Almond Weed Management Research

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Objectives

The overall goals of the tree and vine weed science research and extension program at UC Davis (http://ucanr.org/brad.hanson) is to provide information on weed management and herbicide issues to California growers, Pest Control Advisors, and the UC Cooperative Extension network. The almond industry is one of the key stakeholder groups for this program; however, the majority of our research is broadly applicable to, and partially supported by, other orchard and vineyard commodities in the state as well as the pest control industry.

The specific objectives of this ongoing project (13Hort12.Hanson – Weed Management) mirror the major research areas in our program:

- Evaluation and testing of newly registered materials, tank mix partners, and application techniques for control of weeds with a special focus on glyphosate-resistant species.
- Evaluating herbicide injury symptoms in almonds and developing training tools for Farm Advisors and pest control industry advisors and consultants.

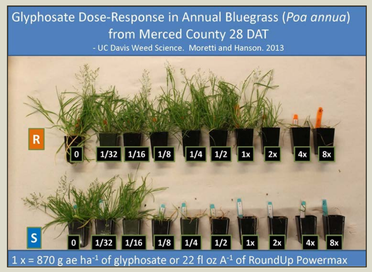
Numerous field and greenhouse experiments were conducted in 2013/2014 to support grower, Pest Control Advisor, and Farm Advisor weed and herbicide research needs. Because a more thorough presentation of these projects is available in the annual reports to the Almond Board and in various online venues, this poster presents only a few representative results. Data from related projects are routinely presented at cooperative extension meetings as well as scientific presentations by members of the research team.

Identification and verification of herbicide-resistant weeds

Weed management in California tree and vine crops is currently dominated by problems with glyphosate-resistant and glyphosate–tolerant species. To date, six species resistant to glyphosate have been confirmed: hairy fleabane, horseweed (aka marestail), Italian and rigid ryegrass, and junglerice, and annual bluegrass. Several other species of concern have been identified and are under evaluation; these include three-spike goosegrass, Palmer amaranth and a suite of summer annual grasses. Research being conducted on herbicide-resistant weeds incudes confirmation of resistance (Figures 1), determining distribution of the resistant populations evaluation of alternative control measures, and determining the underlying physiological and genetic causes of resistance.

Glyphosate-resistant annual bluegrass

Figure 1. Annual bluegrass (Poa annua) response to a range of glyphosate rates in the greenhouse. Both populations were collected from almond orchards in Merced County, the Resistant population (upper) has approximately a 16-fold level of resistance compared to the Susceptible population (lower).



Thus far, GR bluegrass does not seem to be widespread or a severe management problem but growers should consider it when developing orchard weed control programs that minimize resistance.

Other support

In addition to support from the Almond Board of California, the UC Davis Weed Science Program is supported by other commodity boards, federal and state grant programs, and funding from the agricultural chemical industry.

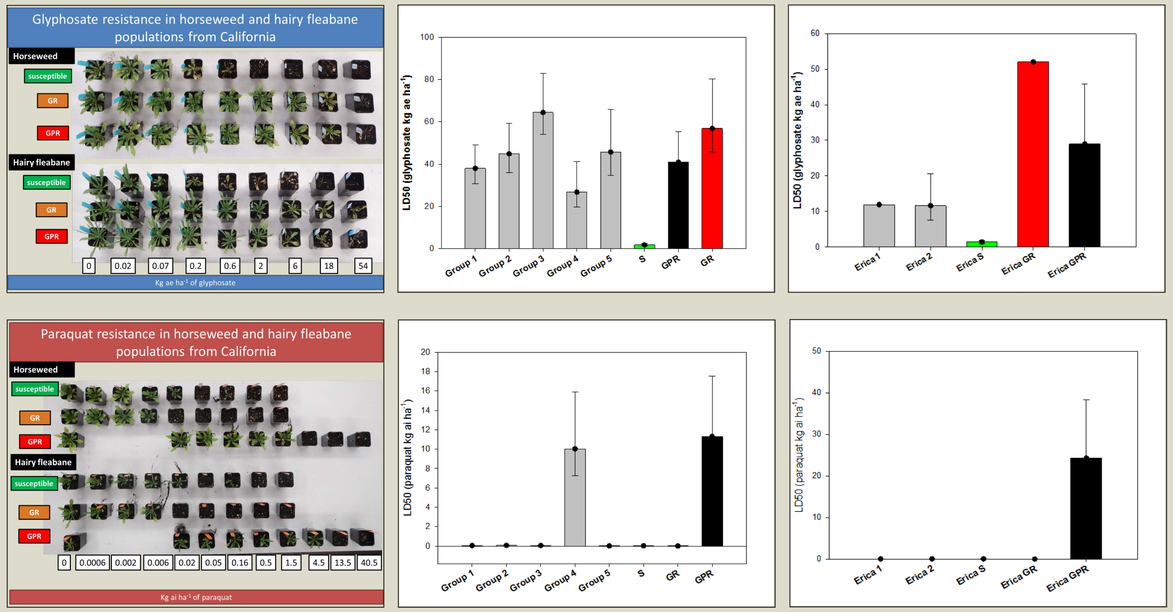
A special thanks to all of our sponsors, collaborators, and grower cooperators.

