



NAAA PROFESSIONAL OPERATING GUIDELINES



NAAA Professional Operating Guidelines

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1 Chapter 1 Operating Guidelines

Article I: Purpose

These operating guidelines are designed to assist our members in establishing a model of operation that will assist in providing superior crop protection services, promote safety among the members and enhance the image of the aerial application industry and its members. Implementing these guidelines in accordance with the unique demands of your operation will improve the public perception of the aerial application industry through a professional attitude that promotes safety and encourages environmental protection. If certain applications are not addressed in this document, applicators are encouraged to make decisions which will promote the goals of these guidelines.

NOTHING IN THIS DOCUMENT SHOULD BE CONSTRUED AS ESTABLISHING ANY REQUIRED METHOD OF OPERATION, EITHER INDIVIDUALLY OR COLLECTIVELY. THESE GUIDELINES ARE OFFERED ONLY FOR PURPOSES OF GENERAL GUIDANCE—ALL APPLICATORS MUST USE THEIR OWN JUDGMENT AND DISCRETION IN TAILORING A SET OF OPERATIONAL GUIDELINES THAT SUCCESSFULLY MEET THEIR INDIVIDUAL NEEDS. EACH APPLICATOR HAS THE FLEXIBILITY TO DEVELOP SYSTEMS UNIQUE TO THAT OPERATION. THE ULTIMATE RESPONSIBILITY FOR THE OPERATION OF THE BUSINESS RESTS SOLELY WITH THE APPLICATOR. THE NATIONAL AGRICULTURAL AVIATION ASSOCIATION (NAAA) ASSUMES NO RESPONSIBILITY FOR THE OBLIGATION OF EACH APPLICATOR TO CONDUCT OPERATIONS IN A SAFE AND ENVIRONMENTALLY RESPONSIBLE MANNER.

NOTHING CONTAINED HEREIN SHALL SERVE TO ESTABLISH ANY NEW LEGAL LIABILITIES OR IN ANY WAY AFFECT ANY RIGHTS, DUTIES, OBLIGATIONS OR LEGAL STANDING OF ANY MEMBER OF NAAA OR ITS MEMBERS. THE GUIDELINES CONTAINED HEREIN SUPERSEDE NAAA'S PROFESSIONAL OPERATING STANDARDS RELEASED IN 2000.

Article II: Overview

Industry: Each applicator should maintain a model operation along with a commitment to professionalism and to the future of the aerial application industry. Implementing these guidelines should help every applicator maintain a high degree of professionalism and promote a safe workplace.

Business Management: Each applicator should strive to maintain business practices that match the highly technical requirements of this industry. Included in these business practices are preservation of one's business and professional reputation and maintenance of a safe workplace for all employees.

Operations: Each applicator should conduct all operations in accordance with government regulations while exercising and encouraging individual discretion and good judgment during all applications.

Employees: To the greatest extent possible, each applicator should provide worker safety and crop protection material and plant nutrient training to all employees and should promote a professional work atmosphere. Applicators and their employees should be trained in their positions to perform their tasks safely and professionally. Pilots should be encouraged to attend an annual Professional Aerial Applicators' Support System (PAASS) presentation, Operation S.A.F.E. (Self-regulating Application & Flight Efficiency) calibration and pattern testing clinic and other continuing education programs. Applicators are strongly encouraged to serve as members of their state/regional and national associations and attend these organizations' conventions for professional improvement.

Maintenance: Each applicator should have aircraft maintenance performed in accordance with appropriate regulations and safety practices.

Equipment: Each applicator should exercise and encourage good judgment while operating equipment associated with the application of crop protection materials and plant nutrients.

Insurance: Each applicator should carry adequate insurance coverage for his or her operation.

Location of Operations: All applicators should endeavor to incorporate these guidelines in accordance with their individually established practices and procedures at all times whether at home or operating away from their home base.

Article III: Implementation

Professional Operating Guidelines: Subject to the specific needs of their business, applicators should strive to implement these guidelines into their own procedures. There being several different types of applicators and operations represented by NAAA, not all of these guidelines are applicable to all operations. Applicators are encouraged to refer to this manual and apply the appropriate guidelines and objectives to their business.

Other Supporting Documents: Many of the subjects included in this document need to be supported by checklists and manuals developed specifically for each individual operation. Applicators are encouraged to develop these supporting documents and use them in conjunction with these guidelines to create a workable set of procedures for their own operation.

IMPORTANT: These guidelines and those contained in all following chapters of this publication ARE NOT a substitute for applicable laws and regulations. Each operator is responsible for operating in full compliance with federal, state and local law.

2 Relations with the Public, Customers, Regulators and Other Organizations

- 2.1 Informing the Public
- 2.2 Posting Fields/Verification
- 2.3 Scheduling Company Operations
- 2.4 Accepting a Job Order or Contract
- 2.5 Informing Customers of Planned Operations
- 2.6 Job Pricing

2.1 Informing the Public

Recommendation

Aerial applicators should endeavor to develop information exchange programs in their local communities to keep the public, customers, regulators and other organizations informed of their operations.

Discussion

An active information exchange between the operator, community, customers and regulating agencies helps to mitigate or eliminate public relations issues for the applicator and the industry.

Suggested Management Practices

- Cultivate positive two-way relationships and information exchanges with: customers, agricultural inspectors, FAA representatives, consultants and adjacent landowners or neighbors.
- Arrange to speak to civic, charitable, public service groups, educators and students in local communities to educate them about the many benefits of the aerial application industry and its commitment to safety, security, environmental stewardship, land protection and the production of a safe, affordable and abundant supply of food, fiber and biofuel.
- Invite the press and regulators to Operation S.A.F.E. pattern testing and calibration clinics and other special events that demonstrate the professional

applicator's commitment to safety, security, environmental stewardship, land protection and the production of a safe, affordable and abundant supply of food, fiber and biofuel.

- Invite first responders to rescue training involving agricultural aircraft and agricultural chemicals.
- Solicit comments from customers on application performance and initiate corrective actions where necessary. Inform customers of any corrective actions taken.
- Notify individuals living in congested areas of planned applications and follow the FAA guidelines for Congested Area Plans.
- Sponsor events to thank customers and the general public for their support of the aerial application industry.
- Be prepared to respond to unplanned media contacts during the season. The NAAA Media Relations Kit is a useful source of information for educating the public about the aerial application industry. It is available on NAAA's website at www.agaviation.org.

2.2 Posting Fields/Verification

Recommendation

Aerial applicators should ensure customers are aware of and willing to carry out and follow any posting restrictions of a pesticide label and verify that posting prior making a scheduled application.

Discussion

While the customer has primary responsibility for posting a treated field to warn workers and the public about any possible hazards, the applicator should, where possible, remind the customer to carry out the posting.

Suggested Management Practice

- Before a field is to be treated with a product that requires posting, check to ensure that the proper warning is displayed. If it is not, contact the customer and delay the treatment.
- Execute written agreements with customers that they will post fields when required and remove postings when reentry is permitted.

2.3 Scheduling Company Operations

Recommendation

Aerial application operations should be scheduled as needed to minimize risks to employees, adjacent property and the general public.

Discussion

Application work is seasonal and often results in prolonged overtime operations. Long hours tend to increase the risks for human errors. Insect or weed infestations that risk crop loss create economic incentives for implementing unsafe work schedules. There are some things that can be done by the aerial applicator and customers to ease the scheduling pressures and reduce the risks. Schedule pressures have been recognized as “root causes” of accidents in all industries. The applicator must exercise independent judgment and discretion in applying these recommendations so as to achieve a safe and efficient balance of these competing needs.

