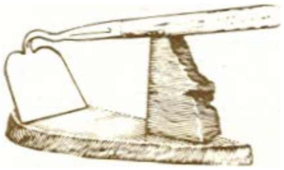

California Weed Science

Information on Weeds and Weed Control from the California Weed Science Society
Volume 2, number 1
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California Weed Science Society News

Introduction

Steve Fennimore, Editor

Happy New Year 2006! This is the 1st anniversary of California Weed Science, a newsletter dedicated to weed science news, research, and other items of interest for weed managers. In this issue you will find introductions of two new weed scientists, updates on wildland weed control, precision cultivation, alligatorweed, and VOCs.

California Weed Science is your newsletter. I am looking for ways to make improvements and to provide the information that you need. Please send me your suggestions and articles for future California Weed Science issues to safennimore@ucdavis.edu, or via fax at 831-755-2814. My office phone is 831-755-2896.

For mailing address changes, please call the PAPA office at 831-442-3536 or by mail at PAPA, P.O. Box 80095, Salinas, CA 93912.

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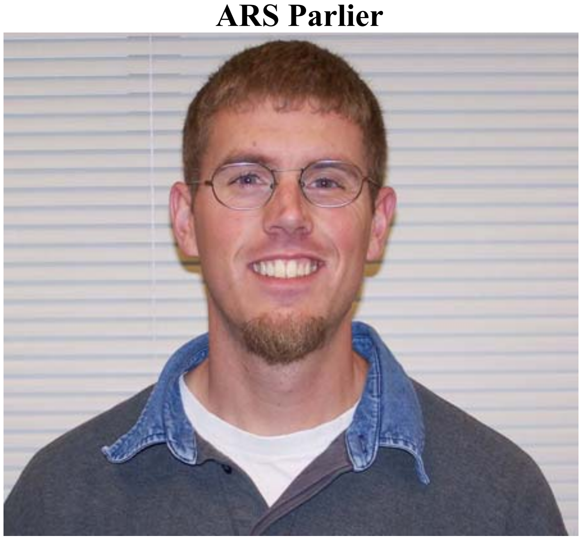
Brad Hanson, Research Agronomist, USDA-ARS Parlier



I grew up on a farm in Iowa where we raised corn, soybean and livestock. I earned a B.S. from Iowa State Univ. in 1996. I have worked in the chemical industry as an applicator and a research intern. I have worked as a research assistant with USDA-ARS and at Oregon State Univ. I received a M.S. from the Univ.of Idaho in 1999 where my research involved weed control in a dry pea/lentil - winter wheat system. I returned to the Univ. of Idaho in 2001 for a Ph.D. program. My research involved gene flow in wheat and jointed goatgrass. I completed my Ph.D. in 2004 and took a post doctoral research position in the Weed Research Lab at Colorado State Univ. I started my current position with the USDA-ARS in November 2005 and my research focus is to identify chemical and non-chemical weed control alternatives to methyl bromide in vine and tree crops, ornamentals and strawberries.

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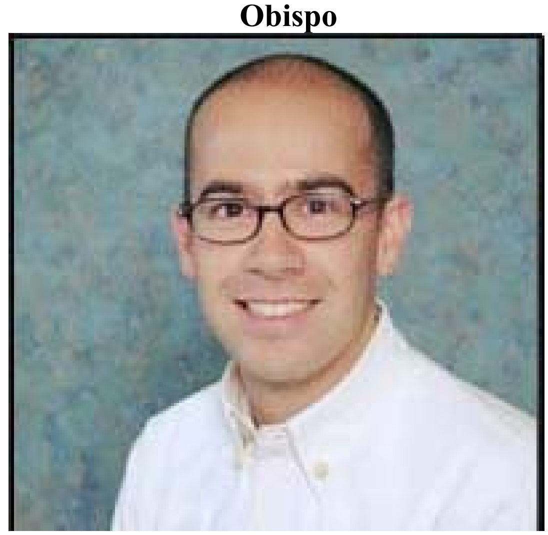
Ramon Leon, Weed Science Professor, California Polytechnic State Univ, San Luis Obispo



Ramon is originally from Costa Rica where he earned a B.S. in Agronomy at the University of Costa Rica. He also earned a M.Sc. and a Ph.D. in Crop Production and Physiology with emphasis in

Weed Science and a Ph.D. in Genetics from Iowa State University. He has conducted research on crops such as citrus, corn, pastures, rice, soybeans, sugar cane, and vegetables. Ramon´s research has been focused on seed dormancy, seed bank dynamics and tillage, but he has also been involved in herbicide development and herbicide resistance research. He is currently working on weed management in vegetables, turf, vineyards and orchards using integrated approaches. Contact information for Ramon is: rleon@calpoly.edu, (805) 756-2272.

