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Preemergence herbicides for olive orchard weed control

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Weed control is always important in table and oil olives and is critical during the first few years after planting when the trees are more vulnerable to weed competition. Olive producers often rely on a combination of tillage and chemical control strategies to manage weeds. Herbicides are primarily used as "strip" or "berm" treatments within the tree rows and are becoming increasingly important as some olive systems shift to moderate- or high-density production systems which limits within-row cultivation. In addition, the shift to low-volume irrigation systems in olive and other tree crops has affected weed emergence and growth, herbicide persistence, and further limits mechanical weed control within the tree row in these orchards.

In terms of herbicides used in olive orchards, there is a heavy reliance on just two active ingredients; glyphosate (Roundup and similar products) and oxyfluorfen (Goal, GoalTender and similar materials) (Table 1). Glyphosate has postemergence activity on many weeds and oxyfluorfen has both postemergence and preemergence control of many broadleaf weeds. However, the increasing prevalence of glyphosate-resistant broadleaf and grass weeds in orchards and vineyards has led to increasing interest in other herbicide options, especially preemergence materials.

Table 1. Top ten herbicides used in California olive orchards (CDPR data).

	active ingredient	2011 treated acreage
1	glyphosate (eg. Roundup)	64051
2	oxyfluorfen (Goal, GoalTender)	23209
3	diuron (Karmex, Diurex)	7910
4	simazine (Princep, others)	7457
5	carfentrazone (Shark)	7297
6	pendimethalin (Prowl H2O)	4513
7	oryzalin (Surflan, others)	4255
8	paraquat (Gramoxone)	3541
9	flumioxazin (Chateau)	752
10	pyraflufen (Venue)	331

Compared to some other tree crops, California olives have relatively few registered preemergence herbicide options (chart below); however, a few new materials are being tested and will hopefully also be available for olives in the next few years. Briefly, here is a rundown of the preemergence herbicides registered in California olives:

Diuron (Karmex, Diurex, others). Diuron provides preemergence and some postemergence control of many broadleaf and grass weeds including suppression of some perennial weeds. This herbicide works by blocking photosynthesis at photosystem II (Group 7 herbicide). This older chemistry typically is used at 1-2 lbs/A once or twice during winter and early spring and requires water for incorporation. Because diuron is quite water-mobile, it can be a leaching hazard in coarse soils and is subject to additional use restrictions in some areas.

Flumioxazin (Chateau, others). Flumioxazin is currently registered only on nonbearing olives. It is a Group 14 herbicide that has good residual weed control activity and also helps with postemergence control of emerged broadleaf weeds when tankmixed. Flumioxazin usually is applied at 6-12 oz/acre with longer residual control resulting from the higher rates.

Indaziflam (Alion). Indaziflam is the newest preemergence herbicide to be registered in olive. It is a long lasting, Group 29 herbicide that controls many grass and broadleaf weeds preemergence but has no postemergence activity. In olive, indaziflam can be used at 5-6.5 fl oz/A and trees should be at least three years old before this herbicide is used.

Isoxaben (Trellis, Gallery). Isoxaben can currently only be used in nonbearing olive orchards. When applied in the winter at 1 to 1.33 lb/A and properly incorporated, it can provide 4-5 months of control of many winter and summer broadleaf weeds. However, isoxaben has little or no activity on grass weeds and will not provide acceptable control of emerged or germinated grass weeds. Isoxaben is cellulose synthesis inhibitor (Group 21 herbicide).

Oryzalin (Surflan, others). Oryzalin is a Group 3 herbicide that provides preemergence control of annual grasses and small-seeded broadleaf weeds but has no postemergence activity. It is typically applied at 2-4 qt/A and must be incorporated by water or tillage for effective weed control. This herbicide is similar to pendimethalin in its weed control spectrum and residual activity.

Pendimethalin (Prowl H2O). Pendimethalin is a Group 3 herbicide that provides preemergence control of annual grasses and small-seeded broadleaf weeds but has no postemergence activity. It is typically applied at 2-4 qt/A and must be incorporated by water or tillage for effective weed control. This herbicide is similar to oryzalin in its weed control spectrum and residual activity.

Simazine (Princep, others). Simazine is a photosynthesis inhibitor (Group 5 herbicide) that controls many broadleaf and some grass weeds preemergence but has little postemergence activity. In olive, it is typically applied once or twice in the winter at 1-2 lb/acre. Because simazine is water-mobile, it can be a leaching hazard in coarse soils and is subject to additional use restrictions in some areas of the state.

Recent research:

Several new herbicides have been registered in other tree and vine, and UC weed scientists have conducted several experiments with the support of the California Olive Commission and the crop protection industry to evaluate their crop safety in olives. Although these herbicides are not currently registered in olive, early crop safety results have been mostly promising with penoxsulam (PindarGT), rimsulfuron (Matrix), mesotrione (Callisto), flazasulfuron (Mision), and saflufenacil (Treevix) – hopefully some of these will eventually be registered in this crop.

Two demonstration trials were conducted in commercial table olive orchards in 2012-13 to evaluate registered preemergence herbicides. At the Corning site (Table 2), the overall weed control ratings were quite good into

early summer following a March application. Note: the Corning orchard was previously treated with glyphosate; thus the untreated plots should really be considered a "glyphosate-only" program. At the Porterville site, weed control was excellent up to 6 months after a November application with Princep, Goal/Prowl, Goal/Surflan, and both Chateau (10 oz or 6 + 6 oz) treatments.

Table 2. Effects of preemergence herbicides on weed control in a young table olive orchard near Corning in 2013.

		Rate	Timing*	Overall weed control (%)**					
		lb ai/a		35 DAT		63 DAT		94 DAT	
1	untreated			45	a	42.5	a	15	b
2	simazine (Princep)	3	A	81.5	a	76.8	a	67.5	ab
3	oxyfluorfen (Goal 2XL)	1.5	A	83.8	a	62.5	a	25	b
	pendimethalin (Prowl H2O)	3.8	A						
4	oxyfluorfen (Goal 2XL)	1.5	A	88.3	a	67.5	a	35	ab
	oryzalin (Surflan)	4	A						
5	isoxaben (Trellis)	1	A	62.5	a	60	a	57.5	ab
6	flumioxazin (Chateau)	0.38	A	83.8	a	77.5	a	27.5	b
7	flumioxazin (Chateau)	0.191 fb 0.191	A fb B	88.3	a	78.8	a	80	a
	LSD (P=.05)			29.95		35.43		35.91	

*The "A" timing was applied March 19, 2013 and the "B" timing on May 21, 2013.
DAT = days after treatment.
**Prior to treatment the site had been treated with glyphosate; thus the weed control data are not solely the residual treatment.
***No treatment resulted in visible injury to the olive trees at any rating date.

In general, integrated weed management programs that include: preemergence herbicide, postemergence herbicides, and tillage are recommended for conventional olive production systems. Including several herbicide modes of action in a tankmix or in rotation will help reduce the selection pressure for herbicide-resistant weeds. This is particularly important as glyphosate-resistant weeds become more widespread in California orchard and vineyard cropping systems.

For the most recent Pest Management Guideline for olive (and dozens of other crops) check out UC IPM Online at http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html. Additional weed control information can be found at the UC Weed Research and Information Center (http://wric.ucdavis.edu/) and at the UC Weed Science blog (http://ucanr.org/blogs/UCDWeedScience/).

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