

# grape growing

## Product Review: Electrostatic Sprayers

Technology provides targeted particles that 'powder coat' vines, resulting in substantial water, chemical and labor savings.

Bill Pregler



COURTESY ON-TARGET SPRAYERS

Electrostatic sprayers create a low pressure, low volume concentration.

**W**ITH EARLY DESIGN flaws behind us, today's electrostatic vineyard sprayers are finally delivering what was originally promised: incredibly precise chemical disposition.

Thanks to precise delivery, growers are experiencing substantial savings in water, chemicals and labor. Some say it is becoming difficult to justify many traditional "air-blast" sprayers.

The original designs date back to the early 1970s, but many experienced electrical problems. "Adoption was slow because of the difficulty of demonstrating and continuously verifying the electrostatic charge was being applied to the droplets," said retiring Dr. **Robert Wample**, chair and director of **Fresno State's** Department of Viticulture and Enology. "But recently the technology has come a long way."

Wample continued, "It was also difficult to see the material being applied when compared to traditional air-blast. There the operator can see the blast of solution being applied, but also onto the ground, into the air and other non-target areas."

Growers today who follow electrostatic rigs will see the difference. Comparing a dry leaf from a few rows over to one just sprayed, you immedi-

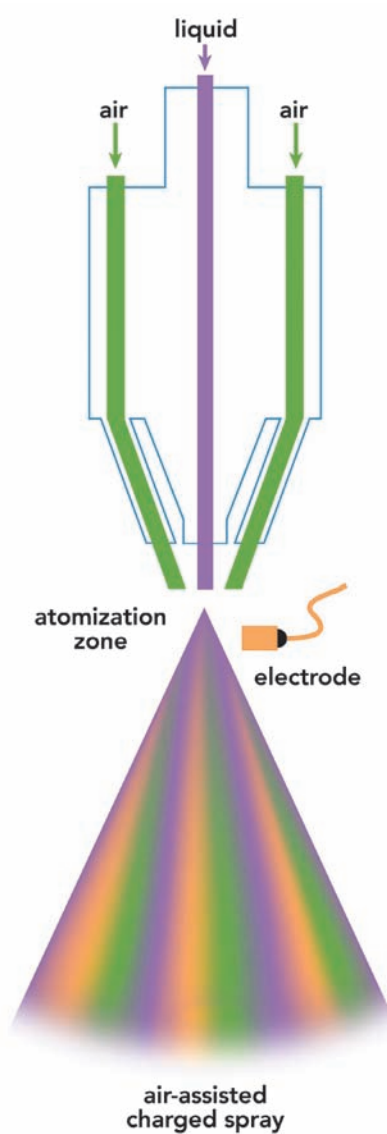
ately notice the entire surface has a shiny thin coating from front to back. And this is why the technology is so exciting for the vineyard manager: fantastic coverage but with no waste.

### HOW IT WORKS

The concept is surprisingly simple. Think in terms of metal filings drawn to a magnet, lint to your clothes or dust on a record. In science, it is known as Coulomb's Law, where opposite electrical charges attract and "like" charges repel. In everyday life, it is known as powder coating.

The automotive industry has been powder coating cars for years. Nowadays portable systems are used on everything from people standing in tanning booths to hospital rooms needing complete antiseptic coverage. The concept is to create opposite electric charges between the "paint" and the object.

With electrostatic vineyard sprayers, everything begins with the spray nozzle. A typical droplet of spray from a conventional air-blast sprayer is around 250 microns. Electrostatic uses an "air-assisted" nozzle, whereby the solution (chemical and water) is combined in a "shearing" action, which



COURTESY ESS SPRAYERS

The electrode located after the air-assisted shear nozzle imparts a negative charge.

atomizes the particles down to 30 to 50 microns. Then, just before the mist exits the nozzle, it is exposed to a negative charge. As the mist enters the canopy, it stalls, resulting in a "charged" fog inside the canopy; and this is when the magic begins.

The electrically-charged particles are automatically attracted to the "grounded vine." This charge is small, but the force attracting the spray to the "target vine" is up to 75 times the force of gravity. The particles actually reverse direction and coat the back sides of the vines throughout the entire canopy. This is referred to as "electrostatic wraparound." In comparison, a 250-micron droplet simply runs off a leaf and onto the ground.

