Using Organic Herbicides on Roadsides and ROW: Evaluating Effectiveness and Costs

Note: Unpublished data in results:
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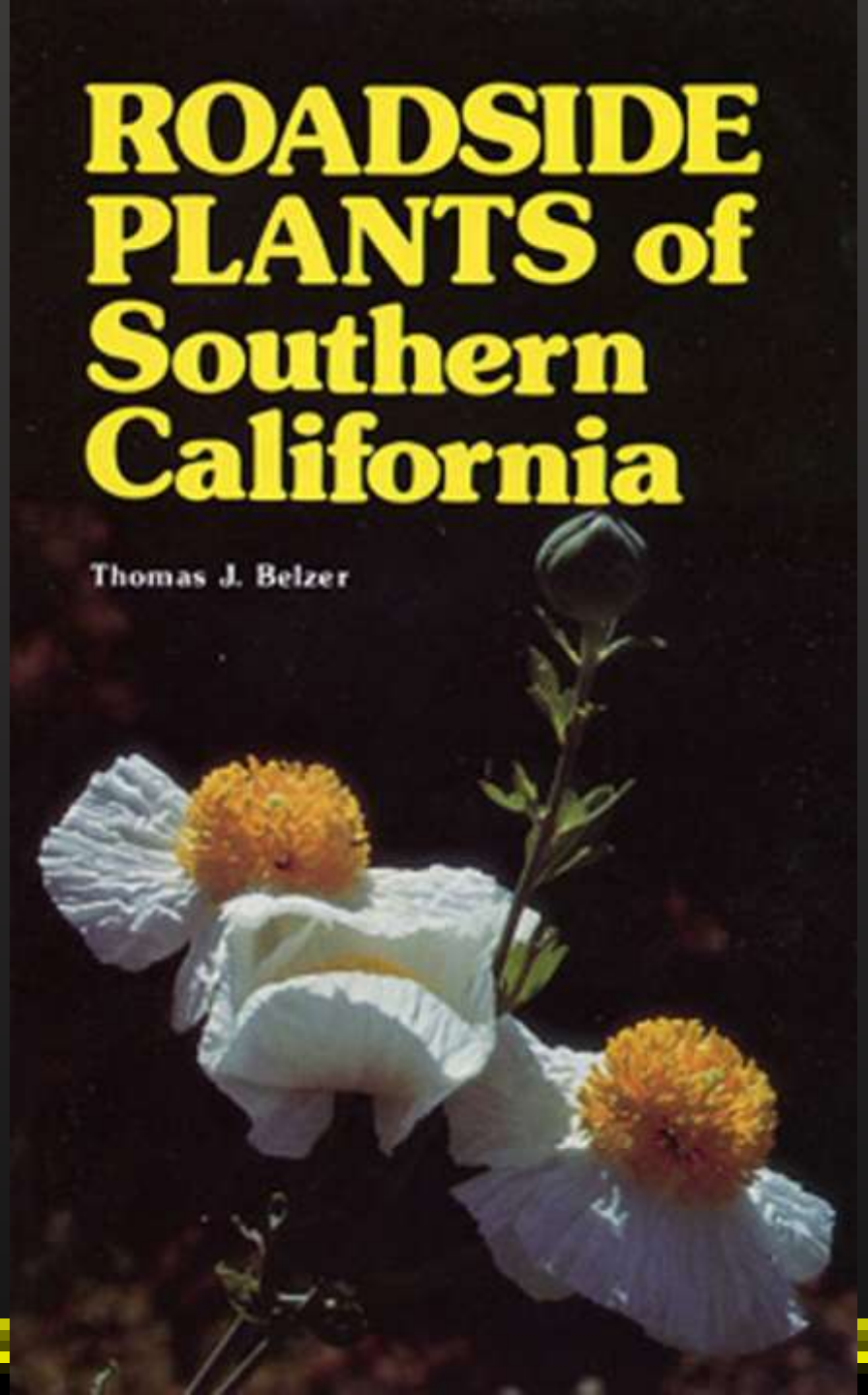
Why Manage Roadsides?

- Maintain road and shoulder structure
- Reduce maintenance and operations costs
- Maintain visibility
- Reduce fire hazards
- Reduce driving dangers and debris
- Aesthetically pleasing
- Low water usage
- Be good managers
- And others…



IPM and the Public

- As part of our Integrated Pest Management program for roadsides managers are striving to reach targets and improve methods of weed control
- The public is also concerned about roadside managers using herbicides, especially glyphosate
- The public is also interested in the use of organic herbicides as a potential substitute for glyphosate-based herbicides

Experimental Purpose

- We designed an experiment to test the use of glyphosate, non-glyphosate synthetic herbicides, and organic herbicides to control roadside vegetation in San Diego County

Research Objectives

- 1- Evaluate the efficacy of non-glyphosate and organic herbicides
- 2- Determine the number of applications to achieve targeted level of weed control
- 3- Determine costs to achieve desired levels of weed control

Example target conditions
Minimal residual vegetation

Practical Considerations

- Tests were conducted on roadsides (not test sites) with standard roadside equipment (injection sprayer w/ boomless ‘nutating’ nozzles) to ensure roadside effects would be incorporated in the experiment
- Herbicides had to control a broad spectrum of weeds on site (annuals, perennials, grasses, broadleaves)

