing tomatoes](#)

[Diagnosing wilt and crown rot diseases of tomato](#)

## Newsletter Articles

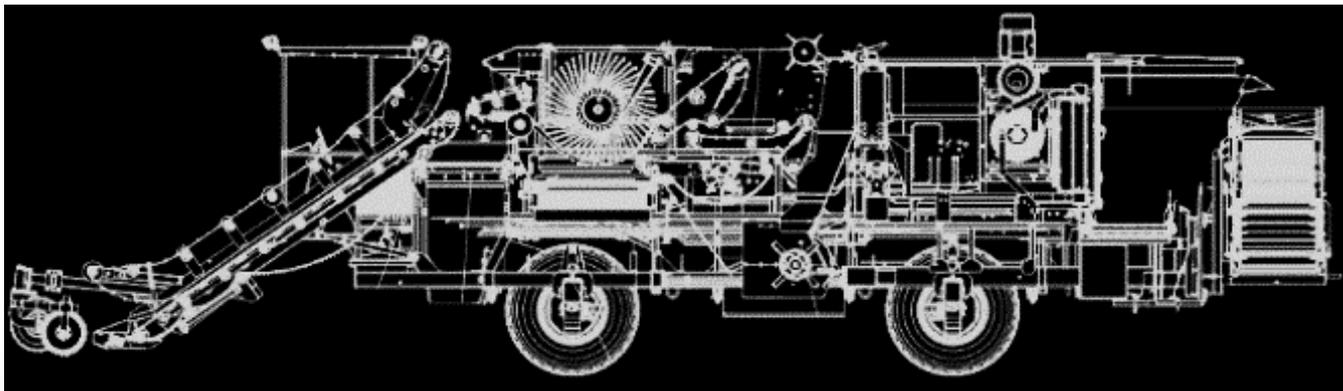
[Southern Blight Cliff Notes 2017](#)

# Take home #7: Use of BMPs is improving harvester sanitation efficacy



# Take home #8: emergency harvest situations post a threat to broomrape spread

- September rain event in Yolo county—emergency harvest
- Many operations outside the county loaned their harvesters
- Highly likely that harvesters from other counties acquired broomrape seed
- In addition, surveys indicate that there are needs for improved for post season harvester cleaning

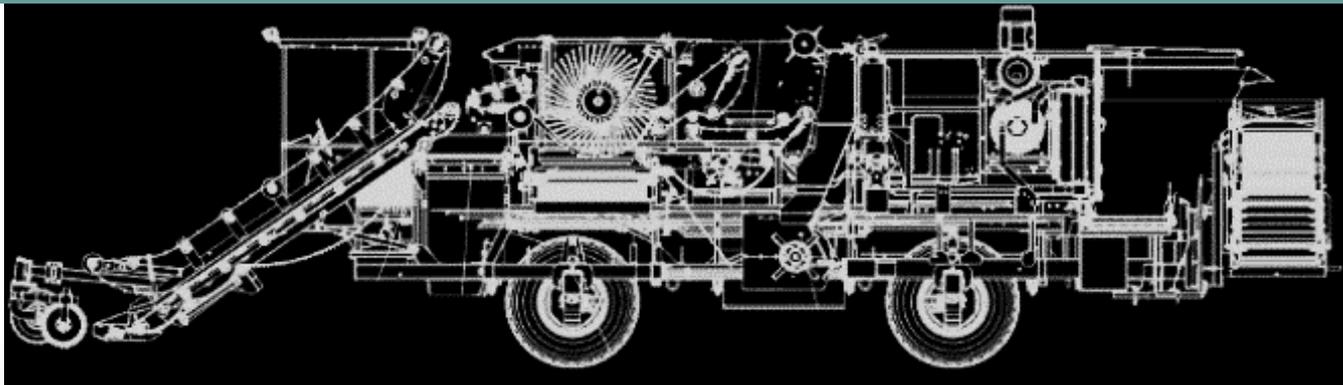


# Take home #8: emergency harvest situations post a threat to broomrape spread

- September rain event in Yolo county—emergency harvest
- Many operations outside the county loaned their harvesters

Effective use of BMPs will be critical to mitigate spread to new counties

Contact us if you would like us to consult with you and/or evaluate efficacy off-season cleaning practices



# Outreach efforts aim to identify additional barriers and provide training

- Planning to do a harvester sanitation field day in 2023
  - English session
  - Spanish session



# Questions?

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BMPs: <https://swetlab.faculty.ucdavis.edu/extension/>

