Broomrape biology and management

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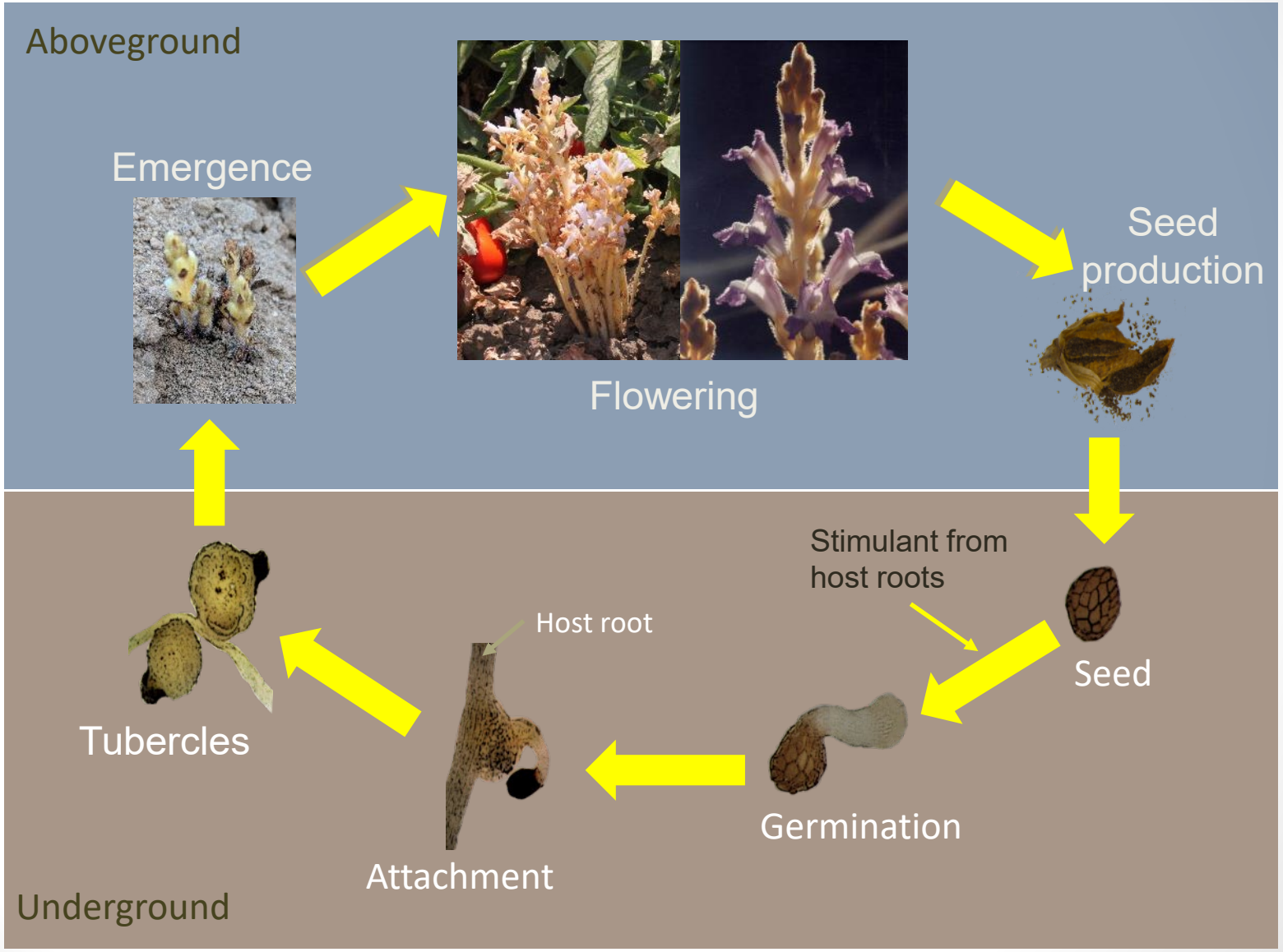
College of Agricultural and Environmental Sciences

Sac Valley Processing tomato mtg
Zoom!
2/10/2022

Broomrape

- A genus of >200 parasitic herbaceous plants
  - Orobanche spp (aka Phelipanche spp).
- Broomrapes are root parasites (attach below ground)
- Holoparasites = derives all carbon from a host plant
- Plants lack chlorophyll
  - Usually yellow- or straw-colored
- Some broomrapes have narrow host range, but others have a much wider host range
- At high density, can greatly reduce yield or even result in crop failure

Lifecycle


Aboveground
Emergence
Flowering
Seed production
Stimulant from host roots
Seed
Host root
Tubercles
Germination
Attachment
Underground

