

Some insights on the seed bank dynamics of stinknet, a difficult weed to contain

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Introductions

- ▶ Stinknet was first found in North America in 1981 near Perris, CA
- ▶ Did not spread very much for the first 10-15 years after discovery, then it started moving
- ▶ By the mid 2000's it was widely distributed, but not very abundant, in several dozen sites in Southern CA and Southern AZ.

Current North America Distribution

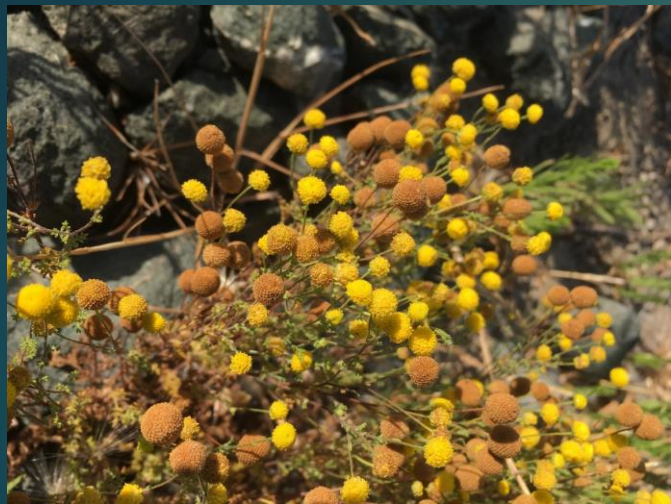


(Note: a few of these locations are incorrect IDs)

