Comments on Federal Register Notice November 4, 2009, 74 FR 57166, Docket No. EPA-HQ-OPP-2009-0628 entitled *Pesticides; Draft Guidance for Pesticide Registrants on Pesticide Drift Labeling*

TO: Dr. Debra Edwards – Director, EPA Office of Pesticide Programs, Washington, DC
CC: US Rep. David Price – NC 4th District & US Rep. John Barrow – GA 12th District
FROM: Dr. S. Edward Law - University of Georgia, Dept. of Biol. & Agrl. Engineering, Brooks Distinguished Professor, Member – National Academy of Engineering
DATE: 3 January 2010
SUBJECT: ***Enabling the Implementation of Environmentally Sound Crop Spraying Technologies by Identifying Regulatory and Standards Impediments Including those under Proposed EPA Pesticide Drift Labeling***

Dear Dr. Edwards:

I appreciate this opportunity to formally comment on the above referenced pesticide registration (PR) notice which attempts to address the significant environmental concern caused by airborne drift of toxic sprays. In response, I am bringing forward the need to exempt proven reduced-volume crop spraying technologies from the seriously hindering constraints imposed by chemical labels and standards which mandate minimum values allowed for spray application volume and droplet size. Ironically, good intentioned efforts (*e.g.*, this PR Notice 2009-X) for correcting pesticide spray-drift problems inherent in conventional application using the mature hydraulic-atomizing-nozzle technology threaten to detrimentally impede other well proven alternative technologies. ***My objective here is to present scientific evidence supporting the exemption of proven alternative crop-spraying technologies from the droplet-size and application-volume regulatory standards/label restrictions being promulgated to control drift from conventional hydraulic-atomizing-nozzle spray application technology.*** Likely you are aware that pesticide labels, currently being enforced in Florida for control of potentially economically devastating "citrus-greening" Asian Psyllid, prohibit sprays smaller than 90 micrometers median droplet size…the realm within which new improved technology has been purposefully developed.

As a point of departure, I'd assume there is general agreement as to ***our overall goal*** as engineers/scientists/regulators/manufacturers facilitating crop pest control *via* spray-application systems: ***Provide efficacious/economic pest control by dispensing into the ecosystem the minimum quantity of control-agent active ingredient efficiently delivered to the intended crop surface, thereon deposited uniformly onto both directly exposed and obscured crop surfaces, while minimizing off-target losses of active ingredient to soil, water and atmosphere.*** There are various equally valid wordings for this overall mission statement…as indeed there are proven alternative technical approaches to achieve it. It is remarkable the degree to which efforts such as PR Notice 2009-X to ameliorate off-target drift seem to have trumped other equally imperative aspects of the above objective…especially the minimizing of pesticide load dispensed into the ecosystem. Hopefully, EPA's OPP will eventually emulate the proven approach of its sister Office of Water in regulation based on the environmental concept of Total Maximum Daily Load (TMDL). In the EPA's proposed labeling under comment, I can find no "credit" such as reduced buffer widths given for actually dispensing less pesticide active ingredient into the environment and depositing it on-target by improved application technology. In contrast, since 2001 the UK's Local Environment Risk Assessment for Pesticides (LERAP) allows such credits (*e.g.*, pest control efficiently accomplished using half-rates a.i. allows the usual 5-m buffer to be reduced to only 2-m width). EPA PR Notice 2009-X should incorporate similar efforts to reduce "TMDL"... shown to currently be achievable by improved technology as documented below.