Practical Considerations

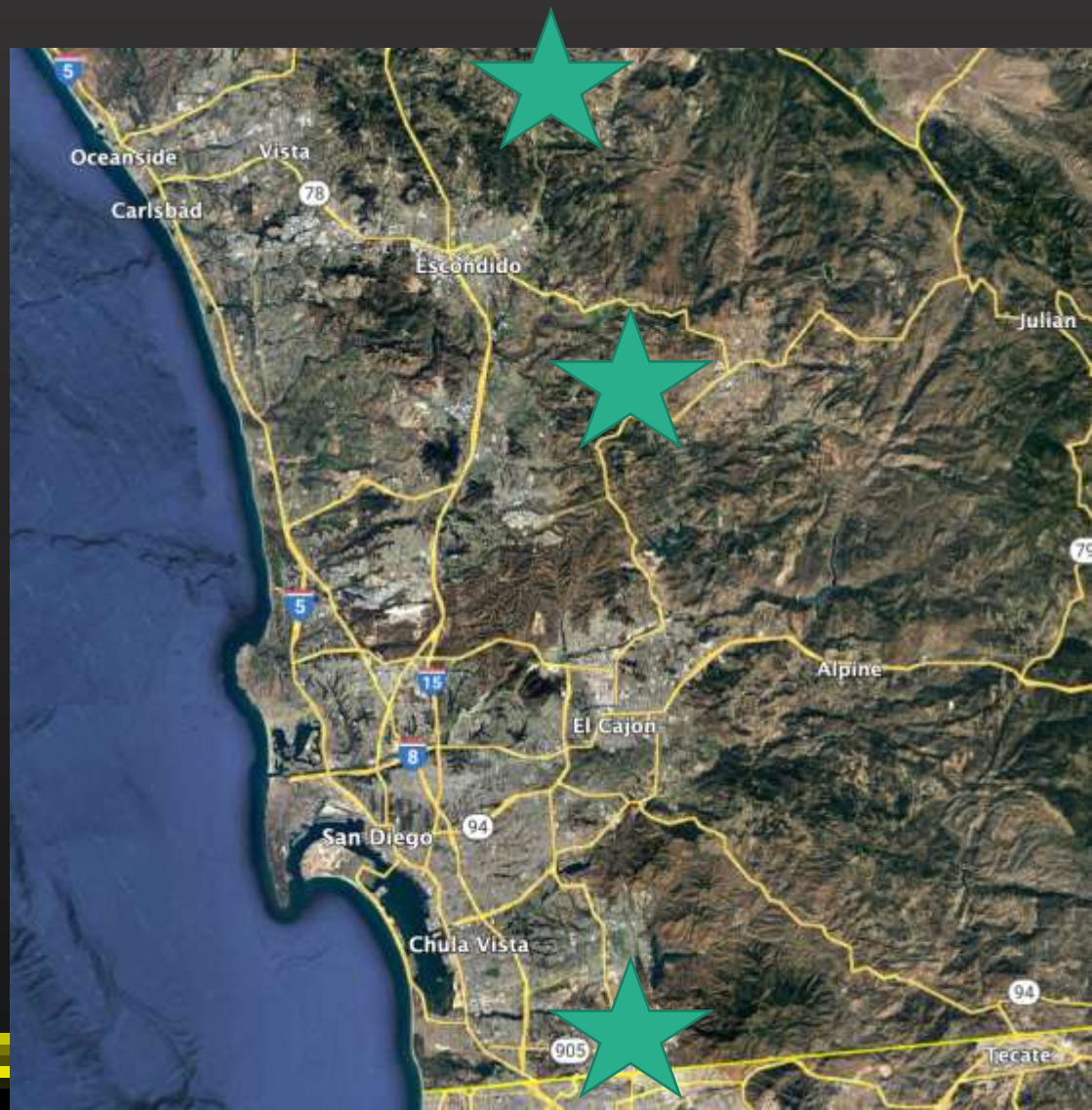
- Use rates had to be less than 10%, standard truck configuration ~8% max
- Applications had to conform to typical work schedule
  - Repeat applications at 1-month intervals
- High deference for applicator and public safety = low signal words, Caution label or lower (no Warning or Danger labels)

Quick Tangent on Organics and Safety

- The term organic (per gov't regulations) relates to the origin of the chemical and how it is manufactured
- In general, USDA "organic" products comes from natural sources and/or have not been synthesized
- Organic herbicides can have Caution, Warning or Danger signal words on label
- Signal word determines acute toxicity, it is not related to organic certification
- For example, organic Danger products can cause more acute harm than synthetic Caution products

Site Locations

- Plots located in 3 sites in San Diego County:
- Valley Center
- Ramona
- Otay Mesa