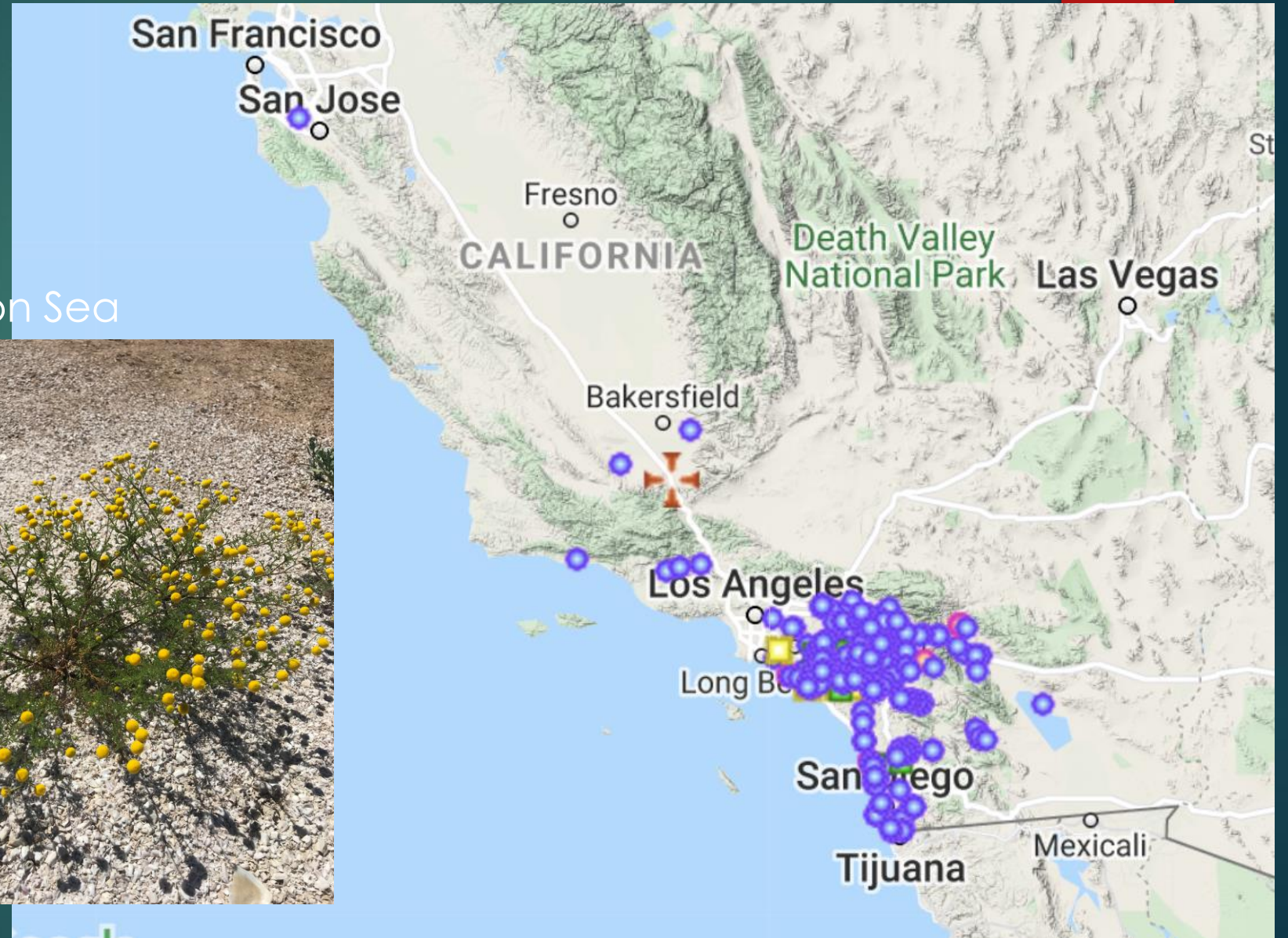
iNaturalist

California Distribution

Mountain
View



Salton Sea



Jennifer Mo

Daniel Cooper

www.CalFlora.org

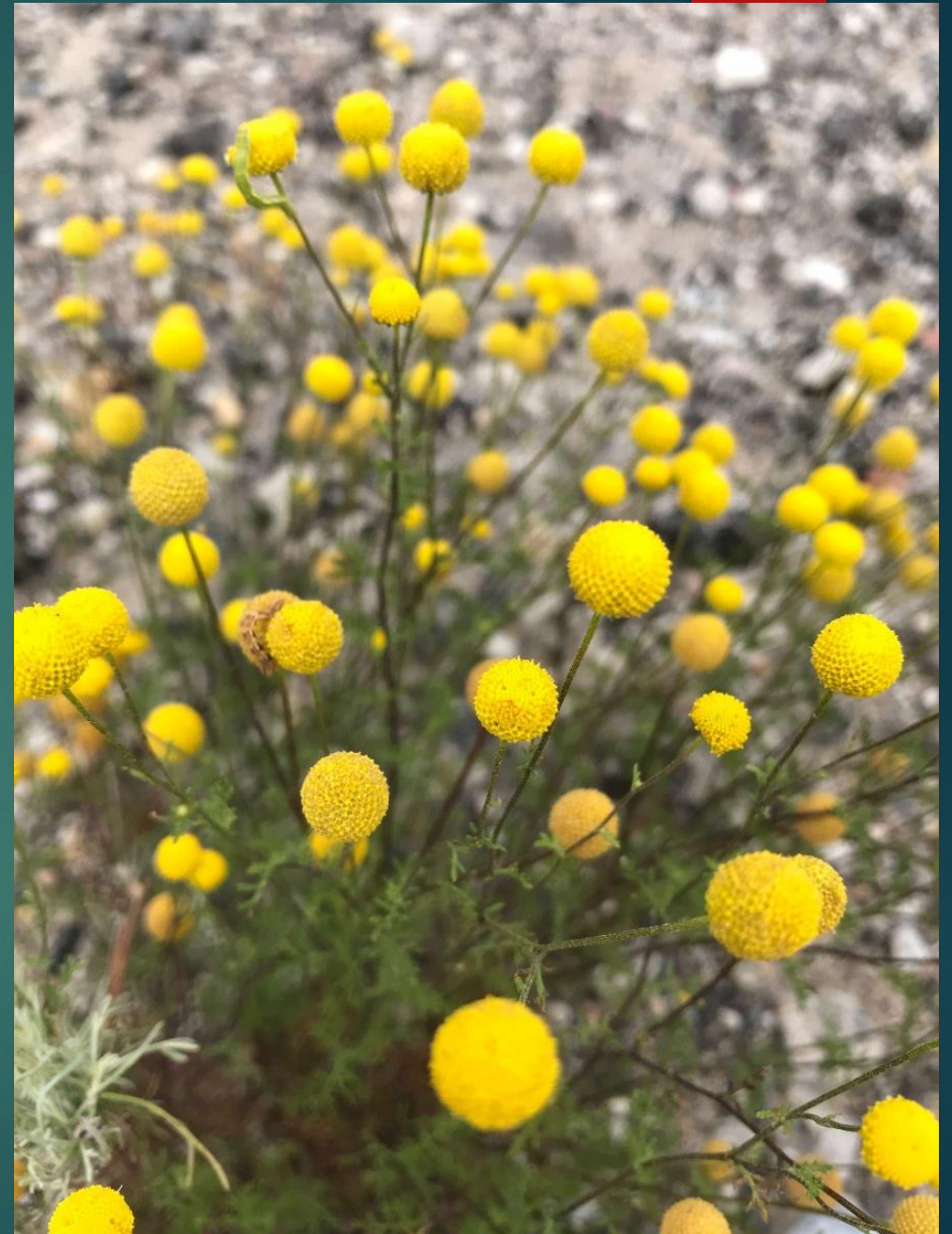
Identification

- ▶ About 6 in. to 3 ft. tall
- ▶ Grows as a rosette then mostly upright before flowering
- ▶ Seedlings and small plants difficult to ID
- ▶ Use your nose, it stinks!!
 - ▶ Piney, turpentine like
 - ▶ Often unpleasant



Identification

- ▶ Round, globe shaped flowers
- ▶ No long petals



Nicole Leatherman

Identification

- ▶ Doubly divided leaves



Ron Vanderhoff

Seed Bank Dynamics

- ▶ What is the seed bank?