Then there is the second half of Coulomb's Law, that "like" charges repel. Since all of the spray particles leaving the nozzles have the same charge, they cannot collect into large droplets, which again fall to the ground. At the same time, the swirling particles are not attracted to areas already coated and continue to seek out uncovered surface areas until there is uniform coverage (disposition) throughout the entire canopy. You have



COURTESY ON-TARGET SPRAYERS

Two-row electrostatic spray booms create a targeted 50-micron fog.



COURTESY ESS SPRAYERS

Adjustable 3-point systems are perfect for small vineyards.

essentially “powder coated” your entire vine with no drips or runs.

Since diseases and insects are usually hidden on the undersides of surface areas and deep inside the canopy, they can continue to survive if the spray coverage is spotty. The distinct advantage of electrostatic spraying is the increased chance of the disinfectant finding its target. One crop with serious disease issues is strawberries, which are dense, grow very low to the ground and are highly susceptible to mites. Electrostatic is now becoming the sprayer of choice because the pesticides migrate beneath the leaf.

### ATTRIBUTES TO CONSIDER

#### Overall Efficiency

We now live in the age of sustainability, and “electrostatic thinking” is a perfect fit. Many environmental impacts are lessened with electrostatic, including chemical drift, the amount of chemicals and water applied, noise, soil compaction and fuel savings.

We also live in a time where vineyard managers increasingly face demands from local, state and federal agencies (EPA) mandating less chemical and water usage; these will only multiply. In June 2009, a group of 28 farm worker unions and advocacy organizations petitioned the EPA “to stop pesticide poisoning of farm worker communities and uphold the Obama Administration’s commitment to environmental justice,” according to a US Newswire article.

#### Water Savings

Each grower will experience different savings based on his comfort level of application; but moving from 250-micron droplets to a 50-micron mist immediately reduces water usage.

“The idea is not to drown the insect,” said Dr. **S Edward Law**, director of the **Applied Electrostatics Laboratory, Biological and Agricultural Engineering Department** at the **University of Georgia**. “Effective pest control is dependent upon uniform distribution, and reducing the micron sizes may give you as much as 10 times the coverage in the same amount of water.”

“The 100-gallon tank on my electrostatic sprayer covers eight acres in full canopy,” said **Marty Hedlund**, vineyard manager at **Dehlinger Winery** in Sebastopol, California. “Our 300-gallon conventional sprayer covers 2.5 acres.”

**Brian Wallingford** of **Mesa Vineyard Management** in Templeton, California agreed. “We noticed the reduction in water use almost immediately,” he said. “We went from applying over 100 gallons per acre down to only 30. With that type of decrease in water, along with chemicals, means the machine will pay for itself in two years.”

As an example: a 100-acre vineyard using roughly 100 gallons of solution with a conventional sprayer uses 10,000 gallons of water. Marty Hedlund, at 12.5 gallons per acre, would use only 1,250 gallons.

Less water with better targeting also means chemicals remain on the vine and not on the ground. Puddling on the leaf structure is also eliminated, reducing phytotoxicity and burning.

#### Chemical Savings

“Once we purchased our electrostatic rig, we were able to reduce applications down to three, two and now only once each year to treat for Pacific mites,” said Wallingford at Mesa Vineyard Management. The company currently oversees 5,000 acres in Monterey, San Luis Obispo and Santa Barbara counties. Combined, that is substantial savings.

But efficiency is also realized by some growers who say they use only one-third of the recommended label law concentrations.

“Label laws are an example of the government deferring to the chemical companies,” said Dr. **Ken Giles**, professor of **Biological and Agricultural Engineering, UC Davis**. Many think label laws, as they are usually called, are a mandate from the government; but it is only a chemical company’s law and refers to its warranty.

In addition, the majority of dilution rates on the labels are based on the 250-micron droplet, not a 50-micron mist. “Conventional application is easy, and sloppy is forgiving,” continued Giles. “The recalculation of dilutions is up to the conscientious grower.”

