



University of California Cooperative Extension
KERN VEGETABLE CROPS

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**Use of Anti-Microbial Agents to Control Lenticel Infections
on Potato Tubers caused by *Erwinia* sp.**

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Potatoes grown in Kern County are plagued each year by post-harvest lenticel infections. As these tubers are packed and shipped to market, the infection can progress to the point that the tubers eventually rot and become unmarketable once they reach their destination. The bacteria *E. carotovora* subsp. *atroseptica* (Eca), *E. carotovora* subsp. *carotovora* (Ecc), and *Erwinia chrysanthemi* (Echr) have been routinely isolated from these infected lenticels.

When the potatoes are harvested from the field, they are brought to the potato shed, unloaded into a dump tank with water to remove the soil from the tubers. The water in the dump tank is high in soil and organic debris from the constant washing of tubers. The water is replaced each day and is chlorinated to kill bacteria. The tubers are then picked up by conveyer belts and washed with a final rise of clean chlorinated water before being sorted and packed. One to 3 days after packing, the lenticels can begin to show symptoms of infection (Figure 1). If proper storage temperatures are not maintained during shipment, the infection can lead to substantial rot of the tuber.

It is believed that once the tubers are dropped into the dump tank that the bacteria are pushed into the lenticels by hydrostatic pressure. Once in the lenticels, the bacteria begin to grow and cause infection.

Materials and Methods

Two experiments were conducted to find out if applying anti-microbial agents as a final spray would help manage this post-harvest disease problem of potatoes. The materials looked at were Tsunami 100® and Oxidate®. Tsunami 100 is composed of 15.2% peroxyacetic acid and 11.2% hydrogen peroxide. Oxidate's active ingredient is 27% hydrogen dioxide. Both products have federal registration to be used on potato tubers but only Tsunami 100 has California approval at time of this report. **[Oxidate has been registered for use in California since this report was written-JN]**

Tsunami 100 was applied at a rate of 6.7 fluid ounces per 100 gallons of water while Oxidate was applied at 2.5 ounces per 1 gallon of water. For each treatment, a 50-pound box of potatoes was removed from the process line and dumped onto a grading table with a grid bottom that water could flow through. The tubers were sprayed with a CO₂ powered backpack type sprayer with a spray wand with one #8002 fan type nozzle. The tubers were sprayed until runoff, each tuber turned by hand and sprayed again until runoff. The spray solution was allowed to drain for a short period of time then placed back in the box.

A control treatment was conducted by simply using untreated 50-pound boxes of tubers right off the sorting line. Each treatment (control, Tsunami 100, and Oxidate) was replicated six times. After treatment, the boxes were placed on a pallet and stored at 50°F and rated every two weeks for lenticel infection for a period of six weeks. The lenticels were rated from 0 to 3, with 0 being no active lenticel infection and 3 being the tuber having many active lenticel infections. At each time that the tubers were rated, the infected tubers were culled out so only new infections would be rated the following two weeks. The experiment was repeated twice.

Results

Lenticel infections occurred throughout the six-week period for the first experiment. In the second trial, lenticel infection only occurred during the first two weeks then stopped. In the first experiment, total score of lenticel ratings show that Oxidate significantly reduced lenticel infection on the tubers (Table 1). Tsunami 100 was not significantly different from the control. The results were the same when looking at average score for each treatment (Table 2).

The results were very similar in the second experiment but infections only occurred during the first two weeks and then stopped. Again Oxidate significantly reduced lenticel infection while Tsunami 100 performed similar to the control (Tables 3 and 4).

The results can also be seen in Figures 1-4.

Potatoes grown in Kern County are not stored and are usually shipped to market within days after harvest. A material that can prevent lenticel infections from occurring only needs to work for 7-14 days. Oxidate showed that it was effective for at least 42 days after treatment. The potatoes should be at market and in consumer hands well within that time span.

Oxidate did show some scarring of the lenticels at the rate we used it in the trial (data not shown). Oxidate was used at the maximum label rate for this project but it may be best to use it at a slightly lower rate when it becomes available in California.

Table 1. Total score of lenticel rating for experiment 1.