Broomrape in California

- At least two species have been detected in CA tomato fields
  - Branched broomrape (*Orobanche ramosa*) - "A-listed"
  - Egyptian broomrape (*Orobanche aegyptiaca*) – "Q-listed"
    - First report in North America – Solano Co. in 2014
- Branched broomrape has been reported on-and-off for several decades in CA
- Egyptian broomrape has a wider host range (~23 crops grown in CA!) and may be an even more serious risk
  - Potential for non-crop risks too

Current management plan in CA

- Scouting, reporting, quarantine, crop destruct…

- We do not currently have data on suppression/control of branched or Egyptian broomrape with CA-registered pesticides
  - Both species have been detected in conventional processing tomato fields; suggests little (or incomplete) efficacy of registered herbicide programs
  - Quarantine treatments are based on soil fumigation
- Minimizing spread will be key in the short-term
- Will need to develop mitigation approaches for our systems

Success in Israel with PICKIT DSS

Pre-2021 work

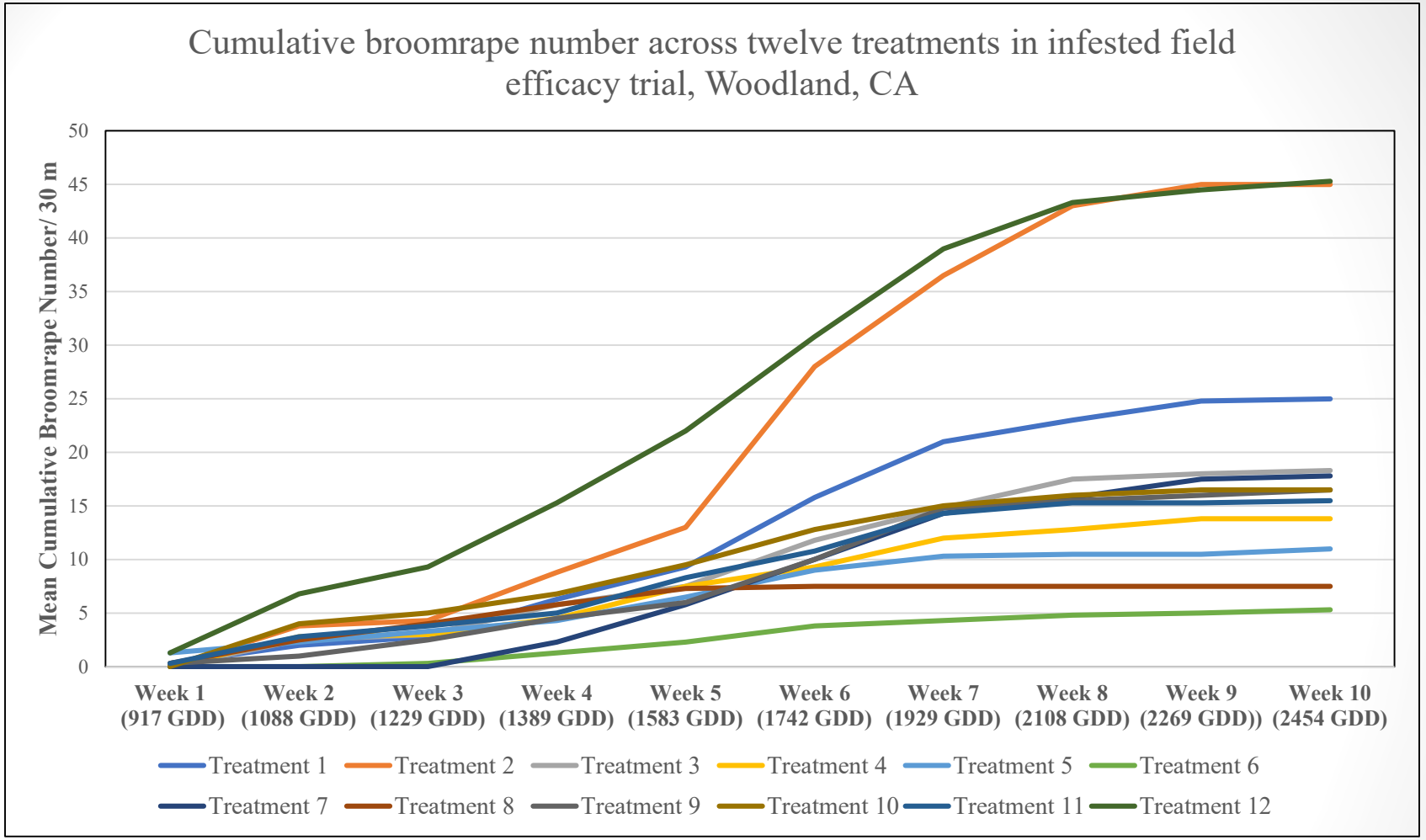
Progress

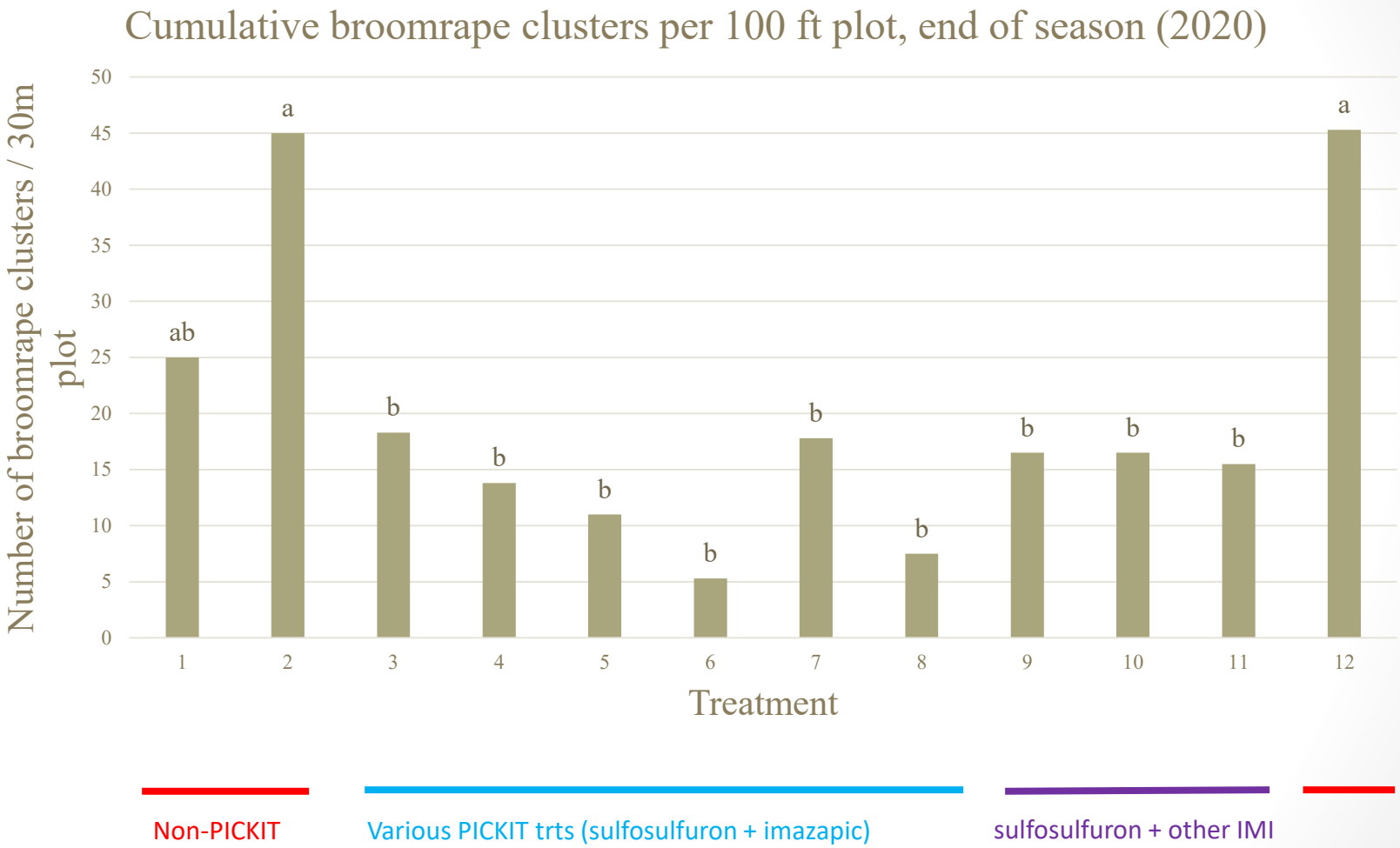
- 2019
  - 2 crop safety trials at UCD
  - Plantback trial (tomato yr)
- 2020
  - 1 crop safety trial at UCD
  - Rotational crop safety eval
  - Efficacy trial in Yolo Co
  - IR4 sulfosulfuron “residue” trials initiated

Results and Challenges

- Crop safety:
  - appears adequate with sulfosulfuron and imazapic
- Plantback:
  - some rotational crop limitations (corn, sunflower)
- Efficacy:
  - Suppressive, but not amazing
  - Timing/rates need adjustment
- Registration outlook:
  - Sulfosulfuron – feasible
  - Imazapic – unlikely
    Switch focus to imazamox

