Evaluation of low VOC oxyfluorfen plus "kicker" treatments for postemergence preharvest weed control in nut orchards

Marcelo L. Moretti, Andrew Johnson, Seth Watkins, and Brad Hanson,

University of California

Trial ID: [a]2012_Hanson_low VOC kickers; [b]2012_Hembree/Hanson Goal formulation comparison
Year: 2012
Location 1a: Littlejohn Farms, Delhi, CA
Location 2a: UC Davis, Davis, CA
Location 3a: Littlejohn Farms; Delhi, CA
Location 4a: UC Davis, Davis, CA
Location 1b: Littlejohn Farms, Delhi, CA
Location 2b: UC Davis, Davis, CA
Crops: Almond, walnut, almond, non-crop

Oxyfluorfen is an important herbicide active ingredient used in tree and vine crops in California. It is usually second only to glyphosate in the number of treated acres in orchard crops (tree nuts, stone fruit, olive, pomegranate, etc) and is one of the top three herbicide active ingredients applied in grape vineyards. In California tree and vine cropping systems, oxyfluorfen is primarily used to control broadleaf weeds, but also provides control or partial control of some grass species.

Oxyfluorfen has both preemergence (PRE) and postemergence (POST) activity. PRE applied oxyfluorfen is usually incorporated by rainfall into the surface soil layer (~upper one inch) and is taken up by the shoots of germinating weed seedlings; susceptible plants usually die as they emerge from the soil. Oxyfluorfen applied POST to emerged plants generally affects only the treated foliage and does not translocate to other plant parts. The herbicide crosses the leaf cuticle and enters the living tissue where it causes cell membrane disruption and desiccation of the treated tissue.

Oxyfluorfen has two distinct use patterns in tree and vine crops in California. As a PRE material, oxyfluorfen is usually applied in the fall (Oct-Dec) before the winter annual weeds emerge and when it can be incorporated by rainfall. Use rates during this time of the year are relatively high (up to 2 lb ai/A; commonly 0.5 to 0.75 lb/A) and can provide several months of residual weed control. In orchards and vineyards, PRE oxyfluorfen is most commonly applied in "strips" centered on the crop row; thus total treated acreage may only be 25 to 50% of the gross orchard area (weeds that emerge between tree rows are usually mowed or cultivated).

Conversely, during the spring and summer, oxyfluorfen is used, primarily, for POST weed control, although it may also provide some residual activity. Summer weed control in tree nuts is critical because a clean, smooth, and firm orchard floor facilitates harvest of the crop that is shaken from the trees and swept from the ground (almond and walnut). Clean orchard floors are also important in other crops in order to minimize problems with diseases, insects, frost, and the disruption of cultural operations. Glyphosate is the most widely used herbicide for broad spectrum weed control in these crops; however, it is relatively ineffective against several key broadleaf weeds (especially Malva spp., Filaree spp., and glyphosate-resistant hairy fleabane and horseweed/mare's tail). POST oxyfluorfen can

significantly increase foliar activity on glyphosate-tolerant or resistant weeds and offer a short level of residual control that reduces weed management efforts prior to and during harvest.

Regulations on several pesticides with high emissions of volatile organic compounds (VOC) are being considered to further reduce pesticide contributions to ground level air pollution during the summer "ozone season". Oxyfluorfen is the only herbicide active ingredient currently listed in the proposed regulation. Low VOC formulations of oxyfluorfen (eg. GoalTender SC) are generally considered to be equivalent, with respect to weed control, to high VOC formulations (eg Goal 2XL) when applied as winter PRE materials in orchards and vineyards. However, low VOC formulations often do not provide as effective and consistent POST weed control during the spring and summer season, which is important for the efficient harvest of tree nuts. Several tank mix additions have been suggested a feasible alternatives to increase the POST activity of low VOC oxyfluorfen formulations. This report presents the results of several recent and ongoing experiments initiated in 2012 to evaluate proposed so called "kicker" treatments to increase the postemergence activity of GoalTender plus glyphosate during the critical preharvest timing for tree nut production.

