Operation S.A.F.E. Fly-in: The North Carolina Experience

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Abstract

The Operation S.A.F.E. fly-in program is designed to evaluate the application accuracy of aerially applied chemicals and seed. Pilots simulate an application by flying over a line of measurement or collection devices. Results are analyzed using computer software and a report is produced of the aircraft's output and uniformity. This article describes a fly-in conducted in North Carolina. Goals of the program were to equip workshop participants with the knowledge and experience to sponsor and conduct subsequent fly-ins, and to provide an opportunity for local pilots to improve the pesticide, fertilizer, and seed deposition of their aircraft.

Keywords: Aerial application, application analysis, Operation S.A.F.E., fly-in

Introduction

Controlling drift and applying products uniformly present difficult challenges for pilots who apply pesticides and fertilizers from small aircraft. Aerial applicators face continuous public scrutiny over their professional conduct and must make critical decisions regarding application timing and aircraft equipment setup. To assist aerial applicators in addressing these challenges, members of the National Agricultural Aviation Association (NAAA), the organization of professional aerial applicators, developed "Operation S.A.F.E.", an acronym for Self-regulating Application and Flight Efficiency.

Operation S.A.F.E. is part of a comprehensive safety education and application-accuracy program known as the Professional Aerial Applicators Support System (PAASS). PAASS is administered by the National Agricultural Aviation Research and Education Foundation (NAAAREF), the research and education affiliate of the NAAA. The PAASS Program Development Committee creates presentations on aerial application safety and drift reduction that are given each year by NAAA pilot members or others at state and regional aviation association meetings.

Dynamic application analyses are conducted at each Operation S.A.F.E. fly-In. A certified analyst evaluates rotary- or fixed-wing aircraft for swath width, pattern distribution, droplet spectra, deposition, and drift potential. Liquid and dry products, including seed, can be tested using fly-in swath analysis equipment and computer software. During the tests, pilots simulate liquid and/or dry material applications by flying over a line of water- or oil-sensitive cards (Syngenta Crop Protection, Basel, Switzerland) and cotton string for liquids, or a series of collection devices for dry materials (Figures 1 and 2). The computer-assisted system provides a quick printout of the results, which are then reviewed by the analyst and presented to the pilot. If the analyst recommends changes, pilots can make adjustments on-site and retest with another series of passes. Pattern-testing clinics like these are unrivaled as an opportunity for a pilot to determine the application uniformity and droplet spectra of his aircraft's equipment.

Upon successful completion of all steps at the fly-in, participants, and their aircraft become certified by the NAAA Operation S.A.F.E. program. An Operation S.A.F.E. emblem is affixed to an aircraft only when the aircraft, its pilot, and the operator have met Operation S.A.F.E. guidelines. Fly-in participation is not limited to NAAA members; however, only current NAAA members can receive the S.A.F.E. emblem.

The value of Operation S.A.F.E. and PAASS have been recognized by The Pesticide Stewardship Alliance (http://tpsalliance.org), which awarded them its 2008 Stewardship Award for Educational Programs. The value of the fly-in clinics is also recognized by pesticide manufacturers and state certification programs. For example, label directions for the aerial application of Consero® insecticide (Loveland Products, Inc., Greeley, CO) specify that, "The aircraft boom nozzle configurations used should be patterned previously (e.g., at NAAA Fly-in) for both crosswind and near parallel winds." Furthermore, participation in a fly-in clinic once every three years is required for aerial applicator recertification in Michigan (http://www.michigan.gov/mda/0,1607,7-125-1569_16988_35289-12015--,00.html).

Methodology

In 1996, Dr. Sterling Southern, North Carolina State University (NCSU) Extension Specialist, and Dr. Ernest Hewett, NCSU Extension Associate, were awarded a Pesticide Environmental Trust Fund (PETF) grant to conduct research and demonstrations in pesticide drift reduction. PETF is administered by the Structural Pest Control and Pesticide Division of the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) using fees collected from companies holding state registrations for pesticides. The goal of the Southern and Hewett project was to develop a program to reduce drift from both aerial and air-blast pesticide applications. Field trials, fly-in clinics, and other workshops were conducted to demonstrate how to reduce off-target deposition. Dr. Dennis Gardisser, Extension Engineer from the University of Arkansas, provided the analysis equipment, training, and evaluation of the pattern tests at fly-ins conducted in Tarboro, Pantego, Washington, Fayetteville, Wilson, and Laurinburg, North Carolina from 1997-2000. Nearly $48,000 in grant money was allocated for fly-in supplies and equipment.