Suggested Management Practices

- Implement work schedules that will provide employees adequate rest periods.
- Provide employees appropriate on-the-job meal times in accordance with applicable law.
- As near as possible, schedule the most difficult and most sensitive jobs when crews are most rested.
- Rotate crew members to less arduous tasks after extended work periods.
- Notify the appropriate person (customer, consultant, manager or property owner) of any scheduling issues that increase the application risks and adjust schedules to minimize those risks.
- Whenever possible, collect information on customers’ planting, harvesting, crop protection material and plant nutrient application requirements prior to seasonal changes. When possible, avoid scheduling other work, such as equipment overhaul, during periods of high demand.

2.4 Accepting a Job or Contract

Recommendation

The application job order from the customer or consultant should be reviewed to determine if the job can be accomplished safely and adequately with reasonable precautions and work procedures. If this cannot be done, the job should be delayed until a revised job order can be agreed upon. If working in a locale where the aerial applicator is not familiar with weather patterns, topography and sensitive areas, it is recommended that information about the aforementioned issues be sought.

Discussion

There are situations where the consultant's recommendation for application calls for one or more materials to be applied to an area that might result in unacceptable risks to adjacent property or employee health. In most cases, the problems are solved by mutual customer/consultant/applicator agreement to a change in material(s), time of application or method of application. There are further instances where it is not practical to do a job under prevailing conditions. In such cases, economic considerations should not prevail over safety and environmental stewardship. It is the responsibility of the applicator to ensure all recommendations are according to the product label.

Suggested Management Practices

Each applicator, based upon his unique business needs and those of his clients, should develop a general list of criteria for determining when to proceed with a job. The location of the job, local weather conditions, proximity to the public, critical areas, safety hazards, label restrictions and limitations of ground crew personnel should all be taken into consideration.

2.5 Informing Customers of Planned Applications

Recommendation

Aerial applicators should work to ensure that the appropriate person (customer, consultant, manager or property owner) is aware of the time and location of the planned application prior to commencing operations.

Discussion

To avoid any incompatible or conflicting work schedules in the area being treated, it is essential that the applicator notify the customer or property owner prior to beginning an application. There are circumstances when, due to environmental changes, unacceptable risks to the owner of the property, adjacent property or

to the applicator necessitate changing the application schedule, thus altering the original work order schedule. The appropriate person (customer, consultant, manager or property owner) should be made aware of any changes in the work schedule. The Environmental Protection Agency's "Worker Protection Standards" found on the pesticide label often require compliance with this recommendation.

Suggested Management Practices

- Resist pressure to perform applications that present unacceptable risk for the pilot, aircraft, environment, public, surrounding crops or wildlife.
- Refuse jobs that are clearly unsafe or illegal.
- Select the type of equipment best suited for the specific job, if different types of aircraft or application equipment (fixed wing, helicopter or ground equipment) are available to the operator.
- Explain to and educate your customers about your operation's application and equipment capabilities to reduce requests for unsafe or unprofessional services.
- Inform the customer or consultant of all schedule modifications to protect field workers, employees and the public.
- Inform the customer or consultant of the general procedures for job scheduling and rescheduling.
- On the day of application, check that the area to be treated is clear and that unplanned conditions have not arisen.
- Maintain contact with the customer in regard to job scheduling, rescheduling or special considerations.

2.6 Job Pricing

Recommendation

Pricing should reflect the important variables and the circumstances affecting your area of operation that determine the difficulty of doing a job while meeting the performance and safety standards of the aerial application industry.

Discussion

There are many variables that contribute to the cost of doing a specific job. Examples of such variables include: the direction the field is to be flown,

prevailing weather conditions, time of day, day of the week, locations of landing strips in relation to the job, location of the field to be treated in relation to the commercial applicator's home base, adjacent water sources, adjacent fields, population centers, ecological hazards, flight hazards, and type of crop protection product used. All of these variables should be considered before quoting a price for the job.

In addition, there are differences in fixed costs for various operations that should be considered when pricing jobs or bidding on contracts, such as: the different types of aircraft, different wage scales and number of people required to maintain and operate aircraft, mix/load rigs and other ground equipment, administrative and management, maintenance and operation of base facilities, finance charges, and equipment replacement costs. Job pricing or bidding practices that undercut prices often result in poor quality job performance, increase the risks to employees and are overall negative for the industry and its sustainability.

Suggested Management Practices

- Develop, or sharpen, awareness of business principles and employee management skills.
- Develop accounting procedures to determine both fixed and variable costs of the total operation.
- Break down costs and quote work based on a price scale that ensures a fair market return.
- Do not take shortcuts in performance or safety to increase profits.

3 Chapter 3

Operations and Employee Relations

- 3.1 Operations Plan
- 3.2 Checking Field Operations
- 3.3 Field Management
- 3.4 Selecting and Training Personnel
- 3.5 Training Mixers/Loaders
- 3.6 Pilot Training and Experience
- 3.7 Providing Task Information to Employees
- 3.8 Communications Between Aircraft and Ground Crew

3.1 Operations Plan

Recommendation

Aerial applicators should incorporate plans that describe the responsibilities and procedures used in their operations.

Discussion

Aerial applicators need customized plans for their specific company's operations. These plans will help reduce the risk of errors that lead to lowered efficiency, costly accidents and off-target applications. These plans may be in the form of a Standard Operating Procedure or a Checklist.

Suggested Management Practices

- Tailor plans to your individual job situation and locale. Address the requirements stipulated by regulatory agencies and consider recognized management practices.
- Some topics to consider in your plans include:
 - Management policies and expectations.
 - Individual employee job responsibilities and procedures.

- Procedures for all operations including the storage, transportation and handling of crop protection products, plant nutrients and fuel.
 - Emergency procedures in the event of accidents, injuries or incidents involving equipment, fuel spills, chemical spills, fires, natural disasters or the like. (See emergency planning in chapter 4)
 - Maintenance tracking and checklists.
- Ensure that all employees understand their responsibilities and demonstrate their ability to implement their portion of the plan.

3.2 Checking Field Operations

Recommendation

Aerial applicators should establish procedures, based on the needs of their own operation, for checking field operations to ensure operations are being carried out safely, efficiently and that applications are on target.

Discussion

The modes of oversight for operations vary widely depending on the task. Regardless of the particular mode used, it is the operator who carries the final responsibility for the performance of his employees in the field.

Suggested Management Practices

- Maintain communication with crews in the field.
- Spot check jobs on a random basis.
- Participate in pre-application planning sessions and post-application debriefings.
- Ensure pilots (employees and contract) are informed of any local issues.
- Consider having extra personnel at the job site during difficult or potentially high-risk operations.
- Review records as needed for accuracy.

3.3 Field Management

Recommendation

A field manager should be assigned for each job and supervise all safety aspects of the application process. These duties include organizing and directing the aerial and ground crew activities.

Discussion

The field manager may be the pilot, a member of the ground crew or an operations chief. It is essential that, whenever possible, someone be appointed to oversee each field application.

Suggested Management Practices

- Clearly define field manager responsibilities with a chain of command established for each operation. Field managers should be knowledgeable of all federal, state and local regulations applicable to the application.
- Have the designated field manager ensure that the job completion includes:
 - Properly maintained and calibrated equipment.
 - Properly trained and qualified employees.
 - Proper operating procedures including flying techniques.
- Have the field manager immediately terminate operations when, at the manager's discretion, he or she determines that:
 - Any stipulated margins of safety are exceeded.
 - Any condition exists that might precipitate an accident or cause an unacceptable risk to workers.
- Prepare checklists to ensure compliance with all applicable regulations.