Basis for One Alternative Technology Developed by University of Georgia - You'll likely have others providing inputs re. benefits of reduced-volume/reduced-diameter spray approaches; thus, I will focus my comments and supporting studies to University of Georgia developed alternative technology which incorporates appropriately balanced aerodynamic energy and electric-force fields to achieve the above stated goal…while typically ***halving*** the pesticide a.i. dispensed into the ecosystem and still achieving the required a.i. mass transfer onto the target crop surfaces. The process basically relies upon pneumatically atomizing the spray liquid into typically 30-40 μm VMD droplets charged to high charge-to-mass which are conveyed to the target and turbulently mixed therein by an air-carrier stream inherently provided by each charging nozzle. Deposition by space-charge electric fields within the plant canopy is relied upon instead of intense high-voltage nozzle electrodes which plants naturally "Faraday shield" to mainly peripheral surfaces. Electrostatic force of attraction of a charged droplet to the crop surface typically exceeds 10-50 times that of gravitational force as primarily relied upon in conventional spray technology…thus providing the control necessary for conveying and depositing these small droplets with maximum on-target *vs.* off-target delivery. This ***"hybrid" air-assisted, electrostatic-induction, crop-spraying technology*** is patent-licensed by the university to Electrostatic Spraying Systems, Inc.[1] (www.maxcharge.com) and being successfully marketed worldwide…but sadly to say, mainly outside of the USA due in part to grower concerns for violating federal label restrictions and voiding chemical-performance warranty. The following bullets provide specific points of evidence supporting the requested label exemption and standards consideration not impeding reduced-volume/reduced-diameter spray technology.

- *Electrostatic Control Dominates Over Gravity for Small Droplets* - Fundamental physics dictates that small droplet size (typically < 100 μm dia.) is the realm for incorporating effective electrostatic control. *Rationale*: the charge-to-mass ratio which can be imparted to droplets varies inversely with droplet diameter…as consequently does the electric-to-gravitational force ratio per unit mass of the droplet. Thus, it's only as diameter is reduced into the small-droplet realm that electrostatic spray-application technology can be effectively engineered to achieve orders-of-magnitude greater droplet control which maximizes on-target deposition and minimizes off-target drift. This major proven electric force-field benefit to crop-spraying technology must not be sacrificed to label and standards restrictions applicable for controlling the drift problem of conventional hydraulic-nozzle technology…*e.g.,* EPA's PR Notice 2009-X.

- *Small Droplets Improve Spray Coverage and Efficacy* - Reduced droplet size is associated with improved spatial distribution of a.i. across target surfaces (*i.e.,* coverage). It's commonly known that one 300 μm droplet "pest-control site" could become 1,000 sites if delivered as 30 μm spray…and effectively deposited by improved technologies incorporating the requisite forces to mitigate off-target drift. Interestingly, respected manufacturers of hydraulic-atomizing nozzles recommend certain catalog products on their merit to "…produce smaller droplets for thorough coverage…". Additionally, for years biological-sciences journals have reported increased pest-control efficacy per unit mass of chemical pesticide for a number of products applied as reduced-size droplets in the sub-100 μm realm…another benefit which restrictions by regulatory labels under EPA's PR Notice 2009-X and standards should not preclude when deposited on-target *via* the various improved application technologies.

