

# New Weed Management Options in Alfalfa and for Ground Water Protection Areas

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## Abstract

Alfalfa is the largest crop produced in California exceeding one million acres. It is estimated that 75% of acreage is treated for weeds on an annual basis. The hay market financially rewards weed free high quality hay with high prices. In 2006, the price for number 1 weed free hay exceeded \$160 per ton to the grower, as compared to weedy hay which sold for \$80 per ton. Managing weeds in a timely manner is necessary to provide maximum production of high quality alfalfa hay. Poor weed management can lead to premature stand loss, poor quality hay, unacceptable weed control, alfalfa injury and a loss of money. Therefore the importance of maintaining an appropriate amount of weed control tools, primarily herbicides is critical to the alfalfa industry.

Increased regulations to insure water and air quality for future generations are impacting many of the agricultural herbicides which fail to meet new standard under our farming practices. California ground water protection regulations and air quality standards begin affecting pesticide usage in 2004. Many of the herbicides targeted for mitigation are the mainstays to annual weed control in alfalfa and other crops. Searching for new farming methods that allow critical herbicide usage and development of new herbicides has a high priority to secure crop production and a high quality product.

**Keywords: alfalfa, ground water protection areas, diuron, norflurazon, pendimethalin, halosulfuron, flumioxazin, Roundup Ready alfalfa.**

## Introduction

Groundwater protection areas GWPA are geographically defined areas that are vulnerable pesticide contamination, either by leaching or runoff. GWPA include all areas previously designated as PMZs, plus new ones based on soil types and depth to ground water of 70 feet or less. Seven herbicides, two of which are used in alfalfa, Karmex® and Zorial® (diuron and norflurazon) have been placed on the ground water protection (6800) (a) list and are limited for use in leaching and runoff areas unless certain irrigation management practices are used. California groundwater area maps and mitigation alternatives can be found at [http://www.cdpr.ca.gov/docs/empm/gwp\\_prog/gwpamaps.htm](http://www.cdpr.ca.gov/docs/empm/gwp_prog/gwpamaps.htm)

Management alternatives for use of herbicides proposed by regulatory agencies may not be accepted under current alfalfa management practices and therefore not satisfactory solutions.

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One of the following management practices must be employed for use of herbicides in leaching GWPA.

1. Shall not apply any irrigation water for six months following application.
2. Shall apply the pesticide to the planted bed or berm above the level of irrigation water for six months following application.
3. Irrigation shall be managed to apply a net irrigation requirement of 1.33 or less for six months after application.

Management practices required in runoff protection areas.

1. Within 7 days before the pesticide is applied, the soil to be treated shall be disturbed by using a disc, harrow, rotary tiller.
2. Within 48 hours of application the pesticide shall be incorporated on 90% of the area treated by mechanical tillage or irrigation.
3. The pesticide shall be applied between April 1 and July 31
4. Retain all runoff in the field for 6 months or,
5. Retain all runoff in a holding area off the field.

Farming practices used in alfalfa make it extremely difficult if not impossible to follow these management guidelines. Retention and recycling ponds are one avenue that provide acceptable alternatives in certain areas where soil type, size of operations make it economically feasible. In the northern SJ valley existing drainage ponds and recirculation back onto irrigated crops is being done successfully.

Air quality standards are also making an impact on pesticides in alfalfa. The Central Valley region produces 60% of the state's alfalfa hay crop, and the desert region produces 20% of the state's alfalfa hay crop. The remaining 20% of the acreage is in the coastal and mountain areas. California Department of Pesticide Regulation has identified a number of pesticides (insecticides and herbicides) used on alfalfa as contributing volatile organic compounds (VOC) to air quality problems in California. A pesticide with an evaporate potential (EP) of greater than 20% is defined as a VOC. Alfalfa hay is the fourth largest VOC contributor of all agricultural commodities from emulsifiable concentration formulations of pesticides and contributed over 189,000 lbs of VOCs in 2005. The top eight alfalfa VOC producing pesticides are;

**Chlorpyrifos, dimetholate, hexazinone, trifluralin, sethoxydim, clethodim, permethrin and methomyl.**

Four of the eight VOC pesticides are herbicides that are important to the Alfalfa industry, hexazinone, trifluralin, sethoxydim, clethodim. If these herbicides were eliminated from use, it would have significant economic impacts to the industry.

