Bees, Lygus and Weevils Research Update 2024

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Lygus Management Studies 2022

- **Native hemipteran**
- **5 nymphal instars**
- **Direct and key pest of alfalfa produced for seed during bloom.**
- **Documented history of insecticide tolerance in alfalfa seed, cotton, and strawberries.**

In 2022 we completed 2 spray trials on Lygus bug insecticide efficacy

- Complete Random Block Design
- 4 Replicates
- 15 Gallons per acre
- $C0_2$ Backpack Sprayer
- 18x36 ft. plots

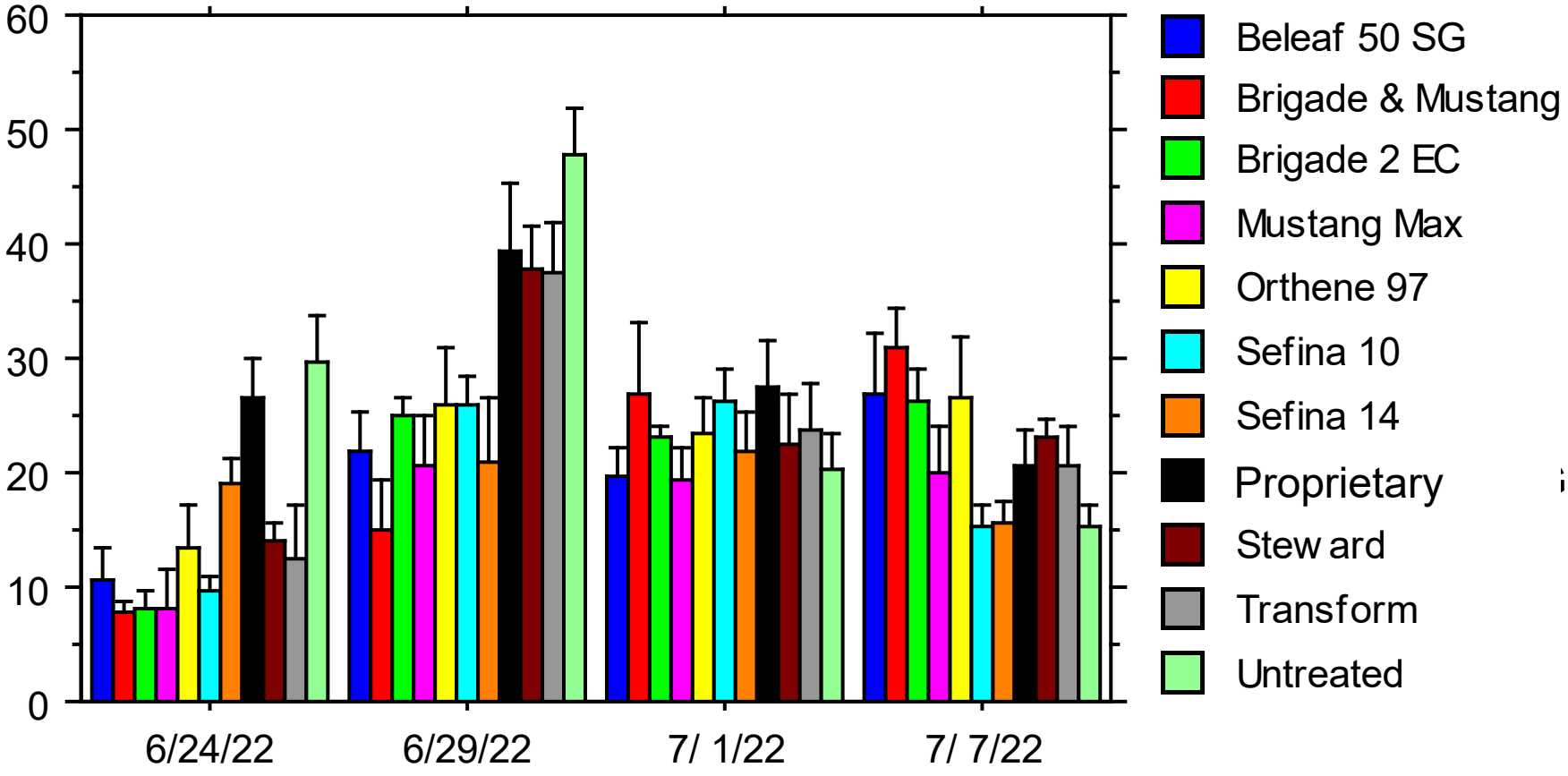
Table 1. Detail of Lygus/aphid pre-bloom sprays on Alfalfa Seed 2022

#	Product	Active ingredient	Rate/acre	
1	Untreated Control			
2	Beleaf 50 SG	flonicamid	2.8	oz/acre
3	Brigade 2EC	bifenthrin	6.4	Fl oz/acre
4	Proprietary	propriatary	81	g/acre
5	Mustang Max	zeta-cypermethrin	4	Fl oz/acre
6	Orthene 97	acephate	1	lb/acre
7	Transform	sulfoxaflor	2.25	oz/acre
8	Steward	Indoxcarb	11.3	Fl oz/acre
9	Sefina	afidopyropen	10	Fl oz/acre
10	Sefina	afidopyropen	14	Fl oz/acre
11	Brigade 2EC	bifenthrin	6.4	Fl oz/acre
	plus Mustang Max	zeta-cypermethrin	4	Fl oz/acre

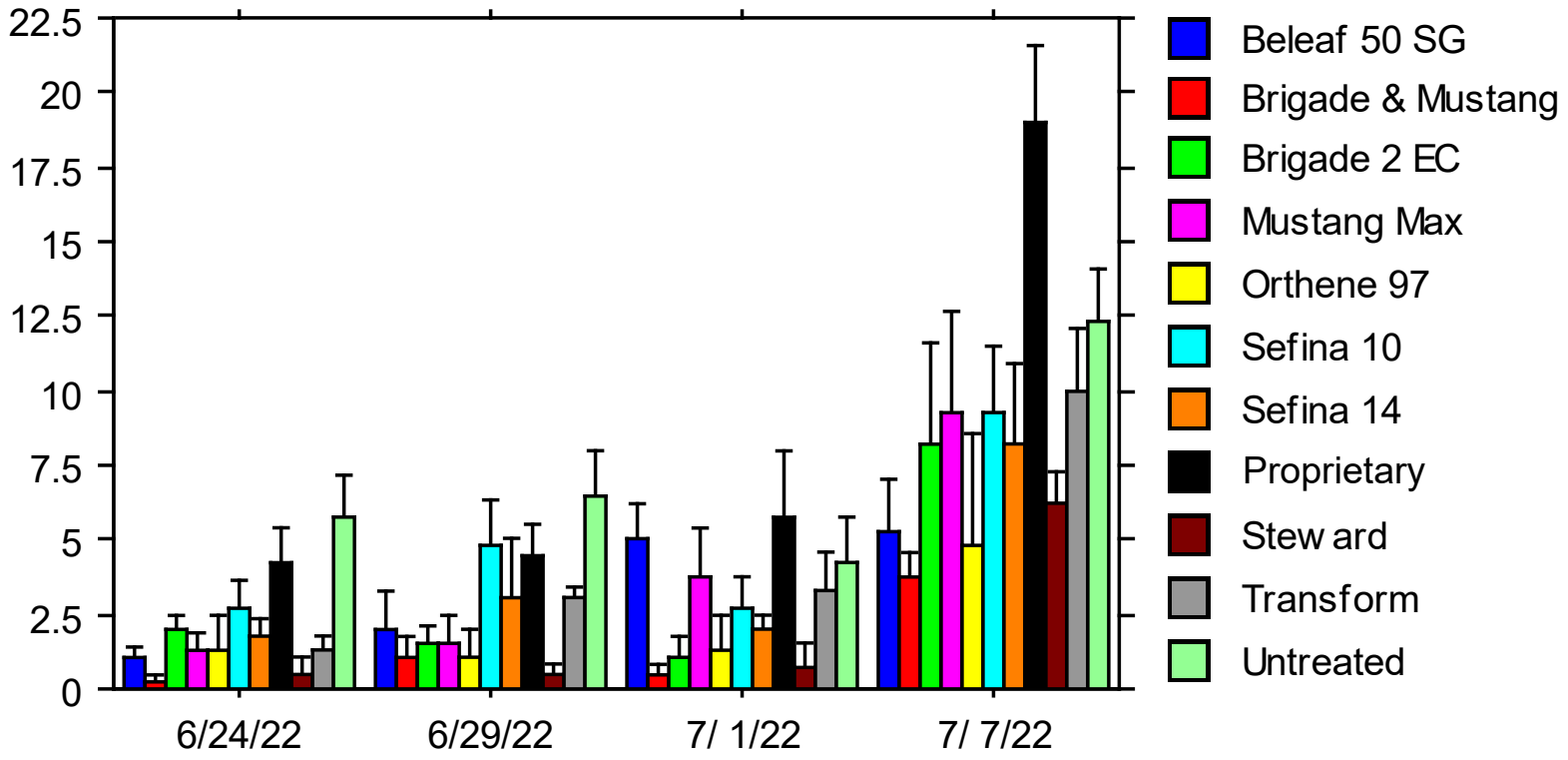
Insecticides were applied on 6/22/22 and the plots were sweepnet sampled pretreatment on 6/21/22 and post-treatment on 6/24, 6/26, 7/1, and 7/7, corresponding with 2, 7, 9, and 15 days after treatment