With impetus from the North Carolina Aerial Applicators Association (NCAAA), Dr. Dennis Gardisser, WRK of Arkansas, submitted a proposal to the North Carolina Pesticide Board in 2008 soliciting PETF support to refurbish and enhance the equipment used in previous clinics and to offer an Operation S.A.F.E. workshop and fly-in clinic the following year. The proposal, entitled "Aerial Pesticide Applicator Fly-In Workshop: Operation S.A.F.E. System," was approved by the pesticide board on Nov. 12, 2008. Grant funds were awarded to Dr. Gardisser, who made significant upgrades to the analysis system, purchased supplies, and provided the training and expert analysis at the workshop and fly-in with his colleague, Dr. Richard Whitney, of WRK of Oklahoma. From this second PETF grant, $27,350 was designated for supplies and equipment. Recognizing the need for the involvement of the North Carolina Cooperative Extension Service (NCCES), Dr. Wayne Buhler, Pesticide Safety Extension Specialist at NCSU, was included as a co-principal investigator of the grant project.

The workshop and fly-in clinic were conducted at Donald's Air Park at Pantego, North Carolina, on May 12-15, 2009. The workshop consisted of two days of intensive classroom (Figure 3) and hands-on (Figure 4) training followed by the fly-in clinic, which served as an extension of the training. Eight members of the NCAAA and Dr. Wayne Buhler attended the workshop. Drs. Gardisser and Whitney led the training. The training content was based on an instructional manual compiled by Dr. Gardisser, which was also provided on a flash drive for participants to transfer to their laptop computers. The training covered all the major duties associated with Operation S.A.F.E. fly-in logistics. Training continued during the scheduled NCAAA fly-in (May 14-15), where students set up and operated both the spray- and dry-material collection equipment to acquire field data and created an "analysis center" to produce data printouts for the pilots. The clinic was attended by groups of NCCES agents, NCDA&CS pesticide regulatory officials, and agrochemical representatives from eastern North Carolina.

Liquid applications, primarily water, were pattern-tested on the first day of the fly-in, and liquid and dry-application systems were tested on the second day. Liquid testing was conducted on a runway running perpendicular to the main runway. The dry flight line was positioned in an adjacent wheat field. An expanse of 300 to 400 hundred feet with no obstructions on both sides of the sample line enabled pilots to make a stable and level approach and to exit over the sample station. Upon their arrival at the fly-in, pilots received instructions to prepare for the pattern test (see Appendix).

Figure 1 shows the layout of the field equipment for liquid applications. Each aircraft, or setup for each aircraft, was evaluated from three passes (one test series) over a string collection system, with water-sensitive cards used on the last pass for droplet spectrum analysis. The sprayed liquid (water or oil), number of nozzles, nozzle type/size/deflection angle, pressure, flow rate, and target rate (gallons/acre) were recorded for each test. Wind direction and velocity, spray release height, ground speed of the plane, and time of day were recorded for each pass.

The string was suspended 12 to 24 inches above the ground. Depositions were made on three 150-foot sections of string, with only one pass made over each section. The string was wound off a supply spool and onto a storage spool after each pass. Red fluorescing dye (rhodamine water tracing dye) added to the spray tank at 50 milliliters per 100 gallons of carrier volume made the pattern deposited on the string (Figure 5) visible to a fluorometer. Computer software produced by WRK controlled the string as it was fed through the fluorometer, recorded the fluorometer signals, and plotted the deposition patterns. The printout included a diagram of the spray pattern uniformity, the optimal effective swath width for both racetrack and back and forth flight paths, and a numerical calculation of pattern uniformity.

Seven water-sensitive cards, spaced at eight-foot intervals, were laid out on the last pass to reveal the droplet spectrum of the aircraft. Wooden blocks held the cards (1” X 3”) at a 30-degree angle (Figure 1 insert). Spray droplets landing on the cards were scanned by a flatbed scanner and analyzed by a WRK software program named DropletScan (Figure 6). A printout of the droplet size statistics was then made available to the pilot.

For dry materials, pilots flew across a set of 25 collectors spaced at six-foot centers, as shown in Figure 2. Each collector contained a plastic test tube that was attached to a reinforced plastic funnel in the center of the collector (Figures 2 and 7). Two pilots tested their dry application equipment with wheat seed and two others with granular fertilizer. After a single pass at an altitude of 50 feet (Figure 8), the test tubes were removed, placed in a rack, and brought to the analysis center. The weight of the contents of each tube was entered in a spreadsheet for computer analysis of the distribution pattern.

