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Herd It Through The Grape Vines A Flock In The Vineyard

By Julia Hollister

It seemed like a good idea—using sheep as weeders in vineyards instead of using pesticides. But when the sheep began to develop a sophisticated palate for the tender grape leaves and succulent fruit, winemakers knew they had a problem.

That's when University of California-Davis researchers came to the rescue with lithium chloride as the seemingly magic bullet.

Sorry I Ate That!

Based on animal behavior research, the UC Cooperative Extension researchers allowed sheep to eat their fill of grape leaves, then administered a small dose of lithium chloride, a harmless medicine that creates the sensation of tummy trouble.

"The sheep experienced a brief period of malaise," said Morgan Doran, lead researcher on the sheep project and livestock farm advisor for Solano County (California). "They recovered quickly, but they don't seem to forget the unpleasant feeling, even after nine months.

"The sheep will damage the vines if not averted and we want to train to aversion. Saving million dollar vineyards was paramount."

Initial field observations of these trained sheep showed they didn't like immature grapes or grape leaves, while their untrained counterparts found them irresistible. In the test vineyard, Doran observed a grapevine with very little new growth that was exposed to sheep that hadn't been trained. In another part of the vineyard, sheep that received training ignored the grape leaves and emerging fruit, concentrating instead on eating weeds.



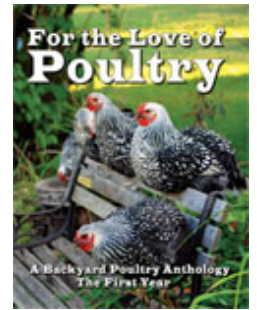
Control sheep at the University of California-Davis research facility in Northern California munch on grape leaves as part of aversion training with lithium chloride. Photos courtesy of Morgan Doran.

If sheep avoid grapes, they can graze the floor of a vineyard, providing farmers an alternative to using herbicides and mowing with heavy equipment.

Doran said the group plans to apply for new funds and start analyzing data.

Particulars Of The Test

"Treated sheep did very little damage to the test vines compared to untreated sheep," he said. "The method of training is let them eat their fill of grape leaves and



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immediately after give them a dose of lithium chloride in either capsule form or in the form of a drench."

Researchers used only seven-month-old ewe lambs that grazed until they were 14-months. The reason why ewe lambs were used in the tests was because they had less dietary experiences. Doran said with experience comes exposure to forages and plants that have secondary compounds.

In the preliminary trial, the team used some young sheep that had only been eating irrigated pasture forage and alfalfa pellets. They discovered these were easy to train with low dose.

However, ewe lambs that had been grazing on rangeland and pasture and had more experience were harder to train.

"We did find the treated sheep had very little impact on the grapevines whereas with the control sheep, the damage was obvious."

And the researchers noticed something else—the sheep had preferences for the leaves of certain varieties and turned their noses up at others. The sheep had an affinity for Chardonnay and Nebbiolo (a black Italian grape cultivar) but they did not like the Aglianico, another Italian grape with black fruit and earth aromas.

Doran and his team tested the treated sheep for nine months.

Viticulturist Guinea Pigs

The next move is to get a group of growers, who are interested in experimenting with this aversion training, to come to UC-Davis to attend a short course in animal eating behavior and ways to manipulate the training of sheep.

"It's not a black and white situation," he said. "They can lose the aversion if grazing is not done correctly. If the sheep in the vineyard encounter little floor vegetation they will perceive the situation as inadequate. They began to mentally weigh the option—of eating the grape leaves even though they might get sick—vs. the need for nutrition. If they are hungry enough they will make the sacrifice. Those are the issues we would like to pursue."

Doran said sheep ranchers and contractors are free to conduct their own aversion training. He advises patience until his researchers have recommendations available. The downside of a "do it yourself" project is that sheep could lose the aversion and damage the costly grape vines or the animals could sour on the whole idea.