- These plots are truly the acid test for Lygus insecticides. We maintain a weedy mismanaged acre of alfalfa that we do not swath until the end of the season. The plot area is surrounded by approximately 30 acres of forage alfalfa that is farmed poorly by WSU staff.

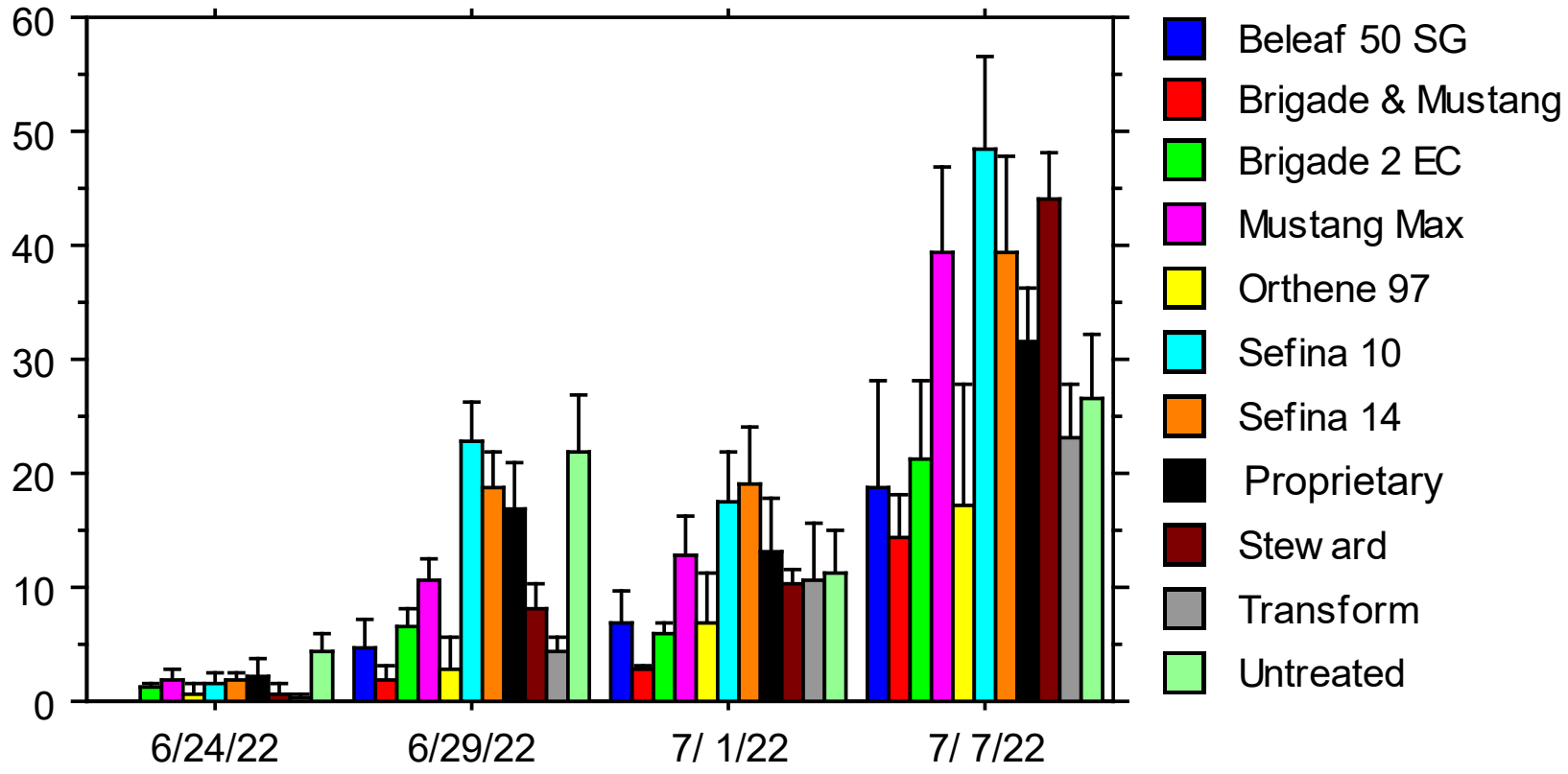
Lygus adults per five 180º sweeps



Large Lygus nymphs per five 180º sweeps



Small Lygus nymphs per five 180º sweeps



Conclusions

- Many of the insecticides applied knocked back the abundance of Lygus adults in these plots for a short-period after insecticide application.
- The older organophosphate and pyrethroid chemistries and Steward and Transform maintained control of Lygus nymphs both large and small for about a week.
- At 9 days after treatment control was beginning to break for Lygus nymph control with most chemistries.