May 29, 2020


Cumulative broomrape number across twelve treatments in infested field efficacy trial, Woodland, CA
Mean Cumulative Broomrape Number/ 30 m
0
5
10
15
20
25
30
35
40
45
50
Week 1 (917 GDD)
Week 2 (1088 GDD)
Week 3 (1229 GDD)
Week 4 (1389 GDD)
Week 5 (1583 GDD)
Week 6 (1742 GDD)
Week 7 (1929 GDD)
Week 8 (2108 GDD)
Week 9 (2269 GDD))
Week 10 (2454 GDD)
Treatment 1
Treatment 2
Treatment 3
Treatment 4
Treatment 5
Treatment 6
Treatment 7
Treatment 8
Treatment 9
Treatment 10
Treatment 11
Treatment 12



*Field variability. Trts #3 and #6 were expected to be good but Trt #8 really shouldn't have been

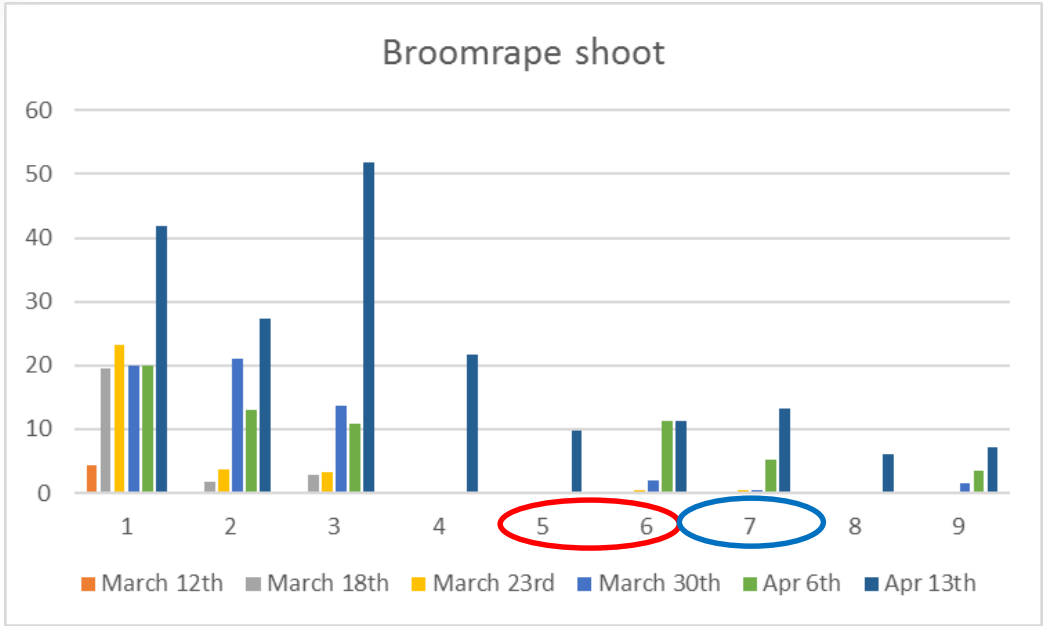
2021 Project – Santiago Chile

- CTRI funding supported a trial conducted by UC Davis Chile Life Sciences Innovation Center cooperators
  - Chemigation study conducted in grower field in Chile
    - Planted January 19, 2021 (later than ideal by 1.5 mo)
  - Trts were focused on PPI sulfosulfuron and chemigated imazamox

2021 Project - California

- Crop safety (two experiments at UCD)
  - Same base protocol as Chile
- New plantback trial started (tomato in 2021)
  - Base treatments same as crop safety, will be replanted in 2022
- Chemigation trial at Woodland grower site
  - Same basic protocol as Chile
- Fumigation trial at Woodland grower site
  - Included MB, 13D:Pic, K-PAM, biosolarization/ASD, anhydrous ammonia

Chilean project 2021 (data are clusters per 17m row)