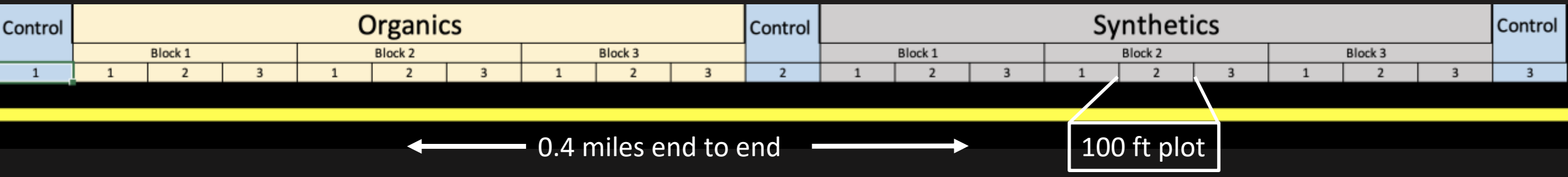
Ramona

Otay Mesa

Valley Center

Methods

- 7 treatments (3 organic, 3 synthetic, 1 untreated control) with 3 replications at each site = 21 plots, randomly in a linear pattern at 50 GPA
- Treatments were 100 ft. long and only middle 80 ft. were measured (20 ft. buffer between treatments) and 4-8 ft. wide depending on shoulder
- Organic and synthetic products sprayed on different ends of site to reduce any cross contamination, and prevent mis-applications



Chemicals and Rates

- Synthetic Herbicides:
- Glyphosate @ 72 ozs./ac. (2.25 qts./ac)
- Cheetah Pro (glufosinate) @ 48 ozs./ac. and 34 ozs./ac. (max annual rate)
  - NOTE: Glufosinate current (2022) label rate: 82 ozs./ac./app. and 246 ozs./ac. annual max, which is 3X higher annual rate then used in this study
- Milestone (aminopyralid) @ 5 ozs./ac and Oust (sulfometuron-methyl) @ 3 ozs. /ac.

Chemicals and Rates

- Organics: Rejected more than 20 organic products that did not meet project requirements

- We used:
- Weed Zap = Clove oil (45%) + cinnamon oil (45%) @ 5% (maximum single application rate)
- Fireworxx = Caprylic acid (44%) + capric acid (36%) @ 6-8% (9% maximum single application rate)
  - Caprylic + Capric acids can come in Caution (Fireworxx) or Warning (Suppress) labelled products. We used Caution label product (different % a.i.'s)

A Note on Organics: Stop Use Notices

- Two other organics were selected, but were stopped

- Two organic products were selected, however CDFA issued a stop use order alleging the products were adulterated with glyphosate and other synthetic active ingredients

Data Collection

- Data were collected:
- 7 d Before T (pretreatment) and then 7, 14 and 30 DAT (days after treatment) after each follow up treatment
- Repeated treatments monthly as needed (surveyed 7, 14, 30, 37, 44, 60, 67, 74, 90 DAT, etc.)
- And then monthly surveys (120, 150 DAT)

- Collected data on weed control (10=100% control, 0= no control), and end of season biomass

Results: Study Sites

- Sites were dominated by non-native winter annual weeds
- Mostly annual grasses (oats, bromes, barleys, perennial ryegrass, fescues)
- Some broadleaves (thistles, tocolote, tumbleweed, mustards, storkbill)
- Few native perennials, few native wildflowers
- All sites received ~40-50% below average rainfall in 2020-2021, i.e. drought, => short growing season, few summer annuals

Results: Objective 1 - Efficacy?

- What was the effectiveness of the non-glyphosate synthetic herbicides and organic herbicides compared to glyphosate and untreated controls?