- ▶ The seed bank is all the living seeds in the soil

- ▶ It includes:

 - Seeds that are likely to germinate under right conditions and dormant seeds

 - Dormant seed resists germination, seeds 'wait' to germinate even under the right conditions



Why is this important?

- ▶ Seed banks can answer several important questions
- ▶ How many years can this infestation last?
- ▶ How many seeds germinate after each rainstorm?
- ▶ Under what conditions do seeds germinate (light, dark, heat)?
- ▶ Can I kill this species with less work?

Germination

Alex Douglas

- ▶ Researchers in Australia have studied the stinknet seed bank
- ▶ Stinknet germinates at 15 and 25 C (59 and 77 F)
 - ▶ but not at 5 C (41 F) or over 35 C (95 F)
 - ▶ Douglas and Nicholson 2019



Germination: Management Implications

- ▶ Germinates under fall and mild winter weather conditions
- ▶ Unlikely to germinate when it is too cold
 - ▶ Is it unlikely to germinate in northern states and high elevations in winter or will it germinate in mild spring conditions?
- ▶ It can germinate in cool, wet late spring conditions in SoCal, including in wet or riparian areas, which means it can grow/bloom into the summer

Seed Production

- ▶ Produces 3,000 to 5,000 seeds on average and up to 100,000 on very large plants

(Douglas and Nicholson 2019)



Seed Production: Management Implications

- ▶ A few large plants can start a large infestation
- ▶ Missing a few large plants can allow an infestation to spread even if many small plants are removed



Longevity

- ▶ In Australia, seedlings were still found 5 years after plants had last set seed
- ▶ Up to 77% of seeds buried in packets were viable after 4 years

(Dodd and Lloyd 1989)



Longevity: Management Implications

- ▶ Likely a 4-5 year seed bank in Australia, possibly similar in California
- ▶ Seeds in California last at least 3 years, possibly longer
- ▶ It is reasonable to expect it to take 3-5 years to fully control an outbreak in CA



Seeds on Surface

- ▶ Do seeds germinate on the surface or when buried, light vs. dark?
- ▶ Nearly all stinknet seeds germinate in the light (39%) vs. dark (1%)
 - ▶ Douglas and Nicholson 2019



Seeds on Surface: Management Implications

- ▶ If stinknet seeds can be buried, such as under a tarp or mulch, it should be an effective control strategy
- ▶ Stinknet should also have a hard time germinating under the dense canopy of shrubs (like chaparral) or trees (like oak)
 - ▶ Field observations seem to confirm this experimental result

Burial Duration

- ▶ Seeds in Australia were buried in small mesh bags at 3 different depths (0, 2, and 10 cm deep) and then exhumed after different time periods (3, 6, 12 and 24 months),
- ▶ This study mimics burial by tilling in ag. for different time periods
- ▶ Douglas and Nicholson 2019, Douglas unpub. data