This vine has been grazed by treated sheep in the U.C.-Davis tests.

UC-Davis researchers have a growing list of people interested in the aversion technique. To learn more, Doran's e-mail is mpdor@ucdavis.edu.

"The group is a couple of years away from compiling a completed set of recommendations," Doran said. "We have experimented with the dosage—150-175 mg per kilogram of body weight."

At this time, there are no wineries in California using the sheep aversion technique in their vineyards.

A negative experience is more likely to keep the animals away from the vines; older sheep are more experienced and more adept at regulating the intake of toxic and nutritious foods.

"From all the research, we concluded that sheep are smart," he said. "They are very good at what they do to associate positive and negative feedback to the foods they eat."

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"The next step is to make lithium available to the public," he said. "If there is a big demand, chemical companies could make it readily available, perhaps as a prescription through veterinarians."

It is easy for researchers to obtain lithium and supposedly someone off the street could purchase it from a chemical company. Doran said he has not found any Federal Drug Administration regulations that prohibit the sale of the chemical to the public and it's affordable.

Lithium chloride is already widely available to various industries: The chemical burns with a bright crimson flame, so is used to color fireworks and vivid red flares. It absorbs water rapidly, which is why it is used for industrial drying and some air conditioning mechanisms. It's also found in aluminum welding fluxes and in common lithium-cell batteries.

When the news of the research spread, calls began pouring in from all around the globe. In addition to the benefits in grape operations, there were a number of inquiries about lithium's use in orchards and the use of lithium-trained sheep as weeders around oak seedlings.

Lithium chloride is not "the new chemical kid on the block." It has been used for years in non-agricultural pursuits, as well.

Robert N. Pavy, M.D., a Redwood City (California) neurologist, has prescribed lithium for his patients. "It has been used since 1949 for the treatment of mania," he said "In fact, lithium compounds have been used as far back as the 18th century and later used extensively in the 1940s to treat heart disease. Because of its toxicity it fell out of favor with the medical community.

By 1970, lithium carbonate (the lithium part of the molecule that is easier to manufacture than lithium chloride) came into general use.

Mania is a term to describe hyperactive individuals who may be functioning abnormally. The life of the person often begins to be out of character with their normal behavior—not needing as much sleep, talking constantly, becoming impulsive, spouting big, albeit, unrealistic ideas, spending money that he or she does not have or becoming sexually active to the point of unacceptable behavior. Manic behavior oversteps the boundary of good judgment and interferes with an individual's lifestyle, business and family. As soon as lithium carbonate gets into the system it changes to lithium chloride.

"No one really knows how lithium works," Dr. Pavy said. "We do know it takes about two to three weeks of adequate levels to see the behavior change. Lithium is well absorbed. It is still used but because of its bad affect, blood levels have to be monitored very closely to avoid side affects such as nausea and vomiting, epileptic seizures, hand tremors, hallucinations and kidney shutdown."

The use of avoidance behavior was first experimented with in animals. For example, researchers gave a laboratory rat a shock and paired that unpleasant feeling with the activity they wanted the animal to avoid or stop.

Physicians use several drugs as an aversion technique to treat alcoholics. The medication is dispensed in a liquid that has no side effects until mixed with alcohol where the result is nausea and vomiting. Then, with this drug onboard, every time the person drinks alcohol he or she immediately becomes ill making them want to avoid alcohol.

(Researchers at the University of Nebraska have even done some work using lithium chloride on sheep carcasses to avert coyotes. This research was inconclusive.)

But let's get back to sheep aversion training.

Training Sheep With Lithium

In an effort to change the sheep's diet preferences, UC-Davis researchers enlisted the help of Fred Provenza, a noted animal behaviorist at Utah State University.

"We got involved in the early 1980s when I was doing graduate work about how learning influences what animals eat," he said. "I started a program that focused on food and habitation selection by animals."

He was able to show that animals learn both good and bad consequences to their actions. He also learned that animals can be trained to eat and/or avoid things.