Methods:

Two experiments were conducted in summer 2012 to compare POST activity of several oxyfluorfen formulations, rates, and tank mix partners. The first experiment, conducted at four sites (Table 1) was conducted to evaluate the proposed "kicker" treatments to increase the foliar activity of low VOC oxyfluorfen treatments compared to low rates of high VOC formulations. A second experiment as conducted to evaluate the relative contributions of EC and SC oxyfluorfen to POST weed control at the low rates commonly used in combination with glyphosate during the preharvest timing in nut orchards. Oxyfluorfen rates in these experiments were 0.125 to 0.5 lb ai/A in experiment 1 and 0.0625 to 0.125 lb ai/A in experiment 2; considerably lower than the 0.5 to 2 lb rates commonly applied during the winter season for residual weed control.

Two studies were conducted in an almond (*Prunus dulcis*) orchard near Delhi, CA in Merced County and two were conducted in a walnut (*Juglans regia*) orchard and a non-crop area at a UC Davis field research station in Yolo County. At each location, 8 by 20 ft plots were arranged between tree rows (middles) and treated with a CO2-pressurized backpack sprayer (Table 1). Weed control was evaluated every 1 to 2 weeks for up to 28 days after treatment (DAT) by visually estimating percent weed control in each plot.

Table 1: Application details

experiment	location	Appl. date	GPA	Air temp (F)	RH (%)	Wind (mph)
Protocol #1 – "low VOC kickers"						
1	Merced County	May 11, 2012	20	72	42	4.2
2	Yolo County	June 23, 2012	25	64	45	5.5
3	Merced County	July 23, 2012	25	93	21	3.7
4	Yolo County	Sept. 12, 2012	25	82	45	1.2
Protocol #2 – "oxyfluorfen rate and formulation comparison"						
1	Merced County	May 11, 2012	20	72	42	4.2
2	Yolo County	June 23, 2012	25	64	45	5.5

The Merced County site was a two year-old almond orchard with sandy soil and solid-set sprinkler irrigation. The first experiment was initiated on May 11, 2012 and was repeated July 23, 2012. Natural populations of hairy fleabane (ERIBO), yellow nutsedge (CYPES), and common evening primrose (OEOBI) were present in the first experiment. Three spiked goosegrass (ELTR2) was also present, but sparsely. ERIBO, and OEOBI were 15 cm tall and at a reproductive stage while CYPES was 7-10 cm tall and at a

vegetative stage when treated. In the second trial, hairy fleabane had been mowed and regrown to a height of 15-20 cm at application. The Merced experiments were evaluated 2 and 4 weeks after treatment.

The Yolo county study was conducted in a two year-old walnut orchard irrigated using a drip system, and located on a clay soil area. Natural population of prostrate knotweed (POLAV), annual sowthistle (SONOL), and little mallow (MALPA) were well established and somewhat drought stressed at application. POLAV, SONOL, and MALPA were at reproductive stages and were 10-15 cm in diameter, 15-20 cm in height, and 15-20 cm in height, respectively. Percent control was recorded at 7 and 14 DAT before the experiment was terminated. The second UC Davis site was established in a sprinkler-irrigated annual crop field. The field was tilled and water applied to germinate and establish the annual weeds. At application, the site was dominated by common purslane (POROL), common lambsquarters (CHEAL), pigweed (both redroot, AMARE, and prostrate, AMABE), yellow nutsedge (CYPES) and green foxtail (SETVI)that were approximately 3-6 inches in diameter or height.

The experimental design adopted for all experiments was a randomized complete block with four replicates. Data were analyzed in Agricultural Research Manager (ARM 9) using analysis of variance (ANOVA), and means were separated by Fisher's protected LSD test (p 0.05). Data failed to meet the assumptions of ANOVA, as well as all tested data transformation. Therefore, analyses were made on original data. Means and data analysis for each experiment are presented separately.

Results: Low VOC kickers

In the first Merced county experiment, weed control was poor to fair (8-45% control) at 14 DAT across all treatments (Table 2). By 28 DAT, overall weed control was similar among all glyphosate + oxyfluorfen treatments (trts 2-5) and matched that observed for GoalTender + Rely 280. Control of the dominant weed species at this site, hairy fleabane, was comparable or better than oxyfluorfen + glyphosate with all "kicker" treatments except for carfentrazone and Hasten (trts 7 and 11) which were no different than the untreated control. With regards to the other dominant weed species, cutleaf eveningprimrose, there were no statistical differences among glyphosate + oxyfluorfen treatments (rates and formulations) or GoalTender + glufosinate. Tankmixes of GoalTender with paraquat, carfentrazone, pyraflufen, saflufenacil, and Hasten did not control cutleaf evening primrose as well as combinations with glyphosate or glufosinate. None of the treatments provided significant suppression of yellow nutsedge in this trial.

