Journal of the American Mosquito Control Association, 13(1):90–91, 1997

AN ELECTROSTATIC BACKPACK SPRAYER: POTENTIAL FOR MOSQUITO CONTROL[1]

J. R. BROWN,[2] D. C. WILLIAM,[3] R. O. MELSON[2] AND T. GWINN[3]

ABSTRACT. A Southwest Electrostatic Sprayers, Inc., nozzle was configured to a Hudson PortaPak® backpack. A test was run to compare deposition of BVA no. 13 oil by the electrostatic nozzle to a standard nonelectrostatic nozzle as collected by Teflon® slides. Results indicate that 100% greater deposition occurred with the electrostatic nozzle.

Although insecticides remain essential for protection against disease vectors, opportunities exist for engineering improvements in the spray-application process. Support for changes can be witnessed in the inability to control a variety of infestations throughout the mosquito control and agricultural industries. Law et al. (1992) stated that conventional spray-application technology, relying on gravitational and inertial forces, often achieves less than 50% mass transfer of the insecticide onto the desired target. Inculet et al. (1984), using the dye uranine, reported up to a 40% increase in coverage using electrostatic nozzles as opposed to conventional mechanical spraying. Chadd and Matthews (1988) also evaluated an electrostatic sprayer for use in residual treatments of dwellings and listed several advantages. Considering the $75 million direct annual cost for mosquito control in the state of Florida alone (State of Florida, Health and Rehabilitative Services, Entomology Division, unpublished data), the significance of potential savings due to engineering improvements becomes obvious.

The droplet velocity vector can be determined by the gravitational field and momentum, the interactions of droplets with the air stream propelling them, and electrical charges (Law et al. 1992). Air-assisted electrostatic spraying (AES) has been an accepted practice in agriculture for more than a decade (Brown et al. 1994). Air-assisted electrostatic spraying exploits gravitational, moment, and electric force fields in which the electric force vector continuously redirects itself toward the earthed plant surface as the aerosol traverses the surface (Law et al. 1992). The conversion of a relatively low-cost backpack sprayer into an air-assisted electrostatic sprayer for use in mosquito barrier control may provide benefits not heretofore allowed, to include increased deposition, more efficient management of resistance through improved insecticide application management, and decreased human and environmental exposure.

The purpose of this note is to describe an initial test with a H. D. Hudson PortaPak® 6800 backpack (H. D. Hudson Mfg. Co., Chicago, IL) modified with an electrostatic nozzle. An air-assisted electrostatic nozzle (Southwest Electrostatic Sprayers, Inc., Houston, TX) attached to a Hudson PortaPak 6800 backpack was used as the electrostatic aerosol generator source. After nozzle removal, the same PortaPak was used as the nonelectrostatic aerosol source. BVA no. 13 oil (BVA Oils, Wixom, MI) was used as the aerosol material. J. W. Hock impingers (J. W. Hock Co., Gainesville, FL) fitted with Teflon®-coated slides were set in 5 rows of 4 impingers each. Impingers and rows were 3.2 m apart. The sprayer was discharged 3 m in front, perpendicular to each row, and downwind. The flow rate was adjusted to 252 ml/min. Tests were performed when ambient temperatures were 22°C. The wind velocity was 1.5–2.9 m/sec and parallel to the impingers. After collecting droplets, slides were sealed in a slide box and were measured within 4 h. Droplet spectra analysis was performed using the VecTor® software program (VecTec, Orlando, FL). The number of droplets/cm^2 was calculated by the formula given in Brown et al. (1993). A chi-square 2×2 contingency table (Conover 1980) was used to analyze the droplet samples. The tests were performed to determine if both populations of aerosol droplets had the same number of droplets/cm^2 and volume mean diameters (VMDs) at the distances tested.

Droplets/cm^2 for each nozzle type clearly decreased over the 12.5-m test distance (Table 1). Overall, 100% more droplets were deposited by the electrostatic nozzle relative to the standard nozzle. Because the test statistic of 4.59 was less than 7.82 (df = 3; $P < 0.05$) (Conover 1980), the hypothesis was accepted that more electrostatically charged droplets than noncharged droplets were collected by this test procedure.

Volume mean diameters for each nozzle type also decreased over the distances tested (Table 2). The test statistic of 0.66 was less than 7.82 (df = 3; $P < 0.05$) (Conover 1980). The hypothesis that electrostatically charged droplets had smaller VMDs than noncharged droplets was confirmed. The mean deposition of BVA no. 13 oil with the

[1] The opinions and assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department, the Naval Service at large, or the University of South Carolina.

[2] Navy Disease Vector Ecology and Control Center, Box 43, Naval Air Station, Jacksonville, FL 32212-0043.

[3] USC-ICPHR, P. O. Box 699, McClellanville, SC 29458.

Table 1. Droplets/cm^2 for a standard noncharged backpack nozzle and an electrostatically charged nozzle.

	Distance (m)				
Nozzle	3.1	6.3	9.4	12.5	Mean
Standard	736	578	274	99	422
Electrostatic	1,365	1,095	597	215	818

electrostatic nozzle was 1.63 times the volume of the standard nozzle.

Electrostatic sprayers have been used in agriculture for more than a decade with proven effectiveness. Their use might result in appreciable savings in time and financial resources in areas of the globe where barrier treatments are more widely used than in the USA.

Table 2. Volume mean diameters for a standard noncharged backpack nozzle and an electrostatically charged nozzle.

	Distance (m)				
Nozzle	3.1	6.3	9.4	12.5	Mean
Standard	54.4	48.6	45.3	36.2	46
Electrostatic	51.7	49.8	36.7	35.4	43.4

REFERENCES CITED

Brown, J. R., V. Chew and R. O. Melson. 1993. Malathion aerosol cloud behavior in a coastal plains pine flatwoods. J. Am. Mosq. Control Assoc. 9:91–93.

Brown, J. D., R. B. Dobbins and I. I. Inculet. 1994. Portable electrostatic sprayer. Inst. of Electrical and Electronic Engineers Ind. Appl. Soc. 29th Annual Meeting 2:1442–1445.

Chadd, E. M. and G. A. Matthews. 1988. The evaluation of an electrostatic spraying method for mosquito control. Trop. Pest Manage. 34:72–75.

Conover, W. J. 1980. Practical nonparametric statistics. John Wiley & Sons, New York.

Inculet, I. I., G. S. P. Castle and R. S. Vermey. 1984. Electrostatic spraying of row field crops. Conference Record Industry Application Society 1984 Annual Meeting, pp. 1058–1060.

Law, S. E., S. C. Cooper and R. D. Oetting. 1992. Advances in air-assisted electrostatic crop spraying of conductive pesticides. 1992 Int. Meet. Am. Soc. Agric. Eng., Charlotte, NC. 92-1062 (10 unnumbered pages).