"We often see livestock and wildlife as eating machines and don't understand that an animal's history influences its diet and habitat preferences," Provenza said. "Behavioral principles can provide solutions to problems faced by producers and land managers."

Animals learn from social interactions with their mothers, peers and humans, feedback from nutrients and toxins in plants, and interactions with their physical environment. This includes locations of water and predators.

Provenza received a large grant to get the word out. He started conducting workshops; sheep producers and contractors came to Utah and discussed local programs in vineyards.

"It is not difficult to do this aversion training," he said. "When I was doing workshops with demonstrations, I often discussed the treatment with people over the phone."

One such couple was Phil and Susan Patton of Grand Junction, Colo. who called after reading about Provenza's work. They had the perfect combination ready for testing—a vineyard, apple orchard and flock of sheep.

"We just bought the sheep when we switched to organic farming and because we wanted to use alternatives to herbicides," Phil said. "We read about the research in California and Utah and called Fred for advice. Fortunately, the Utah researcher planned to be in the area last September (2007) and wanted to help with the training."

They placed 12 sheep in the orchard and let them eat the bottom leaves of the apple trees and then conducted the real test.

The Pattons picked some grape leaves and fed them to the sheep, then gave the group a dose of lithium chloride. They waited 30 minutes before turning them out into the vineyard. They hoped the animals would associate the grapes with the mild sickness they were feeling.

"We turned them out and repeated the test the next morning," Susan said. "We also picked other varieties of grape leaves to feed them because we wanted to make sure they had other choices."

(The Patton's vineyard includes Cabernet Sauvignon, Chardonnay, Riesling and Gewürztraminer grapes.)

The test was administered a third time, and this time all the sheep refused the grape leaves but munched on weeds and grass.

"We did it (the lithium chloride treatment) two to three times," Phil said. "We gave them a little dose of the lithium as a drench in the corral and let them graze down one row in the orchard and it worked—they didn't eat the leaves."



This is the same vine in the previous photo, grazed with untrained sheep. The results are dramatic.

The vineyards were grazed in all seasons so that the sheep would learn to avoid eating the grapevine leaves in every stage of their development.

The couple plan to test the sheep again in the spring when the grape leaves will be fresher and juicier and more appealing.

Can Any Flockmaster Employ Lithium To Train Sheep?

What about home aversion testing of the sheep without professional supervision?

"It (lithium chloride) is not a poisonous substance and I don't see why other sheep raisers or contractors couldn't do it," Phil said. "We had no training and no experience with the sheep so we needed some initial help from Fred. I haven't heard

of a dose to be fatal.

"They are interesting to watch—how quickly they learn! It also was critically important that the sheep never tasted grape leaves prior to the test.

In related research, he said the Agricultural Research Service has been working with cattle and horses to avoid poisonous plants such as larkspur and locoweed, respectively.

However, the work with grapes has created the most buzz.

"Researchers at the poison center here noted similar aversion treatments in cattle will last three years," Provenza said. "Therefore, the same success could occur in sheep, if ranchers and sheep contractors follow a few 'nuts and bolts' guidelines to ensure success."

The first thing is that it is preferable if the animals have never seen the food you want them to avoid. Another is the peer effect. You have to watch animals at first, because they are so social and pay attention to what their buddies are doing. For example, if one sheep starts to nibble the grape leaves, it will create an incredible likelihood others will nibble too. The odds are against it, but every individual sheep is different and the level of sickness will vary.

"Sheep are very smart when it comes to selecting a diet," he said. "When they get sick they can learn how to self-medicate with plants, soils, clay and activated charcoals.

"We're more like sheep than we could ever have imagined," he said. "We are both social animals and our behavior (both good and bad) is often the same.

"It's pretty amazing."

Anyone interested in the aversion program, should get in touch with Provenza's group to learn more about the likelihood of their success. His e-mail is: fred.provenza@usu.edu?

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