The first Yolo County experiment presented a challenging weed control situation due to the presence of large, drought-stressed weeds. In particular, prostrate knotweed can be quite difficult to control at this stage. At the 7 DAT rating, only GoalTender + Rely 280 (trt 8) controlled prostrate knotweed (Table 3). This treatment, as well as GoalTender + saflufenacil (trts 8 and 10), also controlled annual sowthistle and little mallow. By 14 DAT, control of knotweed and sowthistle were similar among all oxyfluorfen + kicker combinations except for glufosinate or saflufenacil, which tended to outperform the others. Little mallow control 14 DAT was similar among all oxyfluorfen treatments.

The second Merced County experiment was conducted in the same orchard as the first experiment; however, the plots were dominated by hairy fleabane plants that survived and regrew following a glyphosate application and mowing operations (Table 4). In this experiment, minimal weed control was obtained with any oxyfluorfen + kicker treatments except for glufosinate or saflufenacil, which controlled glyphosate-resistant hairy fleabane 90-100% by 28 DAT.

The second Yolo County trial was conducted in an annual crop field. After the summer crop was harvested, the field was tilled, and the site was sprinkler-irrigated to stimulate summer annual weeds to germinate and grow. At 7 DAT, control of small annual broadleaf weeds was similar among all "kicker" treatments except for GoalTender + Hasten, which had reduced weed control. Tank mixes that included glyphosate, paraquat, or glufosinate gave the best suppression of yellow nutsedge and grasses. Results were similar by 29 DAT when the experiment was terminated. Weed control efficacy on the small annual weeds present at this site appeared to be driven by the tankmix partner rather than the oxyfluorfen formulation in the mixture.

Results: Oxyfluorfen rate and formulation comparison

As in the previously discussed study, these two experiments presented challenging weed control situations due to the size (large and well established) and conditions (mowed/regrown, and drought-stressed) of the weed populations tested. The comparison of oxyfluorfen formulations and low rates (Tables 6 and 7) highlighted the relatively low postemergence activity of the compound as a solo product. When combined with glyphosate, Goal 2XL and GoalTender, there were few statistical differences between the treatments and the addition of additional non-ionic surfactant made little difference.

Conclusion:

- Overall, these results suggest that low VOC and high VOC formulations of oxyfluorfen can be similarly effective, with respect to POST activity, against specific weed species.
    - The overall success of these treatments will greatly depend on the weed spectrum present and on the tankmix partner used for preharvest weed control in tree nuts.
- In these studies, there were no differences among the glyphosate + Goal 2XL or glyphosate + GoalTender programs. These treatments alone were inconsistent in providing satisfactory control of glyphosate-resistant hairy fleabane, grasses, and sedges.
    - Malva is a key weed genera that drives the addition of oxyfluorfen to preharvest applications of glyphosate. Although not statistically significant, there were 5-34% lower MALPA control ratings in two Yolo County trials when oxyfluorfen SC was used in place of the EC formulation (Tables 3 and 7).
- In the "kicker" experiments, the best performance was usually achieved with the tankmix that included glufosinate (Rely 280). This alternative currently is not viable due to limited California availability of this product due to manufacturing issues and higher demands in other parts of the U.S. This shortage is expected through at least 2014 according to the manufacture.
- Most of these short-term studies were conducted in orchard situations with large and/or difficult to control weeds; thus, care should be taken before extrapolating the results of this limited dataset to the broader California tree nut industry.
    - Specifically, at the Merced site, hairy fleabane exceeded the size for which full control would be expected. Similarly at the Yolo walnut site, the weed spectrum and size was challenging for any of these treatments.
- The issue of herbicide-resistant weeds is evolving quickly in California orchards and vineyards as well as associated non crop areas. Regulatory actions that limit grower options in the short term may, inadvertently, have long term weed management implications.
- Repeating these experiments in additional commercial orchards at multiple locations in the Central Valley will allow for the <u>development of a robust set of data</u> and, subsequently, will lead to CDPR <u>decisions made on sound science</u>.