This is further supported by **Lea Brooks**, assistant communications

director for the **California Department of Pesticide Regulation (CDPR)**. According to Brooks, “The EPA has the final say. But unless prohibited by label warning, the amount of pesticide applied can be reduced below the amount specified on the label. However, even though the lower use is not illegal, it may break any warranty by the company.” By the way, studies are available from the CDPR that suggest they are quite positive about electrostatic technology.

In either case, whether because of fewer applications or increased dilutions, the amount of chemicals used is drastically reduced. Finally, the efficiency of electrostatic not only saves water and chemicals but, resultantly, labor.

#### Labor Savings

“We have vineyards scattered all over the hills, and with 12 gallons per acre versus 100, our operators spend far less time driving back to refill and more time spraying,” said **Mark Lingenfelder**, executive vice president, vineyard operations for **Chalk Hill Estate and Winery** in Healdsburg, California.

**Matt Manna** of **Manna Ranches** in Acampo, California concurred. “We manage thousands of acres and typically used multiple water trucks. We can now continue operations all night and refill only four times per shift as opposed to once per hour,” he said.

Obviously this affects labor costs, but there are additional side benefits due to

**Performance Analysis**

**On-Target Spray vs. Conventional Air-Blast Spray**

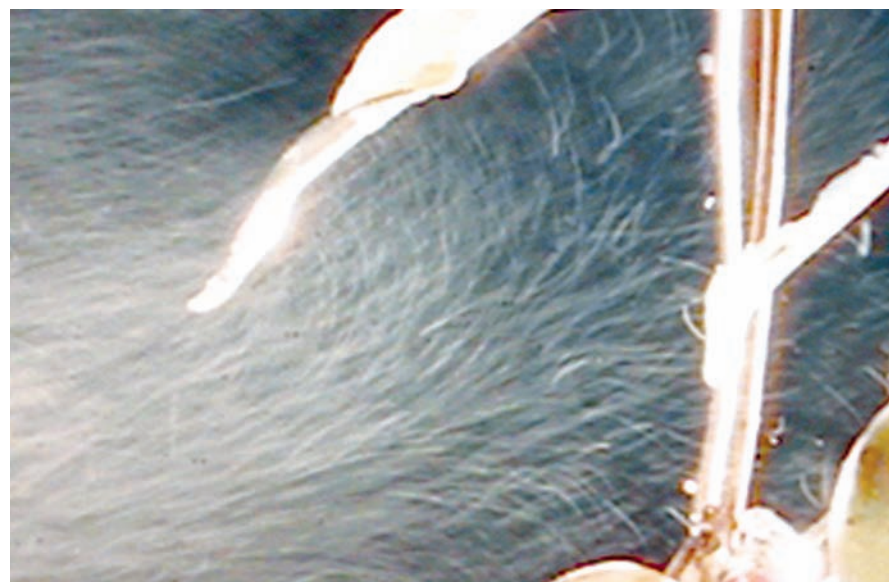
200 Acre Wine Grape Block	ON-Target 300g 2-Row Sprayer	Conventional 300g Air-Blast Sprayer
1320' by 6751' 843 rows on 8 ft. centers	200 Acres	200 Acres
Tank capacity	300 gallon	300 gallon
Ground speed	3 mph	3 mph
Gallons per acre GPA	15 GPA	100 GPA
Boom configuration	2 row	1 row
Row length	1320'	1320'
Time/row	6 minutes	6 minutes
Passes required	422	843
Time required to spray	42.2 hours	84.3 hours
Tank fills required	10	66.6
Water required	3,000 gallons	20,000
Time required to fill	4.1 hours	27.7 hours
Total time to required	46.3 hours	112 hours
Sprayed acres per hour	4.3 acres/hour	1.78 acres/hour

John Deere 5525	ON-Target 300g 2-Row Sprayer	Conventional 300g Air-Blast Sprayer
Engine RPM	1722	2250
PTO hp	32 hp	76 hp
Gallons/hour	2.18 GPH	5.18 GPH
Diesel cost per 200 acres	46.3h X 2.18gph x \$3.00g \$302.80/200 acres	112h x 5.18gph x \$3.00g \$1,740.48/200 acres
Savings per spray	\$1,437.68 per spray	Zero
Diesel savings per season 9 sprays per season	\$12,939.12	Zero

CHART COURTESY OF ON-TARGET SPRAY

In addition to customer references,  
growers should ask for operational cost comparisons.



the target zone. It does not remain in suspension over the canopy. “With our single row sprayer, you can literally watch as the cloud of particles separates and is attracted into the two sides of the row,” said Hedlund at Dehlinger Winery.