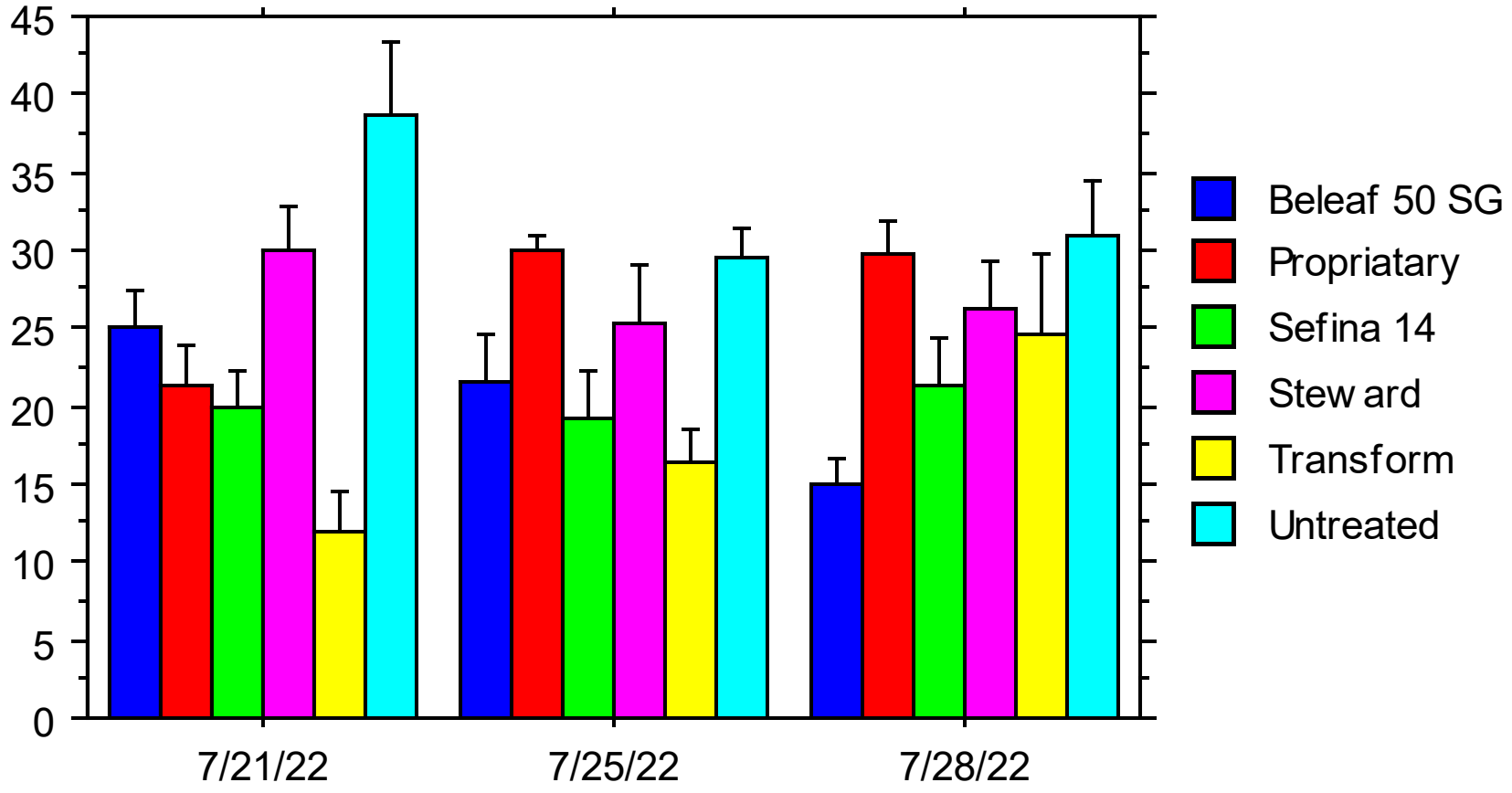
Bloom Sprays

- On July 19 the insecticides detailed below were applied to 4 replicate plots of 12’ by 20’ in the equivalent of 20 gallons of water carrier per acre.

Trt#	Treatment	Active Ingredient	Rate	
1	Untreated Control			
2	Beleaf 50 SG	flonicamid	2.8	oz/acre
3	Proprietary	propriatary	81	g/acre
4	Transform	sulfoxaflor	2.25	oz/acre
5	Steward	Indoxcarb	11.3	Fl oz/acre
6	Sefina	afidopyropen	14	Fl oz/acre

- Plots were sampled by sweep net post treatment on July 21, July 25, and July 28. This was 2, 6, and 9-days post treatment, respectively.

