This Guy Knows Aerial Application

A Q&A with Dr. Clint Hoffmann

The premier agricultural aviation research body in the United States lies deep in the heart of Texas. Down in College Station, the Aerial Application Technology Group (AAT) and its team of scientists, engineers and support personnel are devoted to developing technologies for aerial applicators that mitigate drift and result in more efficacious applications. As this issue's cover story documents, the aerial application industry has benefited from AAT's findings in numerous practical ways. How does AAT determine its research projects? What's on the horizon? How would cuts in federal funding for AAT research impact the industry? *Agricultural Aviation* posed these questions and more to Clint Hoffmann, AAT's lead scientist for aerial application research. In 2009, Hoffmann received NAAA's Outstanding Service Award. He is an outspoken supporter of aerial application and has advocated on the industry's behalf before numerous outside groups and government agencies. In the responses that follow, Dr. Hoffmann takes readers inside the Aerial Application Technology Group and elaborates on the work he and his team of researchers are doing to keep aerial applicators on the cutting edge of technology. *–Jay Calleja, Manager of Communications*

Agricultural Aviation: What kind of impact do you think the USDA-ARS and AAT specifically have had on the aerial application industry?

Clint Hoffmann: The Agricultural Research Service (ARS) serves the needs of American agriculture by providing long-term research programs that address nearly every aspect of agriculture. ARS has two programs (College Station, Texas, and Stoneville, Miss.) that service the aerial application industry. The research missions of these two groups include development and evaluation of new spray equipment and product, spray modeling, precision application, remote sensing of crop conditions and disease stress using multi-spectral cameras mounted on aircraft, product efficacy testing and decision support systems to help aerial applicators make informed decisions quickly and efficiently. Through these research projects, aerial applicators are provided with objective evaluation of numerous products as they come onto the market. Applicators are also provided guidelines and best management practices that lead to more effective spray applications.

AA: How does USDA-ARS decide whether to conduct a particular aerial application research project?

CH: Every ARS research group has a five-year research plan that gets developed through consultation with user groups, ARS National Program leaders, outside experts and the ARS scientists in the project. When putting this plan together, the goal is to lay out a road map that says if this research program completes these three to six objectives, then the program will be successful and serve the needs of their user communities. There are specific accomplishments that are detailed in the plan that the scientists in the project are tasked with completing.

Clint Hoffmann, Agricultural Engineer and Lead Scientist of the USDA Agricultural Research Service's Aerial Application Technology project

Each year around December or January, our group gets together to lay out our research plans for the upcoming year. While keeping an eye on the specific accomplishments that are part of the five-year plan, we also talk about research projects that need to be done related to upcoming issues facing the aerial application industry. Many of these issues are identified in discussions with the NAAA Research and Technology Committee at NAAA Board Meetings and by talking with aerial applicators at the national convention, state conventions or on the phone. These discussions help us to decide if we have the in-house resources to complete a particular project or if we need to collaborate with others outside our group.

AA: What are some major breakthroughs that the Aerial Application Technology Group has achieved that have been beneficial to the industry?

CH: The product that is most commonly used by aerial applicators is the spray atomization models that were first developed by Dr. Buddy Kirk and are currently being updated

and further developed by Dr. Brad Fritz. These models allow aerial applicators the ability to input their application parameters (nozzle type, orifice, airspeed, pressure, orientation) and determine what size of spray droplets they are producing. If a pesticide label requires a certain size of spray droplet, the applicator will know if they are compliant or can change the application parameter to meet the labeled requirements. The newest models are being extended from 160 mph maximum airspeed to 200 mph to meet the needs of applicators who are using some of the newer and faster aerial application aircraft. These models are available on our website at http://apmru.usda.gov/downloads/downloads.htm and some nozzle manufacturer's websites. We are currently in the process of transferring these models into smartphone apps so that aerial applicators can access them more readily.

AA: What can you tell us about equipment/technology that the Aerial Application Technology Group has patented or made available for industry use?