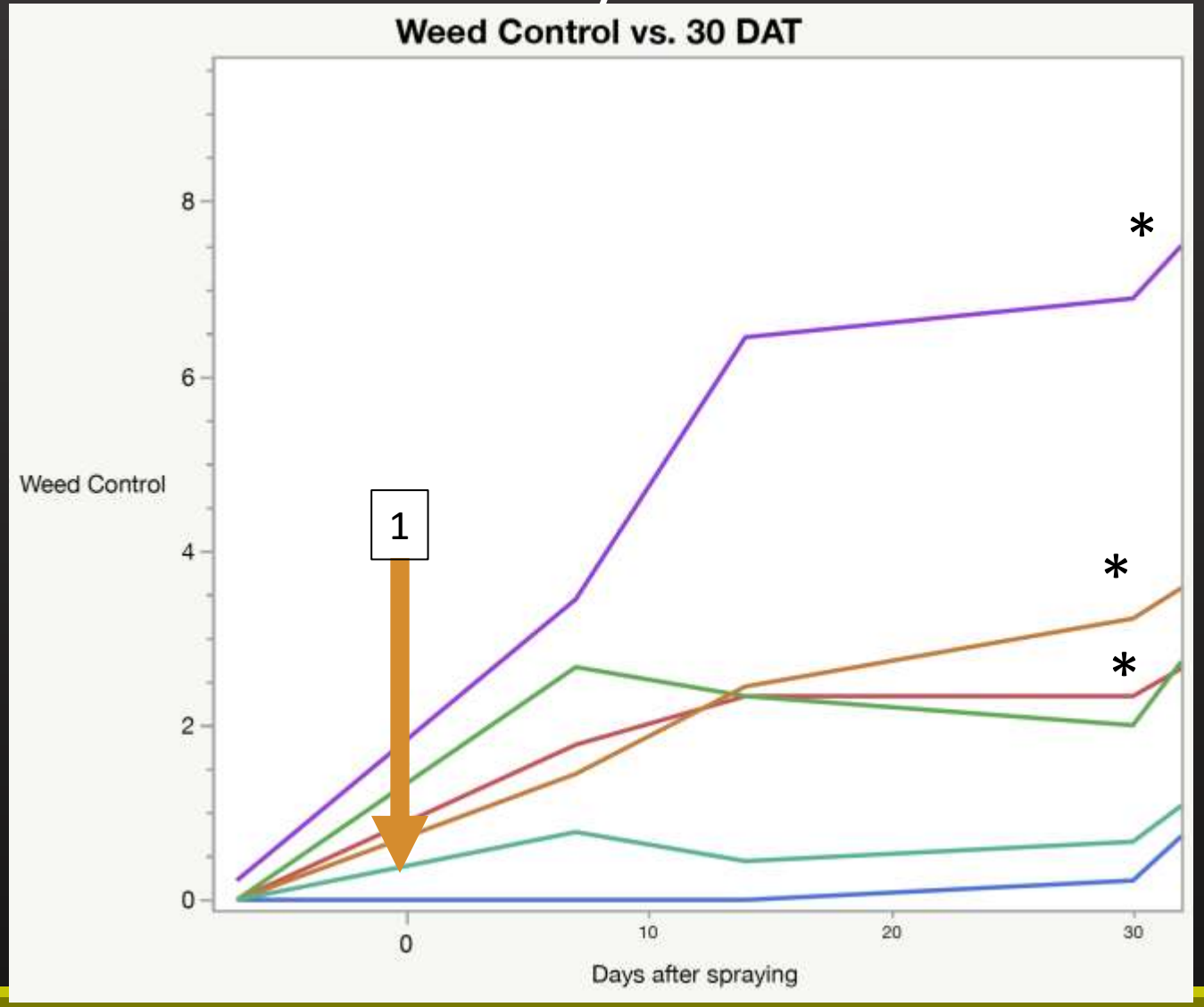
Control	Organics									Control	Synthetics									Control
	Block 1			Block 2			Block 3				Block 1			Block 2			Block 3			
1	1	2	3	1	2	3	1	2	3	2	1	2	3	1	2	3	1	2	3	3

Unpublished data in results: Do Not Cite

Results: Objective 1 - Efficacy?

- 30 DAT
- Glyphosate had significantly highest control (~70%)
- Other synthetics sig. higher than untreated
- Organics had lowest control, not sig. diff. from untreated