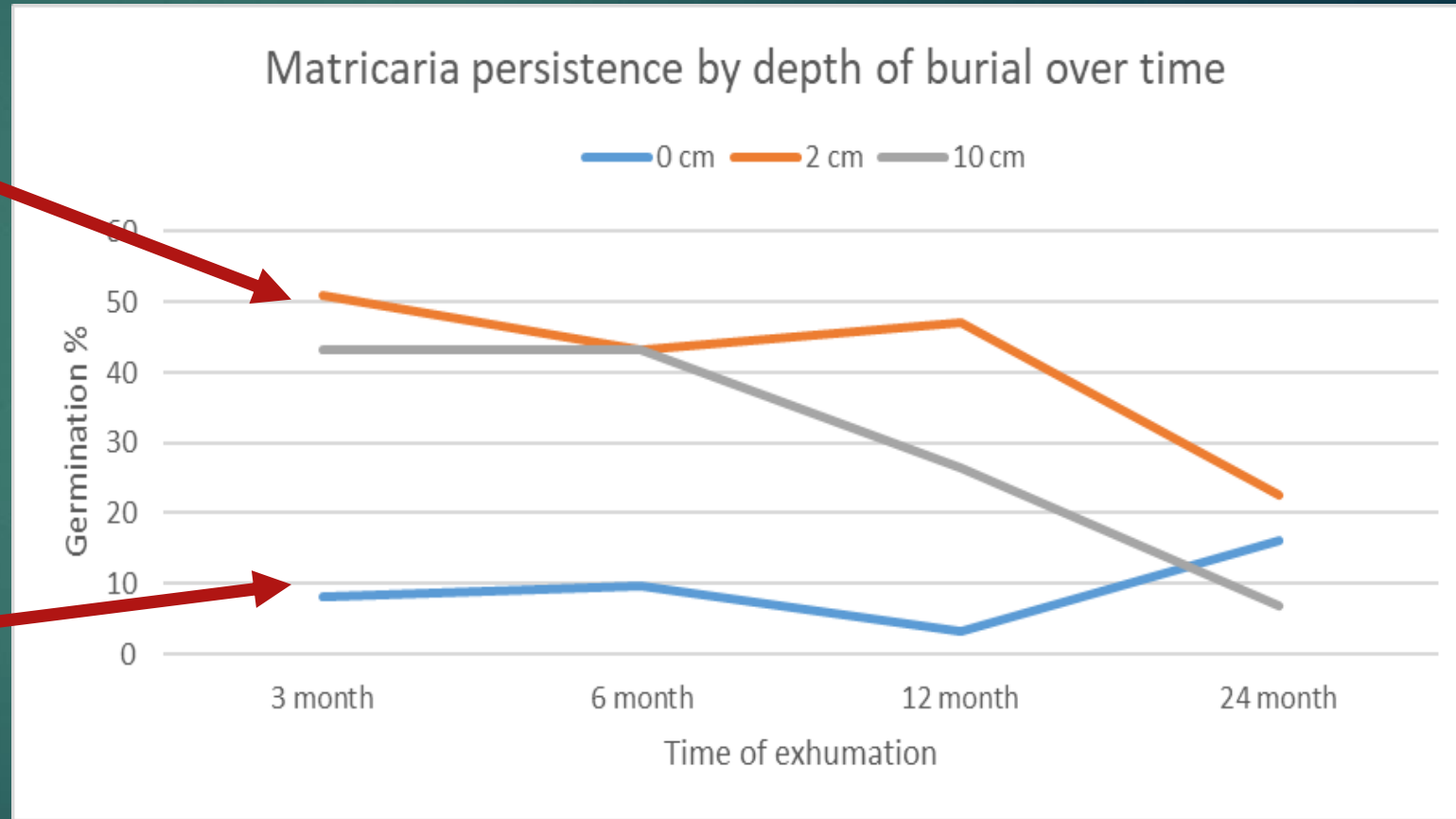
Alex Douglas



Burial

Seeds that were buried and then dug up had a high germination rate and remained viable for 2 years

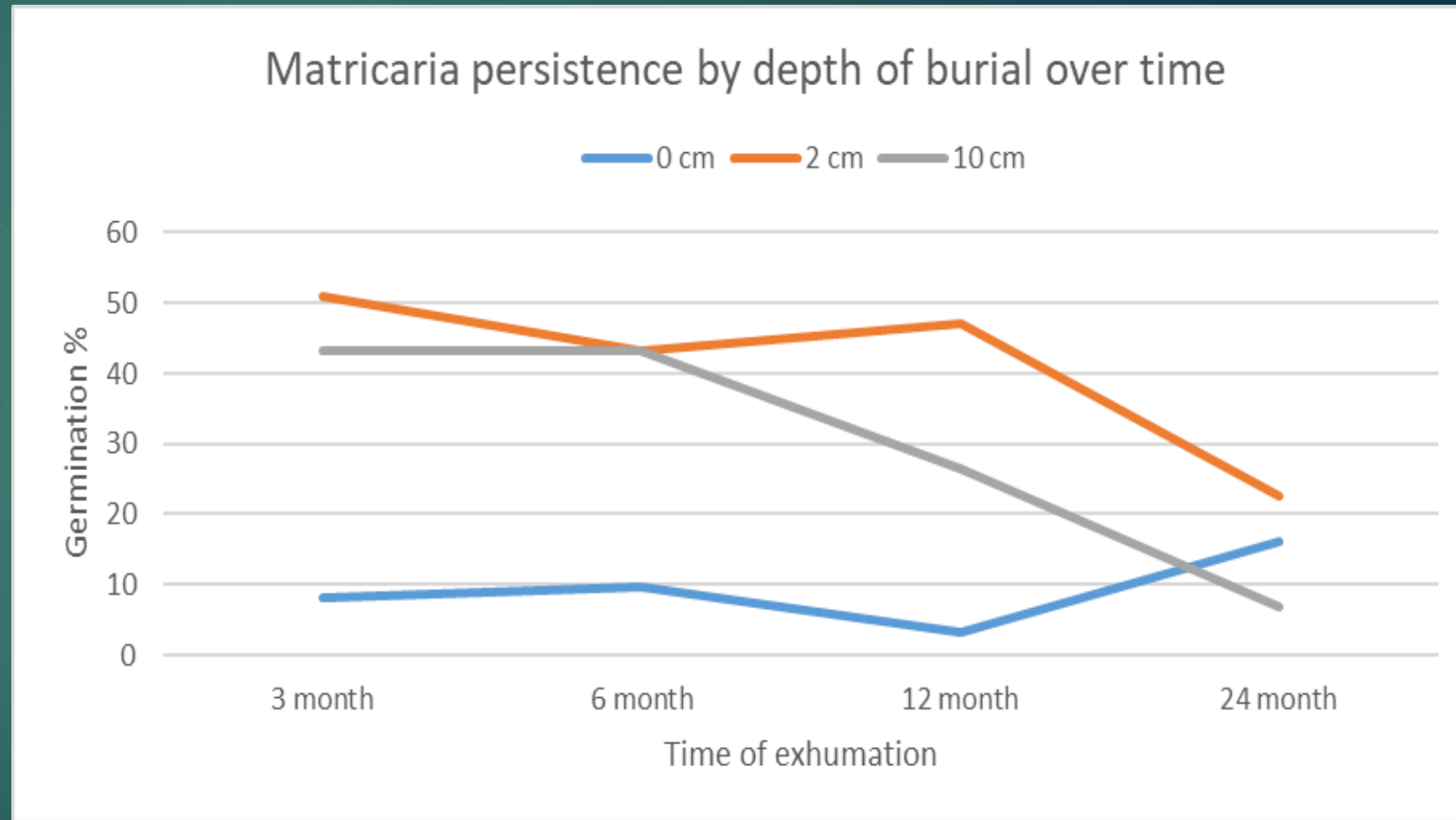
Note: Seeds on the surface may have germinated and died in the bags, confounding this result