Table 2: Postemergence weed control (visual % control) at a low VOC oxyfluorfen plus "kicker" experiment in Merced County treated May 11, 2012.

				May 25, 2012		June 7, 2012							
				14 DAT		(26 DAT)							
				overall		overall		ERIBO		OEOBI		CYPES	
	Treatment	Rate	Unit	%		% control							
1	untreated			0	d[1]	0	d	0	f	0	e	0	a
2	Goal 2XL (oxyfluorfen)	0.125	lb ai/a	25	bc	58	a	45	cd	98	a	0	a
	Roundup WM[3] (glyphosate)[2]	1	lb ae/a										
3	Goal 2XL (oxyfluorfen)	0.25	lb ai/a	26	bc	64	a	51	cd	94	a	0	a
	Roundup WM (glyphosate)	1	lb ae/a										
4	GoalTender (oxyfluorfen)	0.125	lb ai/a	24	bc	59	a	60	bc	98	a	0	a
	Roundup WM (glyphosate)	1	lb ae/a										
5	GoalTender (oxyfluorfen)	0.25	lb ai/a	21	bc	68	a	45	cd	99	a	0	a
	Roundup WM (glyphosate)	1	lb ae/a										
6	GoalTender (oxyfluorfen)	0.25	lb ai/a	23	bc	34	bc	78	ab	43	b	0	a
	Gramoxone (paraquat) + MSO	0.625	lb ai/a										
7	GoalTender (oxyfluorfen)*	0.25	lb ai/a	8	cd	18	cd	16	ef	29	bc	0	a
	Shark (carfentrazone) + NIS	0.031	lb ai/a										
8	GoalTender (oxyfluorfen)	0.25	lb ai/a	45	a	46	ab	58	bc	79	a	0	a
	Rely 280 (glufosinate)	22	fl oz/a										
9	GoalTender (oxyfluorfen)	0.25	lb ai/a	15	bcd	19	cd	31	de	16	cd	0	a
	Venue (pyraflufen) + MSO	4	fl oz/a										
10	GoalTender (oxyfluorfen)	0.25	lb ai/a	30	b	33	bc	91	a	36	bc	0	a
	Treevix (saflufenacil) +MSO	1	oz/a										
11	GoalTender (oxyfluorfen)	0.25	lb ai/a	6	cd	13	cd	6	f	19	cd	0	a
	Hasten (est. veg. oil)	2	pt/a										

[1]Means followed by same letter are not significantly different.
[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.
[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, methylated seed oil at 1% v/v; NIS, non-ionic surfactant (R-11) at 0.25% v/v; ERIBO, hairy fleabane; OEOBI, cutleaf eveningprimrose; CYPES, yellow nutsedge.

Table 3: Knotweed (POLAV), annual sowthistle (SONOL), and little mallow (MALPA) visual control (%) at a Yolo county low VOC oxyfluorfen plus "kicker" experiment treated June 23, 2012.

				June 30, 2012 (7 DAT)						July 7, 2012 (14 DAT)[4]					
				POLAV		SONOL		MALPA		POLAV		SONOL		MALPA	
	Treatment	Rate	Unit	% control						% control					
1	untreated			0	d[1]	0	c	0	d	0	d	0	c	0	b
2	Goal 2XL (oxyfluorfen)	0.125	lb ai/a	11	cd	16	bc	48	bc	20	cd	28	bc	81	a
	Roundup WM[3] (glyphosate)[2]	1	lb ae/a												
3	Goal 2XL (oxyfluorfen)	0.25	lb ai/a	13	cd	21	bc	63	abc	24	cd	36	bc	88	a
	Roundup WM (glyphosate)	1	lb ae/a												
4	GoalTender (oxyfluorfen)	0.125	lb ai/a	7	cd	12	c	45	bc	35	bc	65	ab	75	a
	Roundup WM (glyphosate)	1	lb ae/a												
5	GoalTender (oxyfluorfen)	0.25	lb ai/a	9	cd	13	c	56	bc	34	bc	56	ab	81	a
	Roundup WM (glyphosate)	1	lb ae/a												
6	GoalTender (oxyfluorfen)	0.25	lb ai/a	23	bc	48	b	74	ab	25	cd	59	ab	95	a
	Gramoxone (paraquat) + MSO	0.625	lb ai/a												
7	GoalTender (oxyfluorfen)*	0.25	lb ai/a	15	bc	16	bc	60	bc	24	cd	35	bc	72	a
	Shark (carfentrazone) + NIS	0.031	lb ai/a												
8	GoalTender (oxyfluorfen)	0.25	lb ai/a	79	a	100	a	91	a	81	a	97	a	93	a
	Rely 280 (glufosinate)	22	fl oz/a												
9	GoalTender (oxyfluorfen)	0.25	lb ai/a	26	bc	46	b	68	ab	31	bc	70	ab	60	a
	Venue (pyraflufen) + MSO	4	fl oz/a												
10	GoalTender (oxyfluorfen)	0.25	lb ai/a	41	bc	90	a	90	a	59	ab	98	a	100	a
	Treevix (saflufenacil) +MSO	1	oz/a												
11	GoalTender (oxyfluorfen)	0.25	lb ai/a	4	cd	11	c	50	bc	18	cd	30	bc	80	a
	Hasten (est. veg. oil)	2	pt/a												