Lygus adults per five 180º sweeps



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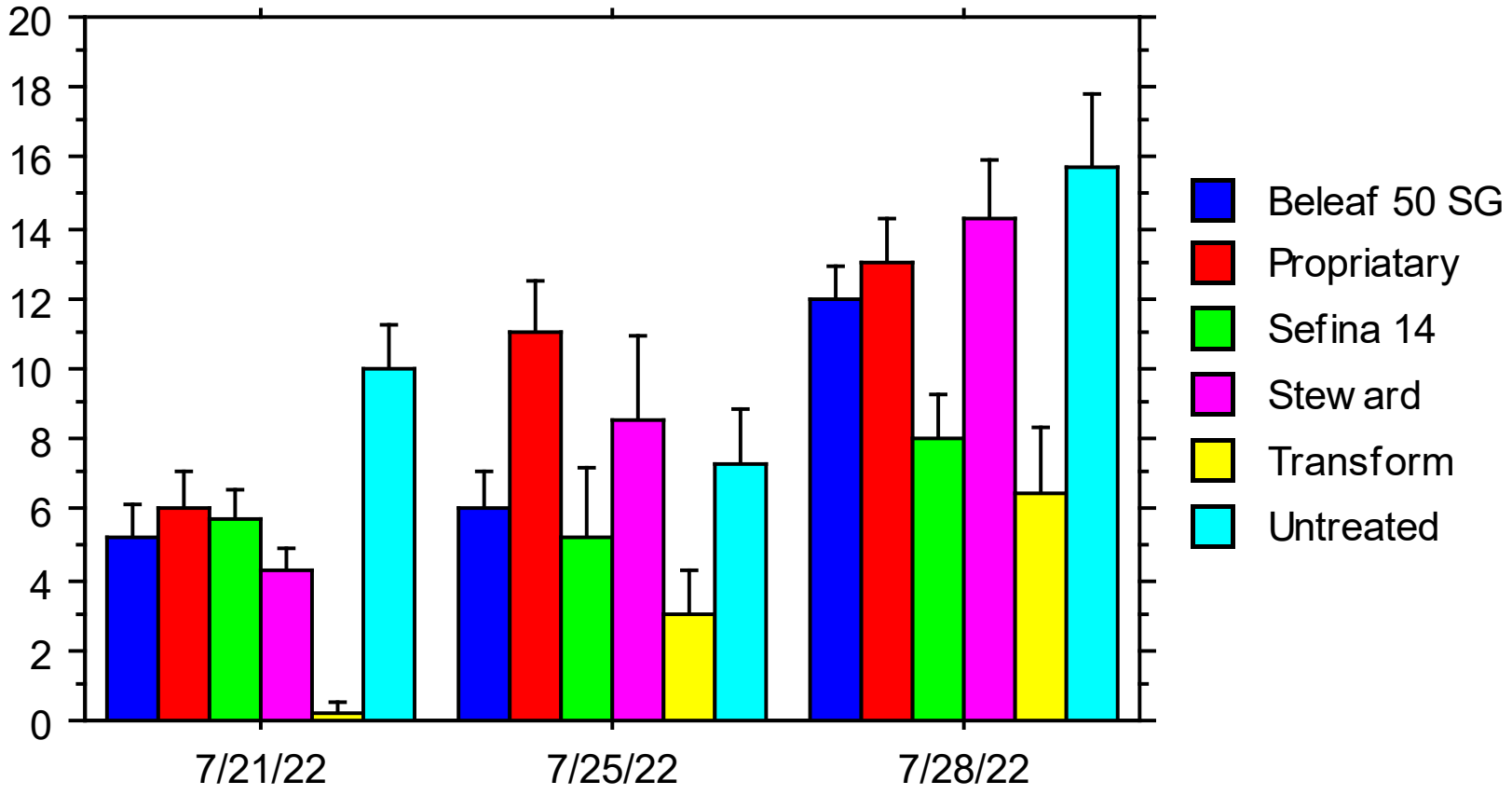
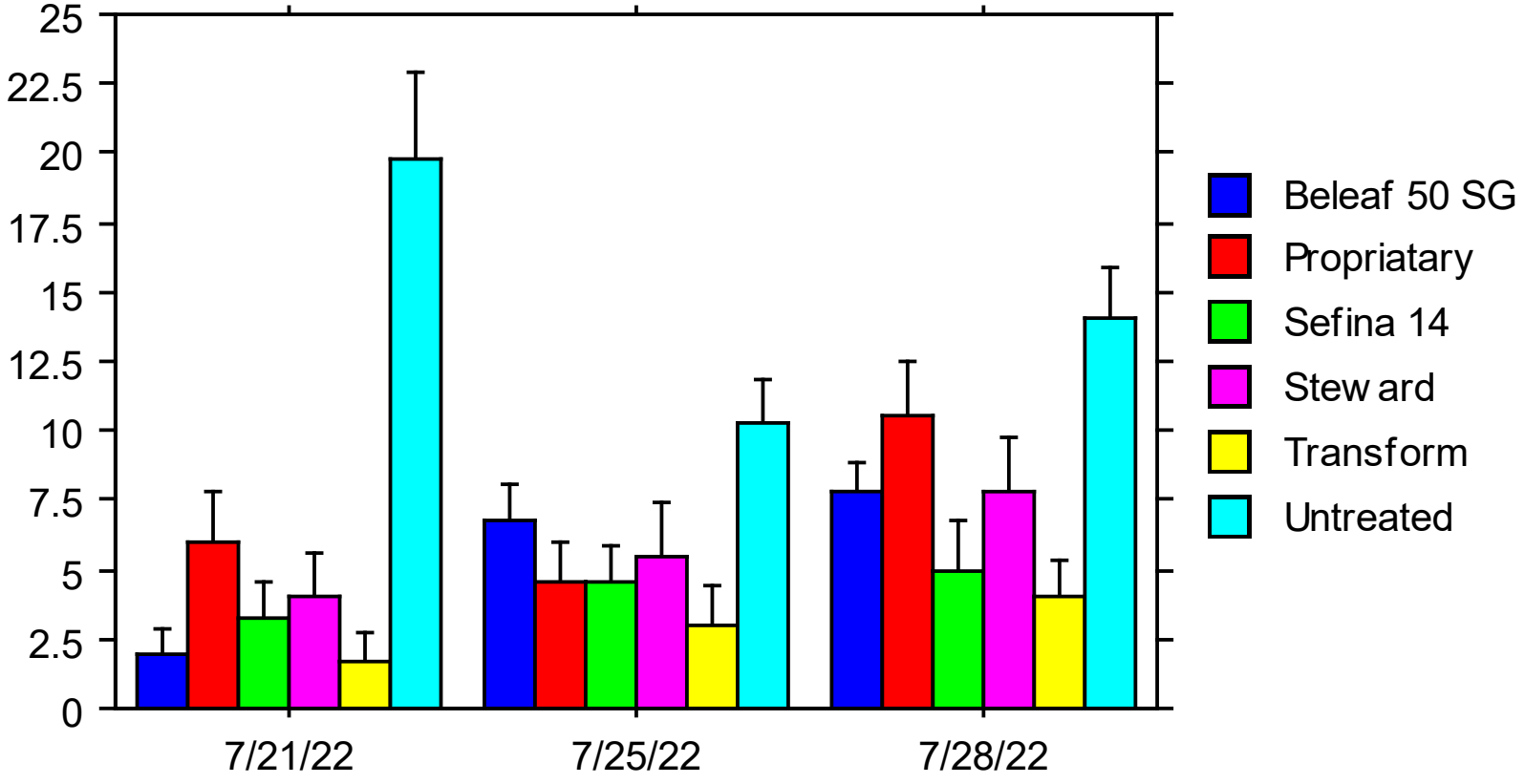


