Card Based Spray Pattern Testing System Designed for Aerial Applicators to Use

Matt Gill, University of Illinois, Champaign, Illinois

Time: 15 minutes (10:00 – 10:15)

Measuring and evaluating an aircraft’s spray pattern is essential. Most aerial applicators, however, are fortunate to have even a single opportunity to accomplish this each year at a regional Operation S.A.F.E. Fly-In. The growing need for high precision agricultural aircraft pattern and droplet size evaluation coupled with the dwindling supply of S.A.F.E. Analysts has resulted in a shortfall of pattern testing opportunities to aerial applicators. To address this, a software program is being developed that will allow an applicator to perform their own pattern testing using only off-the-shelf supplies. The program will provide swath-width and uniformity information, but also percent coverage and droplet spectrum data.

*Matt Gill is an Extension Specialist at the University of Illinois and has served as an Operation S.A.F.E. Analyst since 2011.*
Selecting Appropriate Cameras and Camera Settings for Aerial Imaging

Chenghai Yang, USDA-ARS Aerial Application Technology Research Unit, College Station, TX

Time: 15 minutes (10:15-10:30)

As more and more aerial applicators are using or considering using manned aircraft and/or unmanned aircraft, also known as drones, for aerial imaging, it is very important to select correct cameras and camera settings to obtain usable and quality imagery. In this presentation, I will briefly review the three most common types of cameras for taking normal color (red-green-blue or RGB), near-infrared (NIR), and thermal imagery. Then I will use a Nikon RGB camera and a modified Nikon NIR camera to illustrate how to select appropriate camera settings to obtain quality images. Some of the camera settings include focal length, exposure time, aperture opening, and ISO sensitivity. All these parameters will directly affect the ground coverage, image blurriness, depth of field and image quality. Examples will be provided as to how to select these parameters for different imaging scenarios. As drones has a much smaller payload and flight height than manned aircraft, the selection of cameras and camera settings will also be discussed. This presentation will provide you with practical guidance on the correct selection of cameras and camera settings for successful aerial image acquisition.

Dr. Chenghai Yang is a Research Agricultural Engineer with the USDA-ARS Aerial Application Technology Research Unit in College Station, TX. Dr. Yang’s research focuses on the development and application of airborne multispectral, hyperspectral and thermal imaging systems for precision agriculture and pest management. His recent efforts have focused on developing low-cost imaging systems and image processing techniques for aerial applicators and evaluating these systems for mapping crop pests for site-specific chemical applications. He has authored or co-authored more than 150 peer-reviewed journal articles and serves on a number of national and international professional societies.
Development of Operation S.A.F.E. Flight and Pattern Testing Equipment

Randy R. Price, 1LSU AgCenter, Dean Lee Research Station, Alexandria, LA
Dan Martin, USDA-ARS Aerial Application Technology Research Unit, College Station, TX

Time: 15 minutes (10:30-10:45)

Operation S.A.F.E. is an important part of agricultural airplane testing where spray applications are determined and adjusted for optimum efficiencies. This testing is typically performed by University and government agencies because of the time, equipment, and specialized personal needed to perform and analyze the tests. The LSU AgCenter has been developing new methods to pattern test agricultural aircraft, and a newer recording system has been developed that uses a GoPro camera and a small line laser to record spray patterns at the flight line (without the need for string collection collection). Testing has resulted in a system that can collect patterns at 0.2 seconds per foot (30 seconds for a 150 ft. flight line) and with minimal personnel. Analysis times - digital evaluation of the spray pattern in a computer - were 2 to 3 minutes for every 150 ft. length of string. Advantages of the system are that set distances are not required between the string poles, and counting performed at the winder system, and reels are not required for string storage or transport. This system may allow for a compact, portable, low cost string analysis system to be constructed for Operation S.A.F.E. personnel.

Dr. Price works for the LSU AgCenter where he is a state-wide Agricultural Engineer in charge of pattern testing agricultural aircraft, maintaining the LAIS weather station system, and developing new technologies for precision farming. He currently works at the Dean Lee Research and Extension office located in Alexandria, LA.

