2020 NAAA Aerial Application Technology Research Session Presentations

---

Variation in Your Spray Swath
Author: Sam Marx
A review of what droplet size is, how droplets of different sizes move and how that movement can impact the uniformity of your swath. Swath uniformity is tied to a value listed in string pattern testing results, coefficient of variation or CV. We will discuss what CV is and how that number can be impacted by adjusting operating parameters (e.g. spray nozzle size, spray pressure, etc.) to provide a more uniform spray swath.

Biography: 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.

Identification of Cotton Fields Using Aerial and Satellite Imagery
Author: Chenghai Yang
Remote sensing has long been used for crop identification, but limited work has been reported on its use for identification of cotton fields when cotton plants are small. Early identification of cotton fields is important for advancing the boll weevil eradication program in Texas. Our previous work has demonstrated that aerial imagery with high spatial resolution (<1 m) was effective for this purpose, but large numbers of aerial images are needed to cover large geographic regions. As no-cost Sentinel-2 satellite imagery that has large area coverage with relatively high resolution (10 m) has become available in recent years, we evaluated this type of imagery for differentiating cotton fields from other crops before cotton plants start to bloom. Multiple cloud-free Sentinel-2 scenes acquired during the growing seasons in 2019 and 2020 over a 6 mile by 6 mile cropping area near College Station, TX, were selected to identify cotton fields. The images were classified into different crops and cover types using multiple classification techniques. Results showed that Sentinel-2 imagery in conjunction with appropriate classification techniques was feasible for distinguishing cotton from other crops. The methodologies presented in this study provide boll weevil eradication program managers with a practical tool to identify cotton fields over large geographic areas at relatively early growth stages.

Biography: Dr. Yang is a Research Agricultural Engineer with the USDA-ARS Aerial Application Technology Research Unit in College Station, TX. His research focuses on the development and application of remote sensing technologies for precision agriculture and pest management. Recent efforts have focused on developing low-cost imaging systems and image processing techniques for aerial applicators and evaluating these systems for assessing crop conditions for site-specific chemical applications. Dr. Yang has authored or co-authored 160 peer-reviewed journal articles and serves on a number of national and international professional societies.

Evaluation of Aerial Application Nozzles
Author: Brad Fritz
The USDA ARS wind tunnel facilities, used to evaluate aerial application nozzles, recently underwent a significant upgrade, adding a spray scrubber, instrumentation to monitor spray system and airstream conditions, and additional automation to existing components. With these improvements comes a need to compare results from the new facilities to data from the older tunnel configuration. Initial assessments measure and compare a standard set of reference nozzles that are designed to reveal any potential errors or bias in data from different facilities or system configurations. Then, to provide comparisons to data contained in the existing USDA ARS Spray Atomization models, a selection of 25 new nozzles for several different nozzle types and orifice sizes were evaluated and the results compared. It is expected that some level or variation in flowrate and droplet size exists between identical, factory new nozzles, however the current models do not account for this. By analyzing the groups of 25 identical nozzles, an expected range in flowrate and droplet size can be determined allowing for more appropriate comparisons to the data from the nozzle models. A number of "worn" nozzles, sourced from applicators were also evaluated for flowrate and droplet size and compared to their factory new counterparts. The results are intended to demonstrate that the new facilities provide comparable data to historical data as well as provide guidance on what potential variation may exist amongst worn new and worn nozzles of the same type.

Biography: Dr. Fritz is an agricultural engineer and serves as the Research Leader of the USDA ARS Aerial Application Technology Unit 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 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.

Development of Analysis Equipment for Pattern Testing Agricultural Aircraft
Authors: Randy Price, Daniel Martin, and Kim Brown
Pattern testing of agricultural aircraft is an important feature to maintain consistent spray patterns and low coefficients of variation (C.V.). Still, most pattern testing equipment requires multiple people to operate and stores the pattern test strings on reels, which can greatly limit the number and the amount of test you can perform. We have been working on a system to increase the number of tests that can be performed per flight and even allows full-field testing. This system uses a GoPro camera and green laser system mounted at the collection-end of the flight-line to analyze the strings as it is "pulled-in" from the flight-line for reflectance patterns. This system was successfully used during the 2020 season and greatly reduced the number of people needed to operate the flight-line and the work involved in collecting strings allowing for one person to perform tests on many occasions. It was also successfully used to perform multi-pass, large field scale tests, where swath predictions can be checked and verified to help instill confidence in swath width recommendations to spray plane pilots and operators. This presentation will talk about this system, testing methods, and results from these tests.