Multiple-resistant Conzya

Figure 2a. Response of several horseweed (Conyza canadensis, top) and hairy fleabane (Conzya bonariensis - aka ERICA, bottom) to glyphosate. The "GPR" population is known to be resistant to both glyphosate and paraquat. LD50 values in the figures suggest different levels of resistance among Central Valley populations which may mean different mechanisms of resistance.

Figure 2b. Response of the same horseweed and hairy fleabane populations to paraquat. Results suggest little variability in resistance among populations which clearly separate into R or S groups.

Research is ongoing to develop a better understanding of the mechanism(s) of herbicide resistance in these common orchard weed species. Early results from studies using radio-labeled herbicides suggest that differential translocation may be a contributing factor to resistance in Conyza (data not shown); however, the underlying physiological mechanisms have yet to be elucidated.



Herbicide performance

Several field trials were conducted to evaluate weed control efficacy in commercial almond orchards. In these experiments, research personnel applied replicated, small-plot treatments using CO2 pressurized backpack or ATV-mounted spray equipment. Weed control was visually assessed several times during the growing season and, in some cases, biomass or other quantitative data were collected. A few representative data are shown in Tables 1-5 below; a full accounting is available in the Almond Board Research Report. Many of these data are also presented online at: the UC Weed Science blog (http://ucanr.edu/blogs/UCDWeedScience/index.cfm) and the Almond Doctor blog (http://thealmonddoctor.com/)

Table 1. Selected weed control evaluations from 2013-14 large plot demonstration conducted in an almond orchard near Escalon, CA. (Watkins and Hanson)

					64 DAT-A			122 DAT-A			
					Annual bluegrass	Hairy fleabane	3 spike goose grass	Crab-grass	Annual sowthistle	Hairy fleabane	Spotted spurge	Overall
	Treatment	Rate			% control							
1	Untreated check				-	-	-	-	-	-	-	-
2	Roundup PowerMax	1	lb ae/a	A	98	98	23	0	80	80	33	77
	AMS	2	qt/100 gal	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	10	lb/100 gal	B								
3	Roundup PowerMax	1	lb ae/a	A	99	100	0	67	7	17	0	33
	AMS	2	qt/100 gal	A								
	Goal 2XL	1	pt/a	A								
	Surflan	4	qt/a	A								
4	Roundup PowerMax	1	lb ae/a	A	100	100	0	7	10	27	0	27
	AMS	2	qt/100 gal	A								
	Pindar GT	3	pt/a	A								
5	Roundup PowerMax	1	lb ae/a	A	100	100	0	67	7	13	33	23
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
6	Roundup PowerMax	1	lb ae/a	A	99	100	0	23	43	33	67	60
	AMS	2	qt/100 gal	A								
	Chateau	10	oz/a	A								
7	Roundup PowerMax	1	lb ae/a	A	98	100	0	87	13	13	0	52
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
	Chateau	10	oz/a	A								
8	Roundup PowerMax	1	lb ae/a	A	100	100	0	67	43	77	53	67
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
	Matrix SG	4	oz/a	A								
9	Roundup PowerMax	1	lb ae/a	A	100	100	37	100	93	70	100	77
	AMS	2	qt/100 gal	A								
	Alion	6.5	oz/a	A								
10	Roundup PowerMax	1	lb ae/a	A	100	100	0	0	50	50	0	63
	AMS	2	qt/100 gal	A								
	Trellis	1.3	lb/a	A								
11	Roundup PowerMax	1	lb ae/a	A	100	100	0	100	100	80	93	80
	AMS	2	qt/100 gal	A								
	Prowl H20	3	qt/a	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	2	qt/100 gal	B								
	Prowl H20	2	qt/a	B								
12	Roundup PowerMax	1	lb ae/a	A	99	100	7	50	90	70	67	83
	AMS	2	qt/100 gal	A								
	Pindar GT	3	pt/a	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	2	qt/100 gal	B								
	Prowl H20	2	qt/a	B								
	LSD (0.05)				***12***	***8***	***15***	***59***	***26***	***49***	***59***	***25***

"A" timing was applied on December 17, 2013 and the "B" timing on March 19, 2014.
Note: the large-plot trials did not include an untreated control and, thus, had only 11 treatments.