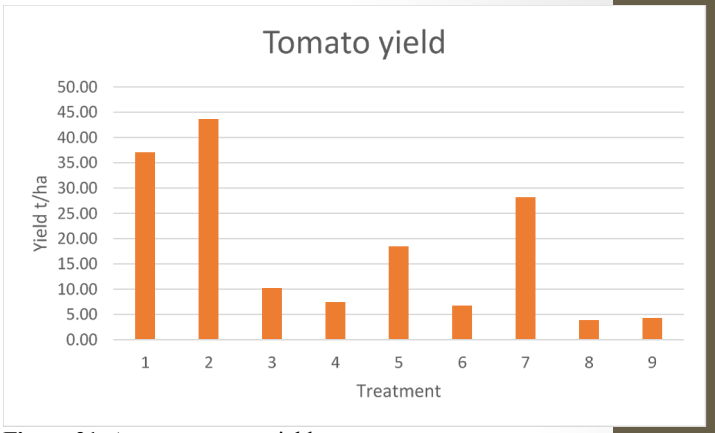
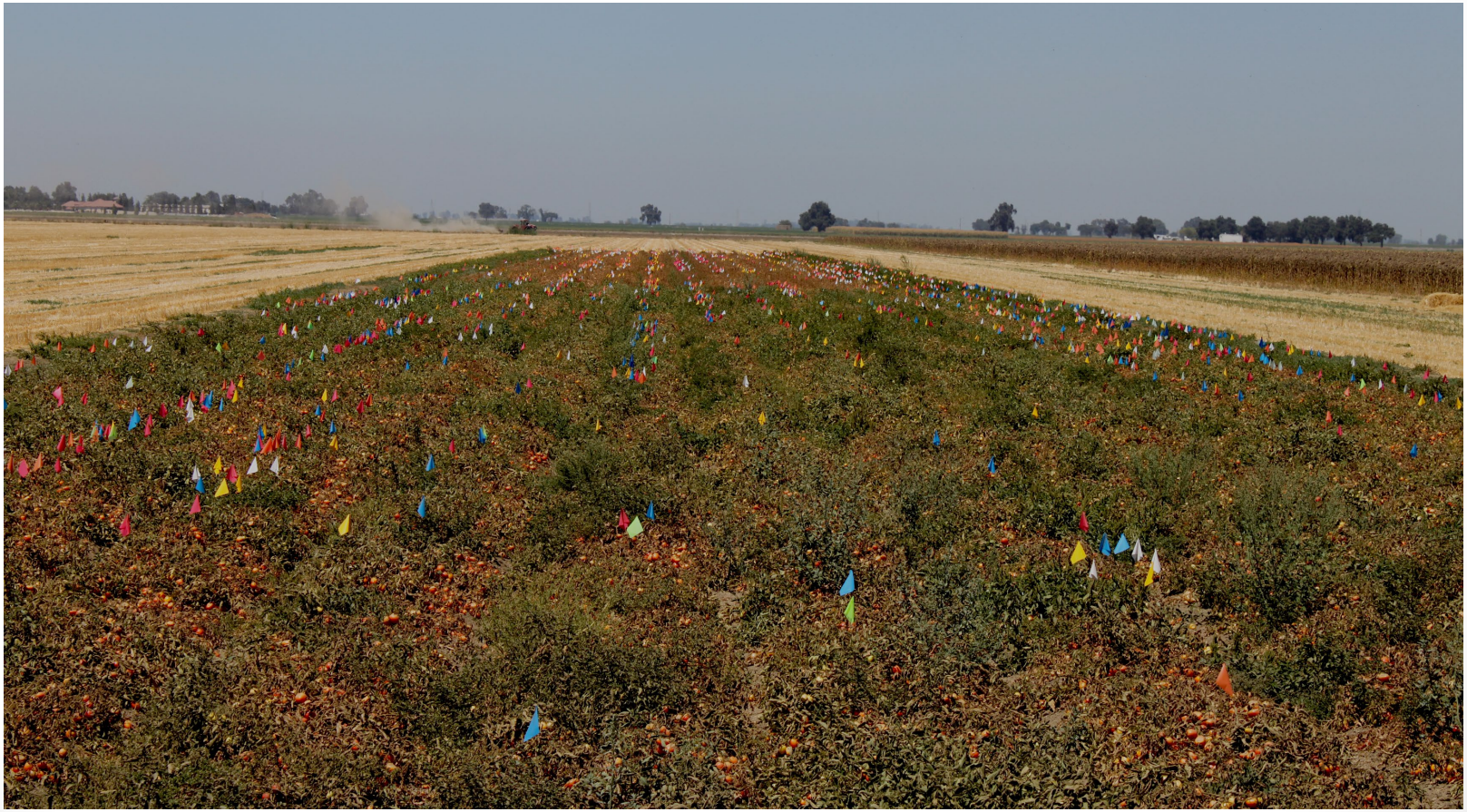


Figure 21. Average tomato yields.

Table 1. List of treatments

Treatment number	description
1	Grower treatment (metribuzin and rimsulfuron).
2	37.5 g ai/ha sulfosulfuron (PPI) + 37.5 g ai/ha sprayed 3 times at 200, 400 and 600 GDD
3	9.6 g ai/ha imazamox (chemigated 5 times)
4	19.2 g ai/ha imazamox (chemigated 5 times)
5	37.5 g ai/ha sulfosulfuron (PPI) + 9.6 g ai/ha imazamox (chemigated 5 times)
6	37.5 g ai/ha sulfosulfuron (PPI) + 19.2 g ai/ha imazamox (chemigated 5 times)
7	37.5 g ai/ha sulfosulfuron (PPI) + 4.8 g ai/ha imazapic (chemigated 5 times)
8	37.5 g ai/ha sulfosulfuron (PPI) + 28.8 g ai/ha imazamox (chemigated 5 times)
9	37.5 g ai/ha sulfosulfuron (PPI) + 38.4 g ai/ha imazamox (chemigated 5 times)