Dr. Martin is a Research Agricultural Engineer with the USDA-ARS Aerial Application Technology Research Unit in College Station, TX. Prior to his tenure with ARS, he directed the aerial application extension program in Louisiana for 10 years, working one-on-one with aerial applicators as an Operation SAFE Analyst and Extension Educator. Currently, he conducts variable rate, UAS and electrostatic aerial application research. He is an active member of several professional societies, serves on several technical committees and has authored numerous refereed publications.
Economic Benefits of the Aerial Application Industry in the United States: Phase 1 – Aerial Herbicide Application Ban Scenario

Senarath Dharmasena, Texas A&M University, College Station, TX
Daniel E. Martin, USDA Aerial Application Technology Research Unit, College Station TX

Time: 15 Minutes (10:45-11:00)

Aerial applications have been conducted in the US for nearly one hundred years for producing a safe, affordable and abundant supply of food, fiber and biofuel, in addition to protecting forestry and controlling health-threatening pests. Aerial application is a very critical component of high-yielding and highly efficient current-day U.S. agriculture. Compared to application by ground rigs, aerial application is up to three times as efficient and can treat a variety of fields such as those that are significantly wet, compacted, prone to topsoil runoff, and have thick crop canopy, such as orchards. The agricultural aviation industry treats 71 million acres of cropland each year, which is about 25% of the total commercially treated U.S. cropland.

According to the researchers’ best knowledge, the total economic value of the aerial application industry to the United States economy could not be found in the extant literature. Therefore, given the importance of this industry to the US economy in terms of food security, this study will estimate the total economic value of the US aerial application industry. There are many products that are aerially-applied that are valuable for a healthy, affordable food supply. They are herbicides, insecticides, fungicides, and fertilizer. Using cutting-edge modeling tools, Phase 1 of this study will focus on estimating the economic value of the aerial application of herbicides to the United States food supply.

The general objective of this study is to conduct an economic analysis of the benefit of the aerial application industry to the United States economy. This model will aid decision-making for aerial applicators, regulators, and legislators with the aim of quantitating the value of the industry to the U.S. economy. Specific objectives of Phase 1 of the project are: (1) to develop an economic model that quantifies the current value of the aerial application of herbicides to the American economy, and (2) to predict what would happen if aerial application of herbicides was no longer operative.

Economic data provided by NAAA and the USDA Economic Research Service will be utilized to develop an economic model using cutting-edge econometric tools to show the multi-faceted effects of a legislative ban on the aerial application of herbicides on the United States economy. Issues of food availability and cost, dependence on foreign nations for our food supply, impact on our rural farming communities, etc. will be explored as a part of this project. Once developed, the economic model will be shared with regulators, legislators and the aerial application industry so that these entities may understand the economic benefit of the aerial application industry to the U.S. economy and its importance to our national security.

Dr. Dharmasena is Assistant Professor, Department of Agricultural Economics, Texas A&M University. Dr. Dharmasena’s current research interests are in the areas of Agribusiness and Food Market Analysis, Economics of Food Security, Market Integration and Price Discovery. He is an expert in applied econometric modeling and has published in leading peer-reviewed journals. He is member of several national and international professional associations.
Regardless of your experience and number of acres flown, a review of some of the basic concepts associated with aerial application and some of the risk factors that should be considered for improving on-target, uniform deposition and mitigating spray drift is worthwhile. We will look at the basics of spray nozzle types and selection, their performance under varying application conditions, and things to consider when setting up your aircraft for any application. Basic concepts related to spray droplet size, using available models and tools to properly select and operate your spray nozzles and spray system to meet label requirements, and the potential impacts of additional tank mix adjuvants will be discussed. Further, considerations of other factors, such as percent boom width used, droplet size being applied, and wind speed and direction effects on spray swath uniformity and spray drift potential will also be considered. Though a full exploration of all these concepts is not possible during this session, we will highlight a number of different resources and contacts that are available to you if additional needs or questions arise.

Dr. Fritz is an agricultural engineer and serves as the Research Leader of the USDA ARS Aerial Application Technology group in College Station, Texas. His areas of research include spray drift measurement and methods of mitigation, understanding the role spray nozzles and formulations play in the droplet size being applied and optimizing aerial application technologies and methods to enhance on target deposition and reduce off target impacts. He is currently an active member of a number of professional organizations including the American Society of Agricultural and Biological Engineers, the American Society of Testing and Materials, the American Mosquito Control Association, and the National Agricultural Aviation Association.
Towards a Standard for Aerial Spray Drift Trials

Dan Martin, USDA Aerial Application Technology Research Unit, College Station TX

Time: 15 Minutes (11:15-11:30)

Spray drift from pesticide applications continues to be an important consideration not only to protect neighboring sensitive crops, but also to keep the product in the target field to improve application efficacy. Many different methods have been used in the past to evaluate spray drift. The most important parameter to control drift has been selecting the right nozzle to produce the correct droplet size for the job. It needs to be large enough to mitigate drift, but small enough to provide the necessary coverage needed for good efficacy. In this presentation, I will discuss a drift study protocol developed to measure spray drift from a UAV in a crosswind scenario using nozzles that produced a fine, medium and coarse spray droplet spectrum and present findings from the study.