	Total Score of Lenticel Rating		
	12/14/06	1/4/07	1/19/07
Control	18.3	2.2	3.8
Tsunami 100	11.8	3.0	3.3
Oxidate	3.2	1.0	0.7

Table 2. Average score of lenticel rating for experiment 1.

	Average Score of Lenticel Rating		
	12/14/06	1/4/07	1/19/07
Control	1.9	0.7	1.1
Tsunami 100	1.9	1.1	1.1
Oxidate	1.3	0.7	0.3

Figure 1. Total score of lenticel rating for experiment 1.

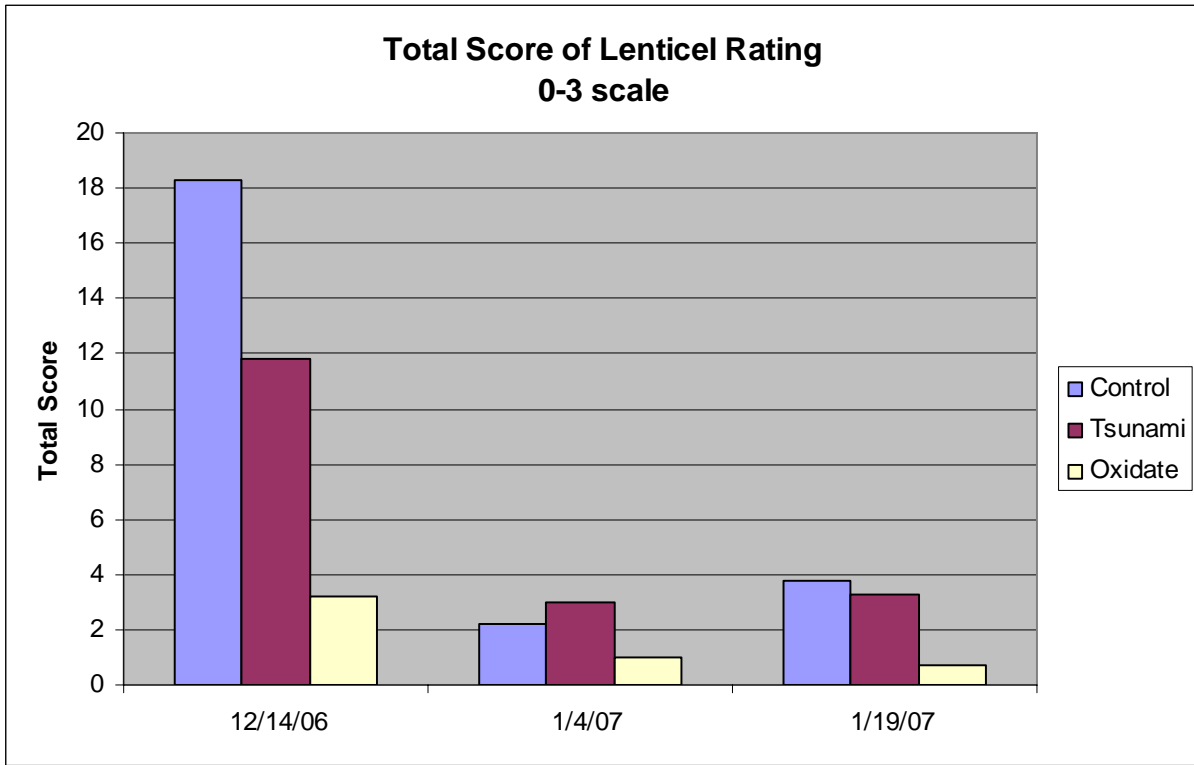


Figure 2. Average score of lenticel rating for experiment 1.