Research is currently underway to study the true economic impacts if these herbicides were removed from the market. In addition, new herbicides are being evaluated as acceptable replacements when needed.

## New Herbicides Options.

Chemical weed control is the most effective and cost efficient method of weed control and is used on an estimated 75% of the alfalfa acres on an annual basis in California. Herbicides are an integral component of the weed management system and when coupled with cultural practices can result in excellent quality hay. Researching the application of new herbicides is critical to obtaining environmentally friendly and safe chemicals. The development of transgenic alfalfa is creating a completely new approach to weed management.

### Roundup *glyphosate* tolerant Alfalfa

Roundup Ready alfalfa for annual and perennial weed control has great potential showing promising results. Having the flexibility of applying an herbicide without limitations to alfalfa size and having a wide range of rate options allows for a timely and more effective weed control program, especially in the case with larger weeds or perennial weeds that more difficult to control. It is also possible to combine other alfalfa herbicides with Roundup without crop injury problems or compatibility issues, so implementing weed management systems that produce weed-free hay seems achievable. Tank mixing or rotating herbicides will also be important in managing weed shifts and protecting against the development of glyphosate resistant weeds. It will take time to fine-tune the weed control system but unquestionably the tools are now available to take alfalfa weed control to the next level.

Without question, the RR alfalfa system has heightened interest and is gaining popularity. The low cost and flexibility of glyphosate with little threat of crop injury, plant back issues or listed as a problem in groundwater; will attribute to a rapid adoption. However, one of the greatest concerns facing rapid adoption of this new technology is the potential overuse leading to weed resistance and weed shifts. In the case where three years of Roundup only was applied, a shift of burning nettle was documented. Figure 1.

### Sandia *halosulfuron*

Sandia herbicide is well noted for nutsedge control in field and row crops. Nutsedge has been a serious problem in alfalfa with few management options that are effective. Sandia was granted a section 18 in established alfalfa for the lower desert areas of California in 200X. In 2006 it was granted a full registration throughout California for alfalfa. Highly effective for control of nutsedge, Sandia can cause temporary stunting and yellowing when applied during the growing season in the Sacramento and San Joaquin Valley. Less injury and yield loss occurs in the desert region.

### Prowl H20 *pendimethalin*

Prowl herbicide has an anticipated registration for California alfalfa in spring 2007. Prowl controls annual grasses and certain broadleaf weeds before they germinate. It will be especially important in alfalfa for summer grass control, dodder control and used as a

tank mix partner for winter dormant weed control. It is safe on established alfalfa once a harvest has been made. Prowl is in the dinitroaniline family of herbicides with little known weed resistance issues. This will be particularly helpful in managing against the development of glyphosate weed resistant in Roundup Ready alfalfa. Initially, it will have a 50 day pre harvest interval which is restrictive to its most effective use in alfalfa which is spring and summer applications. That is expected to change to a shorter PHI by the 2008 season.

### Chateau *flumioxazin*

Chateau has been undergoing alfalfa research for several years in California and Arizona for winter weed control in semi dormant alfalfa. Chateau was granted a section 18 registration in Arizona for groundsel control. It was scheduled for California alfalfa registration in 2007 but that date has been extended until 2008/09 until ongoing research is completed. It has contact postemergence action so it will control small annual weeds. The postemergence action may not be sufficient in most field situations containing emerged weeds, especially large annuals so a postemergence herbicide should be added. Tank mixing with paraquat, glyphosate, imazamox and hexazinone have demonstrated excellent results. Chateau by itself at the low rate of 0.094 lb ai/A gives very good control of common chickweed and common groundsel with 80% control of annual bluegrass and annual sowthistle. The higher rate of 0.125 lb ai provided excellent control ranging from 92 to 100%.