To see if the system is working properly, an easy test is to watch the spray cloud while you alternate power to the electrostatics and look for changes in the pattern. With power off-then-on, the cloud will immediately be diverted in the direction of the canopy.

Again, timing is important, and spraying in windy conditions should be avoided regardless of sprayer. At the same time growers are concerned with drift, they must also be cognizant of neighbors and noise.

**Noise Abatement**

A traditional complaint with air-blast sprayers is the inherent noise produced by the fan blades, similar to the sound of an airplane propeller. New designs now incorporate enclosed rotary vane-blowers instead of fans, resulting in substantial sound reduction.

One manufacturer is currently experimenting with automotive superchargers as the air source. So far the results are positive.

Lingenfelder at Chalk Hill had issues with sound as did Hedlund at Dehlinger, whose owner resides on the property and objected to excessive noise.

**USAGE SCENARIOS**

**Choosing the Right Equipment**

Each manufacturer we approached offers different sizes of spray rigs, from a simple three-point attachment and a maximum 100 gallons to tow-behind trailers holding up to 600 gallons. Total acreage will determine tractor size and spray rig design. Single-row and two-row systems are available.

**Small Growers**

For the large percentage of small vineyards, the three-point is probably adequate. The most obvious reason is due to the substantial increase in effective spray coverage. Most three-point systems have only 100-gallon capacities but will usually afford the grower eight acres of coverage. Less liquid means less weight and automatically allows for smaller tractors. At the same time, the new sprayers require considerably less PTO horsepower. With smaller tractors, growers can negotiate tighter row spacing, hillsides and row ends that require a tight turning radius.

**Medium to Large Growers**

Larger growers with expanded acreage and row spacing will be able to use larger equipment including over-the-row booms. Manufacturers already have spray boom designs that accommodate most trellising configurations, and the equipment is surprisingly adjustable. The good news is these companies are also capable of custom fabrication for the individual vineyard.

less “commuting.” With less driving back and forth, less soil compaction occurs. Less drive time also means greater fuel savings and also less wear-and-tear on equipment.

There are also times when electrostatic spraying affords the grower unexpected benefits. The most obvious are issues with neighbors related to drift and noise.

**Drift**

Regardless of vineyard size, one of the most important concerns for the EPA and CDPR is unintended chemical drift. Make no mistake, this will continue to evolve as a major issue along with over-application of chemicals.

The **University of Florida’s Institute of Food and Agricultural Sciences** has spent a considerable amount of time studying drift, both “swath” and “long-range.” Swath is the lateral displacement of particulate in the immediate location while long-range implies problems when particles settle on

other crops that are sensitive to that chemical.

Drift is dependent on wind speed, humidity, height of emission and, most of all, droplet size. A 400-micron droplet will fall to earth almost four times faster than a 200-micron one. Since electrostatic sprays are only 50 microns, care must be exercised. Obviously, one should not spray in windy conditions. In normal situations, however, the high levels of electrical attraction will easily control most potential problems.

“Chalk Hill Winery has vineyards that were isolated when planted but are now surrounded on three sides by housing developments,” said Lingenfelder. “In order to foster better relations with those close to our operations, we felt it imperative that we minimize spray drift. With electrostatic it is virtually eliminated.”