*- indicates significantly different from untreated plots at same DAT



Glyphosate

Milestone+ Oust

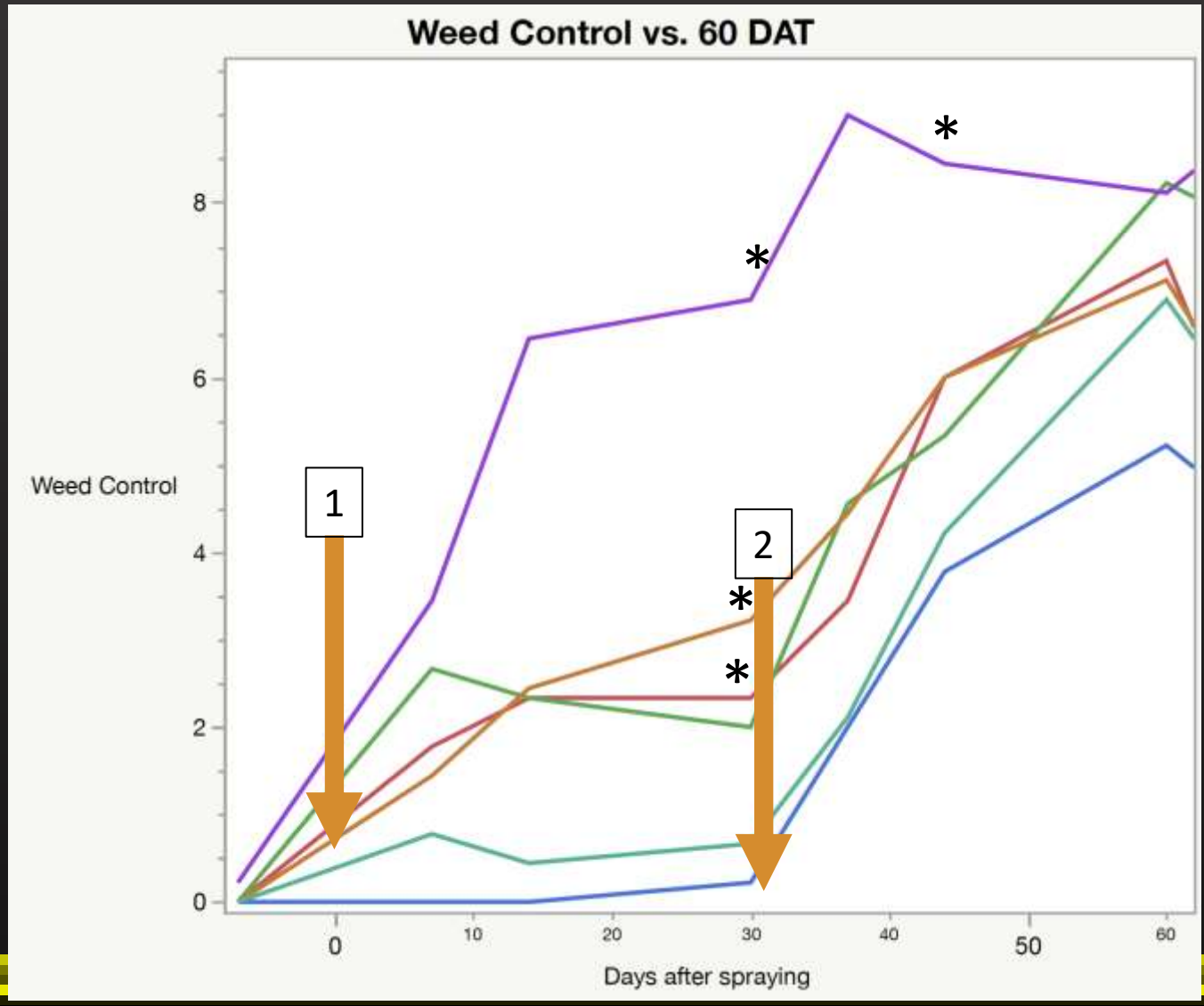
Cheetah Pro Fireworxx

Weed Zap Control

Results: Objective 1 - Efficacy?

- 60 DAT
- 2nd treatment for all herbicides except glyphosate
- Max annual rate for Cheetah Pro and Milestone+Oust

*- indicates significantly different from untreated plots at same DAT



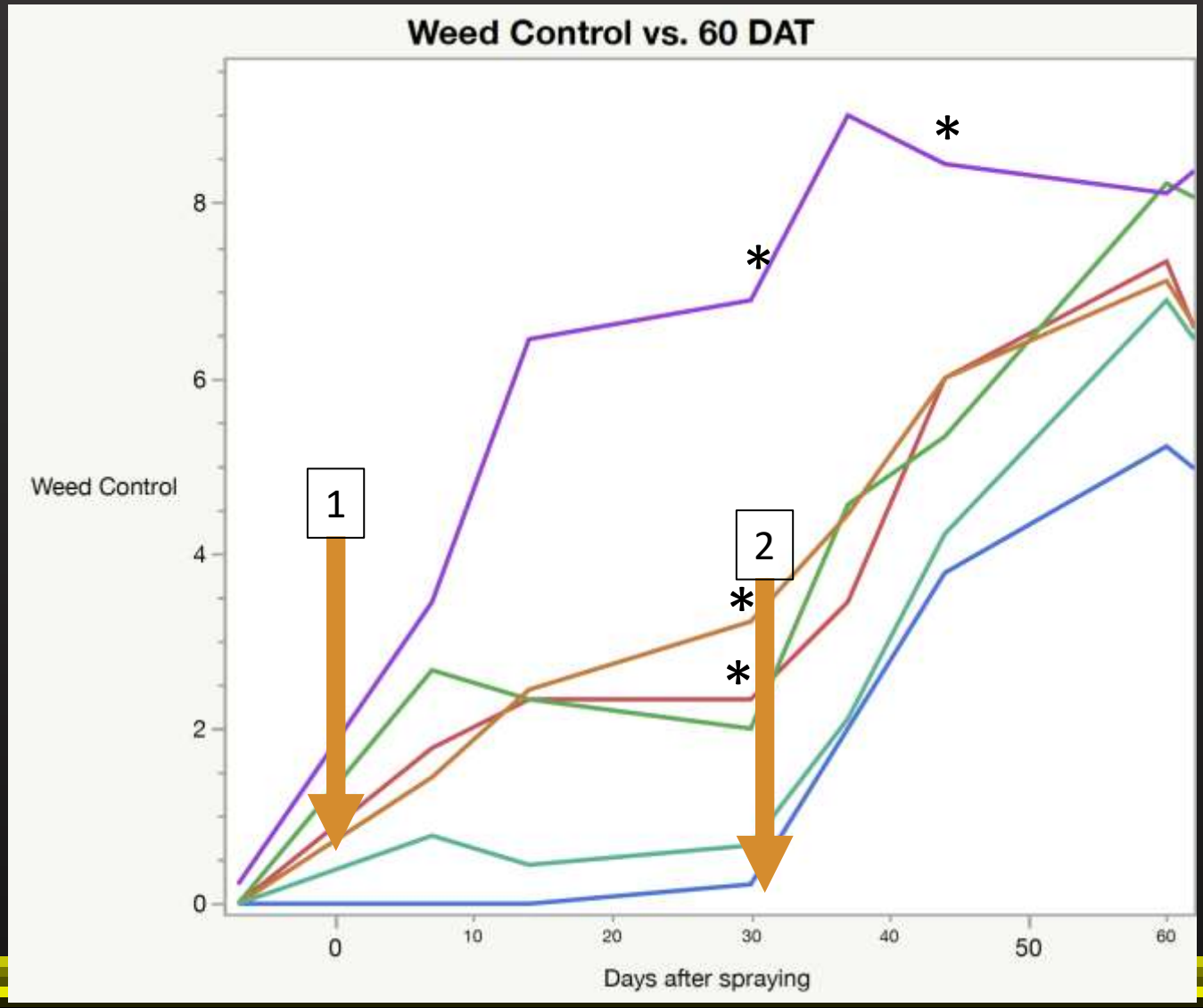
Glyphosate
Fireworxx

Mile+Oust
Cheetah Pro
Weed Zap

Control

Results: Objective 1 - Efficacy?