[1]Means followed by same letter are not significantly different.
[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.
[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, methylated seed oil at 1% v/v; NIS, non-ionic surfactant (R-11) at 0.25% v/v; POLAV, prostrate knotweed; SONOL, annual sowthistle; MALPA, little mallow.
[4]This trial was terminated 14 DAT due to other orchard management operations.

Table 4: Glyphosate-resistant hairy fleabane (EIRBO) control (visual % control) at a low VOC oxyfluorfen plus "kicker" experiment in Merced County treated June 23, 2012.

	Treatment	Rate	Unit	Hairy fleabane control Aug. 6, 2012 14 DAT		Aug. 20, 2012 28 DAT	
				% control			
1	untreated			0	d	0	c
2	Goal 2XL (oxyfluorfen)	0.125	lb ai/a	12	cd	17	bc
	Roundup WM[3] (glyphosate)[2]	1	lb ae/a				
3	Goal 2XL (oxyfluorfen)	0.25	lb ai/a	13	cd	22	bc
	Roundup WM (glyphosate)	1	lb ae/a				
4	GoalTender (oxyfluorfen)	0.125	lb ai/a	7	cd	13	c
	Roundup WM (glyphosate)	1	lb ae/a				
5	GoalTender (oxyfluorfen)	0.25	lb ai/a	9	cd	13	c
	Roundup WM (glyphosate)	1	lb ae/a				
6	GoalTender (oxyfluorfen)	0.25	lb ai/a	23	bc	78	b
	Gramoxone (paraquat) + MSO	0.625	lb ai/a				
7	GoalTender (oxyfluorfen)*	0.25	lb ai/a	15	bc	17	bc
	Shark (carfentrazone) + NIS	0.031	lb ai/a				
8	GoalTender (oxyfluorfen)	0.25	lb ai/a	79	a	100	a
	Rely 280 (glufosinate)	22	fl oz/a				
9	GoalTender (oxyfluorfen)	0.25	lb ai/a	27	bc	47	b
	Venue (pyraflufen) + MSO	4	fl oz/a				
10	GoalTender (oxyfluorfen)	0.25	lb ai/a	42	bc	90	a
	Treevix (saflufenacil) +MSO	1	oz/a				
11	GoalTender (oxyfluorfen)	0.25	lb ai/a	4	cd	12	c
	Hasten (est. veg. oil)	2	pt/a				

[1]Means followed by same letter are not significantly different.
[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.
[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, methylated seed oil at 1% v/v; NIS, non-ionic surfactant (R-11) at 0.25% v/v; ERIBO, hairy fleabane.

Table 5: Summer annual weed control (visual % control) at a low VOC oxyfluorfen plus "kicker" irrigated, non-crop experiment in Yolo County treated September 12, 2012.