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The value of combining two herbicides for wildland weeds.

Carl E. Bell, Regional Advisor-Invasive Plants, UCCE-San Diego

Non-native plants have invaded natural habitats throughout California and herbicides have become one of the most important tools for combating this invasion. The number of herbicides that can be used in wildland sites, however, is small relative to other situations, both because of limited registrations and because of concern for non-target vegetation. This creates a couple of problems, one is lack of effective weed control and the other is the evolution of resistance to the herbicide by the weeds.

All herbicides are selective, even those like glyphosate that are regarded as non-selective. Any particular herbicide will kill some weeds well, some not so good, and some very poorly or not at all. When the herbicide options are limited, it is more likely that people will continue using the same herbicides on weeds that are difficult to kill, because they have little choice. Over time, this practice will lead to habitats dominated by the tolerant weed species and the herbicide will become less and less effective, even when the dosage of herbicide is increased year to year.

In the worst case scenario, weeds evolve resistance to herbicides that are used repeatedly on the same population of plants. Then it will be impossible to kill this population of weeds with the herbicide being used at any dosage. There are already several documented populations of weeds resistant to herbicides in California. These situations are mostly in crops, especially perennial crops like orchards, or along roadsides and irrigation canals where one herbicide has been used repeatedly for years. But with the increased efforts being made to control invasive weeds in wildlands and the increased use of herbicides, resistance is going to happen. While plants can select for resistance against one herbicide, it is much more difficult for a plant species to respond to two or more herbicides if they are attacking different physiological mechanisms in the plant. Both of these problems can be minimized by using combinations of herbicides whenever it is feasible.

Mixing two herbicides together can improve weed control if: they are compatible in the tank mix; they both have an effect on the target weed; and the individual herbicide labels allow, or at least do not prohibit, the combination. Combinations should use two or more herbicides that do not have the same mode of action. If the herbicides have the same mode of action, such as a combination of chlorsulfuron (Telar) and sulfometuron (Oust), the likelihood of resistance remains the same and it is unlikely to improve overall weed control. An exception to this is combining phenoxy herbicides (e.g. 2,4-D, MCPA, dicamba), which have a long history of use and seem to work quite well. Another good reason for combining herbicides is to broaden the spectrum of weeds controlled, but that is not the subject of this article.

When herbicides are combined three outcomes can occur; they are additive, synergistic, or antagonistic. Additive is the most common, essentially 1 + 1 = 2. The combination works about as well as either herbicide alone. Synergism is not very common and difficult to prove. It is 1 + 1 = 3, the combination works better than what is expected from the individual action of each herbicide. Antagonism is 1 + 1 = 1. Sometimes two herbicides are not compatible and putting them together in one tank will reduce the efficacy of one or both and/or cause significant injury to plants they normally don't hurt. There may also be antagonism problems related to surfactants, which are often very specific to particular herbicides. In general, it is probably better to only add the surfactant required for one of the herbicides, but not both. In the case of Roundup, there are so many surfactants already in the formulation that adding more to the spray tank is wasteful. The individual herbicide labels are the best source for this information on this subject.

There are several herbicide mixtures that I have used successfully or am currently doing research with. One is shown below in Table 1. This experiment was trying to determine effective herbicide treatments to kill resprouts from very old olive trees that had been cut off at the ground many years previously. The most effective control was with the 2% rate of imazapyr, but the combination of imazapyr at ½% and glyphosate at 1% was about as good. In this case, because glyphosate is much less expensive than imazapyr, we found a considerably cheaper way to get these old trees out of the reserve. This combination of imazapyr and glyphosate, usually at ½% each, has been used for several years very successfully for control of saltcedar (*Tamarix ramossissima*) as a foliar spray.

Table 1. Visual evaluation of olive root sprout percent mortality at the Santa Rosa Plateau Ecological Reserve, Murrieta, CA.