By 60 DAT No significant differences between any treatment and control plots

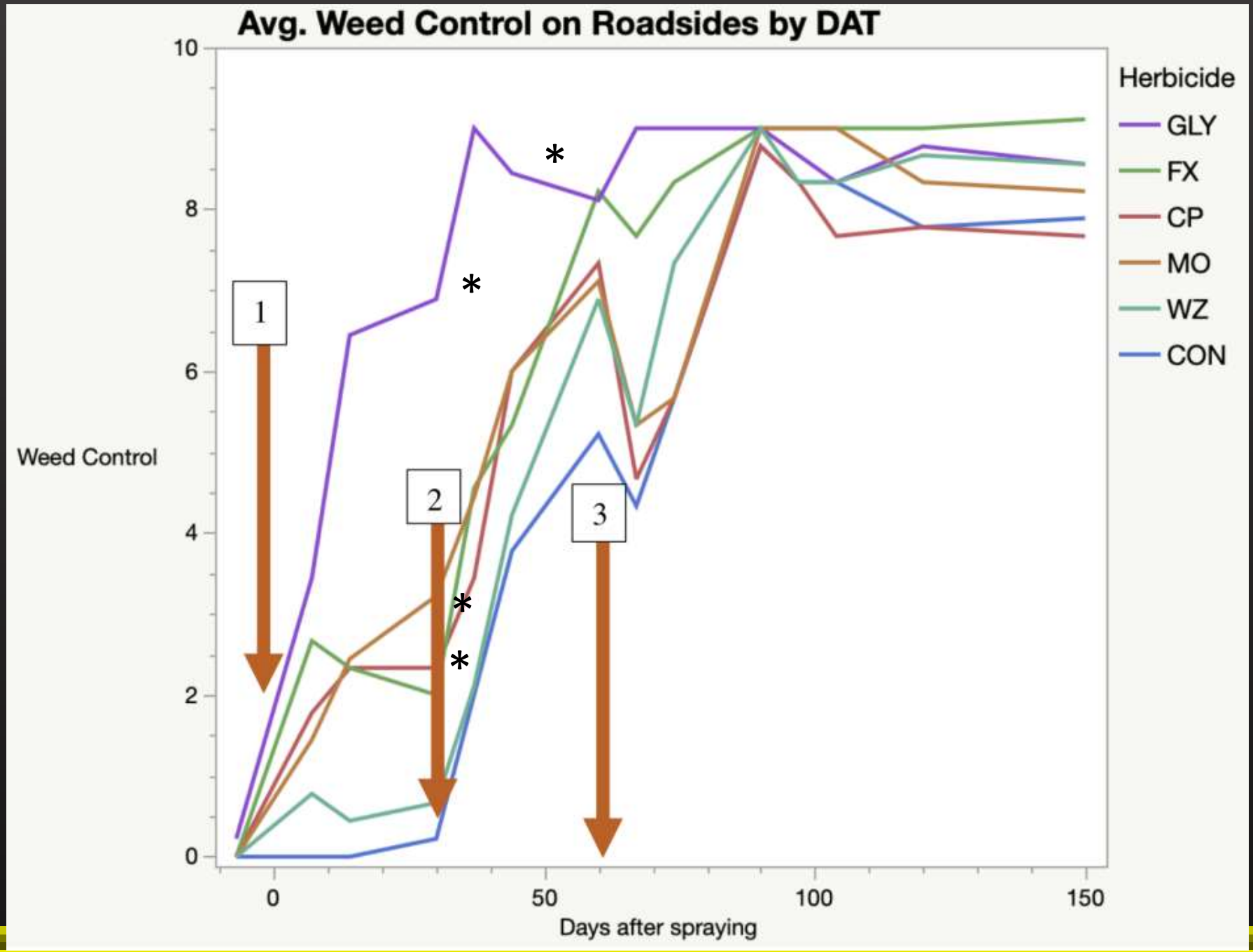


Glyphosate
Firewroxx
Cheetah
Mile+Oust

Weed Zap

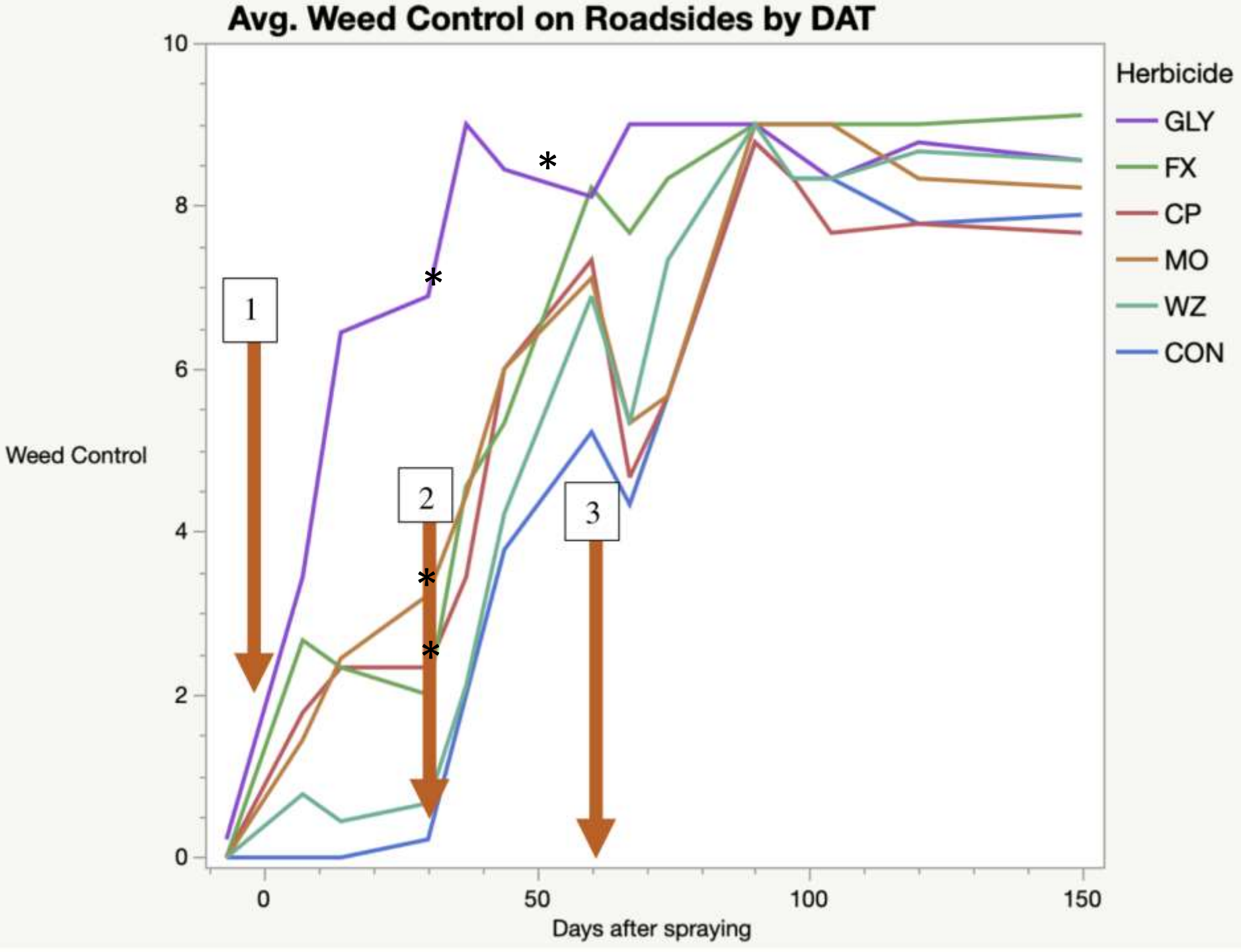
Control