Burial: Management Implications

Seeds that are buried and then surface will be viable for at least 2 years

Mulch and other treatments will need to be consistent for more than 2 years to be effective



Cohorts

- ▶ How many times can stinknet seeds germinate in a year?
- ▶ Placed 15 plots near Perris, CA in each fall/winter of 2017, 2018, and 2019 (45 total)
- ▶ Counted and removed all seedlings in each plot after each storm



Cohorts

- ▶ The largest cohort germinates with the first rains, subsequent cohorts are much smaller (2-3 smaller ones)
- ▶ 80% of seedlings germinated by February 2018
 - ▶ First rain Jan.
- ▶ 97% of seedlings germinated by January 2019
 - ▶ First rain Dec.



Cohorts: Management Implications

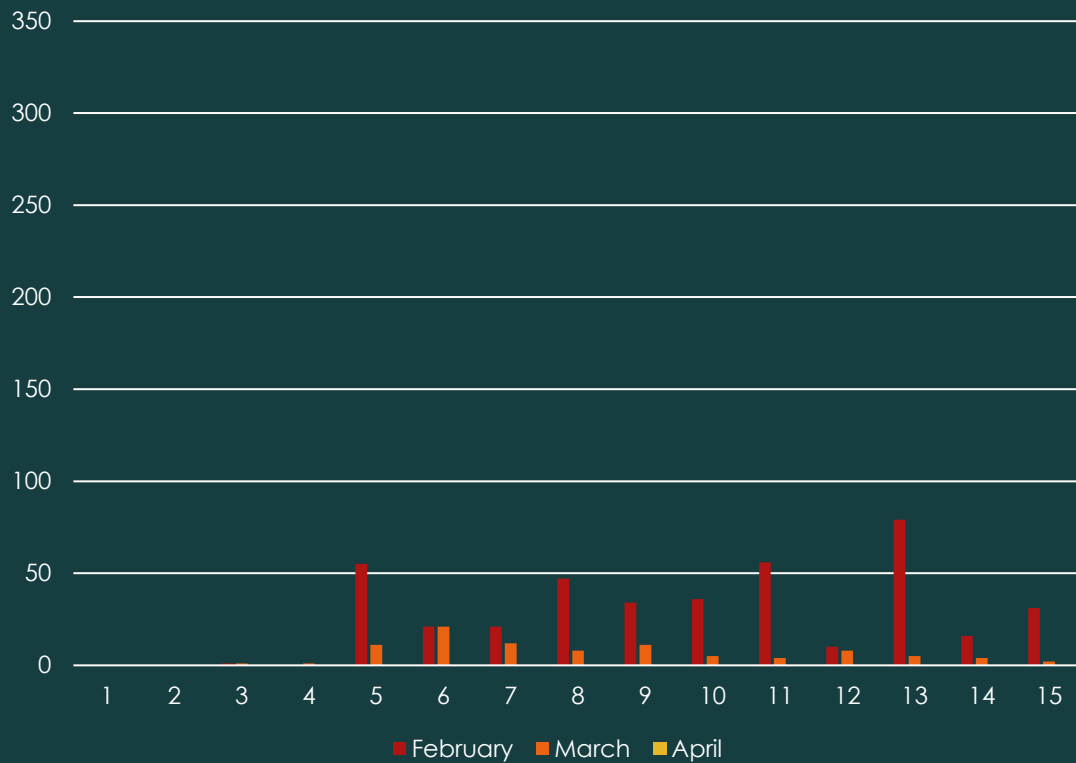
- ▶ Can manage most (80-90+%) plants early in the season
 - ▶ Generally about 1 month after first large rain
- ▶ Pre-emergent herbicides can provide good control
- ▶ Follow up treatments will be needed