		Percent mortality	
Herbicide [1]	Dosage v/v	11/1/02	5/22/03
Imazapyr	1%	2	76
Imazapyr	2%	20	97
Imazapyr + glyphosate	0.5 + 0.5	3	70
Imazapyr + glyphosate	0.5 + 1	12	84

[1] Treated 9/27/02

Table 2. Fennel control with glyphosate and triclopyr at Camp Pendleton, Oceanside, CA.

Herbicide [1]	Dose	Fennel control	
	% v/v	4/12/04	5/10/05
1. Glyphosate	1	75	54
2. Glyphosate	2	82	46
3. Triclopyr	1	99	98
4. Triclopyr	2	98	93
5. Gly. + triclopyr	1 + 1	98	99
6. Gly. + triclopyr	1 + 2	99	99
7. Gly. + triclopyr	2 + 1	99	100
8. Glyphosate	2	98	88
9. Triclopyr	1	98	83
10. Untreated	0	0	0

[1] Applied Feb. 2004 and Mar. 2005.

Another example is a series of field experiments comparing glyphosate and triclopyr for control of common fennel (*Foeniculum vulgare*). Table 2 shows the results of the variety of treatments, which included each herbicide alone and in combination. The additive situation would be treatment 5 in the list. If this treatment is compared to treatment 2 the control is somewhat better and equal to treatment 4.

In some agricultural crops, such as corn and soybean, herbicide combinations are very common and many pre-mixed products are available on the market. In the non-crop area, this is not as common. It is up to the individual user to evaluate different herbicide mixes and see if they work at least as well as the individual herbicide alone. This is, in my opinion, worth the effort for the reasons outlined earlier in this article. However, if the herbicide labels do not specifically mention the combination, the manufacturer may not support that usage. Be sure to read the label before trying a combination treatment.

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Precision Cultivation in Vegetable Crops

Richard Smith and Tiffany Bensen, Univ. of California Cooperative Extension, Monterey County, and Steve Fennimore, Univ. of Calif. Davis

Increasing production costs for vegetable crops, especially labor costs, make labor saving technology very attractive. Virtually all of the lettuce and broccoli acreage on the California central coast is cultivated more than once. Cultivation has always been a tedious and time consuming task which requires a skilled tractor driver. However, commercially-available machine-vision guidance takes the task of guiding the fine movements of the cultivator thus allowing for more rapid and accurate operation. A typical machine such as the Eco-Dan® guidance system uses a digital color camera that takes 25 pictures per second of the green plant row directly beneath it (see photo next page). These pictures are processed by a computer to establish the row centerline. As the row centerline shifts the computer signals a control valve to move a hydraulic cylinder right or left to keep the implement in the correct working position over the row. The Eco-Dan® guidance can differentiate between plants within the row and random weed patterns. One labor saving advantage of the machine vision guidance is that it allows the cultivator to drive faster and cover more acres per day than with a conventional cultivator. Another possible labor savings from this equipment may be to cultivate closer to the seedline so that more weeds are removed and hand weeding costs are reduced. The disadvantage of cultivating closer to the seedline is the potential for more damage to the crop stand. We conducted three studies to determine if we could use an Eco-Dan cultivator to cultivate as close as within 1-inch of a lettuce and broccoli seedline, i.e., a 2-inch uncultivated band. In two studies on Romaine lettuce, 2-inch uncultivated bands had over 50% fewer weeds than the standard 4-inch wide uncultivated band and reduced hand weeding time by 9.8 to 26.7%. No reductions in the stands or yields of lettuce were observed between close and standard cultivation in either trial. A study was also conducted on broccoli. The broccoli field was particularly cloddy and it was determined that

moving the cultivation knives close to 2 inches apart would be too damaging to the crop, so uncultivated bands of 3, 4 and 5 (grower standard) inches were evaluated. The 3 and 4-inch wide uncultivated bands reduced weeds by 44.1 and 35.3%, respectively compared to a 5-inch band. Both of these close cultivation treatments significantly reduced weeding time. The broccoli stand and yield were not reduced in any of the cultivation treatments. These data indicate that a precision guidance system such as the EcoDan® can accurately guide the cultivation rig closer to the seedline, remove more weeds and reduce hand weeding times.

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Alligatorweed in California: Biology, Ecology, and Eradication Program

Daud Senzai, California Department of Food and Agriculture, Lemon Grove, CA

Alligatorweed (*Alternanthera philoxeroides*) is a native of the Parana River System in northeastern Argentina and was first found in the United States in Florida in 1884. Since then, it has spread to many mid-Atlantic and southeastern States. It has also become a weed in tropical and mild temperate regions around the world.