Small Lygus nymphs per five 180º sweeps

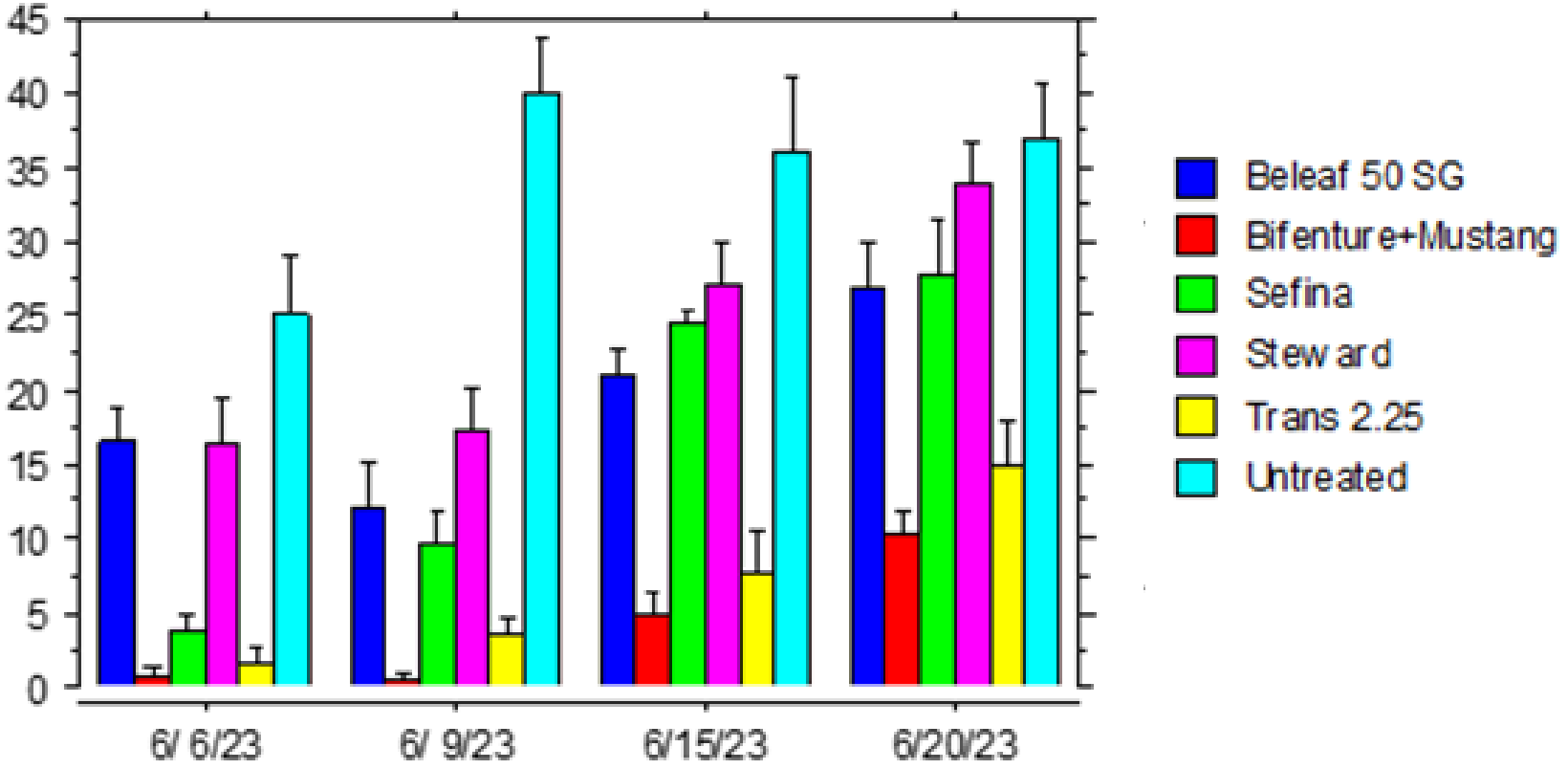


Lygus Insecticide Trial 2023

#	Trade name	active Ingredient	rate		plot #s
1	Untreated Control				103, 204, 302, 406
2	Beleaf 50 SG	flonicamid	2.8	oz/acre	105, 202, 306, 405
3	Transform	sulfoxaflor	2.25	oz/acre	102, 205, 301, 401
4	Steward	Indoxcarb	11.3	Fl oz/acre	106, 203, 303, 404
5	Sefina	afidopyropen	14	Fl oz/acre	101, 201, 305, 402
6.	Bifenture +	bifenthrin	8.5	Fl oz/acre	104, 206, 304, 403
	Mustang Maxx	zeta-cypermethrin	8.0	Fl oz/acre	

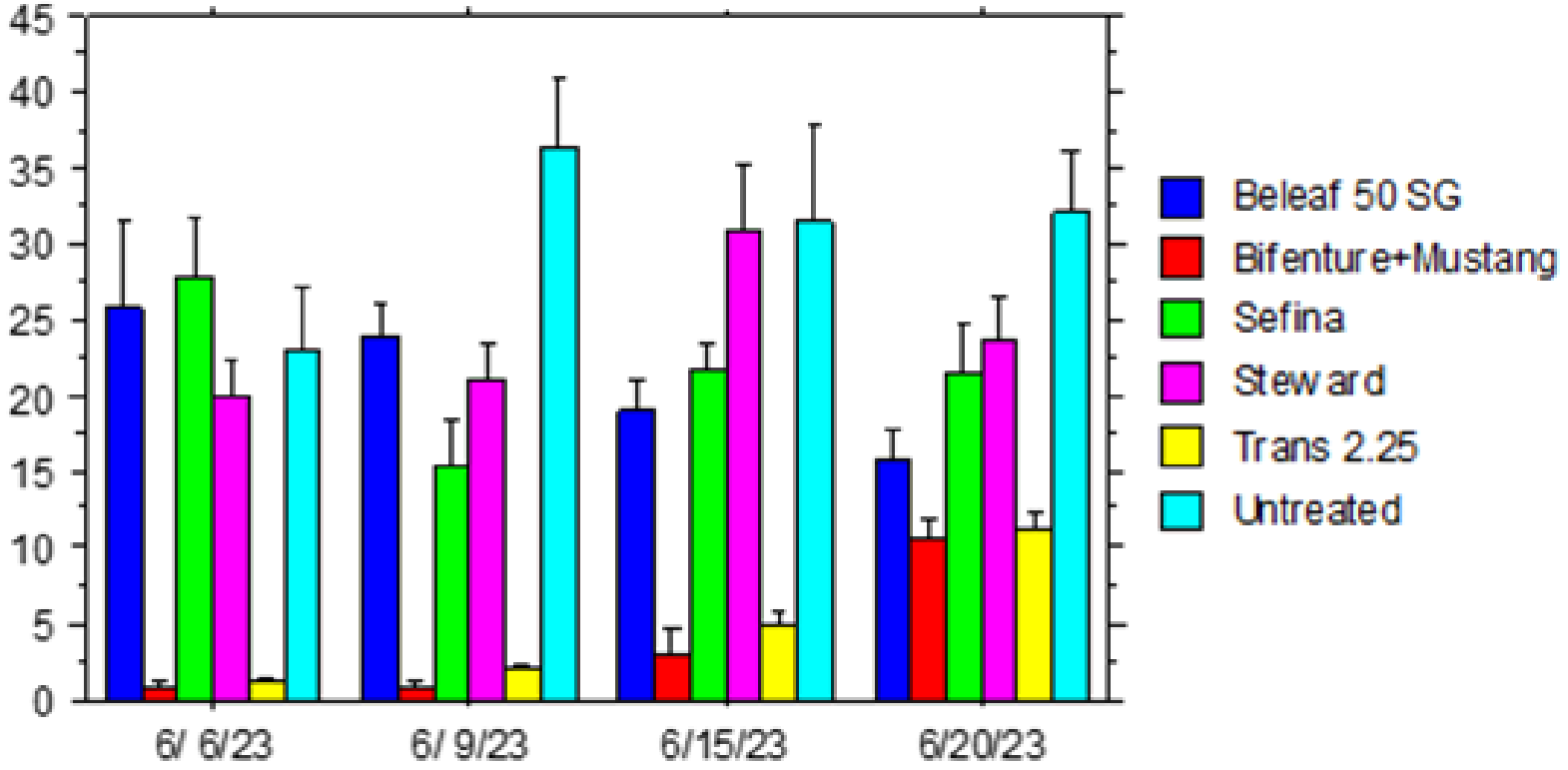
Experimental design was pretty much identical to past studies

Lygus Adults



Lygus adults per 5 sweeps

Lygus Nymphs



Lygus nymphs per 5 sweeps

Conclusion

- Given the results of these field trials alfalfa seed growers have some powerful and effective insecticides available for their use during the bloom period.
- Transform in particular provided effective control of Lygus nymphs for at least a week in these small plots.

Weevils & Insecticide Resistance



- Some Washington State alfalfa forage and alfalfa seed growers have raised concerns regarding the efficacy of specific organophosphate and pyrethroid insecticides that are applied for control of alfalfa weevil.
- Most notably alfalfa forage growers near Goldendale Washington had reported field failures with the formulated pre-mix insecticide Cobalt™ in 2018.
- Cobalt is an insecticide marketed by Corteva™ Agrisciences and is a mixture of the organophosphate insecticide chlorpyrifos (aka Lorsban Advanced™) and the synthetic pyrethroid lambda-cyhalothrin (aka Warrior™).
- Field failures were not unique to a single grower.