3.4 Selecting and Training Personnel

Recommendation

Aerial applicators should establish company policies for selecting and training potential employees keeping in mind, at a company and industry level, "Upon the performance of each rests the fate of all."

Discussion

Aerial applicators recognize that the quality and skill of support personnel within the industry is important.

All potential employees have varying levels of skill and experience which should be considered before they are hired to ensure they are capable of performing their duties once properly trained. The adoption of individual company policies to improve employee selection and training is a beneficial step in the industry-wide effort to implement a professional improvement program.

Suggested Management Practices

- Establish a hiring process designed to select individuals who possess or can be trained to perform the basic skills requisite to their job assignments.
- Establish a program designed to train employees to be team members, proficient in their responsibilities and committed to high performance and safety standards.
- Consider background checks on prospective employees who are not known to you. This may require the potential employee's written consent. Check all applicable laws to ascertain any limitations on your ability to do so.

3.5 Training Mixer/Loaders

Recommendation

Persons employed as mixer/loaders should be adequately trained to perform their tasks safely and effectively.

Discussion

The role of the mixer/loaders in the aerial application industry is critical. An error by the mixer/loader may result in crops being destroyed, an ineffective application, chemical exposure or an accident. Remember, mixer/loaders are the most likely to suffer from exposure to chemical concentrates, and your own policies need to be formulated accordingly.

Suggested Management Practices

- If practical for the size and location of your business, consider the appointment of a crop protection product training officer to develop the company's training program for handling crop protection materials and plant nutrients.

- All mixer/loaders should be skilled and knowledgeable in equipment use and safety. They should be trained in the following:
 - Selecting appropriate Personal Protective Equipment (PPE), according to the product label, and being aware of the personal hygiene related to the job.
 - Transporting chemicals (driving, lifting, securing cargo, appropriate warning signs, unloading chemicals).
 - Servicing tanker and chemical mixing equipment.
 - Understanding mix sheet and delivery procedures.
 - Loading the correct types and amounts of chemicals.
 - Mixing chemicals and worker protection standards.
 - Loading and working safely around aircraft with and without the aircraft engine running. All employees should know how to safely shut off aircraft engines in emergency situations.
 - Performing minor field repairs and maintenance on equipment.
 - Properly rinsing and recycling chemical containers.
 - Understanding the hazards and signs of chemical exposure.
 - Taking proper precautions to minimize spill risks.
 - Containing and cleaning up spills.
 - Handling emergency situations professionally.
- Perform and document training as required by regulation or company policy.

3.6 Pilot Training and Experience

Recommendation

Before being employed in aerial application, a pilot's knowledge, skills and experience should be evaluated to ensure professional performance in all facets of the occupation. This includes aviation skills, commitment to safety, knowledge of the products and proper application techniques.

Discussion

The knowledge and skills requirements of pilots have increased over the years. Most applicators who accept apprentice pilots develop their own training programs. These programs are understandably different and vary in philosophy and content. One important consideration is the job the apprentice is expected to do at the completion of training. In operations where the applicator is also the field manager, the applicator must have a working knowledge of all ground crew responsibilities, as well as pilot responsibilities.

Suggested Management Practices

- Apprentice pilot training should include working in all ground crew jobs in order to gain familiarity with all aspects of the operation.
- Apprentices should be able to demonstrate their knowledge of:
 - Management aspects of the operation, including job planning and field supervision.
 - Job safety and emergency procedures.
 - Recommendation of the symptoms of chemical exposure.
 - Regulations affecting aerial applicators and applications.
- Minimum flight time requirements should be established during which all pilots must fly under the direct supervision of an experienced aerial applicator.
- Training programs should be approved by the operator's insurance company to facilitate the new pilot's insurability.
- The training program should be carefully scheduled and supervised to assure the proper proficiency in all phases of aerial application.
- All pilots should be scheduled for jobs consistent with their skill level and experience.

All pilots need to satisfy the knowledge and skills requirements of FAR part 137. This may be accomplished either by a proficiency check given by the FAA or the certificate holder, unless a designated Chief Supervisor of Agricultural Aircraft Operations has been named, then the demonstration should be to that person. This must be documented by a log book entry or a separate document in the pilot's file prior to the pilot conducting operations under a part 137 certificate.

All pilots should maintain and improve their professional knowledge and skills by attending workshops, seminars and training programs for aerial applicators, such as the Professional Aerial Applicators' Support System (PAASS) and Operation S.A.F.E. calibration clinics. Membership in State and National Agricultural Aviation Associations will provide the pilot with a vital source of information on technological advancements and regulatory changes, while supporting efforts to maintain the viability of aerial application.

3.7 Providing Task Information to Employees

Recommendation

For each job performed, the aerial applicator should provide employees with the information necessary to maximize safety, efficiency and professionalism.

Discussion

Operational problems may result from poor communication or incomplete information regarding tasks employees are asked to perform. It is imperative that each employee knows the expectations for each job.

Suggested Management Practices

- Develop and maintain an inventory of maps of all areas to be treated. Chart hazards, adjacent crops and environmentally sensitive areas and, when practical, examine all new areas by ground and air; keep maps up to date so new obstacles or changes in conditions may be identified promptly.
- Construct maps of the company's various operational areas for orienting crews on the areas to be treated; provide written directions; take new employees to job sites with which they are not familiar.
- Review databases and/or other resources that provide information on sensitive sites or hazards.
- Train mixer/loaders in calculating tank batches, handling procedures and personal protective equipment use and care.

- Designate a person responsible for filling out mix sheets and determining the order of mix and proportions of materials.
- Develop a system for accepting and transmitting information about changes in work orders.
- For each day's scheduled operations, provide essential site-specific job information to employees. Provide job briefings to orient employees as appropriate.
- Provide individual employees with checklists outlining the methods for compliance with, and documentation of, applicable regulations and company policies.

3.8 Communications Between Aircraft and Ground Crew

Recommendation

Communication between the company office, aircraft, ground crew and employees should be maintained during pesticide operations.

Discussion

There are situations during operations that require procedural changes to maintain adequate performance and safety. Equipment failures, accidents, people unexpectedly entering the work areas or adjacent property and changing meteorological conditions can trigger these contingencies. The communications system should allow conveyance of all essential information needed to prevent undesired incidents.

While some of the situations may be handled with prearranged plans and simple visual signals, there are situations that cannot be adequately managed without a quick and detailed exchange of information among all members of the operation.

Suggested Management Practices

- Whenever practical, install communication equipment (i.e., radio transceivers) in all aircraft and ground equipment, and provide key ground management personnel with a portable communication device. Develop communication procedures and contingency plans to ensure management supervision of all situations. If transceivers are not installed in aircraft and ground vehicles, comprehensive contingency plans should be available.

- Train employees on the use of communication devices, including the frequencies to be used.
- Practice procedures and contingency plans to ensure that necessary communications are detailed, quick and accurate.
- Have policies in place that indicate under what conditions it is acceptable for pilots to safely use communication devices while airborne.

4 Chapter 4 Safety

- 4.1 Safety Policy
- 4.2 Emergency Planning
- 4.3 Safe Piloting Techniques
- 4.4 Pilot Personal Safety and Health

Introduction: Safety is addressed in every chapter in this document. This chapter outlines the objectives of a safety policy and addresses safety issues not found elsewhere in the document.