In the US, alligatorweed grows in the coastal plain from Virginia to southern Florida and westward along coastal areas to Texas. Alligatorweed is a federal noxious weed and in California, it is listed as an A-rated noxious weed, meaning that it is subject to quarantine and eradication efforts by the California Department of Food and Agriculture and county Departments of Agriculture.

Alligatorweed is highly competitive and displaces other desirable plants.

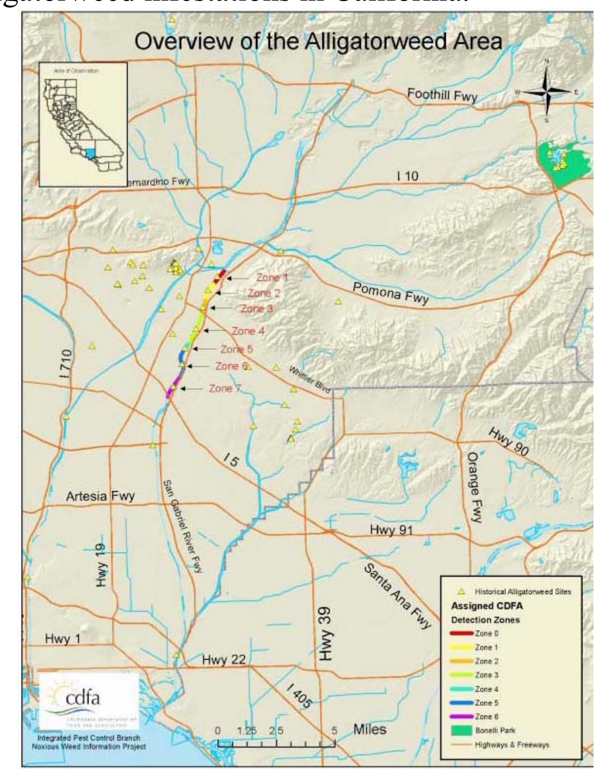
Alligatorweed has been known in California since 1946. However, it was not reported to the Los Angeles County Agriculture Commissioner's office until 1956. It was first found in 1965 in Tulare and in 1969 in Kings County. Both counties are still working to eradicate it. Alligatorweed was first reported in San Diego County in 1986, in San Bernardino County in 1996 and in Riverside County in 1997 and was declared eradicated from the three counties in 1987, in 2001 and in 2003 respectively.

Biology: Alligatorweed is a stoloniferous, herbaceous, perennial, with horizontal to ascending stems. It is a member of the dicotyledon family, Amaranthaceae (Amaranth) and usually spreads vegetatively by fragmentation of stems and roots. Although viable seeds have been found in the US and South America, seeds are not known to be viable in California. Leaves are apposite, elliptic in shape, from 2 to 4 inches long. Leaves have a distinctive midrib, are without hairs (glaucous), and are without petioles. Stems are simple or branched and are distinctly jointed (photo above right). The stems are hollow, fleshy and succulent, light to dark green color in aquatic; and are pink to purplish color and solid or pithy in terrestrial condition, reaching 4-ft. long. Stems root at the nodes and are usually floating or trailing along the ground except for the tips that turn upward. Small white clover-like flowers are borne on short stalks attached in the leaf axils. Seeds are smooth, disc-shaped to flattened, wedge-shaped and are rarely viable.

Ecology and Economic Damages: Alligatorweed is an emerged aquatic plant with the ability to survive in dry land habitats. If a waterway dries, alligatorweed changes to a terrestrial form with smaller, tougher stems and leaves. As an aquatic plant, alligatorweed roots readily along waterways and then grows over the water surface as an anchored floating plant. Typically, plants grow in shallow water or wet soils, ditches, marshes, edges of ponds and slow-moving watercourses. In terrestrial situations, it forms large leafy materials above ground and dense mats of lignified root material under the soil. Requires warm growing season, but can tolerate cold winters. Alligatorweed, like many other invasive aquatic plants, displaces native plants in ditches, along banks, and in shallow water. It disrupts water flow causing increased sedimentation, and it shades submersed plants and animals causing reduced oxygen levels beneath the mat. Infestations of alligatorweed block rivers, canals, and ditches and disrupt many economic uses of water. Thick mats prevent drainage canals, ditches, streams, and other small waterways from emptying rapidly during periods of heavy water load, thus causing flooding. If mats break loose, they create obstructions by piling up against bridges, dams, and sharp bends in waterways. Thick mats also increase mosquito habitat. Navigation of small waterways is obstructed, as is shoreline navigation in large waterways. Efficiency of irrigation systems is decreased.

