Organic Herbicides

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Many organic growers use no-till or minimum tillage in their fields and are looking for alternative methods of weed control. They have relied heavily on cultivation, but due to increased energy cost, concern over soil erosion and movement into waterways, and CO_2 emissions from repeated tractor operation there is increased interest in organic herbicides.

There are some very important questions we need to ask about *organic herbicides*: 1. Are these organic herbicides considered pesticides? 2. What are or can be considered organic herbicides? 3. Can I use them to control weeds in crop production? and 4. How do they work and what factors determine how well they will work?

The California Food and Agricultural Code (FAC) section 12753 defines a "pesticide" as *(1) any spray adjuvant, and (2) any substance, or mixture of substances that is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, as defined in FAC section 12754.5, that may infest or be detrimental to vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment.* The short answer is anything *intended to be used for...mitigating any pest* is a pesticide. *Intent* is the key term; if it is your *intent* to kill weeds with it, it is an herbicide.

Does it have to registered with the United States Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation (CDPR) as a pesticide? Not in all cases. In fact, most organic herbicides are not registered as pesticides with EPA or CDPR. Most of these compounds are exempted under section 25 (b) of The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as *active ingredients which may be in minimum risk pesticide products* (Table 1). The California Code of Regulations Title 3, Division 6, Chapter 2, Subchapter 1, Article 1, Section 6147 establishes an exemption from the requirements of Food and Agricultural Code (FAC) Division 7 for pesticide products containing certain substances or classes of substances. CDPR has determined that the exemption of the pesticides covered by this regulation will not pose unreasonable risks to public health or the environment. Pesticide products that do not meet the criteria of 3CCR section 6147 will continue to be regulated by DPR. The exempted compounds are exempt from regulation in terms of registration but not safety, such as PPE (Personal Protective Equipment). Check with local Ag Commissioner if you have any questions.

Organic herbicide research trial near Woodland, CA., showing good levels of control at 3 days after treatment. Photo by Tom Lanini.

Just as with all pesticides, the use must be allowed on your crop. Acetic acid is not an exempted product (not on the 25(b) list), but is instead registered as a pesticide. At this time the registration is for non-food (non-crop) use only. The compound d-limonene is not on the exempted list but is registered as a pesticide for use in some food crops and has organic certification.

There is another very long list of inert ingredients that may be used in pesticide products that are listed as exempted compounds that don't need registration (Inert Ingredients Eligible for FIFRA 25(b) Pesticide Products that are eligible to be used as inert ingredients Pesticide Registration (PR) Notice 2000-6 List 4A is updated on a continuing basis and current version are available at *http://www.epa.gov/opprd001/inerts/section25b_inerts.pdf)*. The compound that is most relevant to our conversation is acetic acid, aka vinegar. Acetic acid does not appear in Table 1, but is listed on the inert ingredients list, but very specifically as vinegar (maximum 8% acetic acid in solution), and is in fact listed as an inert ingredient in some of the organic herbicides available for use. In the EPA's PR Notice 2000-6 the question is asked: *"If a List 4A minimal risk inert has active, pesticidal properties, am I allowed to use it as the active ingredient in an exempt product?"* The answer is: *No, the two lists are not interchangeable.* It goes on to say, *"Only if the ingredient is*

included on both lists can it be used without regard to its active or inert function. Even then, the ingredient must be designated on the label as either active or inert."

Now that we have determined what can be an organic herbicide, what compounds are being used as organic herbicides? In recent years, several organic herbicide products have appeared on the market. These include acetic acid (formulated at 20%), citric acid, d-limonene, clove oil, cinnamon oil and lemongrass oil and combinations. Overall the efficacy of all these materials is much less than synthetic herbicides. These products are all contact-type herbicides and will damage any green vegetation they contact, though they are safe as directed sprays against woody stems and trunks. Organic herbicides only kill contacted tissue; thus, good coverage is essential. In tests comparing spray volumes and product concentrations, we found that high concentrations at low spray volumes (20% concentration in 35 gallons per acre) were less effective than lower concentrations at high spray volumes (10% concentration in 70 gallons per acre). These herbicides only kill weeds that have emerged and have no residual activity on those emerging subsequently. Additionally, these herbicides may burn back the tops of perennial weeds, but they recover quickly. In a recent study, we found that weeds in the cotyledon or first true leaf stage were much easier to control than older weeds. Broadleaf weeds were also found to be easier to control than grasses, possibly due to the location of the growing point (at or below the soil surface for grasses), or the orientation of the leaves (horizontal for most broadleaf weeds)

Adding an organically acceptable adjuvant has resulted in improved control. Although the recommended rates of these adjuvants is 0.25 % v/v, we have found that increasing the adjuvant concentration up to 1% v/v often leads to improved weed control, possibly due to better coverage. Work continues in this area, as manufacturers continue to develop more organic adjuvants. Temperature and sunlight have both been suggested as factors affecting organic herbicide efficacy. In several field studies, we have observed that organic herbicides work better when temperatures are above 75F. Acetic acid is the exception, working well at temperatures as low as 55F. Sunlight has also been suggested as an important factor for effective weed control. Anecdotal reports indicate that control is better in full sunlight. Under current technology, organic herbicides are expensive and may not be affordable in all commercial operations. New innovations to increase effectiveness, or reduced amount of materials used, or cost, is essential to make organic herbicide use more widespread. If these materials are applied through a green or 'Smart' sprayer where only the living green plants are treated, the amount of material and the cost could be reduced.

Finally, if you have, or are seeking, organic certification it is very important that you check with your certifying agency in advance of using any of these organic herbicides. ❧

Table 1. Active Ingredients Which May Be in Minimum Risk Pesticide Products under section 25 (b) of FIFRA
Castor oil (U.S.P. or equivalent)
Cedar oil
Cinnamon and cinnamon oil
Citric acid
Citronella and citronella oil
Cloves and clove oil
Corn gluten meal
Corn oil
Cottonseed oil
Dried blood
Eugenol
Garlic and garlic oil
Geraniol Geranium oil
Lauryl sulfate
Lemongrass oil
Linseed oil
Malic acid
Mint and mint oil
Peppermint and peppermint oil
2-Phenethyl propionate (2-phenylethyl propionate)
Potassium sorbate
Putrescent whole egg solids
Rosemary and rosemary oil
Sesame (includes ground sesame plant) and sesame oil
Sodium chloride (common salt)
Sodium lauryl sulfate
Soybean oil
Thyme and thyme oil
White pepper
Zinc metal strips (consisting solely of zinc metal and impurities)