4.1 Safety Policy

Recommendation

Aerial applicators should define their safety policy to embrace safety programs which are committed to reducing errors, assuring regulatory compliance, identifying hazards, mitigating hazards and promoting a positive safety culture.

Discussion

Management should commit to the implementation and support of safety programs that will reduce errors and prevent accidents. The core values should include continued safety with a policy that encourages all personnel to report unsafe conditions. A Safety Policy is best developed and maintained by accepting input from all company personnel. All reported unsafe conditions, corrective actions taken and results should be communicated to all personnel.

Suggested Management Practices

- Develop a Safety Policy with a commitment to develop the components necessary to implement safety programs which will reduce errors, prevent accidents and comply with regulation while maintaining a positive safety culture.
- Identify hazards in high-risk operations, then mitigate those hazards by developing risk controls and incorporate them into standard operating procedures.

- Develop a safety assurance component to provide for constantly improving your safety programs, not only to measure but to maintain production efficiency and assure the effectiveness of risk controls.
- Develop a promotion component that provides guidance for training and communication to promote safety as a core value in your organization.

4.2 Emergency Planning

Recommendation

Aerial applicators should develop emergency plans and procedures in the event of accidents or incidents which may occur during application operations.

Discussion

Preplanned actions are helpful in limiting damage to people, the environment and property that can result from accidents or incidents. Unmanaged incidents may escalate into larger problems. Not all circumstances leading to accidents can be foreseen. Detailed planning for a generic type of accident/incident (e.g., aircraft crash, worker exposed to pesticide concentrates or a chemical spill) will result in procedures which provide a foundation for effectively handling a specific emergency situation. A well written emergency plan is one that any employee can access and implement.

Suggested Management Practices

- Consider studying and using components of the National Incident Management System (NIMS), available at www.agaviation.org. Designed for emergency responders, many businesses find NIMS useful for managing incidents and activities in their businesses.
- List the types of accidents or incidents that may happen during operations.
- Develop plans and procedures for mitigating the potential harm to employees and property that could result from accidents or incidents.
- All employees should have access to and understand the emergency plans in the event that upper management personnel are not available or are incapacitated due to the accident or incident.
- Emergency plans should be available in both paper binder form and electronically.

- List all of the agencies that provide emergency medical aid, environmental cleanup and investigative responsibilities with their phone numbers. Post this information prominently in places that are convenient to employees.
- List the agencies which require spill or accident reporting. Train employees in reporting requirements and spill contingency plans.
- Inform and educate local emergency responders, such as firefighters, EMTs and law enforcement officers, about your operation, fuel storage, chemical storage and contingency plans.
- Develop an emergency contact list for all employees.

4.3 Safe Piloting Techniques

Recommendation

Aerial application pilots should use safe piloting techniques throughout the aerial application operation.

Discussion

There are many opinions and ideas of what makes for safe piloting during aerial application. Presented in the Suggested Management Practices below are those that are widely recognized as effective in contributing to safe piloting.

Suggested Management Practices

A. Preflight

- The use of a checklist for the aircraft is recommended, especially when equipment changes or maintenance has been performed.
- When calculating fuel load, consider the length of time required to complete the flight, as well as the location and distance to alternative landing sites.
- Consider fuel load, density altitude, wind direction and runway length and orientation when calculating product load and takeoff distance.
- Build in a margin of error when calculating load and always have an alternative if conditions do not allow the planned application.
- Check maps and databases for low-level towers and other obstructions.

B. Pre-takeoff/Takeoff

- Use a checklist to ensure all flight and engine controls are in the proper takeoff position.
- Program swath guidance and flow control systems.
- Double-check wind direction and velocity.
- Announce intentions or contact the tower if applicable. Check for traffic before entering the runway environment.
- Establish a point on the runway where you are committed to take off or can safely abort a takeoff.

C. En Route to the Field

- Ferry above 500 feet AGL and remain clear of congested areas.
- See and avoid other aircraft and obstructions.
- Ensure application equipment controls are set for the application.

D. Survey the Field

- Adequately survey the field and surrounding area for obstructions, sensitive sites and people.
- Plan your passes and turns so that they are accomplished safely and efficiently.
- Ensure that the area you will be flying in, including turns for trim passes, are clear of obstructions before committing to the field.

E. Making the Application

- Flying safely during the application is about energy management and obstruction avoidance.
- The safest turns are generally smooth and coordinated; they do not use up all of your energy (airspeed), and they do not put the aircraft into an unsafe attitude.
- When possible, with fixed wing aircraft, use patterns that allow for a wide turn such as a racetrack pattern. These types of turns are easier on the aircraft and the pilot.

F. Landing

- Use a checklist to ensure all flight and engine controls are in the proper landing position.
- Check wind direction and velocity.
- Announce intentions or contact the tower if applicable. Check for other traffic and for obstructions on the runway.

G. Landing With a Full or Partial Load

- Expect a longer landing roll due to having to maintain a higher airspeed on approach and touchdown.
- Practice landing a loaded aircraft at an airport that has ample length and the correct orientation into the wind.
- Consider having policies in place that indicate when and where the pilot should land with a loaded aircraft.

H. Emergency Jettisoning of a Load (Fixed-Wing Aircraft)

- Don't delay jettisoning a load if it appears to be needed. Jettisoning a load too late may not allow time for the aircraft to climb or regain airspeed.
- Expect the aircraft to pitch up.
- When jettisoning large amounts of dry material, the drag on the aircraft may increase as the spreader vanes fill with material.
- Contact the aircraft manufacturer and experienced pilots about proper technique, then practice dumping small loads of water, keeping your airspeed down to minimize the aircraft pitching up.

I. Programming and Using GPS and Other Technology While Airborne

- When setting equipment, climb to a safe altitude in an area free from obstructions.
- Maintain a safe airspeed and clear the area of other traffic.
- Make the required programming changes and ensure the device is ready for continued operation before commencing the application.

- While conducting the application, use only the devices and controls that are designed to be used without taking your attention (visual and mental) away from piloting the aircraft.

4.4 Pilot Personal Safety and Health

Recommendation

Pilots should employ all equipment and means to keep themselves safe and healthy.

Discussion

The pilot and his/her equipment are the first line of defense in preventing and mitigating the extent of injury during an accident or incident. A healthy, well rested pilot is less likely to have an accident. The proper use of restraints and personal protective equipment may limit the extent of injuries during an accident.

Suggested Management Practices

Personal Protective Equipment:

The Department of the Interior's Aviation Life Support Equipment (ALSE) Handbook should be consulted for assistance in selecting the following equipment to be worn or installed in the aircraft while engaged in aerial application. The ALSE Handbook is available at www.agaviation.org. The following equipment should be used by all crew members in the aircraft during flight.

- Helmets
 - The ALSE Handbook explains the difference between the effectiveness of helmets approved for use in helicopters and airplanes.
 - Helmets need to be securely fastened to be effective during an accident.
 - A clear or tinted (as needed) face shield on the helmet adds extra protection for the face.
- Lap and Shoulder Harness Restraints
 - Four or Five Point restraints should be used.
 - Restraints need to be tightened properly to be effective.
 - Inflatable Restraints (airbags) should be installed if available.

- Clothing
 - Fire-resistant clothing (including gloves) that covers the complete body is recommended.
 - If commercial fire-resistant clothing is not available, non-frayed natural fibers such as cotton and leather provide better fire resistance than synthetic clothing.
 - At minimum, long sleeved shirts, long pants, gloves and leather footwear are recommended.