CH: Dr. Jim Carlton patented the aerial electrostatic spray system that is currently being sold by Spectrum Electrostatics Systems. Our group has recently applied for patents on a new volatile organic compound (VOC) sensor and an insect bioassay cage. These last two items are designed to address upcoming issues that may impact the industry. For example, in some areas of California, there has been discussion about "no spray days" to prevent some VOCs associated with pesticide applications that may contribute to the production of ozone and smog. There has been very little field verification of the role of pesticides on VOCs released into the environment. Therefore, to complete field studies associated with VOC detection, we needed more economical sensors for this work. The bioassay cage will lead to more effective evaluations of product used to control mosquitoes.

Our group also works with numerous adjuvant manufacturers to investigate the effects of different adjuvants, often experimental, on spray droplet size. These studies are directed at developing products that can reduce the production of small, drift-prone droplets. Additional studies are conducted on numerous pesticides to determine the impact of application parameters on product efficacy. Studies with new chemistries are initially conducted in a spray table to look at a wide range of droplets sizes and spray rates until the optimal combination is found. Then, field studies are conducted with our aircraft to confirm that careful attention to the application parameters are needed to make the most efficacious application. These recommendations then show up as recommended or required application conditions on product labels.

AA: What kind of information do you provide to the EPA when it is evaluating the drift potential of aerial applications, and what role do you play in discussions with EPA related to reducing drift?

CH: The EPA's Drift Reduction Technology (DRT) program is a good example of our group's approach to long-term research directed toward future needs or developments that will impact the aerial application industry. When the DRT program was first being developed, we realized that some aspects of the program could have a significant impact on the materials and methods applicators use in their daily operations; therefore, we took an active role in the DRT program. Over the last five years, our group worked with other researchers to develop the testing protocols and verification procedures that will be used to objectively evaluate a DRT (nozzles, spray modifications, adjuvants, etc.). By publishing these protocols and procedures in peer-reviewed journals, we are providing the data needed by EPA to make science-based regulations.

AA: NAAA has been a strong advocate for the USDA-ARS Aerial Application Technology Program in the halls of Congress and with federal regulatory agencies, and you and your team have been equally strong advocates for sound science and the aerial application industry. How would you characterize the relationship between NAAA and USDA-ARS?

CH: All of our scientists see the aerial applicator as our main customer group and are committed to serving aerial applicators. Scientists in the AAT commonly consult with NAAA personnel in addition to partners in industry as well the applicators in the field to provide scientific support when addressing these changing and often volatile issues. The AAT group serves as a general clearinghouse of scientific information and data for a multitude of user groups including university, state and federal research groups, industry partners, involved professional organizations—including NAAA, ASABE [American Society of Agricultural and Biological Engineers], ASTM International [American Society for Testing and Materials], CPDA [Chemical Producers and Distributors Association], etc.—private research entities and the applicators themselves. These relationships result in numerous collaborative research relationships often allowing for the completion of larger research projects that could not be completed by any single partner. Additionally, the research conducted by the AAT is

continually transferred to users through professional publications averaging nearly 20 publications a year over the last couple of years.

AA: All federal discretionary spending seems to be constricting. What would happen in the aerial application industry if this funding was markedly decreased or eliminated?

CH: The Aerial Application Technology (AAT) group is the largest aerial application research group in the country with unique capabilities and resources not available to any other research group allowing for dedicated aerial spray technology research. The high and low speed wind tunnels with the capability of assessing aerial spray systems using active ingredient spray formulations are unique resources to this research program in the U.S. The group's dedicated research aircraft with available hanger and airport space allow our group to address and respond to research questions that no one else does. Since the group's aircraft fall under the government aircraft certification, they are uniquely qualified for development and early prototype testing of equipment and aircraft modifications that will help aerial applicators. During this development process, the AAT aircraft can be modified or equipment placed on the aircraft without having to go through the lengthy FAA approval process. Examples of products that have been tested on AAT aircraft include flow control systems, auto guidance systems, wingtip modifications, lowered spray booms, aerial electrostatic equipment and wing mounted spray pods.

If the AAT group were to disappear, initially the agricultural aviation industry would lose its ability to quickly respond to changing regulatory mandates and emerging issues that impact daily business operations. The AAT continues to provide the industry applied research that supports safe, effective and efficacious practices. Without these resources and guidance, the agricultural aviation industry would lose access to state-of-the-art best management practices and would lose a significant part of its ability to evolve toward more improved application practices and systems. This would ultimately lead toward a decrease in applicator effectiveness with an increase in adverse impacts to off-target persons, animals and crops, resulting in punitive legal actions and potential decrease or cessation of their daily business operations. Collectively, all of this would lead to aerial applicators losing the ability to support the American food, feed and fiber industries, ultimately resulting in losses in each as a result of these industries not having adequate resources to respond to crop pest and production issues.