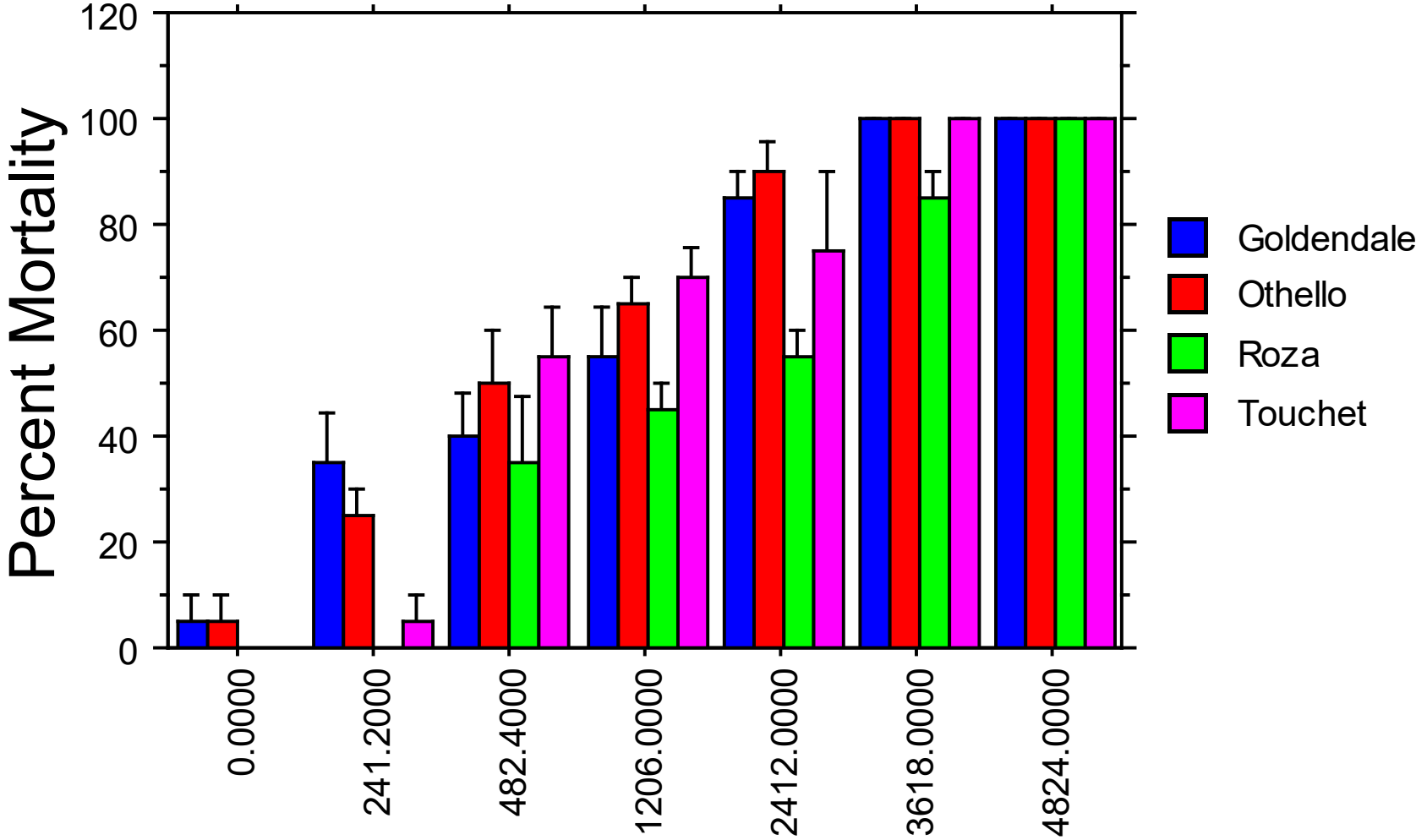
Laboratory Bioassays

- Larva populations were collected from sites including our Roza alfalfa field as detailed above, an alfalfa forage fields in Goldendale and an alfalfa forage fields near Touchet.
- These weevils were then subjected to dose response bioassay via our Potter precision spray tower.
- The 4 insecticides tested included the unregistered product Lorsban Advanced (chlorpyrifos), and the pyrethroid insecticides Warrior (lambda-cyhalothrin), zeta-cypermethrin (Mustang Maxx), and beta-cyflutrin (Baythroid) .

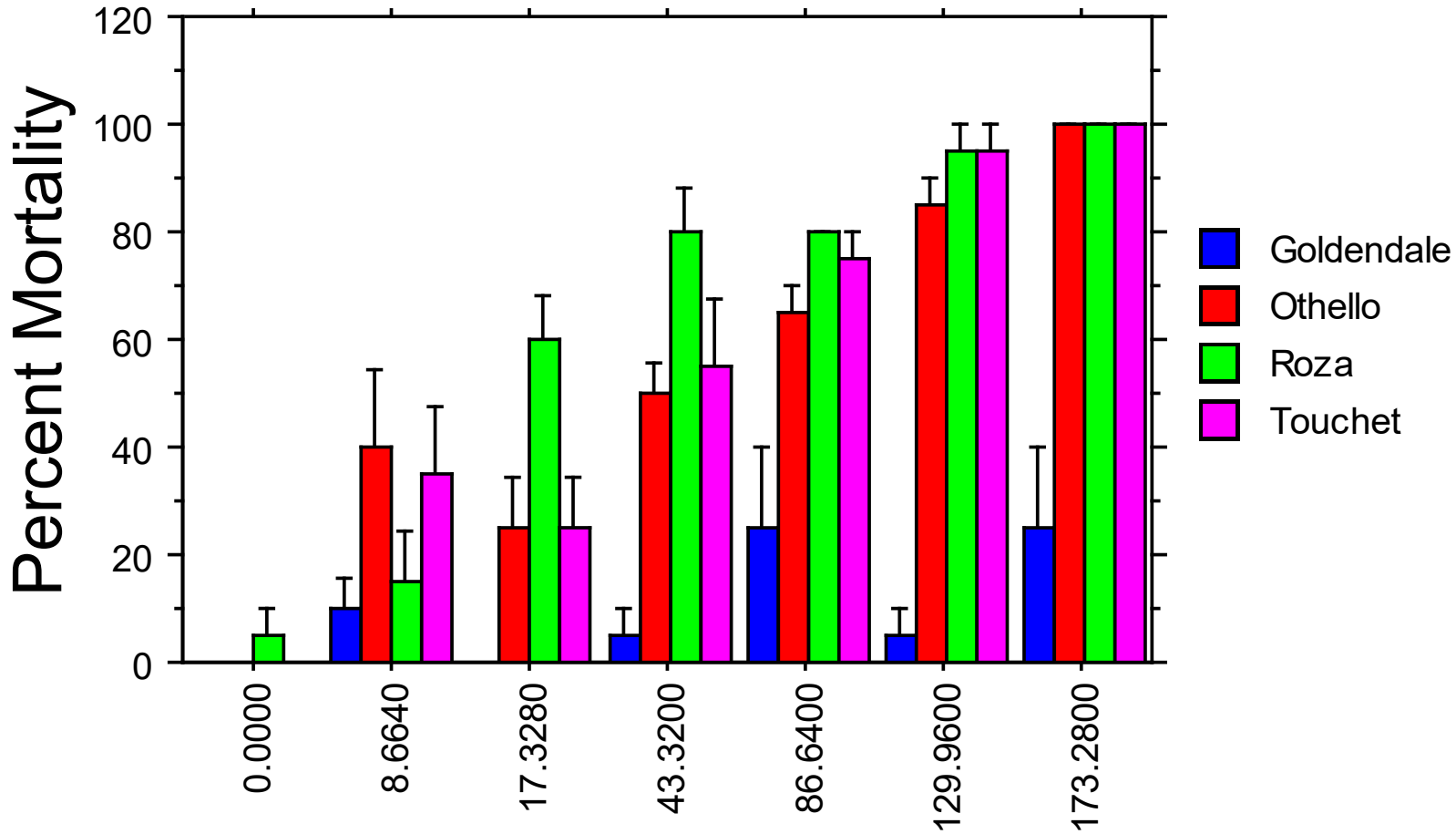
Laboratory Bioassays

- Serial dilutions were completed for each insecticide with the maximum field rate in a dilution equivalent to 20 gallons per acre.
- Subsequent dilutions were made at 75%, 50%, 25%, 10%, 5%, and 0% of the maximum field rate again diluted in the equivalent of 20 gallons of water per acre.
- Each treatment was applied to 4 replicates of 5 weevil grubs in a Petri dish with a filter paper bottom in 2 ml of solution in our Potter precision spray tower.
- The weevil larva were evaluated at 48 hr after treatment for mortality and survivorship.
- Weevil larva were considered dead when they failed to respond to being touched with a fine camel hair brush.