- At 60 DAT applied 3rd herbicide treatment
- 2nd glyphosate app.
- 3rd organic app.



From 60 to 150 DAT no sig. diff. between any treatment and control

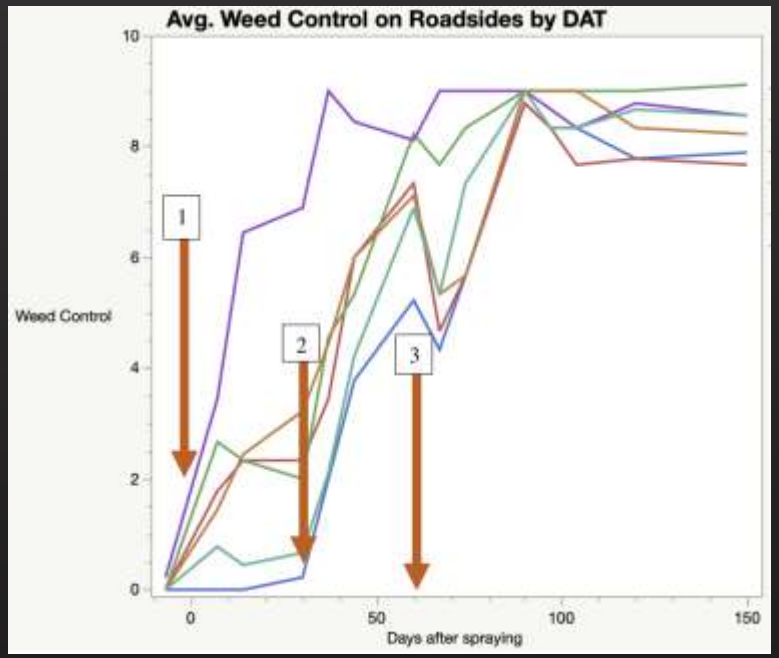
80% of untreated control plants died (annuals)