AA: The support for the aerial application industry from the network of scientists not only at USDA-ARS but at other universities and organizations is impressive. Can you talk more about some of the joint ventures you undertake?

CH: Our group has worked with a wide range of researchers and growers over the years. For example, we have conducted studies in cotton in Arizona and Texas, wheat in North Dakota, South Dakota and Minnesota, corn throughout the Midwest, and orchards in California, Texas and Florida. These field studies allow us to work with researchers and applicators in these areas who have the knowledge and experience in the local area. Many of the joint research projects start from discussions at professional meetings and at NAAA conventions. Since field research is a very expensive undertaking, we can leverage both the financial and personnel resources of another researcher to complete these types of research projects.

Another example of how our cooperation with outside organizations benefits the aerial application industry has been our four-year involvement in the Department of Defense Deployed War-Fighter Protection Program (DWFP). Our expertise in droplet sizing and equipment evaluations supports this program's need for objective testing and development of vector control application equipment. The DWFP's financial support of our program, in turn, has allowed us to add to and upgrade our research equipment with the acquisition of two laser diffraction droplet sizing systems and a new high speed wind tunnel, as well as purchasing two unmanned aerial vehicles (UAV) for some of our remote sensing work. All of this supports our study of aerial application, including further support and development of the spray nozzle models. These new laser systems have also allowed our group to provide much needed support to ground and aerial citrus applicators to comply with new pesticide labels allowing for timely treatment of citrus orchards for Asian citrus pysllids.

Finally, funding from ExxonMobil allowed our group to study methods for applying oil dispersants from agricultural and specialized aircraft. This work was complete and published prior to the Gulf oil spill, allowing us to aid the response efforts with the generation of two white papers documenting that aerial applicators and a 747 could meet the application and regulatory guidelines to apply oil dispersants over the Gulf of Mexico.

AA: How do you get the results from your research projects out to the aerial application industry?

CH: One of our main efforts is to present the projects that are the most applicable to aerial applicators at the NAAA/ASABE Technical Session at the NAAA National Convention. We try to tailor the presentations so that applicators can use the results in their daily operations. We also place all of the papers and presentations from the Technical Sessions on our website. Many of our research projects and results support Allied Industry members such as nozzle and adjuvant manufacturers. We meet with these Allied Industry members at other professional meetings throughout the year. Since we are a scientific group, we publish a lot of our research in peer-reviewed journals. We are currently in the process of creating Applied Research Summaries for each of our peer-reviewed manuscripts to make the research results easier to understand. *[Editor's Note: see pg. 25 for an example of these one-page summaries.]*

AA: Can you talk a little bit about the new equipment you are developing for Operation S.A.F.E. fly-ins?

CH: Hopefully, everyone reading this article has been through an Operation S.A.F.E. clinic and/or had their aircraft's pattern evaluated at a fly-in. The swath analysis system developed by WRK Inc. is the most common method for evaluating an aircraft spray pattern using a dye in the spray tank and analyzing the pattern with a cotton string stretched across the flight line. The current WRK system uses an older model fluorometer to read the amount of dye that deposits on the cotton string. This model of flouorometer is no longer manufactured and new ones are quite expensive. Our group has developed an analysis system to replace this fluorometer that can not only evaluate the amount of dye on the line more quickly but will also output the results in real-time. This will speed up fly-in pattern testing. We are currently working with Scott Bretthauer and other supporters of the aerial application program to make this system available to S.A.F.E. Analysts in the upcoming year.

AA: How does the aerial application industry of today compare to the industry when you first joined USDA-ARS in 1989?

CH: The level of professionalism in the industry has been the biggest change that I have seen. Gone are the days of just some crazy guys who just like to fly and aerial application just happens to be their reason to fly. Today's aerial applicator is a businessperson with a passion for flying and feeding the world. Their level of knowledge about all facets of the industry has really grown and they are committed to keep gaining more knowledge. ■