Dr. Gardisser discussed the results of the test flights with each pilot and suggested modifications for improvement as appropriate. The most common modifications suggested by Dr. Gardisser for liquid applications were changes to the position of nozzles on the boom, replacing worn out or incorrectly sized nozzles, and adjusting the angle of deflection of the nozzle. A change to the angle of the back end of the spreader was suggested for dry application equipment. Five pilots retested their planes to validate these modifications.

Table 1 presents information about the pilots, their airplanes, and the number of tests flown. Twelve airplanes, consisting of Cessna, Ag Cat, Thrush, and Air Tractor planes were tested. Thirty-two tests were flown for a total of 96 individual spray passes. Granular pattern tests (not included in Table 1) for four different airplanes were made with tests of both wheat seed and granular fertilizer. Pilots flying multiple tests (Table 1) may have had their airplane’s performance evaluated at various application rates (ranging from 1-5 gallons/acre), or with the use of different carriers (water vs. oil), or as a retest(s) after modifications were made.

Each year, nine of the aerial applicators listed in Table 1 apply pesticide to nearly 425,000 acres of crops in eastern North Carolina. The majority of these treatments are applied to corn, soybeans, cotton, and tobacco.

Table 1. Pilot participants, number of liquid application tests flown, and airplanes used at the NCAAA Fly-In, May 14-15, 2009.

Pilot	Business Name and Location	# Tests	Airplane Model
James Brinkley	Eastern Flying Services Dover, NC	2	Air Tractor AT301
Matt Crabbe	Crabbe Aviation Mechanicsville, VA	1	Air Tractor AT-400A
Craig Craft	Craft Air Service Hertford, NC	2	Thrush S2R-T34
Dwayne Griffin	Air Ag, Inc. Tarboro, NC	2	Cessna C188
Larry Lee	Lee Flying Service Belhaven, NC	7	Ag Cat G-164A-G600
Boyd Respess	Dreamstreet Aviation Pantego, NC	1	Thrush S2R-600
Dwight Respess	3B Farms Washington, NC	3	Cessna C188
Don Stotesberry	Donald's Flying Service Pantego, NC	3	Thrush S2R-T34
Don Stotesberry	Donald's Flying Service Pantego, NC	1	Thrush S2R-T21
Jonathan Wilson	Craft Air Service Hertford, NC	1	Air Tractor AT301
Tim Whitfield	Tim Whitfield Aviation Fairfield, NC	9	Air Tractor AT402

Participants and observers were asked at the end of the workshop to provide feedback on their experience. A sample of comments from aerial applicators that participated in the fly-in follows:

- "Well worthwhile—something we need to do to do the best we can"
- "Without the testing equipment used in the fly-in, you don't know exactly what you are doing"
- "The fly-in made a huge difference in knowing how to set up my plane"
- "An outstanding event that we really need"
- "This is definitely not a one-shot deal—it will be ongoing"
- "Unless you do this analysis, you're not in compliance with label-specific requirements for droplet size"
- "Through this clinic, I reoriented some nozzles to get a better droplet size and reduced the volume of driftable fines"

Workshop recipients received graduation certificates on the last day of the fly-in. All nine participants were certified as Analyst Candidates and were later approved by the NAAAREF as Certified S.A.F.E. Analysts. Analysts must participate in continued education in order to maintain their certification. Pilots who participated in the fly-in clinic received one hour of continuing education credit in aerial application methods (North Carolina's commercial pesticide applicator category for aerial applicators).

Conclusions

The 2009 NCAAA Operation S.A.F.E. Workshop and Fly-in were a huge success. The training, equipment, and software programs provided by Drs. Gardisser and Whitney equipped workshop attendees with the knowledge needed to set up and use the field equipment, conduct the analyses, and produce test results. The aerial applicators that participated in the fly-in benefited from observing their airplane's output in a scientifically measurable manner. The results help the applicator improve pesticide deposition, determine the appropriate swath width, and minimize off-target drift. Pilots left the fly-in confident that they were conforming to regulations and applying product with adequate droplet size, pattern uniformity, proper swath width, and volume.

Through their participation in the Operation S.A.F.E. workshop and Fly-in, aerial applicators in North Carolina demonstrated their commitment to applying agricultural chemicals as evenly, efficiently, and safely as possible. Although the primary beneficiary of the fly-in is the aerial applicator's clientele, the program benefits everyone involved in agriculture, including consumers.

