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COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
COOPERATIVE EXTENSION

DEPARTMENT OF PLANT SCIENCES
MAIL STOP 4
WEED SCIENCE PROGRAM
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David Lewis
UC Cooperative Extension

Dear David:

I have read over the letter sent to the Department of Agriculture in Marin County by the MOMAS group and I will provide my comments below. However, I must express my disagreement with most of their comments, which seem to directly contradict their initial statement in the areas of the plan that they agree with. For example, Point 3 of their 5 point agreement states "We agree with a collaborative and science-based approach grounded in IPM principles for combating the weeds", yet the comments made throughout the document have no scientific basis and are simply accusations based on rumor or speculation. I will go through the eight Concerns and Questions.

1. I agree that prevention needs to be a major focus of any invasive plant management strategy. Distaff thistle and purple starthistle seed may have originally arrived in Marin County in contaminated feed. Unfortunately, these weeds are now established in Marin County, and the plants themselves are by far the greatest source of seed. Certification of weed-free feed may be helpful if the weeds can be eliminated, but since these weeds are not major problems in other feed-growing areas, any seed contribution from feed is likely insignificant at present.

2. This point assumes that a) organic products are safer than aminopyralid and clopyralid, b) that they are effective control strategies for distaff thistle and purple starthistle, and c) that they are affordable. To address the last point first, the product Pharm Solutions Weed Pharm is $550 per 55 gal drum. These are ready to use products that are applied spray-to-wet, which is the equivalent of 100-200 gals of solution per acre. Thus, under the best case scenario, the cost would be around $1100 per acre if you treated the entire acre in a heavily infested site. This does not include labor costs, which would be much higher than either aminopyralid or clopyralid because of the repeated refills of a backpack sprayer. The cost to treat an acre with aminopyralid or clopyralid is only $8-$10.

More importantly, consider the safety of these organic products. All contain acetic acid as the active ingredient. This is the same product in vinegar, although vinegar is only 5% acetic acid and these products are 20-23%. Summerset All-Down contains an additional 14% citric acid, thus a total of 37% acid. This is a very dangerous product to handle and in fact the label of Pharm Solutions Weed Pharm states that if inhaled, "move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice." In addition it states, "NOTE TO PHYSICIAN: Probable mucosal damage may contra-indicate the use of gastric lavage." The pH of these products is around 2.3, which is very acidic, and the vapor pressure is 11.4 mm Hg at about 25C. I will get back to this vapor pressure below. If you compare the toxicity of acetic acid against aminopyralid and

clopyralid it is considered far more toxic (see table below). From personal experience, Guy Kyser tested the effect of acetic acid on yellow starthistle control. While it did not work to control yellow starthistle, the acid of the spray solution corroded the metal parts of the sprayer; the fumes of the spray solution (due to its high vapor pressure) caused him respiratory distress, eye irritation, and light-headedness. Note that higher numbers in the table indicate lower toxicity compared to lower numbers. From the MSDS sheets for the three compounds, acetic acid is far more toxic from ingestion (rat acute oral), far more dangerous from dermal contact, and about the same acute toxicity for inhalation on a molecule to molecule basis. However, the vapor pressure of aminopyralid is 7.5 x 10-7 mm Hg and clopyralid is 1.0 x 10-7 mm Hg at 25C. Compared to acetic acid, both herbicides are more than 1 million times less volatile and pose virtually no threat of toxicity though vapor pressure. In column three of the table, the realistic toxicity of acetic acid to inhalation is far greater than either herbicide by a factor of six.

Herbicide	Rat oral acute LD50 (lethal dose that kills 50% of the rat population) in mg/kg	Dermal hazard on rabbits in mg/kg	Acute toxicity from inhalation of vapor in ppm (parts per million)
Acetic acid	3310-3530	1060	5620
Aminopyralid	>5000	None	>5500
Clopyralid	>5000	>2000	>1300

Finally, consider the effectiveness of acetic acid. Acetic acid and other organic products work by destroying plant membranes which they contact. In effect, they are “burn-down” herbicides which kill only above-ground parts of the plant. Acetic acid must be applied at high rates (spray-to-wet) to have any activity, and the larger the plant the less effective the control. Burn-down herbicides have no effect on the plant’s rootstock, and as a result are ineffective on perennial plants such as purple starthistle. In the late season (spring), even vigorous annuals such as yellow starthistle, and perhaps distaff thistle, will regrow from the roots after treatment with burn-down herbicides. Acetic acid can be effective when treating plants at the seedling stage, when they have no root reserves; however, this chemical is non-selective, meaning that all seedling plants sprayed will die. To treat thistles at the seedling stage means applying acetic acid during winter, when it is likely to kill all desirable forage and native plants as well.

Furthermore, at such high rates, might this product impact soil pH and thus other aspects of the environment? What if it got into water through runoff? What would be the effect on aquatic organisms if the pH of the water became more acidic? For these reasons, we would not recommend using acetic acid on a broad scale, particularly without further study. We have no bias against organic herbicides, but to date have not seen them demonstrated as effective. Many experiments have been conducted on the environmental effects of aminopyralid and clopyralid, but few on acetic acid. Just because it is natural does not mean it is safe. Some of the most toxic compounds in the world are natural products, e.g. botulism, ricin, abrin, coniine, cicutoxin, and many of the opiates.

One advantage to aminopyralid and clopyralid is that they are selective toward thistles and do not harm grasses. Another is that they control the germinating seedlings of these weeds, so they are usually applied only once during a season. Burn-down organic herbicides would have to be applied every time a new flush of seedlings emerged.