Table 2. Postemergence weed control in an almond orchard trial conducted near Wasco, CA in spring 2014. (Moretti, Watkins, and Hanson)

				15 DAT		28 DAT			
				Annual bluegrass	Hairy fleabane	Jungle-rice	Annual bluegrass	Hairy fleabane	Total biomass
				%					g/m sq
1	untreated control			0	0	0	0	0	137.1
2	Roundup Powermax	1	lb ae/a	100	30	65	100	67	23.8
	AMS	2	pt/a						
	NIS	0.25	% v/v						
3	Roundup Powermax	44	fl oz/a	98	73	90	100	93	4.3
	AMS	2	pt/a						
	NIS	0.25	% v/v						
4	Rely 280	48	fl oz/a	100	100	87	98	100	1.4
	AMS	2	pt/a						
5	Rely 280	82	fl oz/a	100	100	91	98	87	0.7
	AMS	2	pt/a						
6	Gramoxone SL	1.25	pt/a	100	0	92	100	50	52.5
	NIS	0.25	% v/v						
7	Gramoxone SL	4	pt/a	100	0	92	100	78	7.9
	NIS	0.25	% v/v						
8	Matrix	2	oz/a	60	50	86	98	72	42.0
	AMS	2	pt/a						
	NIS	0.25	% v/v						
9	Roundup Powermax	1	lb ae/a	100	88	98	67	93	0.1
	Matrix	2	oz/a						
	AMS	2	pt/a						
	NIS	0.25	% v/v						
10	Roundup Powermax	1	lb ae/a	100	53	100	100	86	64.9
	Pindar GT	1.5	pt/a						
	AMS	2	pt/a						
	NIS	0.25	% v/v						
11	Chateau	6	oz/a	100	75	100	100	66	0.1
	NIS	0.25	% v/v						
	Roundup Powermax	1	lb ae/a						
	AMS	2	pt/a						
12	Poast	1.5	pt/a	0	0	0	33	27	217.8
	COC	1	% v/v						
13	Poast	1.5	pt/a	100	40	98	67	95	74.7
	COC	1	% v/v						
	Roundup Powermax	1	lb ae/a						
	AMS	2	pt/a						
14	Roundup Powermax	1	lb ae/a	100	75	100	100	92	0.1
	Matrix	4	oz/a						
	Ammonium Sulfate	2	pt/a						
	NIS	0.25	% v/v						
15	Roundup Powermax	1	lb ae/a	100	34	97	100	98	12.6
	AMS	2	pt/a						
	NIS	0.25	% v/v						
	Goal 2XL	0.125	lb ai/a						
	LSD (P=.05)			***1***	***44***	***26***	***41***	***50***	***115.3***

** All treatments applied POST on April 23, 2014.*

Table 3. Selected weed control evaluations from 2013-14 comparison of Alion and other preemergence tankmix and sequential partners in an almond orchard near Escalon, CA. All treatments included a high rate of Rely 280 and Roundup Powermax to ensure good control of existing weeds. (Watkins and Hanson)

					3 spike goose-grass	Crab-grass	Sow-thistle	Hairy fleabane	Spotted spurge	Overall	Overall	Overall
					122 DAT-A						164 DAT	196 DAT
	Treatment	Rate			% control							
1	Untreated Check				0	0	0	0	0	0	0	10
2	Alion	2.5	oz/a	A	45	100	100	88	100	80	70	55
3	Alion	3.5	oz/a	A	45	100	93	100	100	86	78	68
4	Alion	5	oz/a	A	70	100	100	98	100	92	85	83
5	Chateau	10	oz wt/a	A	38	38	55	93	50	73	43	33
6	Matrix	4	oz wt/a	A	38	50	43	98	0	73	50	28
7	Pindar GT	2.5	pt/a	A	18	25	15	78	0	65	8	13
8	Goaltender	4	pt/a	A	18	45	5	45	0	55	18	18
9	Alion	5	oz/a	A	58	100	95	93	100	85	86	73
	Chateau	6	oz wt/a									
10	Alion	5	oz/a	A	59	100	100	100	100	91	89	73
	Matrix	2	oz wt/a									
11	Alion	5	oz/a	A	55	100	100	100	100	89	86	80
	Pindar GT	1.5	pt/a									
12	Alion	5	oz/a	A	90	100	98	98	100	94	91	84
	Goaltender	2	pt/a									
13	Chateau	10	oz wt/a	A	60	100	100	98	100	94	93	84
	Alion	3.5	oz/a	B								
14	Chateau	12	oz wt/a	A	75	98	100	100	100	98	94	91
	Alion	5	oz/a	B								
15	Matrix	4	oz wt/a	A	63	100	100	100	100	97	94	84
	Alion	5	oz/a	B								
16	Alion	5	oz/a	A	75	100	100	100	100	98	96	91
	Alion	5	oz/a	B								
17	Alion	3.5	oz/a	B	50	100	100	78	100	92	71	60
18	Alion	5	oz/a	B	65	100	98	83	100	95	79	74
	LSD (P=.05)				***32***	***34***	***20***	***22***	***14***	***11***	***17***	***18***