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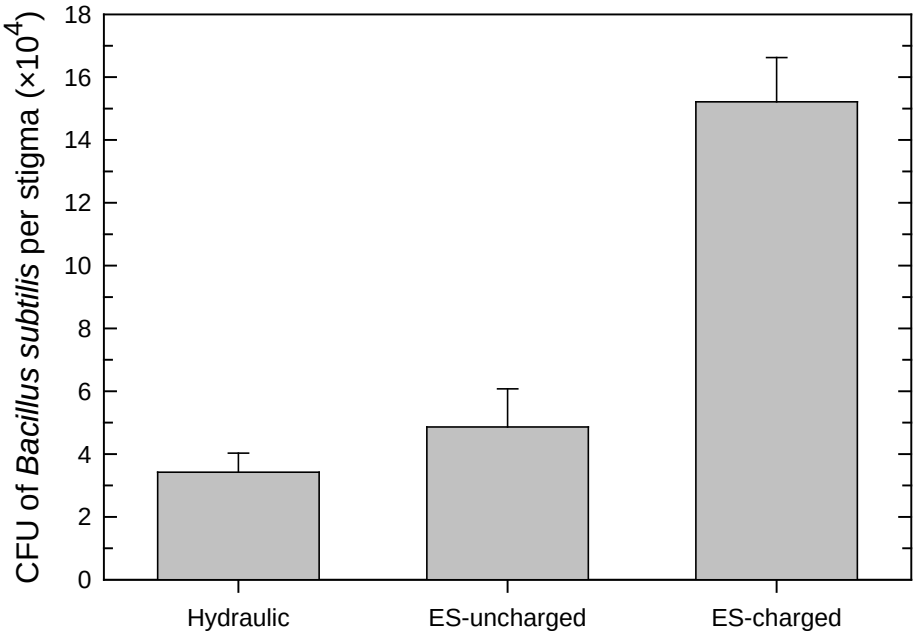
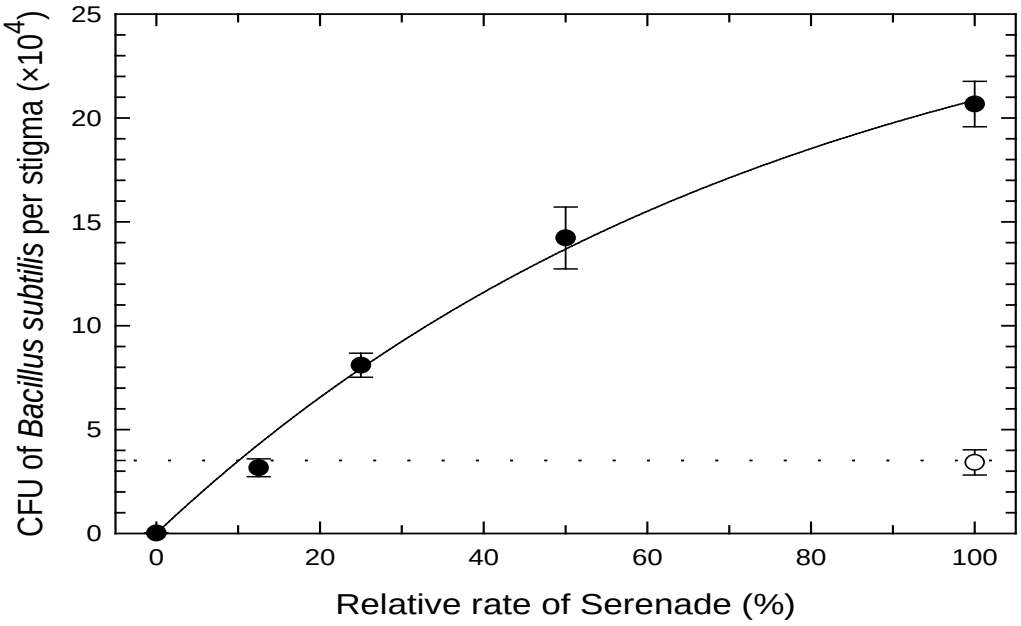
[1] *Disclaimer* – I have chosen to have no financial investment in ESS, Inc. in order to fully direct, with no conflict of interest, the research capabilities of our University of Georgia Applied Electrostatics Laboratory to ensuring the firm scientific basis underpinning air-assisted, electrostatic-induction, spraying technology.

- *Scientific Evidence by U.Ga. Supporting Exemption* - The appended listing of over 100 refereed U.Ga. scientific/engineering journal publications establishes several decades of research documentation of the reliability/robustness/safety of the pneumatic-atomizing, induction-charging-nozzle process which imparts exceptionally high droplet charge-to-mass (10-20 mC/kg) using charging voltages typically <2% those of industrial coating processes, droplet mass-transfer efficiency to various biological and modeled targets, uniformity of deposition onto leaf frontside/backside, pest-control efficacy, physics of charged-spray-to-target transient interactions, *etc*. See, for example, chapter 8 by Law in the 1987 Cambridge University Press book Rational Pesticide Use which theoretically analyzes basic phenomena active in electrostatic pesticide spraying. More specifically, the 1994 publication by Mark Evans *et al*. (now with John Deere plant/Grovetown, GA) used light-intensified image analysis to quantify significant improvements in target deposition, both quantity and distribution frontside/backside, directly attributable to air-assisted electrostatic-spraying *vs.* conventional hydraulically-atomized sprays. Similarly, for application of a commercial biofungicide (Serenade) onto blueberry plants, the 2005 Law & Scherm paper microbiologically documents a 4.5-fold increase ($\alpha = 0.05$) for on-target deposition of bioagent *B.subtilis* colony-forming units using only1/8th the spray volume of the conventional application as graphed below. Correspondingly, electrostatic deposition of these 30-40 μm droplets permits a 4.5-fold reduction of dispensed a.i. into ecosystem. At URL for University of Georgia Applied Electrostatics Laboratory (http://ael.engr.uga.edu/wp-content/uploads/2014/09/MVC-001W.mpg) see 15 sec. video file of such air-assisted spray passing right-to-left under blueberry plant demonstrating characteristic droplet attraction upward against gravity as charging is electronically switched OFF-ON-OFF-ON.