One of the sure signs of good electrostatic spray disposition is how quickly the spray cloud is attracted directly to

### Electrostatic Spray Manufacturers

Company	Location	Phone	Web	Design	Row Design	Width	PTO	Tank Size	Fan	Pumps	Warranty
Electrostatic Spray Systems	Watkinsville, GA	800-213-0518	<a href="http://www.electrostaticspraying.com">www.electrostaticspraying.com</a>	3-point	1 Row	32-39"	15 HP	100 Gal	Blower	Cent/Diaph	1 year
Progressive Ag Inc.	Modesto, CA	800-351-8101	<a href="http://www.proaginc.com">www.proaginc.com</a>	Tow only	2 Row	50"	65 HP	300-600 Gal	Squirrel Cage	Centrifugal	1 year
On-Target Sprayers	Wilsonville, OR	503-549-0607	<a href="http://www.ontargetspray.com">www.ontargetspray.com</a>	Tow/3-Point	Both	32"	12-32 HP	50-300 Gal	Blower	Centrifugal	1 year

#### POTENTIAL DOWNSIDES

##### Cost

A typical tow-behind air-blast sprayer will be around \$15,000 to \$18,000 while a comparable electrostatic can cost twice as much.

A typical three-point electrostatic (100-gallon) rig may be \$20,000. But the payback with efficiency can easily offset additional expense.

Brian Wallingford at Mesa Vineyards Management said, "I needed to get my customers to budget additional funds to allow me to buy electrostatic. I explained I was saving \$14,000 in chemicals (alone) on 300 acres, and the cost of the rig would be recouped in two years."

He added, "When you also consider savings in water usage, we can plan for the future. Currently, my counties require meters on all wells, and we are required to report usage on an annual basis. We are not paying yet, but we have concerns about the next few years."

A good exercise is to discuss savings with each manufacturer. They typically have charts that will compare tractor fuel costs per acre, labor, chemical and water savings (see example). Then get a list of their customers and make some phone calls. We found talking to growers using electrostatic will answer a host of questions.

##### Training

According to Dr. Giles at UC Davis, "The downside of this new technology is, if not operated properly, you can get mixed results. It can work extremely well with proper technology transfer."

He added, "The operator cannot treat them like the old sprayers. They require more management effort and more operator training." It is highly recommended to query vendors about their training programs and support.

##### MAINTENANCE

Two things are important with electrostatic sprayers: keeping the nozzles clean and monitoring the electronics.

With the small orifices it is imperative to thoroughly flush the units after each use and then to check the spray patterns of each nozzle. Originally there was a problem with powdered sulfurs due to poor mixing and suspension resulting in plugging. Manufacturers have addressed this with better agitation and pumps. Look for centrifugal pumps with improved silicon-carbide seals. Seal erosion due to suspended solids has essentially been eliminated.

At the same time, since the electronics are the heart of the system, a different type of maintenance is required compared to a conventional sprayer. For the electronics to work, all

that is required is a 12-volt battery on the tractor, which is then amplified through step-up transformers to thousands of volts. While this sounds dangerous, there are no amps involved so safety is not an issue.

What is most important, however, is to check each nozzle for proper voltage. As mentioned, a quick "in-field" test is to simply observe the spray cloud during operation. Turn the electrical power off and then back on and watch the immediate change in disposition. The purchase of this equipment should include a volt meter for individual nozzle testing. While it is not difficult, it may involve additional time.

Beyond this, maintenance will be the same as any rig including winterizing the mechanicals, checking belts and gear box oil. Warranties are normally one year, and all companies claim to maintain a healthy supply of technical assistance and parts.

##### EFFICIENT TECHNOLOGY

Of the three academics we interviewed for this article, the consensus was this technology is the future for chemical application. The growers using the equipment agreed, and even the CDPR likes electrostatic spraying. And as usual with any new technology, it took time to fine-tune the mechanicals, and that has been done.

The basic concept of efficiency is what is so exciting and will help growers to look forward—specifically using less water and fewer chemicals. It is also reasonable to assume government regulations are going to increase, so it makes sense to plan for tomorrow by being as efficient as possible today.

"Electrostatic sprayers are so efficient because they save time, reduce water consumption, reduce chemical volume and provide excellent coverage," said **James Beville**, vineyard manager at **J&L Farms** in San Lucas, California. "Due to the low PTO demand, we are conserving fuel. We are spending less time in the vineyard, thereby reducing compaction and extending tractor life. I do not understand why anyone would want to spray any other way." **wbm**

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