Health:

- Proper nutrition including adequate water intake should be maintained both during operations and during the offseason.
- Obtain adequate sleep/rest.
- Pilots should not fly when emotional stress, anxiety or physical illness causes impairment.
- Use only medications approved for use during flight.

5 Crop Protection Material and Plant Nutrient Handling

- 5.1 Personal Protective Equipment
- 5.2 Storage and Security of Crop Protection Material, Treated Seed and Plant Nutrients
- 5.3 Transporting Crop Protection Materials, Treated Seed and Plant Nutrients
- 5.4 Mixing and Loading System Design
- 5.5 Closed Mixing/Loading Systems
- 5.6 Equipment Inspections
- 5.7 Preventive Maintenance
- 5.8 Crop Protection Material, Treated Seed and Plant Nutrient Container Handling
- 5.9 Preparing Containers for Disposal and Recycling
- 5.10 Washing Aircraft and Equipment
- 5.11 Hazardous Waste Generation and Disposal

5.1 Personal Protective Equipment

Recommendation

All workers who may be exposed to crop protection or seed protection materials and/or plant nutrients (materials) should wear appropriate personal protective equipment (PPE) as specified by the product labels or safety data sheets (SDS), formerly known as material safety data sheets (MSDS). Federal and State Worker Protection Standards should be complied with by aerial applicators and their staff.

Discussion

Because of variations in the relative toxicity of materials, as well as the mitigating effects of closed mixing/loading systems (closed systems or systems), and the conditions of the work environment, regulations requiring the use of PPE are fairly complex. Exposure to residues on product containers, equipment and aircraft may necessitate employees using protective clothing and safety equipment, even though they are not handling the actual products. In extremely hot weather, wearing protective clothing for prolonged periods may create health

hazards to employees. Periodic removal of safety equipment during activities that do not require PPE may reduce the danger of heat exhaustion. Judgment and flexibility are required to meet the requirements imposed by local weather conditions and the seasonal changes that alter these conditions.

Suggested Management Practices

- Have all personnel wear clothing as required by the label. This often requires at a minimum: resistant gloves, long sleeved shirt, long pants, socks and shoes.
- Issue mixer, loaders and flaggers PPE as needed, and make them responsible for wearing and caring for this equipment.
- Instruct employees to keep protective gloves and respirators separate to prevent possible contamination.
- Ensure that gloves are rinsed before removal and that all PPE is washed per the manufacturer's instructions.
- Ensure the daily availability, cleanliness and serviceability of PPE.
- Ensure that PPE, including respirators, fit properly and that personnel are trained in its use.
- Perform periodic checks to assure that clean, undamaged PPE is available. Replace damaged or worn safety equipment immediately.
- Provide a readily accessible emergency washing facility at the work site. A clean change of clothing should be available in case of contamination.

5.2 Storage and Security of Crop Protection Material, Treated Seed and Plant Nutrients

Recommendation

To provide for rigorous control and security, all materials should be stored in covered and locked facilities.

Discussion

Applicators should store all materials in secured, weather-tight buildings and maintain records of materials on hand. Posting and placarding of storage facilities is recommended and various state and local regulations may apply. Be sure to confirm what requirements apply in the location of your operation.

Suggested Management Practices

- Upon receipt of materials from suppliers, check purchase orders against the materials delivered. Do not accept containers that have been opened or have seals broken.
- Store containers in weather-tight, well-ventilated, well lit, secured enclosures separated from other equipment storage areas. Ensure that remote-site temporary storage facilities can be secured.
- Consider electronic surveillance and security for the storage area.
- Ensure that all material storage areas have the appropriate product containment system to contain all products in the event of a spill or leak. Storage facilities should not have any open drains or direct drainage to the outside of the facility. Have an appropriate-sized cleanup kit and supplies for the quantity stored.
- Storage areas should be appropriately marked with warning signs. Local emergency service agencies should have knowledge of the location and purpose of the storage site.
- All pesticides should be stored in their original containers with manufacturers' labels intact and legible. Do not store pesticides containers directly on the floor. Use pallets or other shelving/storage systems to keep stored products off the floor.
- Post signs that disallow drinking or eating in storage areas.
- Provide proper lighting in all storage areas.
- Develop a schedule for periodic inspection of storage areas, checking for leaks or other anomalies, and address all issues immediately and properly.
- Keep a running inventory of materials on hand.
- Follow all state and federal regulations pertaining to storage and containment of products.

5.3 Transporting Crop Protection Materials, Treated Seed and Plant Nutrients

Recommendation

Aerial applicators should develop procedures for and instruct all mixer/loaders/handlers in the proper methods for transporting materials.

Discussion

Mixing and loading operations may be conducted at job sites or remote landing strips. Remote operations require that the mixer/loader select containers of product(s) and transport them to the mixing site. Special precautions should be taken to comply with all federal, state and local transportation regulations. While transporting these products, if a spill occurs, it is the carrier's responsibility to notify the appropriate agencies and to immediately clean up the spill. Applicators should check for local restrictions, ordinances or regulations in each area where they conduct operations.

Suggested Management Practice

- Prepare guidelines to comply with all applicable transportation regulations. Carry an appropriate-sized spill cleanup kit on all vehicles.
- Prominently display emergency numbers and placards on all material transportation vehicles including numbers for notification of accidents or spills.
- Do not transport materials with other commodities such as food for humans or animals.
- Reseal partial containers prior to transport. Never carry open containers during transport.
- Secure the load to prevent load shift, damage to, loss of or theft of materials.
- After transportation, inspect the vehicle for contamination and all containers for damage or leaks.

5.4 Mixing and Loading System Design

Recommendation

Mixing and loading equipment should be designed for efficiency and safety while considering the job size and purposes for which the equipment is intended. Protecting employees from unnecessary exposure should be a primary consideration in mixing/loading equipment design.

Discussion

In aerial application there is no such thing as a standard system design. Typically applicators design their system to fit their operational requirements. Because of the uniqueness of systems and their operation, a design that fits one operation may be economically or physically impossible and wrong for another. Each applicator should exercise their own judgment in determining which design best suits their own operation.

Suggested Management Practices

Periodically review your existing systems and procedures to identify areas of improvement for efficiency and safety and correct accordingly.

5.5 Closed Mixing/Loading Systems

Recommendation

Closed systems should be used to the maximum extent possible for the mixing and loading of materials.

Discussion

A closed system is one that transfers the material from the original container to or through a measuring device and into the aircraft spray system without open air exposure. A closed system will prevent or limit worker exposure to the materials being handled.

Suggested Management Practices

- Choose closed systems to fit the equipment and procedures used in your operation.
- Maintain the decal instructions on the closed system that describe its operating procedures.
- Develop special procedures for the mixing and loading of toxic materials. Spell out how the open system portions of the operation are to be performed safely. Check periodically to assure that closed systems are in good working order and are being operated properly.

- Flush closed systems regularly and avoid letting product concentrate stand in the system for long periods of time.
- Maintain a regular maintenance schedule for closed systems and keep records of system inspection and repairs.

5.6 Equipment Inspection

Recommendation

All equipment used in handling, mixing, loading and application of materials should be inspected for defects prior to its use and at the end of each workday.

Discussion

Worn, leaky or broken equipment may impair performance, cause spills or trigger serious accidents.