2020 = ~2700 broomrape clusters in 1.5 A
2021 = ~0 broomrape clusters in the same field

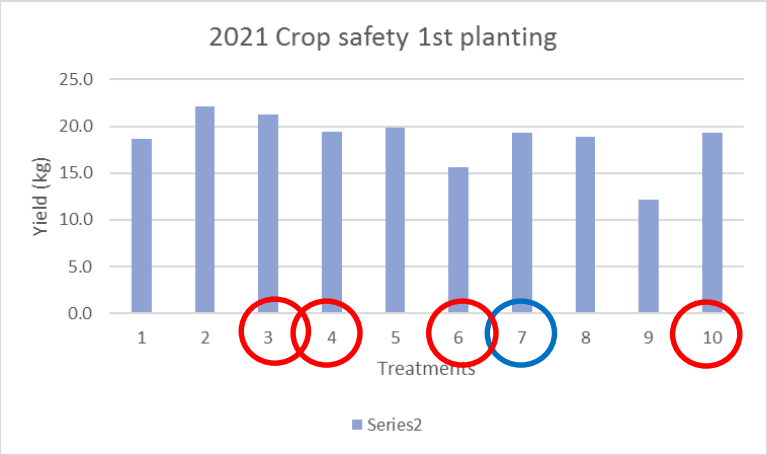


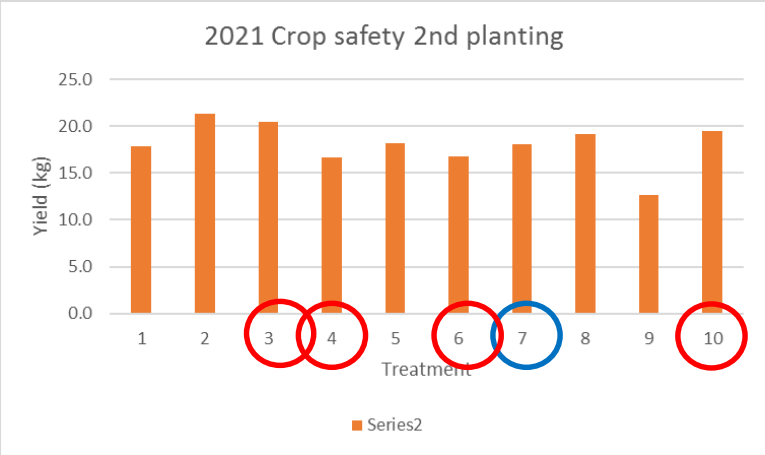
2021 California results

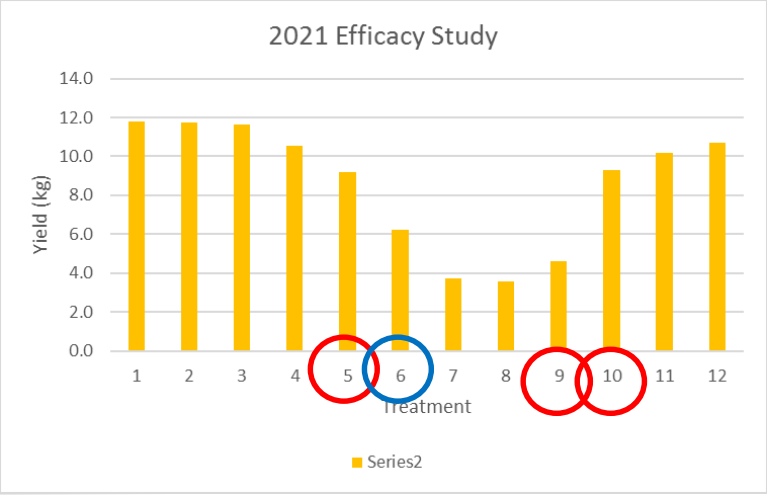
Imazamox at 9.6 g/ha

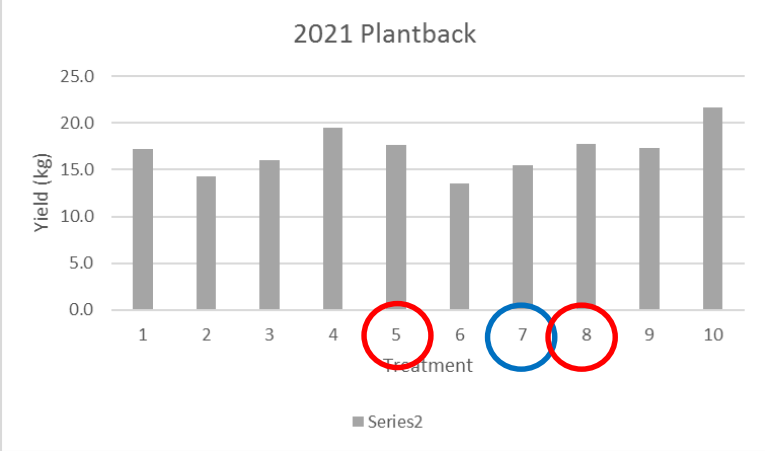
Imazamox at 19.2 g/ha

(prelim. Tomato yield – kg/sq m)









2022 objectives

1. Further evaluation of sulfosulfuron PPI treatments supplemented with imazamox and evaluation of modified rimsulfuron treatments and timing for control of branched broomrape in processing tomato in Chile during winter 2021-22.
2. Further evaluation of sulfosulfuron PPI treatments supplemented with imazamox and evaluation of modified rimsulfuron treatments and timing for control of branched broomrape in processing tomato in California during spring/summer 2022.
3. Evaluate the impacts of three tomato transplanting dates (early, mid, very late season) on broomrape emergence in infested field sites in Chile and California.
4. Conduct an initial cultivar sensitivity screening of commercial varieties to broomrape parasitism in the quarantine greenhouse at UC Davis.
5. If experimental use authorization permit not requiring crop destruct can be obtained in California for the most promising herbicide programs, a large-plot grower demonstration will be conducted.

Draft of 2022 herbicide trts

1. Grower treatment (e.g. trifluralin & metolachlor & rimsulfuron).
2. 9.6 g ai/ha imazamox (chemigated 5 times)
3. 19.2 g ai/ha imazamox (chemigated 5 times)
4. Chemigated rimsulfuron (3 trts, 1/3 of yearly max)
5. Foliar rimsulfuron (3 trts, 1/3 of yearly max)
6. 37.5 g ai/ha sulfosulfuron (PPI) + 9.6 g ai/ha imazamox (chemigated 5 times)
7. 37.5 g ai/ha sulfosulfuron (PPI) + 19.2 g ai/ha imazamox (chemigated 5 times)
8. 37.5 g ai/ha sulfosulfuron (PPI) + chemigated rimsulfuron (3 trts, 1/3 of yearly max)
9. 37.5 g ai/ha sulfosulfuron (PPI) + foliar rimsulfuron (3 trts, 1/3 of yearly max)