Chateau 12 days after treatment and depending upon the rate shows alfalfa burn from 15-27%. Alfalfa stunting at 36 DAT ranged from 13-28%. Prior to harvest alfalfa had completely recovered with normal yields.

Chateau would be an excellent addition for alfalfa especially in winter applications for preemergence weed control. It has no restrictions in GWPA or worker safety issues and has been granted fast track registration in California for trees and vine crop use. See Figure 2.

### Summary

Alfalfa acreage in California continues to increase and prices are escalating as the demand for high protein weed free hay remains strong in the dairy and horse industry. As the mature herbicides are faced with new regulatory restrictions and possible elimination, it becomes critically important to find alternative solutions through alternative farming systems and development of new herbicides.

The use of glyphosate tolerant alfalfa will be rapidly adopted and create higher expectations of weed control leading to potential for over use. Across the country in other RR crops, weed shifts and possible herbicide resistant's may emerge. The importance of developing new herbicides in alfalfa becomes even more important for rotation and adds balance to an integrated system. The new herbicides entering the alfalfa market are not only timely from a weed management standpoint but extremely important as new regulations reduce the weed management options available.

Figure 1

### Glyphosate Tank Mixtures for Weed Control in Established Roundup Ready Alfalfa

Treatments	lb ai/acre	% Crop Injury & Weed Control				% Biomass @ Harvest	
		Burning Nettle	Chickweed	Annual Bluegrass	Sowthistle	Alfalfa	Weeds
Roundup Ultra Max 4SL	2.0	73	95	93	48	53	47
Roundup Ultra Max 4SL	1.0	30	7	90	52	23	77
Roundup Ultra Max 4SL	0.5	0	72	85	43	18	82
Velpar 2EC + Gramoxone Max 3EC	0.5 + 0.375	95	95	93	60	74	26
Roundup Ultra Max 4SL + Velpar 2EC	1.0 + 0.5	95	88	76	73	73	27
Untreated		0	0	0	0	11	89

Evaluations 62 days after application.

Figure 2

### Alfalfa & Weed Yield in Dormant Alfalfa

Treatment	Rate (lb ai/acre)	Alfalfa & Weed Yield		
		Weeds (lbs/acre)	Alfalfa (lbs/acre)	Alfalfa Quality TDN
Chateau	0.094	200 f	3400 cd	58.4
Chateau	0.125	0 g	3800 bc	58.3
Chateau	0.188	0 g	3600 cd	58.5
Chateau	0.25	0 g	4400 ab	55.8
Gramoxone Inteon	0.5	800 c	2200 f	58.5
Gramoxone Inteon + Chateau	0.5 + 0.125	0 g	4600 a	56.4
Gramoxone Inteon + Chateau + Velpar	0.5 + 0.125 + 0.5	0 g	3400 cd	58.3
Gramoxone Inteon + Velpar	0.5 + 0.5	200 f	3400 cd	57.7
Raptor	0.047	600 d	3000 de	56.8
Raptor + Chateau	0.047 + 0.125	0 g	3200 cd	56.8
Raptor + Chateau	0.047 + 0.188	0 g	3600 cd	59.6
Chateau + Velpar	0.125 + 0.5	0 g	3600 cd	58.3
Velpar	0.5	800 c	3000 de	57.9
Gramoxone Max + Velpar	0.5 + 0.5	400 e	3000 de	58.4
Check	-	1200 a	2400 ef	56.6
Gramoxone Max	0.5	1000 b	3200 cd	57.8

Yield 1st cutting; 4/24/06, Hay = 90% D.M.