Suggested Management Practice

- Inspect all equipment for signs of leaking and mechanical damage. Give special attention to hoses, connectors, seals, valves, nozzles, booms, pumps and closed system hardware.
- Do not operate equipment with known defects that may cause mixer/loader/applicator exposure, spills or accidents.
- Provide tools and supplies for minor field repairs to correct leaks or equipment failures that might occur during the application operation.
- At the end of each day, have employees identify and correct all equipment problems before their next use.

5.7 Preventive Maintenance

Recommendation

A preventive maintenance program for all equipment used in handling, mixing/loading and application should be conducted in order to minimize risks of leaks, spills, accidents and lack of product performance.

Discussion

Aerial applicators should establish systematic maintenance programs to maintain their mixing/loading/spraying equipment. Regular preventive maintenance programs contribute to accident-free job performance, reduced product exposure, reduced number of lost workdays due to illness and improved long-term capital investment outlays.

Suggested Management Practices

- Assign each piece of equipment used in the operation to an individual employee who will monitor its serviceability.
- Establish company procedures for inspecting and cleaning individual pieces of equipment. Be alert for buildups of sludge, scale or other deposits.
- Establish regular maintenance schedules for critical components such as pumps, fittings, hoses, connectors, diaphragms and nozzles.
- Equip each vehicle with a checklist of its required equipment, spare parts and tools.

5.8 Crop Protection Material, Treated Seed and Plant Nutrient Container Handling

Recommendation

Aerial applicators should require that all materials be furnished in containers that are compatible with safe handling practices and the system in use.

Discussion

Aerial applicators deal with a wide variety of containers. Types of containers that are incompatible with specific systems may increase an employee's risk of harmful exposure to materials. In these cases, an alternative method of mixing and loading products should be used rather than trying to introduce them into a non-compatible closed system.

Suggested Management Practices

- Request that suppliers deliver products in containers that provide the most compatible and safest operation for your equipment.
- Ensure that all employees read and follow all label instructions, noting requirements specific to particular containers and/or packaging.
- When materials will be used in hot weather, take precautions to keep the containers out of direct sunlight, so the pressure buildup in the containers is minimized. Wear all protective equipment required, and take special care when opening containers in hot weather.
- Load powders, dust or granules from the upwind side of the mixing system.

- Be aware of the extreme flammability of sulfur and other dust-formulated products, as well as volatility and flammability of some liquids. Ground all equipment used in the mixing/loading process, including the aircraft, to minimize static electricity buildup.
- Bulk handling systems can be used to reduce exposure in many operations that use large amounts of a given product.

5.9 Preparing Containers for Disposal and Recycling

Recommendation

As the label requires, all disposable chemical containers should be rinsed at the job site and secured in an area inaccessible to the public until they can be recycled or disposed of in a legal, designated disposal site. Packaging for dry materials should be disposed of according to the label. Return reusable packages to the distributors, sealed and unrinsed as required by the manufacturer.

Discussion

Generally, properly rinsed containers are returned to the base of operations, stored, secured and allowed to dry prior to being recycled or hauled to a disposal site. Many agricultural chemical distributors offer returnable containers and shuttles for aerial applicator use.

Suggested Management Practices

- Properly rinse and, if necessary, re-rinse all containers at the job site according to the label. Add the rinsate to the mixture that is applied to the field being treated.
- Ensure that the rinse system is doing an adequate job, and that all necessary precautions are being taken.
- Store emptied, rinsed containers in a manner that will not allow them to fill with rainwater.
- Do not reuse containers that are not approved for repackaging.
- Secure the storage facilities for emptied, rinsed containers.
- Contact industry organizations that provide recycling services to arrange for collection of empty, rinsed containers. More information may be found at www.acrecycle.org.

5.10 Washing Aircraft and Equipment

Recommendation

Wash aircraft and ground equipment that are exposed to materials after each day's operations. Comply with any federal and state regulations requiring containment of wash and rinse waters.

Discussion

Exposure of equipment used in aerial application to materials is a continuous and daily occurrence during field operations. While every effort is made by applicators to minimize exposure, it is not possible to completely eliminate this concern. Equipment is typically washed after each day's use not only to minimize hazards to the individuals who work with the equipment, but also to minimize corrosive effects that may lead to equipment damage, failures and costly repairs.

Suggested Management Practices

- Restrict washing operations to a specifically designed contained wash rack capable of handling product residues. Collect wash and rinse water and transfer it to a closed holding tank.
- When the constituents of the residues in the wash and rinse water are known, use this liquid as makeup for subsequent product mixes, or dispose of it at an approved site.

5.11 Hazardous Waste Generation and Disposal

Recommendation

All aerial application operations should be conducted in a manner that minimizes the generation of hazardous wastes and provides for opportunities to reduce, reuse and recycle materials and their containers. Aerial applicators should store and dispose of waste products in compliance with local and federal laws and develop company policies to limit the generation of hazardous waste.

Discussion

The bulk of hazardous waste falls in two categories: product containers and liquid waste, such as rinse water, and unused product solutions. There are three major areas where aerial applicators can minimize the generation of hazardous waste: 1) The washing of aircraft and other equipment used in application; 2) Minimization of partially used product containers; 3) The minimization of rinsate produced due to the mixing/loading operations. A popular and environmentally sound approach for managing liquid wastes is collection in holding tanks wherein the liquid waste is used as the carrier for future product

applications or disposed of in an approved disposal site. An alternative is a process of filtration and decontamination of the liquid waste. The choice of system depends on several variables, such as the amount and type of liquid waste generated, the costs of storage and proximity to disposal sites. The method chosen by each applicator should be made according to the unique needs and demands of his or her operation.

Suggested Management Practices

- Discourage accumulation of partially used containers and request that suppliers or customers collect any remaining product on a scheduled basis.
- Design systems to minimize the generation of hazardous wastes.
- Design systems that can be easily and completely flushed over the treated field.
- Thoroughly rinse all material containers at the job site.
- Flush systems and put the rinse solution in the final load to be sprayed over the treated field.
- Use systems designed to first load the mixed materials followed by an adequate amount of fresh water to thoroughly rinse the loading system.
- Design wash facilities for aircraft and equipment used in aerial application to ensure all wastewater is collected and stored in above-ground tanks.

6

Chapter 6

Making Accurate Applications

- 6.1 Swath Marking and Tracking
- 6.2 Selecting, Positioning & Operating Spray Equipment
- 6.3 Measuring Distribution Equipment Performance
- 6.4 Site Specific Meteorological Criteria
- 6.5 Flying Techniques
- 6.6 Impact of Crop Protection Products and Adjuvants
- 6.7 Nearby Crops and Sensitive Areas

6.1 Swath Marking and Tracking

Recommendation

Aerial applicators will have a system for marking or tracking swaths when applying crop protection materials and plant nutrients to assure uniform application and to prevent damage to property, adjacent fields and sensitive crops.

Discussion

There are three general systems for providing swath guidance to assure straight passes and uniform application. The most prevalent and accurate is the differentially-corrected Global Positioning System (GPS). This system also negates the use of ground personnel in the immediate spray area, reducing the potential for human material exposure. A second system uses an airborne dispenser to drop weighted streamers of biodegradable paper at the beginning and/or end of the passes. The third system involves the use of a human flagger, either on foot or in a vehicle, who traverses the field in advance of the aircraft along the field boundary marking the swaths. While there are advantages and disadvantages (both technical and financial) to each system, GPS technology has become the industry standard for accuracy, reliability and safety. Pilots should use disciplined techniques to ensure any guidance system, regardless of the method chosen, does not become a distraction causing unsafe flight around obstacles and hazards.