Dr. Martin is a Research Agricultural Engineer with the USDA-ARS Aerial Application Technology Research Unit in College Station, TX. Prior to his tenure with ARS, he directed the aerial application extension program in Louisiana for 10 years, working one-on-one with aerial applicators as an Operation SAFE Analyst and Extension Educator. Currently, he conducts variable rate, UAS and electrostatic aerial application research. He is an active member of several professional societies, serves on several technical committees and has authored numerous refereed publications.
Conducting Field Operations with a Remotely Piloted Aerial Application System

Wayne Woldt, Associate Professor and Extension Specialist, University of Nebraska-Lincoln, Lincoln, NE. Yeyin Shi, Assistant Professor and Extension Specialist, University of Nebraska-Lincoln, Lincoln, NE. Daniel Martin, Research Engineer, USDA-ARS, College Station, TX.

Time: 15 minutes (11:30-11:45)

There is an increasing interest in remotely piloted aerial application systems for targeted application of products that can minimize damage to agricultural products. Remotely piloted aerial application systems (RPAAS) are a fairly recent innovation, and continued research and development will be necessary to continue advancement of these emerging technologies. Field-based flight operations, including spraying, are a necessary component of continued research and development. This presentation will review important components of conducting a successful field deployment of an RPASS in a typical agricultural setting. Flight operations involve all elements of RPAAS deployment, including: pre-planning for the site(s) with a review of aerial aspects, organization prior to departure to the field, confirming awareness of on-site aerial hazards, setting up the base of field operations upon arrival at the site, aircraft setup and preparation, aircraft preflight check, performing aerial application flight(s), cleaning systems and packing for return from field operations. Procedures that have been utilized to achieve each of these elements as part of an RPAAS field campaign will be presented and discussed.

Dr. Woldt is an Associate Professor and Extension Specialist at the University of Nebraska, in the Department of Biological Systems Engineering and the School of Natural Resources. He has been at UNL for 27 years, and has developed a research and extension program on the application of unmanned aircraft systems. Wayne is the Director of the Nebraska Unmanned Aircraft Innovation, Research and Education (NU-AIRE) laboratory and his areas of interest include: agriculture, flight safety, and land mapping. Specific areas of research and education include: small unmanned aerial application systems, development of a safety beacon for UAS flight operations, development of passive and active sensing technologies for agriculture and natural resources, deployment and flight operations of unmanned aircraft systems, and performance of autonomous navigation systems. Wayne has been flying unmanned aircraft for the past 6 years, and obtained the first FAA issued Certificate of Authorization to fly unmanned aircraft in Nebraska. His pilot ratings include private, glider, hot air balloon, and remote, with over 700 hours of total flight time.
The Impact of Nozzle Relative Velocity on Droplet Spectra

Sam Marx, University of Nebraska-Lincoln, Lincoln, NE

Time: 15 minutes (11:45-12:00)

It has been shown that change in pressure changes droplet spectra, from a change in spray velocity, both on ground and aerial application equipment. How does relative velocity (the difference between the spray’s velocity and the plane’s velocity) play into that equation on high speed aerial applications? Looking at USDA high speed models, a correlation between nozzle size, pressure, fan angle, deflection angle and air speed was found. With this information, selecting the right nozzle, or even allowing for more nozzles with a smaller tip size, for the application may be easier to do.

Sam Marx is currently a Research Technologist for the Biological Systems Engineering Department at the University of Nebraska-Lincoln. He is simultaneously pursuing his PhD in Agricultural and Biological Systems Engineering at UNL. His current research includes aerial nozzle development using computational fluid dynamic modeling as well as other ground based and UAV precision application technologies. Sam has a history in the agricultural engineering industry working on development, testing and production of agricultural application systems, including aerial application equipment. Sam is an active member of ASABE where he is Chair of the MS-23/6/2 Aerial Application Standards and Safety Committee and Vice Chair of the MS-23/6/5 Anhydrous Ammonia Application Standards and Safety Committee.