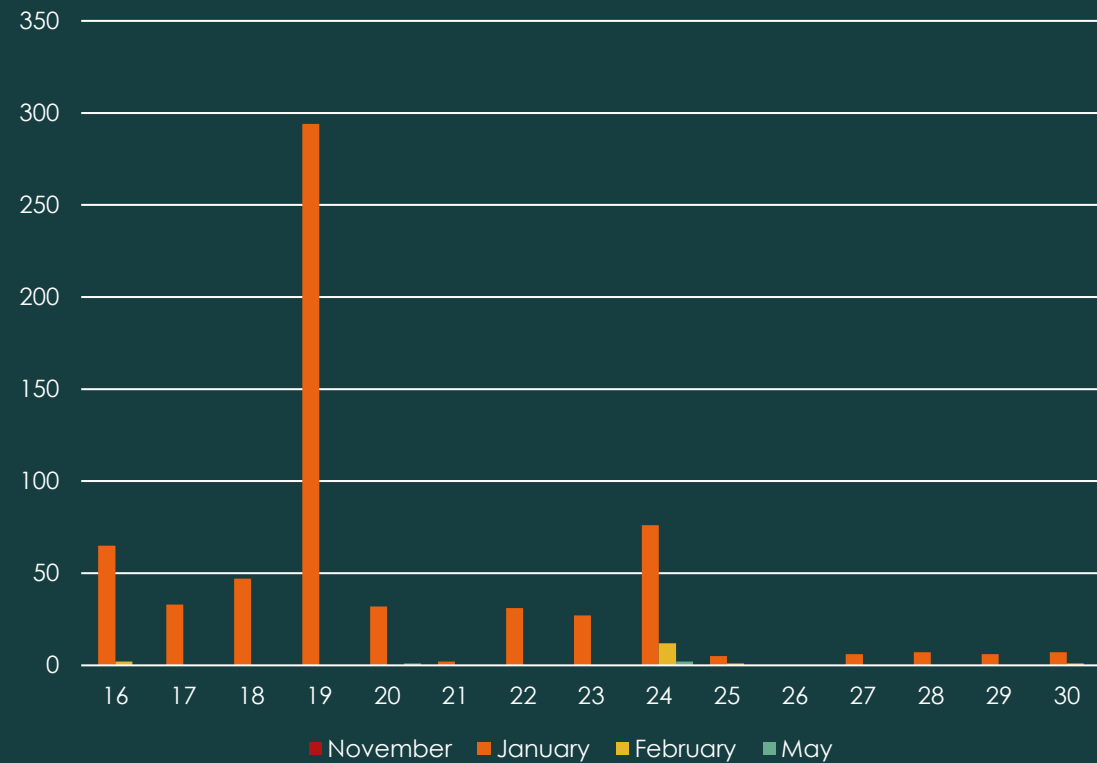
Cohorts

► 2017-2019 data

2017-2018 Stinknet Seedling Cohorts



2018-2019 Stinknet Seedling Cohorts



Cohorts

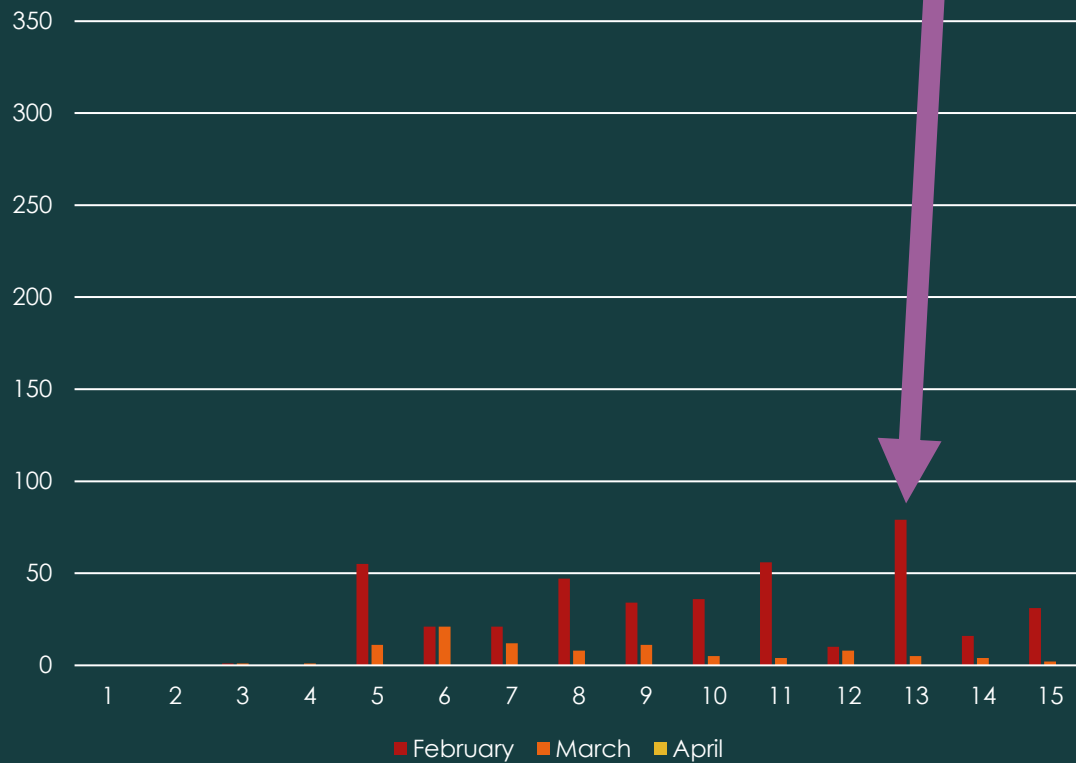
Spring 2018 drought
Spring 2019 wetter

► 2017-2019 data

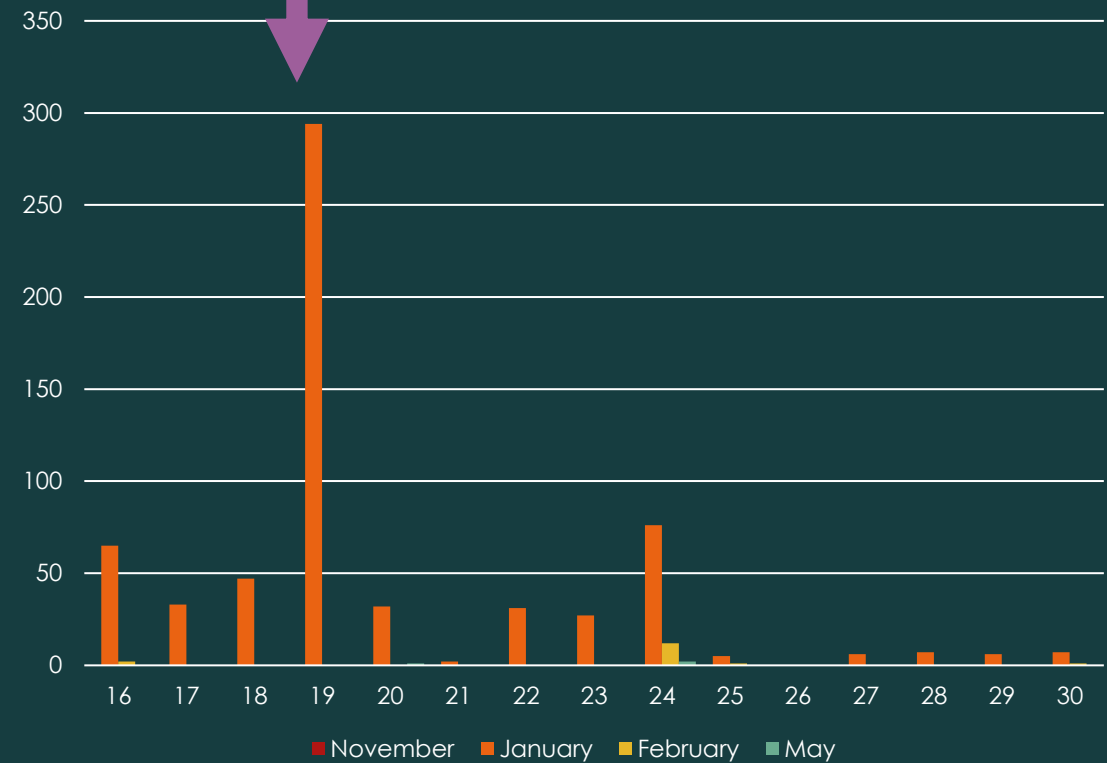
80 seedlings

300 seedlings

2017-2018 Stinknet Seedling Cohorts



2018-2019 Stinknet Seedling Cohorts

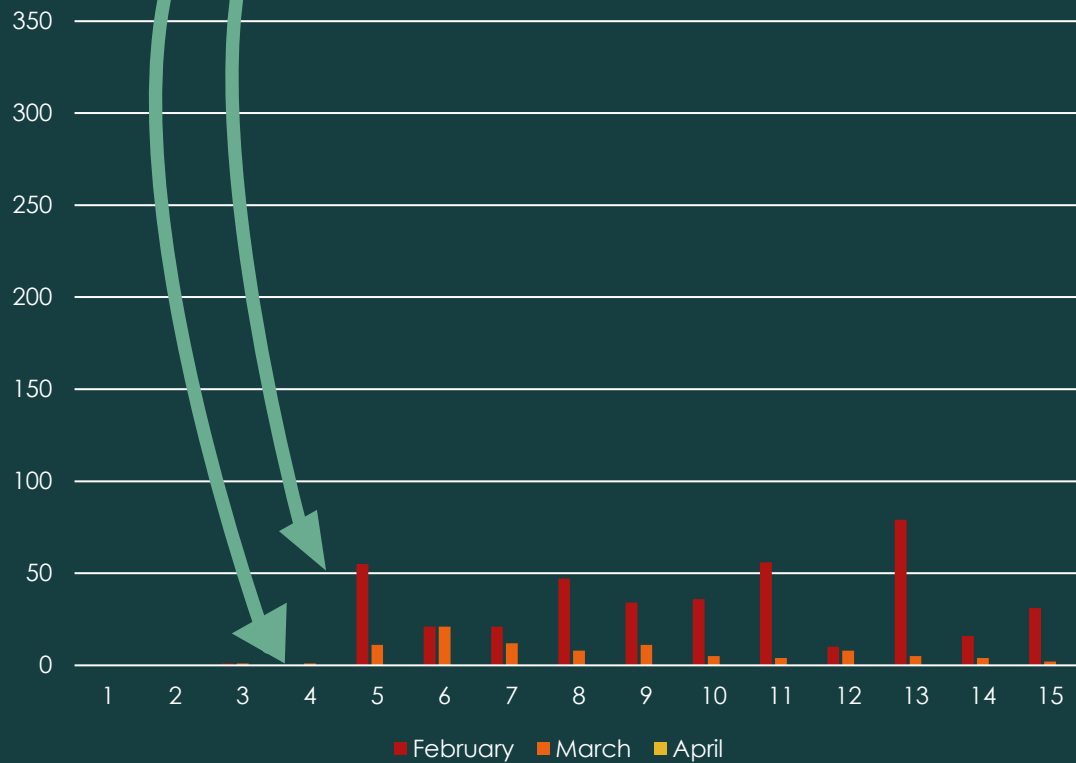


Cohorts

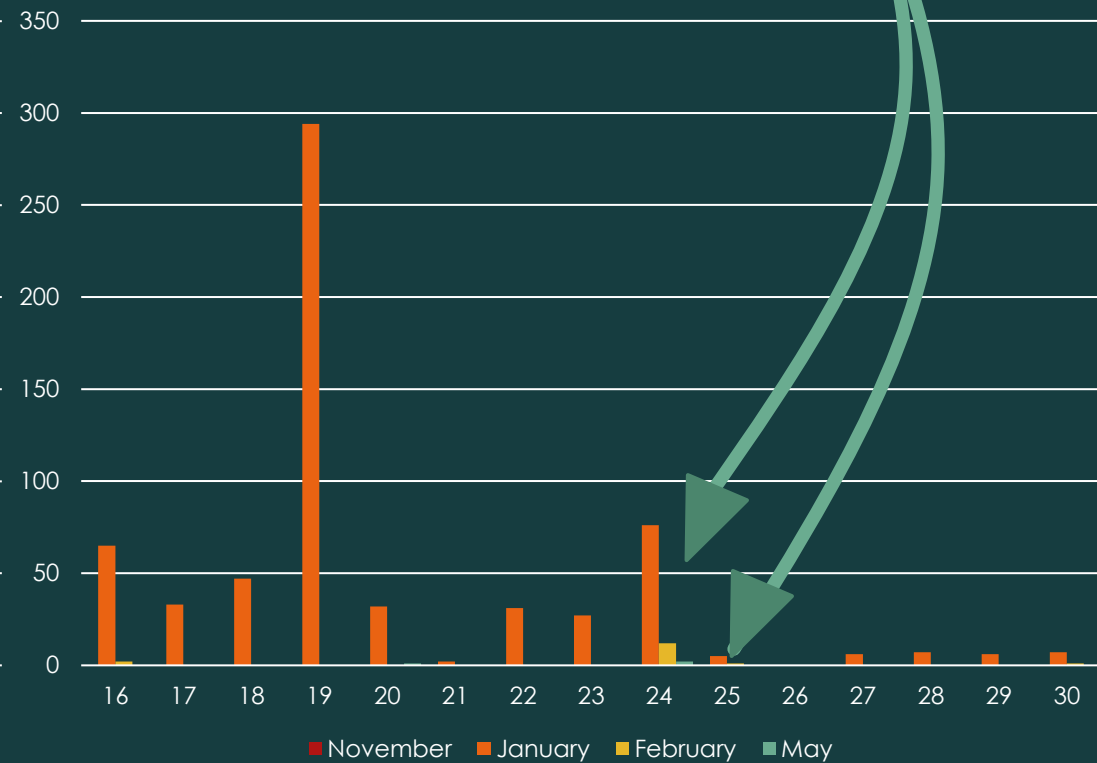
Number of seedlings in plots next to each other is highly variable
From dozens to zero plants

► 2017-2017 data

2017-2018 Stinknet Seedling Cohorts



2018-2019 Stinknet Seedling Cohorts



Cohorts 2020

- ▶ Dec 2019, was a disaster
(a prelude of things to come?)
- ▶ Many plots had 1 stinknet seedling per sq. cm. (6 per sq. in.), estimated 5-600 seedlings per plot
- ▶ Way too dense to pull and count individual stinknet seedlings





31 seedlings in this pic
~15 cm sq (4.8 x 3.2
cm)
2.1 seedlings per sq.
cm.
21,000 plants per m²

1 inch



1 inch

California



1 inch

Australia

Summary

- ▶ Stinknet seeds spread
- ▶ Seeds may live up to 5 years, 4 very likely
- ▶ Germinates in the light, near the soil surface
- ▶ Seedlings are tiny
- ▶ Mulch can provide good control
- ▶ Most (80-90+%) seeds germinate after first large rainstorm
- ▶ Pre-emergent herbicides can provide good control
- ▶ Stinknet patches can be very dense



Questions?

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