Suggested Management Practices

- Choose the field marking system that provides the best performance and level of safety for your job conditions and mode of operation.
- Continuously evaluate the system used to assure that the material label is being followed, the customer's expectation of uniformity of application is being met and that the proper protection from material exposure is provided for work crews.
- Comply with the manufacturer's updates and required maintenance for the guidance system you choose to use.

6.2 Selecting, Positioning & Operating Distribution Equipment

Recommendation

Distribution equipment should be selected, placed and operated on the aircraft in a manner designed to maximize effectiveness and minimize off-target movement of the product.

Discussion

Applicators have a wide variety of options as to the equipment used in their operations. Each applicator, based upon his/her own discretion, will select and adjust this equipment to conform to his/her specific preferences. Since each applicator starts with different management objectives based on the customer's needs, there are no specific standards accepted for equipment configurations. These vary from job to job and in many instances are site specific. Each setup should have the goal of providing application efficacy with on-target material delivery for the specific jobs being performed. There is an increasing body of research available regarding delivery systems that provides information on both the efficacy of these systems and how effectively the systems minimize off-target movement of material. Swath displacement, partial boom shutoffs and working with the prevailing wind direction are techniques often used to keep products on target. Properly aligned and configured spray delivery systems optimize spray droplet size, increase efficacy and maximize on-target applications. Each applicator has developed a unique equipment arrangement that fits individual customer needs, local conditions and state and local regulations and ordinances. Field calibration measurement techniques and instrumentation for swath measurement are available and are recommended for use by the applicator.

Suggested Management Practices

- Each aircraft used in aerial application should be adjusted to provide treatment efficacy and to minimize off-target movement.
- Consider crop density and canopy, efficacy and physical characteristics of materials and combinations of materials when selecting the optimum droplet size for an application.
- Distribution equipment should be selected and placed on the aircraft in a manner designed to maximize effectiveness and minimize off-target movement.
- Keep all connections and fittings tight and in good repair to eliminate the possibility of leaks.
- Position booms and nozzles to allow release of spray materials in non-turbulent air (laminar airflow). To prevent reverse airflow don't release spray directly behind the boom in the low-pressure area. Extending the nozzles slightly behind and below the boom with fittings usually will remedy reverse airflow.
- Placing nozzles to either side of or below any airflow obstruction will minimize distortion of the spray pattern. Such obstructions include, but are not limited to, landing gear, oil coolers, boom hangers, pumps, flow control valves and swath marking equipment.
- Choose nozzle types and orifice sizes and operate them within the correct pressure range. Position them in the air stream to produce the largest drop size that still provides acceptable performance for each job.
- Place nozzles along the boom to produce a uniform deposition in the plant canopy when the aircraft is flown at the normal spraying airspeed and altitude.
- In varying volume-per-acre applications, change nozzle orifice sizes and number of active nozzles as required to achieve the desired spray application rate, a uniform spray pattern and the desired droplet size.
- Protect employees from the risk of material exposure while changing nozzles and spray equipment configurations.

- Keep the boom suck-back valve, which maintains negative boom pressure while the gate ball is closed, adjusted and in good working order to safeguard against leaking nozzles.
- Be constantly alert for leaks in the spray system and take appropriate corrective measures to avoid contamination of non-target areas. Correct leaking nozzles by cleaning or replacing parts as often as needed. Nozzle inspection should be a routine part of the ground crew's duties when servicing the aircraft.

6.3 Measuring Distribution Equipment Performance

Recommendation

Each aircraft used in application should have its distribution equipment tested to ensure efficacy and to minimize off-target movement of crop protection materials and plant nutrients. This testing is frequently conducted at Operation S.A.F.E. fly-in clinics by NAAREF-certified analysts. Individual applicators may also use other means to accurately measure spray system performance when required.

Discussion

Each combination of aircraft and distribution system has its unique swath profile, swath width, droplet size and distribution characteristics. These are further affected by:

- Aircraft and distribution system designs (e.g., airspeed, wing span, wing loading, etc.).
- Position of boom in relation to the aircraft structures.
- Boom pressure.
- Viscosity of liquid spray material; specific drift characteristics of certain chemical formulations or tank mixes, etc.
- Nozzle type, adjustment and orientation.
- Volume of material required per unit area.
- Flight techniques (e.g., speed and height above canopy).
- Meteorological conditions; wind, temperature and humidity.

Research has demonstrated that there are some generalizations on the gross effects of these eight variables on swath profiles and off-target movement of chemicals. New techniques for computer modeling to predict changes in the profile which correspond to specific changes in these variables have been developed. Applicators use modern aircraft which have been deliberately designed and engineered as total distribution systems, rather than as combinations of existing aircraft and ground spray systems. All aircraft need periodic field adjustments for optimum performance of spray delivery systems. Field measurement procedures can measure spray pattern uniformity and drop size and assist applicators in making adjustments to the systems that increase accuracy and effectively reduce the amount of off-target movement of crop protection products.

Suggested Management Practices

- To the greatest extent feasible, prior to use on a job, measure and calibrate all aircraft spray systems used in aerial application for each type of job to be performed. Measurements include:
 - Spray pattern
 - Nozzle flow rate
 - Droplet size
- Measure and calibrate each spray system every 24 months or after any modification is made to the aircraft, the distribution system or flight procedures that could significantly affect the swath profile.
- In order to achieve the proper volume-per-acre application rate, uniform droplet size and distribution, and to maximize on-target applications for each job, measurements are needed to determine the following:
 - Best boom configuration and positioning on the aircraft.
 - Proper nozzle configuration and orientation with respect to the boom and flight path.
 - Proper nozzle flow rates and boom pressures.
 - Optimum flight techniques to enhance performance and mitigate drift.
 - Check swath pattern uniformity and droplet size for each open nozzle position configuration used for the various gallon-per-acre jobs.

6.4 Site Specific Meteorological Criteria

Recommendation

In order to provide maximum efficacy, minimize risks due to off-target movement of products and to prevent incidents and property damage, meteorological criteria should be established prior to beginning each job.

Discussion

Wind direction and speed, temperature, humidity and atmospheric stability (including the presence of temperature inversions) are some of the most obvious of the meteorological factors affecting aerial application. In addition to the impacts on flight characteristics, the wind velocity and direction play an important part in determining deposition, spray pattern and off-target movement of materials. Changes in wind velocity in the layer(s) of air over the crop canopy as well as flow around prominent terrain features nearby will affect the application. It behooves the applicator to note and account for these influences. The percentage of application material susceptible to off-target movement increases as the speed of the wind increases. Since all material movement is downwind in direction, observing and recognizing the wind direction will enable the applicator to eliminate any off-site movement to sensitive areas upwind.

Temperature and humidity impact material movement by changing the evaporation rate of spray droplets. As temperature increases and/or humidity decreases, evaporation increases. For small to moderate sized droplets, increased evaporation can create an increased risk of off-target movement because the droplets shrink to a critically smaller size faster. This smaller size makes them more susceptible to off-target movement.