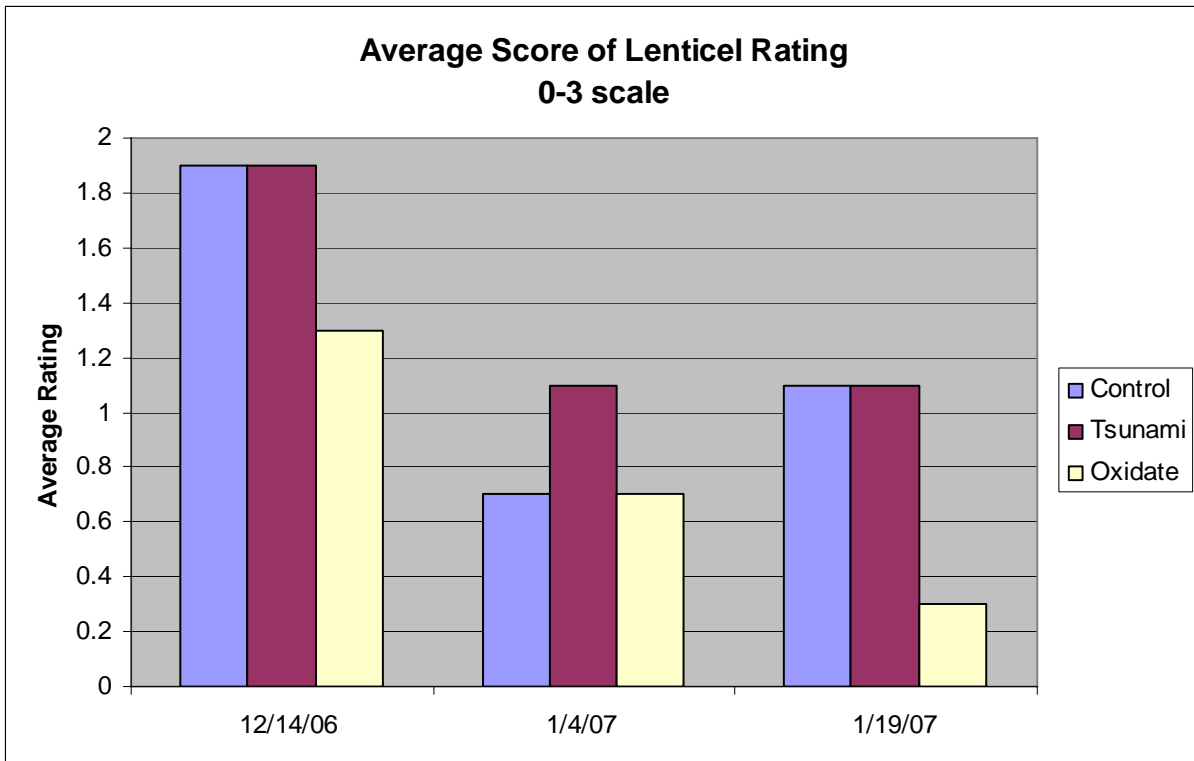


Table 3. Total score of lenticel rating for experiment 2.

	Total Score of Lenticel Rating		
	2/9/07	2/22/07	3/8/07
Control	12.4	0.0	0.0
Tsunami 100	12.6	0.0	0.0
Oxidate	2.6	0.0	0.0

Table 4. Average score of lenticel rating for experiment 2.

	Average Score of Lenticel Rating		
	2/9/07	2/22/07	3/8/07
Control	1.3	0.0	0.0
Tsunami 100	1.5	0.0	0.0
Oxidate	0.9	0.0	0.0

Figure 3. Total score of lenticel rating for experiment 2.