Biography: Dr. Price is an Associate Professor at the LSU AgCenter, Baton Rouge, Louisiana. He continually works on new equipment and methods to help the agricultural spray plane industry and is a certified Operation S.A.F.E. analyst.

How Much is the Aerial Application Industry in the United States Worth?

Authors: Senarath Dharmasena and Daniel E. Martin

Agricultural aerial applications have been used in the United States 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 very critical component of high-yielding and highly efficient current-day U.S. agriculture. Compared to ground application equipment, aerial application is up to three times as efficient and can treat a variety of fields. According to a 2019 National Agricultural Aviation Association survey, the agricultural aviation industry in the United States treats about 127 million acres of cropland each year, which is approximately 28% of the total commercially treated U.S. cropland.

Aerial application industry in the United States is important to many participants. Most people know that the industry has tremendous value, but having an objective measure of the industry's far-reaching impact on the U.S. economy would be useful not only to the industry but also to legislators, producers and consumers. The importance of this industry to keep the continuous food, fiber and forestry products supply to the U.S. economy is further highlighted during the current global health crisis related to COVID-19 pandemic. Due to this health crisis, the agricultural supply chains were disrupted as never seen before and it is still important that the U.S. agricultural producers continue to produce healthy, nutritious and affordable food to keep the population fed with the help of agricultural aerial applicators.

The big question is what would happen if aerial application were no longer operative. What would be the cost to the U.S. economy? Therefore, given the importance of this industry to the United States economy, this study estimates the economic value of the U.S. aerial application industry. As such, we expect that this study will aid in prudent decision-making for aerial applicators, regulators, and legislators. This study estimates the economic value based on the revenue forgone by U.S. farmers of not having aerial applications to treat their crops, hence loss of cultivated cropland followed by the loss of yield and farm revenue.

Crop acreage and production data are gathered from United States Department of Agriculture—National Agricultural Statistical Service (USDA-NASS) crop production 2018 summaries (published in February 2019). Once this simulation model is run for all crops considered in this study (cotton, corn for grain, wheat, soybean and rice), the total revenue loss of not having agricultural aerial applications to the Texas and the U.S. economy was about $0.7 and $23 billion, respectively, in 2018. This is substantial provided the economic activity that these raw crops would have created.

Biography: Dr. Dharmasena is Assistant Professor, Department of Agricultural Economics and Associate of the Agribusiness, Food and Consumer Economics Research Center (AFCERC) at Texas A&M University. His current research interests are in the areas of Consumer Economics and Applied Demand Analysis, Agribusiness and Food Market Analysis, Behavioral Economics, Health and Nutrition Economics, Economics of Food Security, Food Environments and Obesity, Causality Modeling, Probability Forecasting and Forecast Evaluation, and Market Integration and Price Discovery. He is an expert in applied econometric modeling, both structural and time-series.

Aerial Application Methods for Control of Winter Weeds

Authors: Dan Martin, Ab Latheef, Juan Lopez, Sarah Duke

Prolific growth of weeds is common on Texas farms during early winter and spring when farmers begin chiseling and disking operations for spring planting. Objectives of this research were to evaluate aerial application methodologies for the control of weed species in farmlands left fallow until spring. This is likely to facilitate low or no-till production agriculture through efficacious management of winter weeds. Glyphosate was aerially applied using a fixed wing aircraft and conventional hydraulic and electrostatic nozzles during year one. In year two, rotary atomizers were added as an additional treatment. Control plots were maintained during both years. The spray application rates for the conventional and rotary nozzles were 3 GPA while that for the electrostatic nozzle was 1 GPA. Aerial and ground-based spectral reflectance data quantified weed injury. The efficacy of each of the aerial application technologies will be discussed. The results from the study will help provide guidance to aerial applicators seeking to make efficacious herbicide applications for control of winter weeds.

Biography: 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.