INTERNATIONAL PEST CONTROL

September/October 1995
Volume 37 Number 5

CROP AND STOCK PROTECTION
PUBLIC HEALTH, WOOD PRESERVATION

ISSN 0020 8256

- Background news
- Brighton Conference preview
- AgrEvo research report
- Mosquito larvicide evaluation
- Leaffolder on rice research
- Cockroaches and resistance
- Fly control in food premises
- Electrostatic spray head for mistblowers
- Pest control developments
- Book reviews

Electrostatic spray heads convert knapack mistblowers to electrostatic operation

Teresa Dobbins*

ELECTROSTATIC technology significantly improves spray deposition on the top and bottom surfaces of leaves, reduces drift and run-off, provides a means of reducing the amount of pesticide/dilutent and, thereby, increases the efficacy of pesticide application.

Spectrum electrostatic sprayers from Southwest Electrostatic Sprayers, Inc. of Houston, Texas have been successfully used for several years in agricultural markets in the USA, on such crops as citrus, stone-fruit, avocado and tropical fruit and in nut orchards and vineyards.

Spectrum models range from 30-600 gallon pto-driven trailed sprayers and three-point (tractor mounted) sprayers and skid-mounted sprayers with integral power source. In addition to agricultural applications, several of the models are designed for multi-purpose use in landscape management and greenhouse/nursery and dairy/livestock operations.

Conversion spray head

The most recent development from Southwest Electrostatic Sprayers is the Spectrum 3010 Electrostatic Spray Head which converts most motorised knapsack mistblowers to electrostatic operation. It weighs less than a pound (0.4 kg), requires no external battery power source and is simple to install.

The spray head fits over the end of the knapsack air duct, the inside of the head being tapered to provide a secure fit on different makes/models of knapsack. Inside the head, on one interior wall, is the patented OGee airshear nozzle, fabricated from non-conductive plastic. Mounted on the oppostite interior wall is the conductive electrode.

Outside the head, the electrostatic power supply (RC filter and rectifier circuit) is connected by a single wire to the knapsack magneto at the spark plug. A second wire, connected to the chassis of the knapsack, provides the earth.

Current is supplied to the electrode when the engine is started and results in the creation of a negative electrostatic field within the head. With the OGee nozzle and electrode placed on opposite walls — and within the airstream — liquids released from the nozzle are simultaneously atomised and electrostatically charged.

Application performance upgraded

Deposition studies have shown that knapsacks, equipped with the 3010, deliver 50% more droplets to a target surface than are delivered by standard spray heads.

Beyond the potential of the 3010 for improving knapsack efficiency in agricultural/horticultural applications, evaluations are currently underway to assess the potential benefits of electrostatic knapsack application to the public health area. Investigations are being directed towards determining if the increased deposition associated with this technique will extend the residual activity of mosquito adulticides commonly used in dengue and malaria control, or if the increased deposition will allow a smaller amount of active ingredient to be used.

The key to this device — and to all Spectrum sprayers — is that air-assist, airshear and electrostatic technologies are used in combination. For the 3010, the air-assisted portion, a high velocity airstream, is provided by the knapsack mistblower.

The 3010 components then, physically and electrically, alter the spray to improve its movement and deposition. To achieve this, liquids are atomised into smaller, more uniform droplets, 50-60 microns in size, that carry a strong positive electrostatic charge.

Numerous studies have been conducted to compare Spectrum electrostatic sprayers with conventional hydraulic equipment. In all these studies, air-assisted/electrostatically charged

A Stihl SR400 knapsack mistblower, equipped with the Spectrum 3010 Spray Head

*Southwest Electrostatic Sprayers, Inc., 6222 Richmond Avenue, Suite 575, Houston, Texas 77057, USA.

The Spectrum 3010 Electrostatic Spray Head

sprays resulted in more efficient delivery of spray to the target. Examples of the findings include: chemical application costs in citrus pest management reduced by $70-78/acre (33%); pesticide deposition in orchards increased by 46%; foliar uptake of nutrients in pecans increased by 31%; and dermal/respiratory exposure of workers to azinphos-methyl reduced by 82%.

Importance of droplet size

Electrostatics apart, the range and size alone of droplets in any given spray has tremendous influence on coverage, volume of spray used, retention, fallout and drift. For treating foliage, the optimum range is generally considered to be between 40 and 100 microns (μm). Droplets in this range cover more surface area, require lower volumes, are more readily retained and less susceptible to fallout and runoff than those >100μm; they are also less susceptible to drift than those <40μm.