Since the first NAAA-sanctioned fly-in in 1980, clinics have been conducted throughout the U.S. and in several foreign countries. Scheduling a fly-in involves contacting a certified analyst listed on the NAAA web site, at www.agaviation.org/opsafepage.htm. The web site includes additional information on Operation S.A.F.E., a fly-in clinic schedule, a listing of certified S.A.F.E. pilots, and details about the benefits of the program.

Acknowledgements

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Appendix

Pilot Instructions for Spray Pattern Analysis:

1.) Find the analysis center and sign up for a spray pass.

2.) Contact fly-in personnel before testing. You will be briefed on how to fly over the flight line, where to get test materials, and when you will be able to fly.

3.) Each time that you sign up for an analysis, record the number of nozzles, nozzle type, orifice size, deflection angle, pressure, target application rate, and swath width, and address information on a data sheet.

4.) Obtain a bottle of dye and load the aircraft with the spray solution. If you already have water in the aircraft, you simply need to add the dye (1 ml. dye/2 gal. of total volume). After the person before you has landed, taxi your aircraft to the staging area and wait for a signal.

5.) Do not take off until you are sure you have been instructed to do so! You will be signaled either verbally (by radio) or by an orange flag on the flight line when it is time for you to take off and make your first pass over the string system.

6.) Once airborne and over the proper area, purge the spray system until dye is visible from all nozzles, particularly the end ones. Make sure spray pressure is properly adjusted to achieve the desired flow rate.

7.) Line up with the marker flags for the center of the flight line and make a spray pass going into the wind. This should be done at the airspeed, height, etc. that you would like to check. If you approach the track and you feel that you are not lined up properly simply break off and re-align.

8.) Turn spray system on at least 100 yds. ahead of the sample collection site on the approach side and keep the spray on for at least 100 yds. on the departure side of the test site. Maintain level flight for at least 400 yds. beyond the collection line if possible.

9.) A total of three passes will be made. Each of the three passes will be made in the same direction with operating characteristics as close as possible.

10.) Wait for the flag. After making the first pass, simply circle nearby until you receive a signal (a single flag waved in the air by the flight line crew) that it is time to make the second or third pass. If two flags are waved simultaneously, something has gone wrong and the crew would like for you to land.

11.) After all three passes are made, land and park the aircraft as close to the analysis center as practical. Your data will be transported inside to an analysis center for evaluation. The results will be printed out and placed in your envelope. When the results are completed, an analyst will be available to discuss them and suggest any possibilities for improving the spray pattern. This is generally done by going to the aircraft and discussing the setup and results.

12.) If changes are necessary, make the appropriate modifications and sign up to test again. If you are satisfied with the results, then you may want to look at another rate, different boom or nozzle type, or other variables.