	Treatment	Rate	Unit	POROL				CHEAL				CYPES				AMARE			
				7 DAT		29 DAT		7 DAT		29 DAT		7 DAT		29 DAT		7 DAT		29 DAT	
				% control															
1	untreated			0	b	0	b	0	c	0	c	0	c	0	b	0	c	0	b
2	Goal 2XL (oxyfluorfen)	0.125	lb ai/a	100	a	97.8	a	100	a	100	a	70	b	91	a	100	a	100	a
	Roundup WM[3] (glyphosate) [2]	1	lb ae/a																
3	Goal 2XL (oxyfluorfen)	0.25	lb ai/a	100	a	96.3	a	100	a	100	a	75	b	92.5	a	100	a	100	a
	Roundup WM (glyphosate)	1	lb ae/a																
4	GoalTender (oxyfluorfen)	0.125	lb ai/a	100	a	97.5	a	100	a	100	a	72.5	b	93.8	a	100	a	100	a
	Roundup WM (glyphosate)	1	lb ae/a																
5	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	100	a	100	a	100	a	72.5	b	88.3	a	100	a	100	a
	Roundup WM (glyphosate)	1	lb ae/a																
6*	GoalTender (oxyfluorfen)	0.5	lb ai/a	100	a	100	a	100	a	100	a	75	b	92.5	a	100	a	100	a
	Roundup WM (glyphosate)	1	lb ae/a																
7	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	97.5	a	98.3	a	50	b	88.8	a	69.5	a	100	a	100	a
	Gramoxone (paraquat) + MSO	0.625	lb ai/a																
8	GoalTender (oxyfluorfen)*	0.25	lb ai/a	100	a	100	a	99.5	a	98.8	a	7.5	c	17.5	b	100	a	100	a
	Shark (carfentrazone) + NIS	0.031	lb ai/a																
9	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	99.8	a	100	a	100	a	62.5	b	37.5	b	100	a	100	a
	Rely 280 (glufosinate)	22	fl oz/a																
10	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	100	a	100	a	100	a	7.5	c	17.5	b	100	a	100	a
	Venue (pyraflufen) + MSO	4	fl oz/a																
11	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	100	a	100	a	100	a	11.3	c	17.5	b	100	a	100	a
	Treevix (saflufenacil) +MSO	1	oz/a																
12	GoalTender (oxyfluorfen)	0.25	lb ai/a	100	a	98.8	a	65	b	10	c	7.5	c	15	b	77.5	b	90	a
	Hasten (est. veg. oil)	2	pt/a																

[1]Means followed by same letter are not significantly different.

[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.

[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, methylated seed oil at 1% v/v; NIS, non-ionic surfactant (R-11) at 0.25% v/v; PORAL, common purslane; CHEAL, common lambsquarters; AMARE, redroot pigweed; CYPES, yellow nutsedge.

[4] 7 DAT = September 19. 2012; 29 DAT = October 11, 2012. The 14 DAT evaluation data showed similar trends to 7 and 29 DAT.

* Treatment renumbering. Treatment 6 included at this experimental site was not included in the earlier trials due to a calculation error.

Table 6: Postemergence weed control (visual % control) in an oxyfluorfen rate and formulation comparison in a Merced County almond orchard trial treated May 11, 2012.

	Treatment	Rate	Unit	May 25, 12 (14 DAT) ground cover		June 7, 2012 (26 DAT) overall		ERIBO		OEOBI		CYPES	
				% cover		% control							
1	untreated			100	a	0	c	0	d	0	b	0	a
2	Goal 2XL	0.0625	lb ai/a	98	a	6	c	5	d	4	b	0	a
3	Goal 2XL	0.125	lb ai/a	100	a	4	c	0	d	9	b	0	a
4	Goal 2XL	0.1875	lb ai/a	97	a	3	c	1	d	4	b	0	a
5	GoalTender	0.0625	lb ai/a	99	a	10	c	5	d	18	b	0	a
6	GoalTender	0.125	lb ai/a	99	a	3	c	3	d	6	b	0	a
7	GoalTender	0.1875	lb ai/a	99	a	6	c	4	d	5	b	0	a
8	Goal 2XL + R-11	0.0625	lb ai/a	99	a	3	c	1	d	3	b	0	a
9	Goal 2XL + R-11	0.125	lb ai/a	98	a	10	c	4	d	9	b	0	a
10	Goal 2XL + R-11	0.1875	lb ai/a	98	a	8	c	1	d	9	b	0	a
11	GoalTender + R-11	0.0625	lb ai/a	98	a	6	c	4	d	8	b	0	a
12	GoalTender + R-11	0.125	lb ai/a	98	a	3	c	0	d	5	b	0	a
13	GoalTender + R-11	0.1875	lb ai/a	98	a	6	c	0	d	20	b	0	a
14	Goal 2XL	0.125	lb ai/a	81	bc	64	b	45	c	98	a	0	a
	Roundup WM	1	lb ae/a										
15	GoalTender	0.125	lb ai/a	85	b	73	ab	60	b	98	a	0	a
	Roundup WM	1	lb ae/a										
16	Goal 2XL	0.125	lb ai/a	74	c	74	a	65	ab	98	a	0	a
	Roundup WM + R-11	1	lb ae/a										
17	GoalTender	0.125	lb ai/a	81	bc	73	ab	59	b	92	a	0	a
	Roundup WM + R-11	1	lb ae/a										
18	Rely 280	1	lb ai/a	31	d	76	a	74	a	99	a	0	a
	Roundup WM	1	lb ae/a										