Eradication: The current Alligatorweed Eradication Project in Los Angeles County consists of a cooperative coalition of the Los Angeles County Department of Agriculture, the Flood Maintenance Division of the Los Angeles County Department of Public Works, the Los Angels County Department of Parks and Recreation, the U. S. Army Corps of Engineers and the California Department of Food and Agriculture.

Considerable effort is being expended to eradicate alligatorweed in the Los Angeles County area. A total of 89 plants were discovered over the twelve months survey period with a total surface area of 68 square feet. Of the 89-alligatorweed plants found in 2004, 70 (79%) were found in the flood control, lower San Gabriel River areas and 19 (21%) were found in Bonelli Park near San Dimas (see map on this page). All of the alligatorweed plants were dug-out, double bagged and safely destroyed. In some cases, Casoron® G10 (dichlobenil) was applied immediately after digging the plants. The size of individual plants has been smaller (0.8 sq ft area) in 2004 and the total number of the plants found has been fewer as compared to the year before. In 1956, when alligatorweed was first reported to the Los Angeles County Department of Agriculture, there were 115 net acres of alligatorweed. Due to the efforts of many agencies and CDFA statewide eradication programs it has been reduced to almost 1/1,000th of an acre in 2004. The data for the year 2005 are not available yet. However, the trend of the past months shows that there would be fewer plants found this year than before. Persistent survey and applying combination of eradication methods, especially mechanical and chemical will end the alligatorweed infestations in California.



Control: Alligatorweed will not establish in water deeper than 6 feet. Establishment of competitive grasses or other native species on the banks of ponds, irrigation ditches, or other waterways will reduce soil erosion and prevent alligatorweed infestation. Mechanical removal, without careful removal of all plant parts, can facilitate spread. Stolons can regenerate from burial to 30 cm (~12 in) deep. Care must be taken to prevent transport of detached stems down water, where re-establishment can rapidly occur. The release of several South American insect species in the southeastern US, (Florida, Georgia, the Carolinas and Alabama from 1971-1973); to control alligatorweed resulted with varying degree of success. However, the attempts in Albany, California, from 1967 to 1971, were unsuccessful. Treatments of alligatorweed with 2,4-D, glyphosate (Rodeo®) or Banvel® (dicamba) have demonstrated considerable success. The project in Los Angeles County uses Casoron® but a more effective product is needed. Project personnel are planning to test the new aquatic herbicide product, Habitat® soon.

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Volatile organic compounds (VOCs): and how weed management practices may contribute to their reduction.

Anil Shrestha[1] and Rick Roush[2]
[1]IPM Weed Ecologist [2]Director
Univ. of California Statewide IPM Program

What are Volatile Organic Compounds? Volatile organic compounds (VOCs) are carbon-containing substances that have a high vapor pressure and low water solubility. These compounds are present in hundreds of products such as paints, refrigerants, pharmaceuticals, exhaust fumes, cigarette smoke, household chemicals, formaldehyde, aromatic hydrocarbons, and certain pesticides. Even if sold as a liquid, these compounds volatilize into gaseous or vapor form when exposed to air. VOCs can contribute to the formation of ground level ozone (by combining with nitrogen oxides in the presence of sunlight). VOCs also contribute to the greenhouse effect as methane and photochemical oxidants produced from them are both green house gases. Some VOCs are also believed to be common ground-water contaminants.

Why the recent concern about VOCs? In California, all industries and sources of compounds that contribute to ozone formation are being asked to reduce emissions to meet the new stringent ground-level ozone standard in the San Joaquin Valley. There are thousands of organic compounds in the troposphere that meet the definition of a VOC; however, most attention has been focused on the 50 to 150 most abundant hydrocarbons. One such focus of the California Dept. of Pesticide Regulation (DPR) is on VOC emissions from pesticides because many active and inert ingredients in pesticides are VOCs. Pesticides accounted for 6.3% of the total VOC emission in 2004.