Results Objective #1 - Efficacy

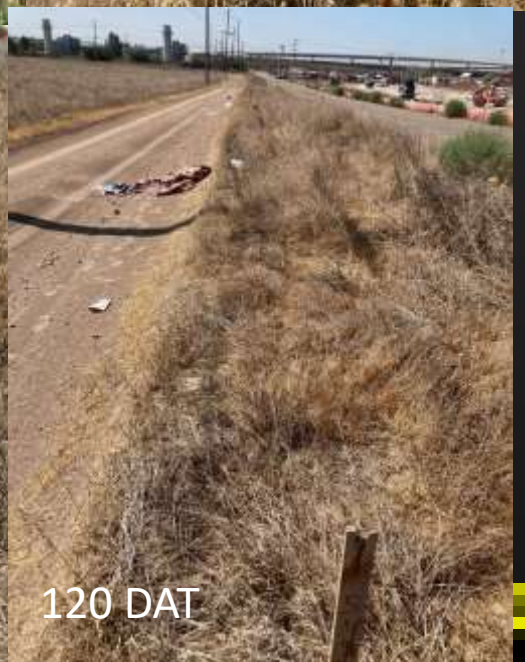
- Glyphosate with 2 applications had the fastest and most effective weed control (~80-90%)
- By 44 DAT only glyphosate was significantly higher than control plots
- From 60 DAT to 150 DAT all treatments were not significantly different from control plots, and few summer annuals germinated

- The lack of rainfall killed the annuals quickly



37 DAT, 1 glyphosate app., 2 apps. for other herbicides

Time series of Fireworxx from -7 to 120 DAT



Time series of Glyphosate from -7 to 120 DAT

Results: Objective #2 – Number of Applications

- 3 applications of WeedZap never had weed control significantly higher than untreated plots
- 3 applications of Fireworxx resulted in control significantly higher than untreated plots only one time (37 DAT) (46 vs. 20%, respectively), but significantly less than glyphosate (90 vs. 46%)
- 2 applications of glyphosate averaged 80-90% control
- 2 applications of Milestone+Oust had significantly higher control than untreated plots, but less than glyphosate
- Cheetah Pro was less effective than Milestone+Oust , but not significantly different from organics

Results: Objective #3 - Cost per treatment?

- Cost of herbicides per treatment?
- Labor, equipment, surfactants, maintenance not included

Results: Objective #3 - Cost per treatment?

Herbicide (H)	H Type	Rate (ozs.) at 50 GPA	Cost per Ac.	Ratio of Cost H:Lowest Cost H	Ratio of costs to replicate study results	Gallons of herbicide needed to treat 100 ac.
Glyphosate	Synthetic	72	$9.36	1.0	1.0	56.3
Aminopyralid	Synthetic	5	$12.63	1.8	1.8	3.9
Sulfometuron	Synthetic	3	$4.69			2.3
Glufosinate	Synthetic	41	$19.85	2.1	2.1	32.0
Clove+Cinnamon Oils	Organic	320	$207.14	22.1	33.2	250.0
Caprylic+Capric acids (8%)	Organic	512	$402.28	43.0	64.5	400.0
Capry.+Capric(9% max rate)	Organic	576	$452.56	48.4	72.5	450.0

Purchase prices for each herbicide obtained by SD AWM in Dec 2020-Jan 2021

Results: Objective #3 - Cost per treatment?

- Summary of costs:
- Organic use rates are much higher than synthetics (4-100X more product)
- This leads to much higher product costs per acre
- Because organics needed more applications costs were 50% higher again than glyphosate (65-73X), or Milestone+Oust (36-40X)

- UPDATE outside of scope of this study: Prices of glyphosate and other herbicides have changed drastically since pandemic lows, cost ratios are not current

Results: Objective #3 - Cost per treatment?

- Summary of costs:
- When treating large acreages, storage of hundreds to thousands of gallons of organic herbicide will be needed
  - 400-450 gallons per 100 ac. treated each application
  - 4,000-4,500 gallons per 1,000 ac. treated each application

What Did Others Find Using Organics on Roads?

- S.L. Young, Weed Tech. 2004
- Northern California

- 5 applications of acetic acid, pine oil and plant essential oils and 2 apps. of glyphosate
- No organic achieved same control (88%) as glyphosate (100%)
- Organic costs were 28-42X higher than synthetics

Herbicide	Yellow Star Thistle	Buckhorn plantain	Hairy vetch	Slender Oat
	109 DAT	109 DAT	109 DAT	109 DAT
Glyphosate	100 a	100 a	100 a	100 a
Acetic Acid	36 b	49 d	60 b	83 a
Pine Oil	81 a	65 c	100 a	41 b
Plant Essentials	85 a	84 b	100 a	86 a
Control	0 c	0 c	0 c	0 c

Summary

- The two organic herbicides, applied 3 times, were less effective than synthetic herbicides at controlling roadside weeds, and only marginally better than untreated plots
- At least three organic herbicide applications were needed throughout the growing season during this drought, synthetics needed 2 apps.
  - In years or areas with more rainfall and a longer growing season, at least 4+ organic applications could be needed to control winter and summer annuals
- The best performing organic herbicide was less effective and much more costly than glyphosate at end of season
  - When treating large areas, will need to store hundreds to thousands of gallons of organic herbicides for each application

Questions?

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THANK YOU to Project Partner

San Diego County Dept. Agriculture, Weights and Measures

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