10. 37.5 g ai/ha sulfosulfuron (PPI) + 4.8 g ai/ha imazapic (chemigated 5 times)

What can I do NOW?

- #1. Clean equipment between fields
- #2. Scout fields and train field workers and farm staff to ID broomrape
  - Clean vehicles and footwear of irrigator and weed crews

- A best guess (but legal) herbicide approach to consider…

A herbicide approach to consider

- Rimsulfuron (e.g. Matrix) is used to control broomrape in some Mediterranean countries
  - Typical use is chemigated via drip system (this is NOT registered here!)
    - They apply rimsulfuron 3 times: ~30, 50, 70 days after transplanting
  - Also has been some research on foliar rimsulfuron applied at similar intervals; however, this was usually sprinkler-incorporated after application

- In fields of concern, you could consider POST applications of Matrix at ~30, 50, and 70 d after transplant
  - Label allows up to 4 oz product / A / yr. 4÷3=1.33 oz
  - Do not make more than 3 applications per year
  - 45 day PHI
- This broomrape timing will likely not be helpful for other problem weeds in tomato but "might" suppress or control broomrape at key phenological stages of this late-emerging parasitic plant
    - Caveat: this is legal, but I do not yet have efficacy data to know how well it will actually work

Draft of 2022 herbicide trts

1. Grower treatment (e.g. trifluralin & metolachlor & rimsulfuron).
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10. 37.5 g ai/ha sulfosulfuron (PPI) + 4.8 g ai/ha imazapic (chemigated 5 times)

- Project collaborators
  - CTRI, UCCE, UC Davis, Newe Ya'ar Research Center
  - UC Davis Chile Life Sciences Innovation Center
- Funding sources
  - California Tomato Research Institute
  - USDA-IR4 and CDFA-DPR grants
  - CDFA – Specialty Crop Block Grant funding
- Material support and cooperation
  - Ag Seeds: transplants and transplanting services
  - Grower/cooperator: land, equipment, crop management!