The surface area of any liquid is enormously increased when broken into small droplets. Therefore, the volume needed to cover plant surfaces decreases proportionally with droplet size. Table 1 provides a wide range of droplet sizes/corresponding volumes with which 50-60 μm droplets can be compared.

Table 1: *Liquid required, litres/ha, for a density of 1 drop/mm² applied evenly to a flat surface*

Droplet diameter μm	Litres/ha 1 droplet/mm²
10	0.005
20	0.042
30	0.141
40	0.335
50	0.655
60	1.131
70	1.797
80	2.682
90	3.818
100	5.238
200	41.905
500	654.687

Studies have also shown that larger droplets are not well retained due to their high kinetic energy. When droplets >150μm strike certain leaf surfaces, they become flattened, but their kinetic energy is such that they retract and bounce away. Very large droplets, >200μm, have so much energy that they shatter on impact. Small droplets are better retained as they lack the kinetic energy to overcome the surface energy and viscous changes that occur on impact and cannot bounce away.

Table 2: *Fall time of various sized droplets when released from a height of 3m in still conditions*

Droplet diameter μm	Fall time 3m
1	28.10 hr
10	16.90 min
20	4.20 min
50	40.50 sec
100	10.90 sec
200	4.20 sec
500	1.65 sec

The weight of individual droplets and the effect of gravity on them increases proportionally with droplet size. Table 2 reflects the time to fall from a height of 3 metres in still conditions of a wide size range of droplets. Without electrostatics, Table 2 can also by interpreted reversely for drift. Here the risk of drift increases inversely with droplet size and proportionally with wind speed.

Electrical force influence on spray movement

Where uncharged small droplets are more susceptible to off-site drift, charged droplets are not. When sprays are uncharged, neither the droplets nor the target surfaces have any influence on each other. The droplets are controlled by forces generated by the application equipment (pressure, air) and by the external forces of gravity and air drag.

Electrostatically charged droplets are, obviously, also influenced by these mechanical forces; however, once they reach the vicinity of the target, electrostatic forces take over to a very large degree. To compare influence, the electrostatic force on small charged droplets is 40X that of gravity.

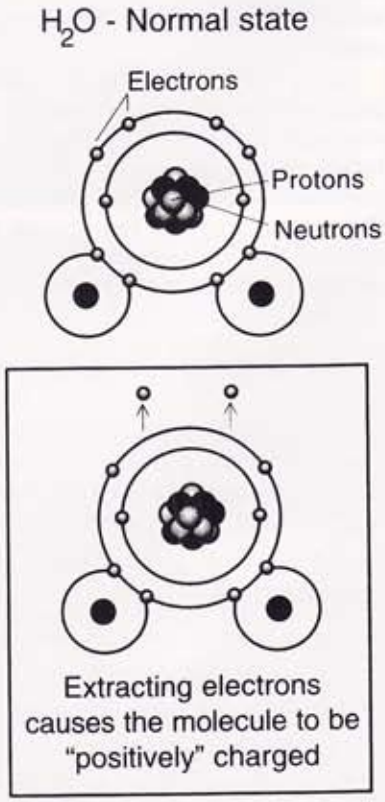
The wrap-around effect, for which electrostatic sprayers are known, visibly shows that the attractive force between charged droplets and targets overrides gravity and inertia by pulling droplets out of their paths — up, down, sideways — to the closest surface.

The most notable difference is the increased deposition on under/back sides of leaves and in dense vegetation. It is widely recognised that some of the largest crop losses and vector control problems — caused by such insects as whiteflies, boll worms, mosquitoes etc — are due in large part to inadequate target coverage, particularly on the undersides of leaves.

Uncharged/charged molecule differences

Uncharged sprays are made up of molecules in their normal, neutral electrical state, i.e. the atoms have equal numbers of protons (+) and electrons (—). A charged spray — or any object — has either had electrons added to or substracted from its atoms. The Spectrum 3010 Spray Head gives knapsack sprays a "positive" charge by extracting electrons from them as they pass

Fig. 1.Water in its normal electronically neutral state (top) and positively charged following electron extraction (bottom)