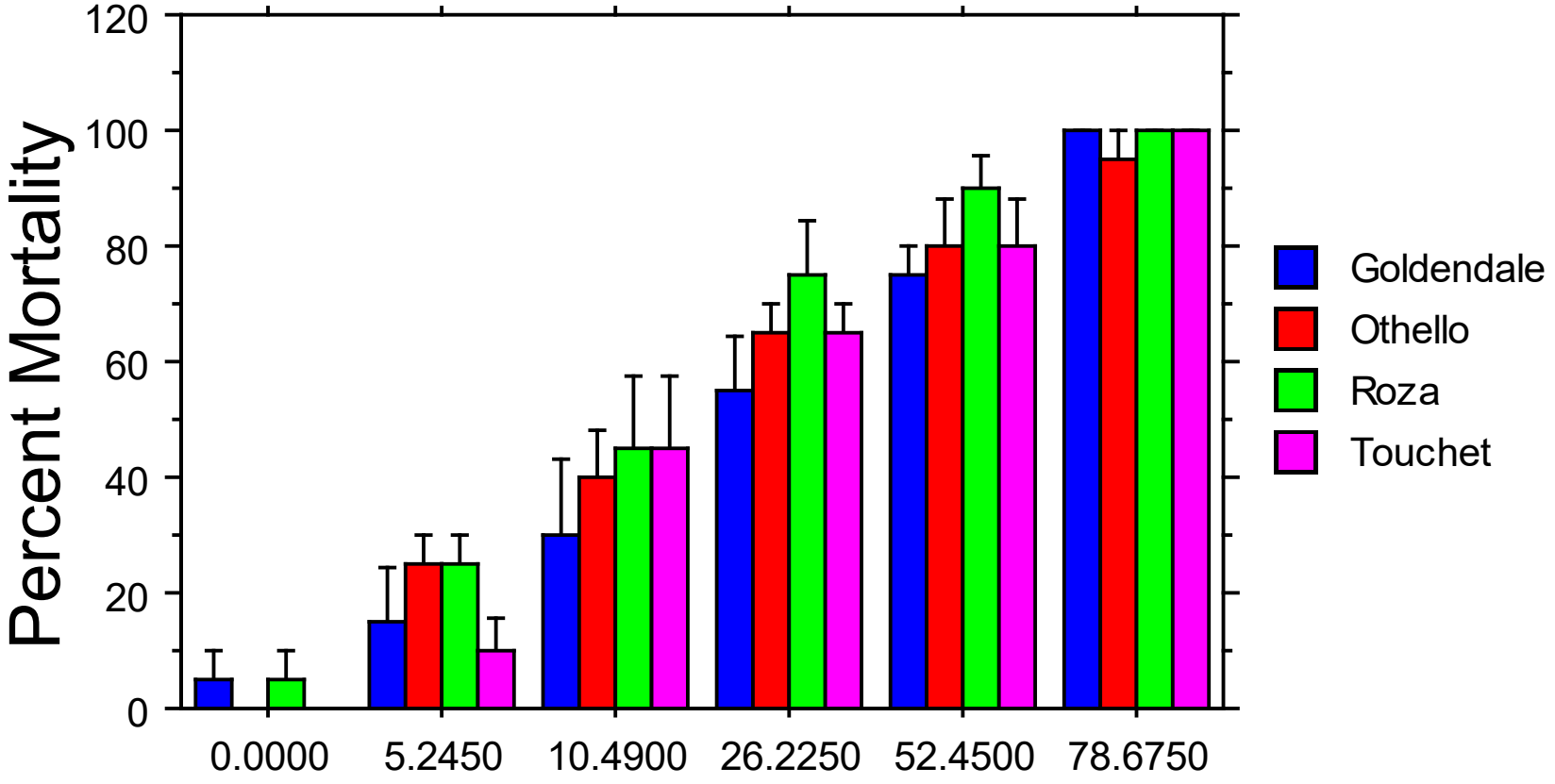
Dose response of alfalfa weevil populations in percent mortality ± Std error to chlorpyrifos (Lorsban Advanced)at concentrations equivalent to 0, 5, 10, 25, 50, 75, and 100% of the maximum field rate in parts per million (mg/liter)



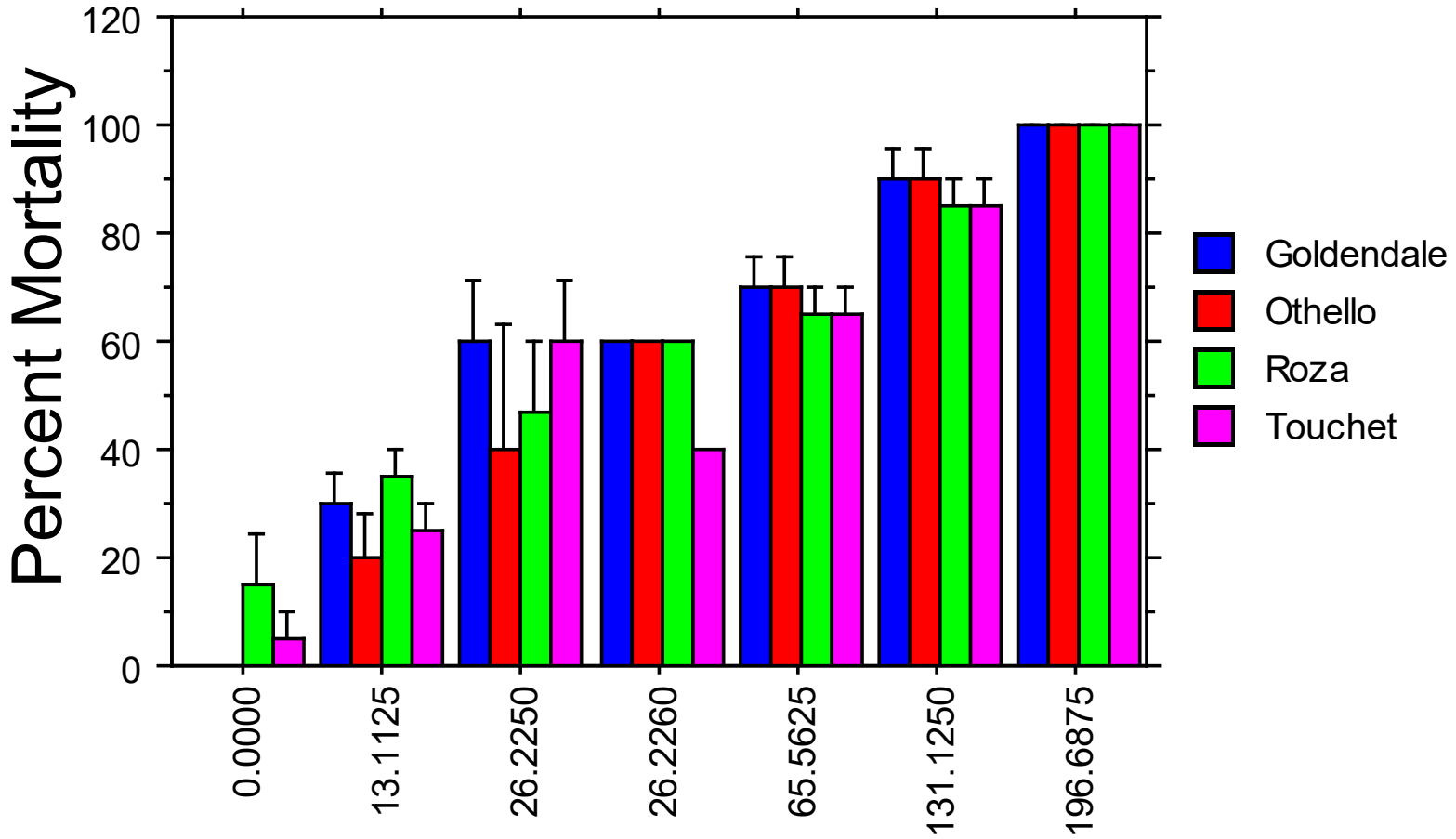
Dose response of alfalfa weevil populations in percent mortality ± Std error to lambda-cyhalothrin (Warrior II) at concentrations equivalent to 0, 5, 10, 25, 50, 75, and 100% of the maximum field rate in parts per million (mg/liter)