3, 4. The letter states that there are no chronic toxicology studies for these herbicides. However, the EPA has conducted many such studies, all of which show either no effect or slight effects (at extremely high and unrealistic exposure rates). This logic is misleading, as the same could be applied to food. For example, if a human ate 5 lbs of onions it would be toxic due to the high concentrations of sulfur compounds. But it is not realistic to do that. Furthermore, the toxicity of chlorine that is used in swimming pools is 8 times higher than clopyralid or aminopyralid, yet the average parent has no problem letting their children swim in pools. The reason pool water is clear is because chlorine is a general pesticide. Parents often don't even worry when their children drink a little pool water. Thus, just reporting clopyralid or aminopyralid toxicity based on test results is misleading unless it is put into perspective. The EPA designated aminopyralid as a low risk herbicide when they considered all aspects of its toxicity. Clopyralid is also considered a low risk product, though it does not carry the official designation by EPA.

The letter notes that the inert ingredients may cause problems. Like the active ingredient itself, formulations are also evaluated for toxicity, and both herbicides showed no effects. Note that, likewise, the organic herbicides do not list their inert ingredients (63%); this should not be taken to imply that these unlisted ingredients are toxic.

The example of Roundup toxicity is sensationalized, unscientific, and out of context. The linked study describes an experiment where the surfactant in Roundup – a type of detergent which helps the chemical to spread over a leaf surface – was applied to isolated cells in petri dishes. The reported results would have been similar whether the substance used was chlorine, salt, shampoo, or acetic acid. To pick through the literature to try and find a piece of data that supports a predisposed view, while ignoring the majority of the evidence, is irresponsible and misleading.
The MSDS does state that formulated Milestone is combustible. However, this refers only to conditions where concentrated material is exposed to fire. That does not apply to field conditions, where the herbicide is mixed with water. Furthermore, the fumes may be toxic if a storage facility burns with high amounts of concentrated materials, but that does not apply to grasslands burning after a treatment. Clopyralid is applied at 4 to 10 oz product/acre (1.6 to 4 oz of active ingredient per acre), and aminopyralid is applied at 3 to 7 oz product/acre (0.75 to 1.75 oz of active ingredient). To make a comparison, imagine spreading half of an 8- ounce stick of butter over a full acre… or one-quarter of that stick. The rates of these herbicides are so low and the toxicity so low that they pose no health risk to humans or animals. Consider that the toxicity of acetic acid is higher on a by-weight basis and it is applied at a minimum of 160 lbs per acre (or 2560 oz/acre), or 1600 times more than the normal use rate of clopyralid. It is difficult to make a preferential case for acetic acid compared to aminopyralid or clopyralid on the basis of its expense, toxicity, and poor weed control performance.

The letter discusses the residual activity of clopyralid. The product has a half-life of 40 days on average. That means that 50% of the product will break down after about six weeks. For this reason, we consider the product (like aminopyralid) to have about 3 months of effect control on thistles. This residual activity of both products is what makes them so effective for the control of thistles. Beyond three months they do not appear to have any biological activity on any weed, and after a year they would, in essence, be gone from the soil, through microbial breakdown and photodegradation. The degradation products are not toxic. There are few, if any, reports of either product moving into groundwater. They do not leach to a great degree; if they did, they would not be very effective as they would move out of the root zone. Since they are generally applied in winter, leaching would be expect to be at its greatest since this is the rainy season. Yet they remain within 6 inches of the soil surface and provide effective control. Clopyralid is not registered for use near water so there should not be any direct application to a body of water. Tests conducted for aminopyralid have found no

toxicity to aquatic organisms. Thus, Dow AgroSciences is pursuing an aquatic registration for aminopyralid.

5. The insinuations of health impacts on humans, animals, and insects are speculative and lacking in any scientific evidence. Our studies show that native and forage plant diversity go up when invasive thistles are controlled using aminopyralid or clopyralid. Thus these chemicals have a long-term benefit on plant diversity as well as an economic benefit to land managers. In addition, entomologists at CDFA have studied the impact of these herbicides on bees and found no effect.

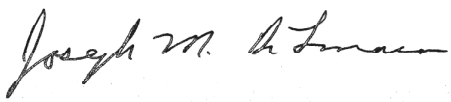
6. We don't perceive any implied pressure in the Plan for organic farmers to give up their certification and use herbicides. Organic certification is a valuable asset, and we would assume these growers will try alternative means of weed control and only go to herbicides as a last resort. If this were necessary, we think that most organic growers would use chemical control only long enough to control the infestation, then wait to re-certify. The land is not "destroyed," and the growers could return to sustainable practices over the long term.

7. These chemicals are not persistent, do not contaminate water, and are not bio-accumulated. We understand that past abuses – most conspicuously, the insecticide DDT – have created a blanket mistrust of chemical control methods. However, this is a very different type of material, and the EPA's testing and regulatory processes are far more intensive now.
The drift issue brought up in the letter is not common. When these products are applied under proper label conditions, drift is minimal. In fact, we conducted a study (and published it in California Agriculture) that showed that an aerial application of clopyralid over a yellow starthistle infested field did not drift to a downwind stream when a 30 m buffer was established.

8. We support in principle the call for more specificity in setting area buffers and time frames for application. When establishing these parameters, however, the County should bear in mind that growers must respond to changing conditions in a timely manner.

In our laboratory, we sympathize with the organic growers that cannot control these noxious thistles and want to maintain their organic status. To address this, we have written a proposal to try and develop effective organic methods for controlling both distaff thistle and purple starthistle. The proposal is in review, but we hope to get it funded so that we can work with the organic growers. However, to date there are no effective organic methods to control the species. The two website pages referenced in this letter for the control of these plants were written by myself and Guy Kyser, who works with me. We are familiar with the known control strategies and unfortunately we are not aware of any successful approaches other than the use of aminopyralid and clopyralid that will still allow for the production of forage grasses..

Sincerely,



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