[1]Means followed by same letter are not significantly different.
[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.
[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, R-11, non-ionic surfactant (NIS) at 0.25% v/v; ERIBO, hairy fleabane; OEOBI, cutleaf eveningprimrose; CYPES, yellow nutsedge.

Table 7: Knotweed (POLAV), annual sowthistle (SONOL), and little mallow (MALPA) visual control (%) in an oxyfluorfen rate and formulation comparison in a Yolo County walnut orchard trial treated June 23, 2012.

	Treatment	Rate	Unit	June 30, 2012 (7 DAT[1])			July 7, 2012 (14 DAT)		
				POLAV	SONOL	MALPA	POLAV	SONOL	MALPA
				% control			% control		
1	untreated			0 c	0 c	0 b	0 b	0 b	0 b
2	Goal 2XL	0.0625	lb ai/a	0 c	1 c	5 b	5 b	6 b	41 ab
3	Goal 2XL	0.125	lb ai/a	0 c	0 c	0 b	13 b	3 b	39 ab
4	Goal 2XL	0.1875	lb ai/a	3 bc	8 c	6 b	10 b	1 b	48 ab
5	GoalTender	0.0625	lb ai/a	1 c	6 c	0 b	6 b	15 b	35 ab
6	GoalTender	0.125	lb ai/a	4 bc	6 c	20 b	14 b	14 b	44 ab
7	GoalTender	0.1875	lb ai/a	0 c	0 c	0 b	11 b	11 b	76 ab
8	Goal 2XL + R-11	0.0625	lb ai/a	0 c	0 c	0 b	1 b	8 b	38 ab
9	Goal 2XL + R-11	0.125	lb ai/a	0 c	3 c	4 b	6 b	10 b	46 ab
10	Goal 2XL + R-11	0.1875	lb ai/a	0 c	0 c	0 b	3 b	4 b	30 ab
11	GoalTender + R-11	0.0625	lb ai/a	4 bc	3 c	8 b	26 b	6 b	64 ab
12	GoalTender + R-11	0.125	lb ai/a	0 c	0 c	3 b	8 b	10 b	85 a
13	GoalTender + R-11	0.1875	lb ai/a	0 c	0 c	0 b	6 b	4 b	35 ab
14	Goal 2XL	0.125	lb ai/a	0 c	0 c	0 b	25 b	25 b	95 a
	Roundup WM	1	lb ae/a						
15	GoalTender	0.125	lb ai/a	9 b	18 b	23 b	31 b	15 b	83 a
	Roundup WM	1	lb ae/a						
16	Goal 2XL	0.125	lb ai/a	4 bc	5 c	11 b	10 b	11 b	71 ab
	Roundup WM + R-11	1	lb ae/a						
17	GoalTender	0.125	lb ai/a	0 c	0 c	3 b	23 b	6 b	40 ab
	Roundup WM + R-11	1	lb ae/a						
18	Rely 280	1	lb ai/a	78 a	98 a	96 a	91 a	95 a	100 a
	Roundup WM	1	lb ae/a						

[1]Means followed by same letter are not significantly different.
[2]Ammonium sulfate (10 lb/100 gal.) was added to all glyphosate and glufosinate treatments.
[3]Abbreviations: DAT, days after treatments; WM – WeatherMax; MSO, R-11, non-ionic surfactant (NIS) at 0.25% v/v; POLAV, prostrate knotweed; SONOL, annual sowthistle; MALPA, little mallow.