California Tomato Research Institute

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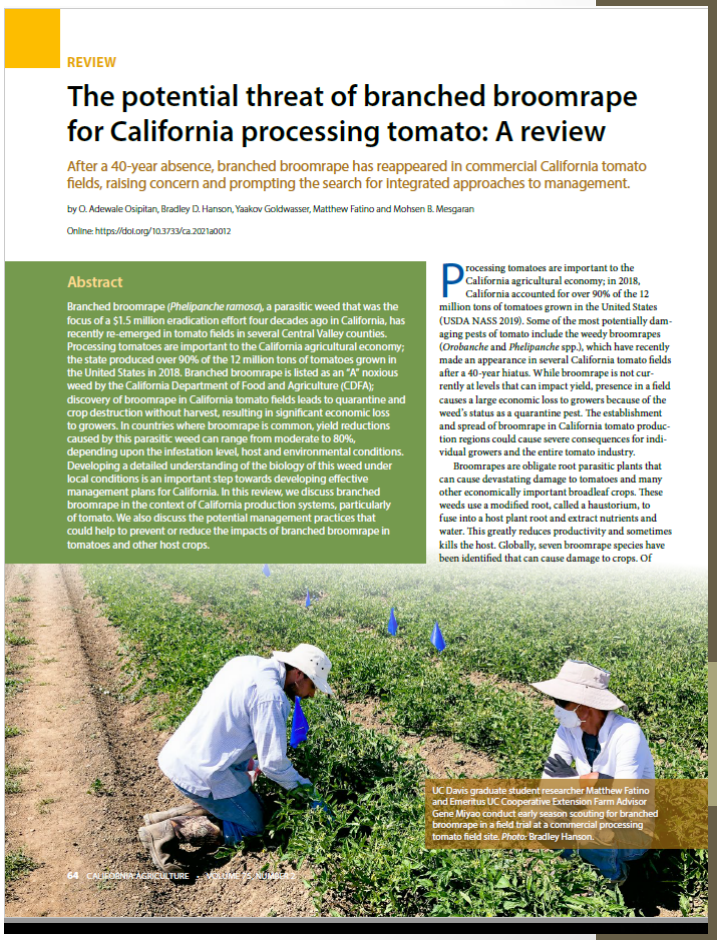
- April-June 2021 issue of “California Agriculture”
  - Online: https://doi.org/10.3733/ca.2021a0012



REVIEW

The potential threat of branched broomrape for California processing tomato: A review

After a 40-year absence, branched broomrape has reappeared in commercial California tomato fields, raising concern and prompting the search for integrated approaches to management.

by O. Adewale Osipitan, Bradley D. Hanson, Yaakov Goldwasser, Matthew Fatino and Mohsen B. Mesgaran

Online: https://doi.org/10.3733/ca.2021a0012

Abstract

Branched broomrape (*Phelipanche ramosa*), a parasitic weed that was the focus of a $1.5 million eradication effort four decades ago in California, has recently re-emerged in tomato fields in several Central Valley counties. Processing tomatoes are important to the California agricultural economy; the state produced over 90% of the 12 million tons of tomatoes grown in the United States in 2018. Branched broomrape is listed as an “A” noxious weed by the California Department of Food and Agriculture (CDFA); discovery of broomrape in California tomato fields leads to quarantine and crop destruction without harvest, resulting in significant economic loss to growers. In countries where broomrape is common, yield reductions caused by this parasitic weed can range from moderate to 80%, depending upon the infestation level, host and environmental conditions. Developing a detailed understanding of the biology of this weed under local conditions is an important step towards developing effective management plans for California. In this review, we discuss branched broomrape in the context of California production systems, particularly of tomato. We also discuss the potential management practices that could help to prevent or reduce the impacts of branched broomrape in tomatoes and other host crops.

Processing tomatoes are important to the California agricultural economy; in 2018, California accounted for over 90% of the 12 million tons of tomatoes grown in the United States (USDA NASS 2019). Some of the most potentially damaging pests of tomato include the weedy broomrapes (*Orobanche* and *Phelipanche* spp.), which have recently made an appearance in several California tomato fields after a 40-year hiatus. While broomrape is not currently at levels that can impact yield, presence in a field causes a large economic loss to growers because of the weed’s status as a quarantine pest. The establishment and spread of broomrape in California tomato production regions could cause severe consequences for individual growers and the entire tomato industry.

Broomrapes are obligate root parasitic plants that can cause devastating damage to tomatoes and many other economically important broadleaf crops. These weeds use a modified root, called a haustorium, to fuse into a host plant root and extract nutrients and water. This greatly reduces productivity and sometimes kills the host. Globally, seven broomrape species have been identified that can cause damage to crops. Of

UC Davis graduate student researcher Matthew Fatino and Emeritus UC Cooperative Extension Farm Advisor Gene Miyao conduct early season scouting for branched broomrape in a field trial at a commercial processing tomato field site. *Photo:* Bradley Hanson.