Effect of spray application method of Serenade biofungicide (*Bacillus subtilis* strain QST 713) on population densities of the biocontrol agent deposited on stigmas of blueberry flowers. Values are means and standard errors of four independent experiments, each subsampled with three flower clusters per run and three flowers per cluster. CFU = colony-forming units, ES = air-assisted electrostatic spray application.



Effect of relative rate of Serenade biofungicide (*Bacillus subtilis* strain QST 713) on population densities of the biocontrol agent deposited on stigmas of blueberry flowers when applied as an electrostatic spray. Values are means and standard errors of three independent experiments, each subsampled with three flower clusters per run and three flowers per cluster. The full rate (100%) corresponds to 16.37 L/ha (7 qt/acre) of formulated product. The regression equation is of the form $y = a\ (1 - e^{-bx})$, (R = 0.997, P = 0.0002). For comparison, the dashed line through the open-circle symbol with error bars indicates the mean population density of *B. subtilis* when applied as a conventional hydraulic-atomized spray at full rate (100%). (n = 4). CFU = colony-forming units.

- *Scientific Evidence Provided by Other Universities* - For documentation of improved deposition of a.i. onto plant surfaces conducted by other universities evaluating U.Ga. air-assisted, induction-charged sprays, see for example the refereed publications by Ken Giles/U.C.-Davis and Richard Derksen/Cornell University. Using statistically rigorous field tests, Giles (collaboratively with the Calif. Dept. of Food & Agrl.) confirmed that equal leaf deposition of fungicide a.i. and identical persistence of protective deposit over the subsequent 21-days was achieved on strawberry crops by [50% rate a.i. applied as 30-40 μm VMD droplets in only 8.5 gal/acre using air-assisted electrostatic spraying] *vs.* [100% rate a.i. applied in 200 gal/acre using conventional large-droplet/higher-volume spraying technology] as graphed below by the two overlapping curves…again confirming efficacious pest control while halving the ecosystem's a.i. load. Further comparisons by Giles *et al.* documented target-plant deposition of synthetic pyrethroid a.i. onto greenhouse crops to be [3.7-times greater when electrostatically applied as 30-40 μm droplets in ~1/10th the spray volume as well as a significant reduction in non-target deposition] *vs.* [the best available conventional hydraulic-nozzle spray application].

Giles, D. K., and T. C. Blewett. 1991. Effects of conventional and reduced-volume, charged-spray application techniques on dislodgeable foliar residue of captan on strawberries. *Journal of Agricultural and Food Chemistry* 39:1646-1651.