Each state must submit a State Implementation Plan (SIP) for achieving and maintaining federal ambient air quality standards, including the ozone standards of the Federal Clean Air Act. Regions that do not meet either federal or state ambient air quality standards are called Nonattainment areas (NAAs). In California, the NAAs include the Sacramento Metro, the San Joaquin Valley, Ventura, South Coast, and the Southeast Desert. In 1994, California's Air Resources Board (ARB) and DPR developed a plan to reduce pesticidal sources of VOCs in NAAs as part of the California SIP to meet the 1-hour ozone standard. Pesticidal VOC emissions in the San Joaquin Valley NAA declined for several years, but have recently increased above the limit specified in the SIP. In April 2004, the U.S. EPA issued a more stringent 8-hour ozone standard, likely requiring additional VOC reductions. DPR is preparing a new SIP and additional VOC reductions from all sources will likely be required to meet the new ozone standard.

How does DPR estimate VOCs? DPR estimates VOC emission as the product of VOC fraction in product and the amount of product applied (emission = VOC fraction in product X amount of product). The emission potential of the VOC is determined by lab test (thermogravimetric analysis, TGA), water inorganic subtraction, confidential statement of formula, or a default value. The DPR estimates VOC emissions from agricultural and structural applications for each year since 1991. Their data show that more than 90% of the emission from pesticides is from agricultural sources except on the South Coast. DPR, ARB, and others are working to increase the accuracy of VOC emission estimates and reduce VOC emissions from pesticides. It should be noted that the current method of estimation assumes a 100% loss of the VOCs in the pesticide. However, revisions are planned on the estimation methods.

So what does this mean for weed management? In California, weed control remains a significant cost in crop production and in non-crop areas (e.g., roadsides, urban area, forests, aquifers and waterways, etc.) vegetation management. Herbicides are still the primary tool for weed management in most crop and non-crop areas. DPR agricultural data shows that by acres treated, (story continued on page 7)

Table 3. Herbicides with VOC concerns by commodity and acreage treated.

Commodity	Active ingredient [1]	2003 Application Acres	Share harvested Acres
Almond	Oxyfluorfen	262,042	48%
Apple	Oxyfluorfen	3,527	13%
Bok Choy	Bensulide	137	-
Carrot	Trifluralin	9,487	13%
Cherry	Oxyfluorfen	8,060	32%
Cherry	Paraquat Dichloride	3,021	12%
Grape	Oxyfluorfen	70,036	21%
Kiwi	Oxyfluorfen	600	13%
Nectarine	Oxyfluorfen	12,403	34%
Onion, dry	Bromoxynil Heptanoate	14,138	32%
Onion, dry	Bromoxynil Octanoate	16,677	38%
Onion, dry	Oxyfluorfen	8,740	20%
Onion, dry	Pendimethalin	6,418	15%
Onion, green	Bromoxynil Heptanoate	239	-
Onion, green	Bromoxynil Octanoate	243	-
Onion, green	Oxyfluorfen	83	-
Peach	Oxyfluorfen	16,718	25%
Persimmon	Oxyfluorfen	136	-
Plum	Oxyfluorfen	9,250	26%
Squash, zucchini	Bensulide	105	-
Tangerine	Trifluralin	1,349	14%
Tomato	Trifluralin	12,147	33%
Tomato, Processing	Trifluralin	95,056	35%

[1] Herbicides (active ingredient with trade names in parenthesis) that have VOC emission potentials and might be subjected to reformulation include:

1. 2,4-D (Weedone Lo Vol 6, Albaugh Solve 2,4-D, Speed Zone St. Augustine Formula Broadleaf herbicide, Speed Zone Southern Broadleaf herbicide for turf, Crossbow, Spectracide Lawn weed killer 2 33 Plus, Weedar 64, Weedaxe, Nufarm Esteron 99 concentrate herbicide, Hivol-44, Brush Buster).
2. Acrolein (Magnacide H)
3. Alachlor (Lasso)
4. Bromoxynil Octanoate (Buctril, Buctril EC)
5. Clethodim (Prism 2 EC, Envoy)
6. Dicamba , Dimethylamine salt (Banvel)
7. Dithiopyr (Dimension)
8. Ethalfluralin (Sonalan HFP, Sonalan EC, Clean Crop Curbit EC)
9. Metolachlor, S-Metolachlor (Dual Magnum, Dual II Magnum, Pennant Magnum)
10. Oxyfluorfen (Goal 1.6 E, Goal T/O, Goal 2E, Goal 2XL, Galigan 2E)
11. Pendimethalin (Stomp 3.3EC, Prowl 3.3EC, Pendulum 3.3EC)
12. Sethoxydim (Poast, Grass Getter)
13. Triclopyr, Butoxyethyl ester (Turflon Ester, Garlon 4, Remedy)
14. Trifluralin (Treflan HFP, Tenkoz Trifluralin 4EC, Triap 4HF, Treflan EC, Treflan 5, Gowan Trifluralin 4, Gowan Trifluralin 5, Trilin 5, Trilin, Tenkoz Trifluralin 4EC, Clean Crop Trifluralin HF, Seadagri Trifluralin 480, Vegetable and ornamental weeder)