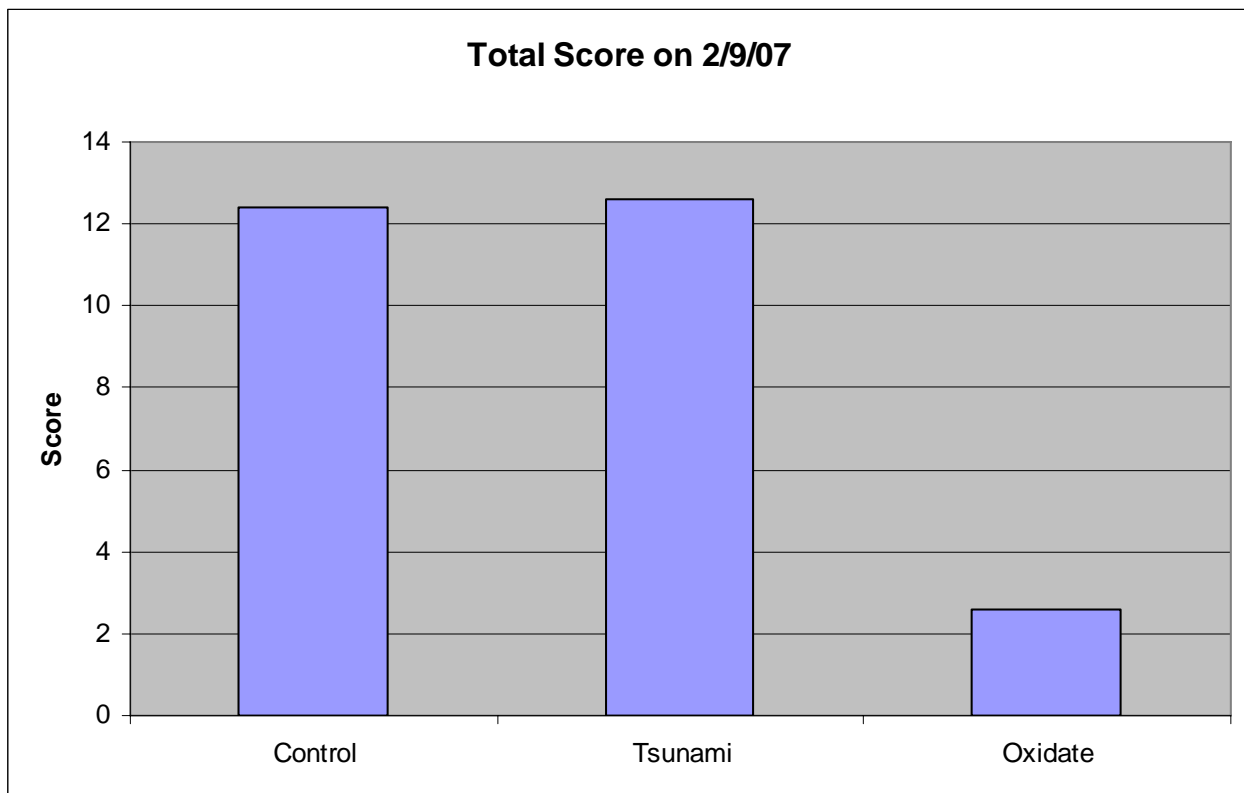
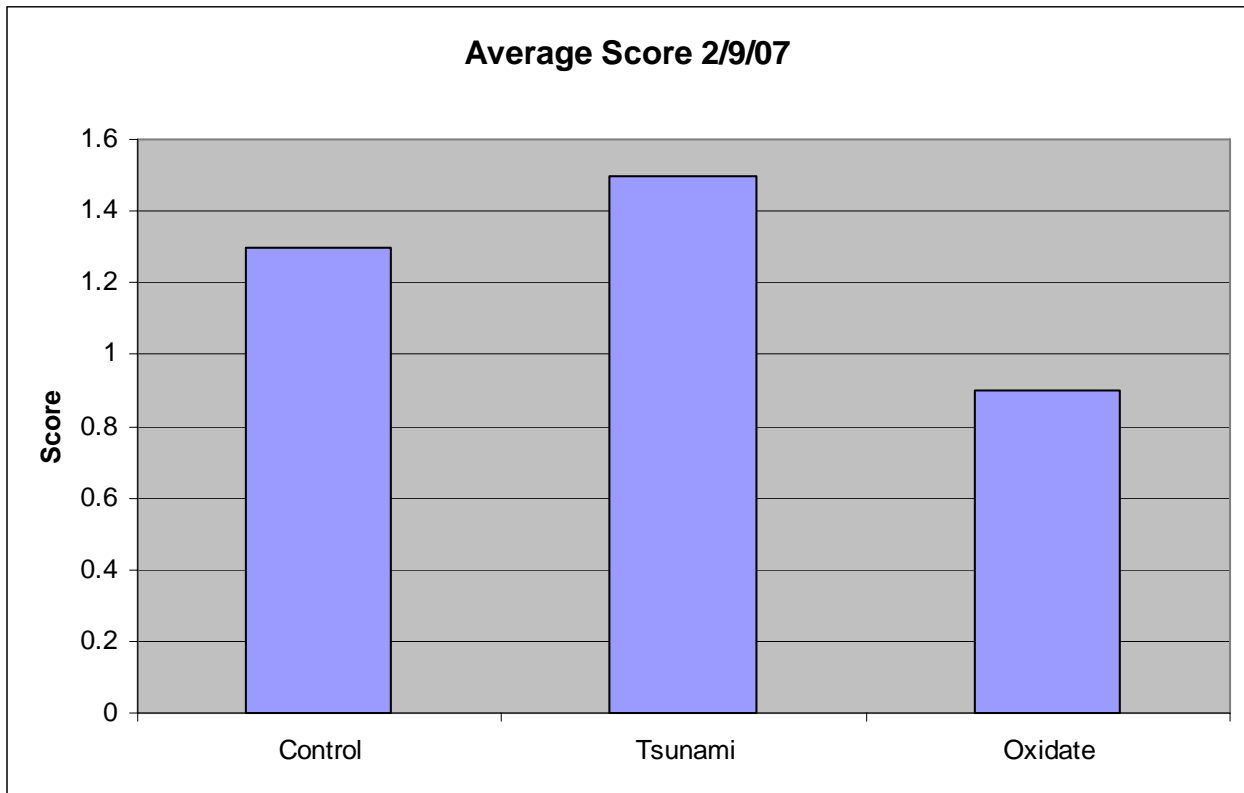