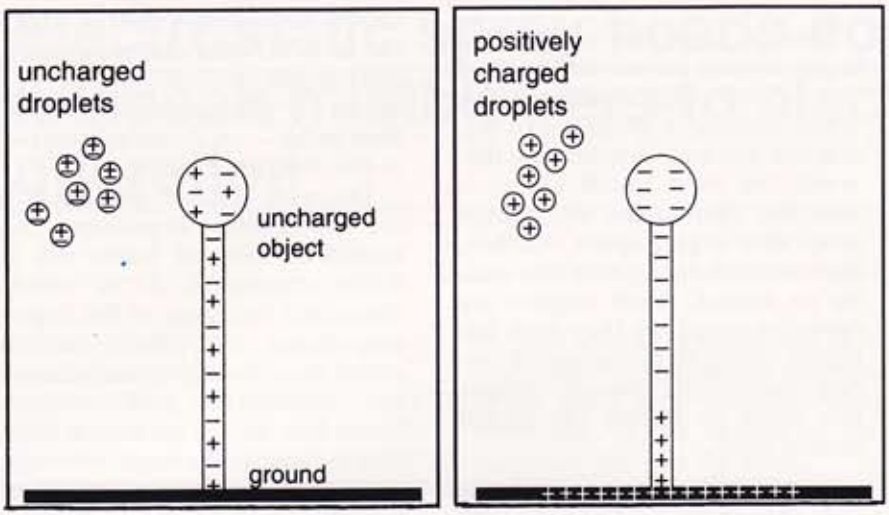


Fig. 2. Without electrostatic charge, spray droplets exert no effect and are controlled only by external forces (left); when positively charged droplets are brought near an uncharged object, the object becomes negatively charged as its electrons are attracted by and move towards the positively charged spray

over the electrode inside the head, fig. 1.

The primary substance, which carries the charge in sprays, is water because of its electrical conductivity, irrespective of whether or not the active ingredient is conductive. Electrostatic charging has no effect on the chemical make-up of the active ingredients.

Applications

Charged sprays are attracted to any targeted, conductive and earthed objects such as plants, trees, animals and certain types of building materials.

Thus, when spraying is taking place, as the collection of positively charged droplets approaches a target, it pulls the negative electrical particles, electrons, that are inside the target, up from the ground to the surface. As a result, the target surface becomes negatively charged, fig. 2. In turn, the negatively charged surface pulls the mobile, positively charged droplets to it.

Charged sprays, unlike uncharged sprays, resist coalescing into larger droplets both in transit and deposition. As each charged droplet is deposited on a surface, electrical charges balance out at that site, making it no longer attractive to other charged droplets. The droplets following are, therefore, pulled instead to the rest of the surfaces which remain attractive.

By changing the way pesticides are applied, the Spectrum 3010 offers farmers, horticulturalists and vector control professionals, who rely on knapsack sprayers, a more effective, economical way to improve control and reduce the chemical use and environmental damage caused by drift, run-off and fallout.

For more details in the USA contact W.T. (Terry) Dobbins, Jr., Southwest Electrostatic Sprayers, Inc., Administrative Offices, 6222 Richmond Avenue, Suite 575, Houston, Texas 77057, USA. Tel: (713) 783-5771; Fax: (210) 783-5772. Internet: http://www.wantabe.com/spectrum; E-mail: sesinc@wantabe.com

More details from outside the USA from J. Scott Schlieman, Lobel Chemical Corporation, 100 Church Street, New York, NY 10007-2682, USA. Tel: (212) 267-4265; Fax: (212) 349-0869 or (212) 406-9788; E-mail: jsslobel@pipeline.com

Bibliography

Haney, Philip B. *et al. Reducing Pesticide Use and Energy Cost in Citrus Pest Management.* University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources. UC IPM Publication 15.

Matthews, G.A. *Pesticide Application Methods.* 2nd Edition. Longman (1992).

Schneider, Frank *et al. Comparison of Applicator Exposure to Azinphos-Methyl, Using Electrostatic and Conventional Air Blast Sprayers in California in 1986.* Division of Pest Management, Environmental Protection and Worker Safety, California Department of Food and Agriculture.

Unpublished studies

Castle, G.S.P., I.I. Inculet *et al. Pesticide Deposition in Orchards Using an Electrostatic Sprayer.* Presented at the Florida Conference on Pesticide Application Technology, Gainsville, Florida (1981).

Madden, George. *Electrostatic vs. Conventional Higher Volume Sprayers for Insect and Disease Control and Foliar Nutrient Uptake in Pecans.* Paper presented at the Louisiana/Mississippi Pecan Growers' Association annual meeting held in Alexandria, Louisiana in June 1992.

Reprinted from
International Pest Control
37, 155-158

COVER PHOTOGRAPH

R.B. Dobbins, US developer of the Spectrum Electrostatic Spray Head for knapsack mistblowers, demonstrates its use in spraying dense foliage