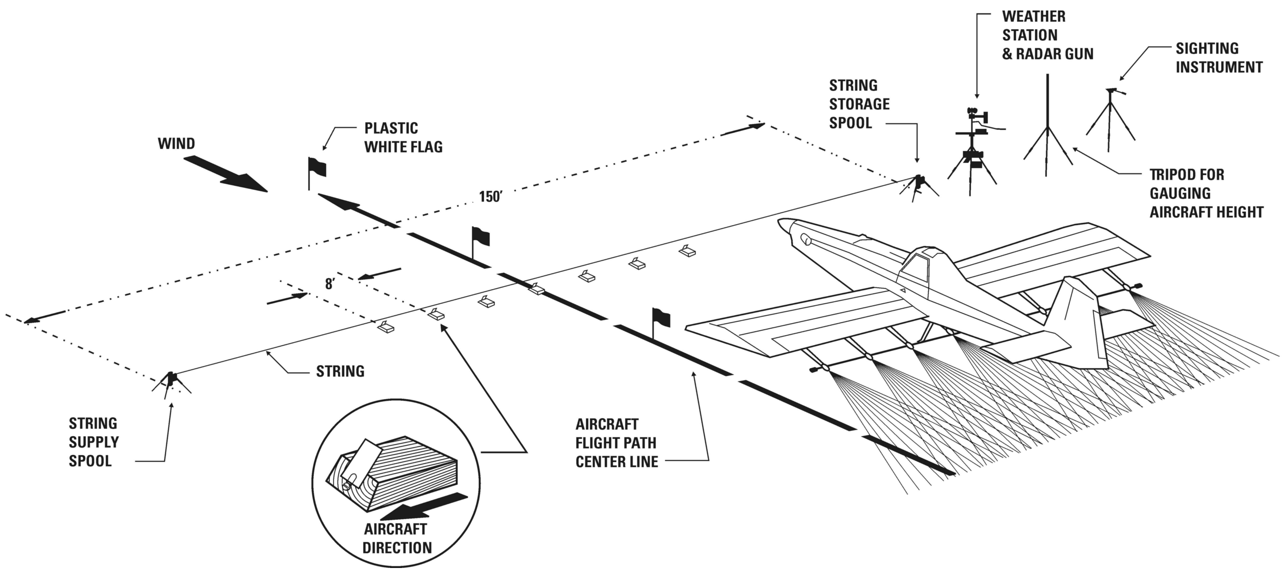

Figure 1. Fly-in spray solution collection layout**.**

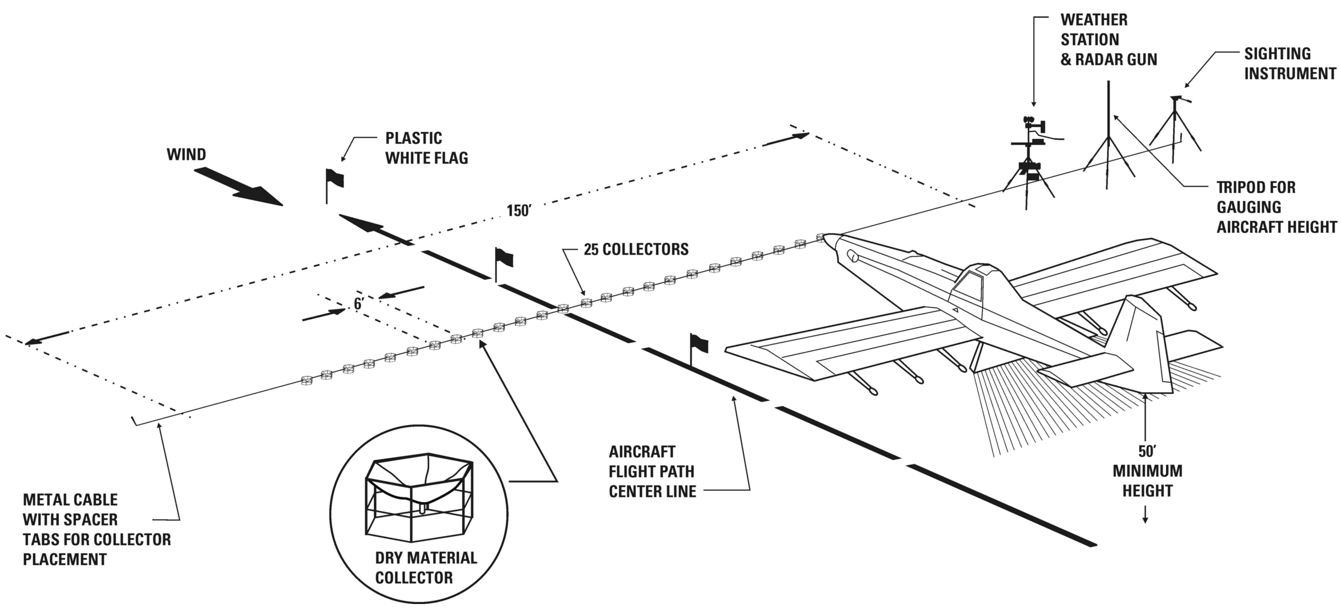

Figure 2. Fly-in dry material collection layout.

Figure 3. Drs. Dennis Gardisser (standing) and Richard Whitney (seated right) instruct workshop participants on the operations of the fly-in clinic.

Figure 4. Dr. Dennis Gardisser demonstrates the use of the sighting instrument for measuring the altitude of the airplane as it crosses the sample line to workshop participants.

Figure 5. Airplane flying into the wind over sample line while depositing water mixed with fluorescing dye. Notice the centerline consisting of three wooden stakes with white plastic trash bags attached. The string and several wooden blocks are visible directly below the plane.

Figure 6. Mr. Tim Whitfield, fly-in participant, arranges water-sensitive cards on the scanner for analysis. Other equipment at the analysis center table included two laptop computers, a scale for weighing dry material, a printer, and the fluorometer (far end of table).

Figure 7. Collectors used in the fly-in to capture dry materials such as granular pesticides, fertilizers, and seed.

Figure 8. Airplane depositing wheat seed as it flies over the line of dry collectors.