Figure 4. Average score of lenticel rating for experiment 2.



Effect of Mustard Seed Meal on Carrot Production

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Mustard meal is a by-product of the production of bio-diesel from mustard seed. After the seed is crushed to remove the oil, a seed meal is left behind. As a by-product, researchers have been searching for ways of using this material. Like mustard green manure, the mustard meal is high in glucosinolates which converts to isothiocyanates. Isothiocyanates are biocidal and can reduce various soil borne pests in the soil. Mustard meal is also high in nitrogen content and can be used as a source of nitrogen for crops.

Researchers at the University of Idaho have been studying mustards as a biofumigation green manure and also as a source of bio-diesel production from the seed oil. They have also been investigating ways to use mustard seed meal as a by product of bio-diesel production. In trials at the University of Idaho they have found that mustard meal applied to the surface of the soil can prevent weeds from growing. In their trials carrots could grow through the mustard meal while weeds were suppressed. They have also been conducting trials using mustard seed meal as an organic fertilizer.

A trial was conducted at the Kearney Ag Center to determine if mustard seed meal could be used as an organic herbicide and if it would provide enough nitrogen to a carrot crop.

Materials and Methods

Mustard meal was obtained from High Performance Seed Company, Moses Lake, WA which sells a pelletized mustard seed meal manufactured in Italy. The mustard seed meal product is called Biofence and is marketed as an organic fertilizer. The treatments were as follows:

1. control
2. mustard seed meal incorporated into the soil at a rate of 1 ton/acre
3. mustard seed meal on surface of bed at 1 tone/acre.

Each plot was 4 beds wide and 50 feet in length. The treatments were replicated four times.

The beds were cultimulched and bed shaped into 36-inch wide beds. After bed shaping, treatment 2 was applied by spreading the mustard seed meal by hand over the treatment area. After treatment 2 was applied, the beds were cultimulched and shaped again to incorporate the mustard meal. Treatment 3 was applied the same way but was left on the surface and not incorporated into the soil.

The plots received 2 irrigations for 2 hours each at 24 and 72 hours after planting. The plots were planted 7 days after applying the mustard meal (10/4/06) with SugarSnax carrots. The plots were planted with an Earthway planter with 3 lines per bed. After planting the field was irrigated everyday until germination. After germination, the plot was irrigated as needed. No nitrogen was applied to the field.

Results

A significant amount of weeds appeared in the plots. There was no difference in weed density among the treatments. It was decided to treat the plots with linuron at 2lbs product/A to control the weeds. The plot was allowed to grow to maturity to obtain yield data.

The plot was harvested on 3/3/07 by digging up 1 meter of row from each plot, removing the tops, and weighing the carrot roots.

There were visible differences in plant growth in the field. The tops of the control plots were very short and yellowed, while the plots that received mustard meal on the surface were slightly larger and greener, and the plots that received incorporated mustard meal were the largest and the greenest (Figure 3). The carrot yield data show that the incorporated mustard meal had the greatest impact on increased yield, while the mustard meal on the surface only had a slight increase over the control (Table 1). Figure 1 shows this information graphically.