The 'A' timing was applied December 17, 2013 and the 'B' timing on March 19, 2014. All treatments at both timings included Roundup Powermax plus Rely 280 and AMS for control of emerged weeds.

Table 4. Treatments and weed visual control ratings for a 2014 burndown trial conducted in a fallow field near Davis, CA to compare new glufosinate formulations to Rely 280 for California orchards and vineyards. (Moretti, Watkins, and Hanson)

				7 DAT	15 DAT	21 DAT	7 DAT	15 DAT	21 DAT
	Treatment*			Pigweed			Prostrate knotweed		
				% control					
1	Untreated			0	0	0	0	0	0
2	Lifeline	48	fl oz/A	98	99	96	98	63	20
3	Lifeline	65	fl oz/a	99	100	99	98	73	30
4	Lifeline	82	fl oz/A	99	100	99	98	87	48
5	Rely 280	48	fl oz/A	99	95	93	98	60	25
6	Rely 280	65	fl oz/A	99	99	99	98	86	33
7	Rely 280	82	fl oz/A	99	100	100	97	89	50
8	Reckon	48	fl oz/A	99	100	97	98	84	20
9	Reckon	65	fl oz/A	99	77	98	98	81	30
10	Reckon	82	fl oz/A	99	100	98	99	96	48
11	Cheetah	48	fl oz/A	98	94	93	98	48	18
12	Cheetah	65	fl oz/A	99	99	96	98	80	20
13	Cheetah	82	fl oz/A	99	99	97	97	86	30
	LSD (0.05)			***1***	***18***	***5***	***3***	***23***	***15***

* all treatments included AMS at 10 lb/100 gal spray solution. DAT = days after treatment

Table 5. Selected weed control evaluations from 2013-14 comparison of Alion and other preemergence tankmix partners in an almond orchard near Wasco, CA. All treatments included a high rate of Rely 280 and Roundup Powermax to ensure good control of existing weeds. (Watkins, Moretti, and Hanson)

					61 DAT-A				125 DAT-A	
					Annual bluegrass	Shepherds-purse	Hairy fleabane	Overall	Junglerice	Hairy fleabane	Overall
	Treatment	Rate			% control						
1	Untreated Check				0	0	0	0	0	0	0
2	Alion	2.5	oz/a		100	100	88	97	97	97	97
3	Alion	3.5	oz/a		100	100	88	97	98	92	92
4	Alion	5	oz/a		100	100	40	85	99	69	76
5	Chateau	10	oz wt/a		100	100	70	94	75	57	77
6	Matrix	4	oz wt/a		100	85	83	95	58	40	40
7	Pindar GT	2.5	pt/a		92	100	93	97	87	96	92
8	Goaltender	4	pt/a		99	100	100	100	98	98	97
9	Alion	5	oz/a		100	100	90	97	100	97	97
	Chateau	6	oz wt/a								
10	Alion	5	oz/a		100	100	93	98	100	100	100
	Matrix	2	oz wt/a								
11	Alion	5	oz/a		100	100	65	95	99	86	96
	Pindar GT	1.5	pt/a								
12	Alion	5	oz/a		100	100	88	97	100	98	97
	Goaltender	2	pt/a								
	LSD (P=.05)				***6***	***7***	***31***	***9***	***24***	***34***	***25***

Treatments applied on January 16, 2014. All treatments included Roundup Powermax at 2 qt/A, Rely 280 at 2 qt/A, and AMS at 2 qt/100 gal spray solution.