Dose response of alfalfa weevil populations in percent mortality ± Std error to zeta-cypermethrin (Mustang Maxx) at concentrations equivalent to 0, 5, 10, 25, 50, and 75% of the maximum field rate in parts per million (mg/liter)



Dose response of alfalfa weevil populations in percent mortality ± Std error to beta-cyfluthrin (Baythroid) at concentrations equivalent to 0, 5, 10, 25, 50, and 75% of the maximum field rate in parts per million (mg/liter)



Conclusions-

- Among all the 4 populations tested against the organophosphate chlorpyrifos and the 3 synthetic pyrethroids, only the Goldendale population exhibited resistance to lambda-cyhalothrin and the Roza population exhibited resistance to chlorpyrifos.
- As a result of litigation, all tolerances are reinstated….. For now!
- Alfalfa is among the 9 special uses!
- Best advice. Use what you've got. Don't buy a bunch.
- We'll ask, again, about a 24C on alfalfa seed (non food/ non feed) next week.

Enhancing and Protecting Populations of Alfalfa Seed Pollinators

- Doug Walsh, Professor of Entomology
- Washington State University

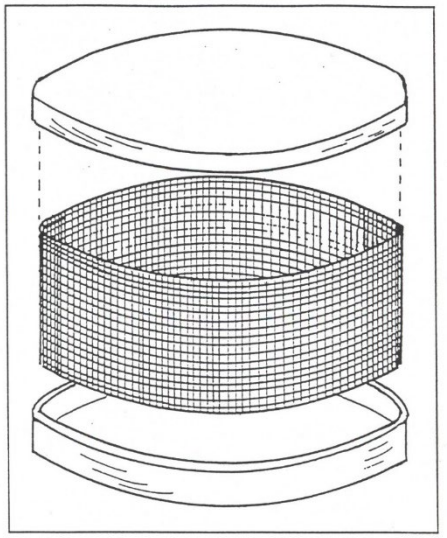
Objective 1. Conduct topical direct contact bioassays with candidate pesticides on ALCB.

Small plots of 0.01 acre each were sprayed on July 8, 2022 with a proprietary candidate insecticide and a newer, reduced-risk insecticide, afidopyropen at maximum proposed field rates.

A CO_2 pressurized sprayer was used at a rate of 26 gpm using a hand-held boom.

Bioassay Protocol

- **Alfalfa samples were collected at 1 hr, and placed into bioassay chambers.**
- **Approximately 20 leafcutting or were placed into each chamber and exposed to the treated alfalfa for a set period of time.**
- **Bees were fed 50% sucrose solution in a cotton wad.**
- **Mortality was scored at the end of an 8 hr exposure time.**



Bees were considered as “living” if they were capable of flying away after the 8 hour exposure in the bioassay arena. The bees were considered as “dead” if they failed to fly away. Moribund is if they wander aimlessly and don’t fly away. Mortality was corrected against control bioassay arenas. Control mortality was 5% in 2023.

Conclusions

Corrected mortality of ALCB to 8 hrs of exposure to treated alfalfa foliage collected 1 hr after insecticide application.

Product	Rate per acre	ALCB % Corrected Mortality
Acequinocyl (Kanemite)	31 fluid oz	4%
Fenazaquin (Magister)	36 fluid oz	8%

- Our results were conclusive that the candidate acaricides acequinocyl (Kanemite) and fenazaquin (Magister) could be considered safe for foraging ALCB at the maximum labeled rates
- Past research has demonstrated that less than 25% mortality in the contact bioassays in 1 hr residues is indicative that these pesticides will not have knock-down toxicity to foraging bees.

Conduct an annual census of the alkali bee population abundance in Walla Walla County, WA. Alkali bee population surveys 2010 - 2023.

- Alkali bee emergence hole counts have been recorded annually at the end of the alkali bee nesting season (mid to late July) from 2010 to 2023, in accordance with standardized methods established by Vinchesi and Walsh in 2014.
- In this method 0.5 sq meter quadrats made of lightweight PVC pipe, with dimensions of 0.7m by 0.7m, are haphazardly tossed across each surveyed bee bed 24 times, and the number of emergence holes contained within each quadrat is counted and recorded.
- The same 13 bee beds were consistently sampled year-after-year and were initially selected for observation due to known history of alkali bee nesting activity, ease of access, and interest from grower collaborators.

2 x (Mean number of quadrat counts per 0.5 m2] x [2/3] x [surface area of bee bed])

- This formula was first proposed by Jim Cane through video observations of nesting activity that found that about two-thirds of nest holes were being actively provisioned.
- The practice of using surface nest holes to estimate alkali bee populations was then validated by Vinchesi and Walsh in 2014, which confirmed that surface nest hole counts were tightly correlated with the abundance of belowground prepupae.
- The above formula has been adjusted to rectify an error in Vinchesi and Walsh in 2014, which failed to account for the use of 0.5 sq m2 quadrats instead of 1m2 quadrats.
- As a result, all population estimates previously reported by Vinchesi and Walsh in 2014 were doubled before inclusion here.

	Original 13 beds	Plus 3 new beds
2010	8,437,000	
2011	5,335,000	
2012	9,428,000	
2013	6,917,000	
2014	4,005,000	
2015	6,177,000	
2016	8,211,000	
2017	7,053,000	
2018	7,354,000	10,294,000
2019	4,763,000	6,550,000
2020	3,590,000	4,564,000
2021	1,601,921	2,505,126
2022	2,279,528	3,272,243
2023	1,919,444	2,932,364

Estimated population abundance of alkali bees from 13 managed bee beds from 2010 through 2017, in 16 managed bee beds from 2018 through 2020, and in 15 managed beds in 2021 in the Touchet Valley of Walla Walla County, WA.

Bed 12 from the original 13 was eliminated in 2021.

- **Discussion:**
- Alkali bees continue to serve as an important resource for alfalfa seed growers in the Touchet, Gardena, and Lowden alfalfa seed growing areas.
- The population abundance has dropped over several years but had a slight rebound in 2022, but then had a small decline in 2023.
- Economic issues and low demand for seed have led to a decrease in acreage over the past several years. This may be contributing to recent declines in alkali bees.
- How these contribute to the population decline is unknown at this time.
- We anticipate that 20234will be another low year for alkali bee abundance.
- Well managed alkali bee beds appear to be very resilient.
- If economic conditions improve for alfalfa seed growers, we anticipate that alkali bee populations will prove resilient and rebound.

Acknowledgments

- Funding was provided by the Washington Alfalfa Seed Commission, the Washington State Commission on Pesticide Registration and the USDA-ARS Alfalfa Pollinator Research Initiative.