(continued from page 6) the pesticides with the greatest use in 2002, after sulfur, were glyphosate, oxyfluorfen, and paraquat dichloride, all herbicides.

Herbicides come in several formulations: solutions (S), liquids (L), dry flowables (DF), water dispersible granules (WDG), wettable powders (WP), flowables (F), micro-encapsulated (ME), and emulsifiable concentrates (EC). All these formulations are generally mixed with water and sprayed. There is a general focus on EC formulation of herbicides because they are believed to be the highest VOC contributors among the various formulations.

An EC is a pesticide formulation consists of an active ingredient and an emulsifier in an organic solvent. The solvent is usually not soluble in water. An EC product mixed with water results in a dispersion of fine, oily particles in water.

Herbicides with an emission potential greater than 20 percent. Several herbicides are available in EC and other forms. The DPR has prepared a database of EC products with emission potentials of more than 20% by active ingredient. Table 3 shows the herbicides of concern by commodity. It should not be assumed that this is a complete list nor that changes will necessarily be made to any given product. As a general rule of thumb, DPR's review will probably affect most products with an E or EC formulation. There are many glyphosate products with EC formulations, however. These products are currently under review. Table 4 provides examples of the emission potentials of some herbicides and their various formulations.

With so many common successful herbicides on the watch-list, it remains to be seen what affect these regulatory changes will have on day-to-day weed management. In some cases, it may be as simple as replacing an EC with a non-EC formulation. Similarly, in some cases it may be possible to obtain exemptions based on critical needs. However, we should consider the impacts on production and investigate alternatives to manage weeds in our cropping systems.

Table 4. Emissions potential by herbicide.

Herbicide	Emission Potential (EP)	Formulation
Glyphosate		
Glyfos X-tra herbicide	5.7	liquid concentrate
RoundUp Original Herbicide	0.0	liquid concentrate
RoundUp Superconcentrate Weed & Grass Killer	39.2	EC
RoundUp Ultra Herbicide	5.7	liquid concentrate
RoundUp Ultramax Herbicide	39.2	EC
Oxyfluorfen		
Goal 2XL Herbicide	39.2	EC
Galigan 2E Oxyfluorfen	39.2	EC
Goal 2XL	39.2	EC
Goal 1.6 E Herbicide	65.5	EC
Goal 2E Herbicide	39.2	EC
Trifluralin		
Gowan Trifluralin 4	39.2	EC
Triap 4HF	53.7	EC
Treflan HFP	53.7	EC
Clean Crop Trifluralin HF	39.2	EC
Tenkoz Trifluralin 4 EC	53.7	EC
Tenkoz Trifluralin 10G	3.3	Granular/Flakes
Gowan Trifluralin 10G	3.7	Granular/Flakes
Surflan A.S.	39.2	EC
Farmsaver.com oryzalin 4 A.S.	5.7	Aqueous conc.
Surflan A.S.	7.3	solution/liquid
Surflan A.S.	7.4	solution/liquid
Oryza AG	5.7	Aqueous conc.
Vegetation Manager Oryzalin 4 Pro	5.7	Aqueous conc.
Gramoxone Extra Herbicide	0.0	solution/liquid
Gramoxone Max	5.7	Aqueous conc.
Gramoxone Super Herbicide	37.5	EC
Gramoxone Paraquat Herbicide	7.3	solution/liquid
Ortho Paraquat CL	7.3	solution/liquid
Starfire Concentrate	0.0	Aqueous conc.
Clean Crop Paraquat Plus	7.3	solution/liquid
EPTC		
Eptam 7E selective herbicide (only active EPTC reg.)	97.9	EC