Conclusions

Mustard meal had no effect on weed control in this trial. The plots became overrun with weeds even though the plots were pre-irrigated to germinate weeds and then mulched before doing this experiment. Previous research at the University of Idaho had shown that mustard meal applied to the surface of the soil at 1 ton/A would control weeds.

As a fertilizer, mustard seed meal must be incorporated into the soil otherwise the nutrients are not available to the plant and will otherwise stay on the surface. That was demonstrated in the yield differences between the one ton/A mustard meal on the surface and incorporated. One hundred twenty pounds of nitrogen was applied at one ton/A of mustard meal. Normally that should be enough nitrogen to grow a crop of carrots. These carrots were grown during the off cycle for carrot production in the San Joaquin Valley. They were planted in October and harvested in March. There may not have been total mineralization of the nitrogen in the mustard meal during the winter months.

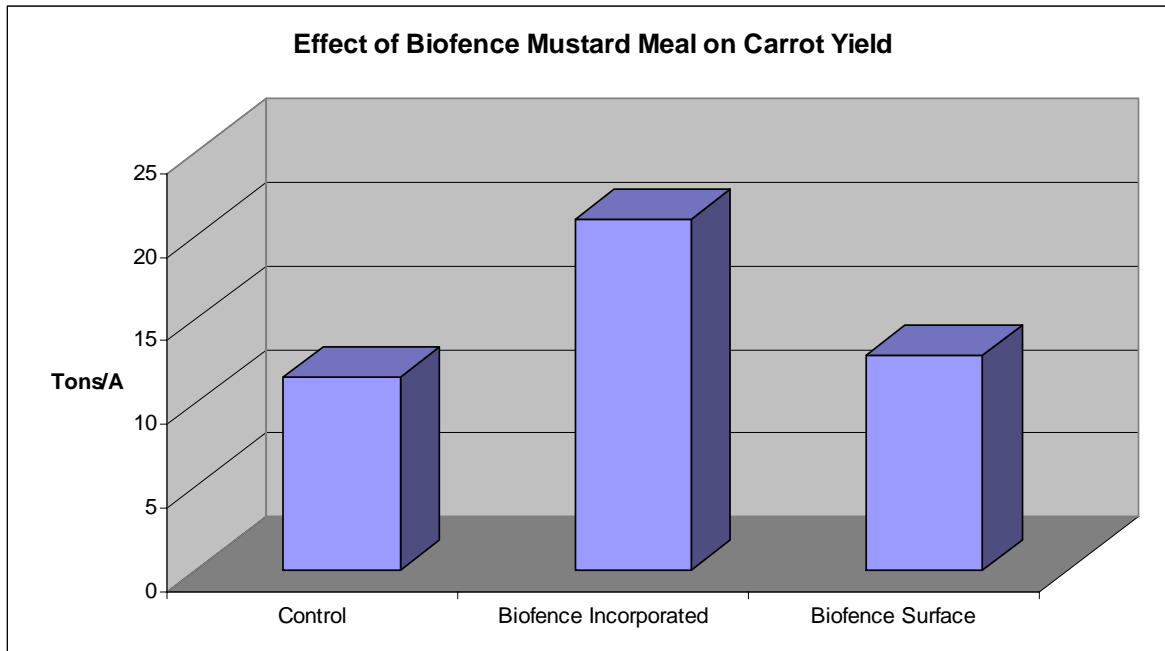
However, there didn't appear to be any lack for nitrogen in the mustard incorporated plots compared to the control or the mustard meal left on the surface.

At a cost of approximately \$1,250 per acre for Biofence, the cost would be prohibitive except for high value specialty crops. However, Biofence is a processed mustard seed meal imported from Italy. As the drive for alternative renewable energy resources continue, the local availability of low cost mustard seed meal by-products become more likely. The University of Idaho is currently looking for commercial partners to help make mustard seed meal commercially available to the U.S. market.

Table 1. Carrot yield after treated with mustard meal.

	<u>Tons/A</u>
Control	11.52 A
Mustard Meal Incorporated	20.96 B
Mustard Meal Surface	12.84 A
P=	0.0202
%CV=	23.91
LSD, P=0.05	2.798

Figure 1. Carrot yield after mustard meal treatments.



Disclaimer: Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.

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