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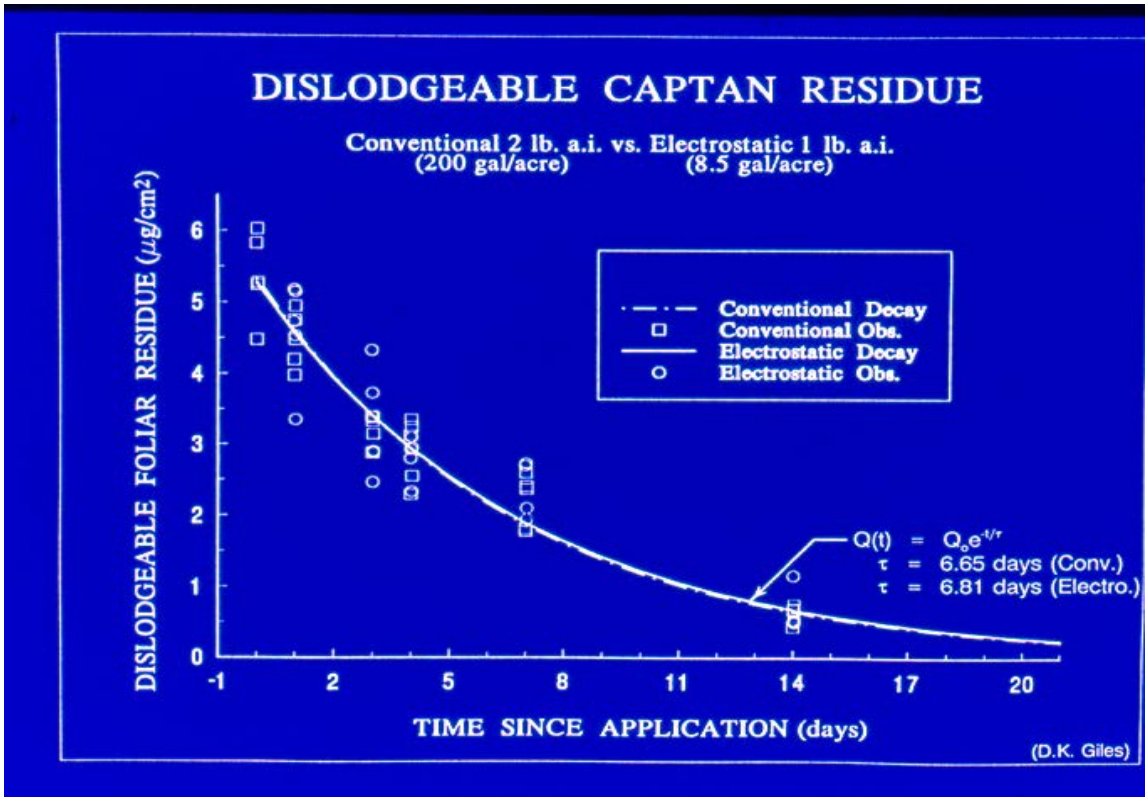

- *Logistical, Energy, Economic and Environmental Benefits Accrue* - As verified in the above publications and typical graphs, efficiently deposited reduced-diameter sprays often permit a concomitant reduction in application volume…directly permitting lighter weight sprayers demanding less soil-traction energy, logistical benefits for the grower having less demand for mix-water, as well as significant environmental and economic benefits when dispensing typically half-rates of pesticide a.i. from the nozzles. Several years of cost savings from reduced pesticide usage typically amortize the added equipment cost associated with the air-assisted electrostatic-nozzles system as well as with other proven reduced-volume/reduced-diameter alternative crop-spraying technologies.

In conclusion, on October 5, 2009 the National Academy of Engineering (www.nae.edu) assembled a panel of most distinguished industry and academic leaders to address our nation's critical need and strategy for ***Rebuilding a Real Economy: Unleashing Engineering Innovation.*** There was overall optimism that for mutual benefit academic researchers, global corporations, and government regulatory agencies could work together to develop, manufacture and implement America's necessary new and improved technological innovations …consistent with good economic, energy and environmental stewardship. To this end it is of utmost importance that implementation of the various new and improved spray-application technologies meeting our own pest-control mission statement as justified above not be impeded by non-relevant standards and label restrictions (*vis-à-vis* minimum values of application volume and droplet diameter) promulgated to address the spray-drift problem of the mature conventional method of spray application. I thus strongly urge major revisions in EPA's proposed Pesticide Drift Labeling now under review as PR Notice 2009-X so that it does not itself become an impediment to environmentally sound, improved pesticide application technology.

SUPPORTING PUBLICATIONS

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