Temperature inversions, by definition, are present when the temperature increases with altitude rather than the normal decreasing of temperature with increasing altitude. Within inversion conditions, the atmosphere is very stable (i.e., minimal vertical air mixing) and typically with light winds present. With minimal vertical air mixing within a temperature inversion small spray droplets remain suspended for a longer period of time and in a higher concentration near the application zone. This longer suspension time enables material to move off-target. Ground-based temperature inversions commonly begin to develop in the very late afternoon or early evening, and then deepen and strengthen overnight. Erosion of the overnight, surface-based inversions begins shortly after dawn and continues to erode the inversion from below as the surface heats through the morning hours. Note that some labels disallow a material's use when a temperature inversion is present. Other labels may prescribe applications when

temperature inversions exist (i.e., pollinator protection, mosquito control, etc.). Caution should always be taken when applying materials within temperature inversions knowing the risk of off-target deposition will be a greater under these conditions.

Extensive research has been done on the effects of weather on off-target material movement. Many of the methods to accurately determine wind velocities, velocity gradients and temperature gradients require precise instrumentation. However, onsite meteorological measurements and observations can be an important element for reducing off-target movement. These observations may be made using an on-the-ground observer with portable weather instruments. The aerial applicator can obtain wind information by use of an aircraft smoke system, observing the wind as it affects vegetation, and using other visual indications of wind velocity and atmospheric stability such as smoke columns. On-board weather instruments are becoming available and are able to provide accurate real-time weather data in the aircraft. However, pilot experience and general knowledge of local weather conditions remain key elements in recognizing a satisfactory environment for the application. The type of weather instrumentation, if any, utilized by each applicator is subject to the type and limitations of each individual operation.

Suggested Management Practices

- In order to provide maximum on-target applications, meteorological criteria should be established prior to commencing each job.
- Stipulate weather margins, including thresholds of changing weather conditions, and include in the operational plan for each job. Establish a firm chain of command for making weather-related decisions in regard to all applications.
- Determine wind velocity and direction at the job site by using aircraft smokers, on-board meteorological instrumentation, an anemometer, surface-based visual indicators or pilot estimation.
- Avoid applications upwind of sensitive sites within an inversion by monitoring the vertical temperature gradient, if possible using smoke as a visual indicator, or waiting for specific temperature changes or wind speeds that provide information that the inversion has mixed-out.
- Be aware of temperature and humidity and its impact on the application quality, as well as the risk of off-target material movement for each individual job; adjust spray equipment to alter droplet size as needed.

- Ensure that pilots and ground crews act as a cooperative team in communicating meteorological observations, especially during conditions that approach shutdown thresholds.
- Arrange application schedules to take advantage of the most favorable weather conditions. For example, do the upwind half of a field and then wait for a wind change, or do downwind headlands in the morning if the wind is expected to increase later in the day.

6.5 Flying Techniques

Recommendation

While making applications, the pilot should select flying techniques that will minimize off-target movement and maximize efficiency.

Discussion

An important part of the effort to maximize application performance and mitigate off-target material movement is the flying technique of the individual pilot. Even though the other factors have been set properly to minimize off-target movement of materials, if the pilot is not operating the aircraft in an appropriate manner, these other factors might be negated. The pilot, as operator of the aircraft and distribution system, bears the responsibility for keeping the material on the target area. It should be recognized that the uniform placement of the material on the target, and at the proper rate, is a critical task.

Flight height should be based on safety and providing a uniform pattern with superior deposition. Increasing the flight height to increase the swath width without concern for application uniformity or deposition in the crop should be avoided. Rather, the pattern should be adjusted to be uniform at the appropriate height of the flight. The appropriate flight height is one that will produce an accurate application, and is based largely on aircraft size and speed. Flying too low can increase the risk of pattern distortions and off-target movement. Flying too high can increase the risk of off-target movement and decrease deposition in the crop canopy.

Granular materials such as baits, seeds and fertilizer should be flown at heights that produce the best distribution. This can be determined by testing similar to that which is done at fly-in clinics. Above that height, the wide pattern or extended swath due to crosswinds makes it difficult to maintain proper matching of adjoining swaths.

It is the pilot's responsibility, aided by the ground crew, to monitor local weather conditions that will affect material movement after it leaves the aircraft.

These weather conditions can lead to pattern distortion and streaking of the application. If the predetermined minimum conditions are exceeded, the job should be stopped rather than risk a non-uniform application or off-target movement. In some weather conditions, swath width or placement can be adjusted to deal with the situation.

Suggested Management Practices

- When treating a field, the pilot should select flying/application techniques that minimize material movement off target.
- Fly at an altitude that maximizes material deposition and uniformity of application and minimizes streaking and off-target movement of products.
- Turn spray on and off within the boundaries of and at the same altitude the field is flown. This will help ensure that material is applied uniformly and does not move beyond the target area.
- Be aware of any adverse wind currents generated by the aircraft due to aerodynamics. Use flight techniques that minimize these effects.
- Fly at the speed and operate the spray system at the boom pressure that has been verified in the equipment selection process to produce the best performance.
- When using a flow control system, be aware that changes in speed will be handled by the system by adjusting the boom pressure to maintain the required nozzle flow rate for the aircraft speed. These changes in pressure can have an effect on spray droplet size.
- Fly the headlands and edges of fields next to sensitive areas when there is a positive air movement away from critical areas. Consider using half boom shutoff valves and make half (½) swath width passes next to sensitive areas.
- Trim up fields as necessary to ensure a uniform and effective application over the entire field.
- Be aware that certain crops may also be damaged by an overly heavy application, caused by extra trim passes or excessive swath overlap.

6.6 Impact of Crop Protection Products and Adjuvants

Recommendation

The applicator should be aware that different materials added to the spray solution will impact the spray droplet size and thus efficacy and the risk of off-target movement. The applicator should make every attempt to determine what the impact of the products used will be on the droplet size.

Discussion

All products, including the crop protection materials and any adjuvants, added to the spray solution change the characteristics of that solution, including the surface tension and viscosity. This impacts the resulting droplet size. How spray solution components alter the droplet size varies depending on nozzle selection and setup, application speed and other variables. Research is available and will continue to be ongoing to help applicators determine these complex relationships. The application of dry materials (dust, granules, pellets, seed and fertilizers) presents another set of variables in dealing with off-target movement because each formulation behaves differently when discharged from an aircraft.

Suggested Management Practices

- Be aware of all the products to be used in an application and verify with the label that any adjuvants to be used are permissible.
- Use all available information to determine how the products will impact droplet size and other factors of the application. Sources of information include but are not limited to:
 - Company literature
 - USDA-ARS research publications
 - University publications
 - NAAA Annual Convention
 - State convention
 - Trade publications
- Adjust application equipment setup or techniques to compensate for adjuvant-caused changes.
- Use the appropriate adjuvants for your application that maximize both efficacy and safety of the application.
- Mix products in the correct order and manner to avoid compatibility issues.

6.7 Nearby Crops and Sensitive Areas

Recommendation

The aerial applicator should attempt to identify what crops and other potentially sensitive areas are adjacent to and in the vicinity of the application site.

Discussion

All aspects of aerial application operations should be designed to keep the applied materials confined to the treatment area. Activities by applicators should be planned to address the concerns of local communities, adjacent landowners and neighbors who may be affected by the application. It is important to know which areas near the application site could be particularly sensitive to the materials being applied. Identification of non-GMO crops is critical when making applications of certain products. Some formulations of herbicides, insecticides and fungicides call for extra precautions and increased awareness of wind direction, velocity and sensitive downwind areas. Care should always be taken with applications near bodies of water. Knowledge about local bee activity is necessary when making applications of many insecticides. Organic crops need to be identified for all applications of materials to avoid misapplications. Be aware of materials that may volatilize and move off target after application with increased temperatures.

Suggested Management Practices

- Scout job sites prior to application to determine what is adjacent to the target area.
- If a crop is present determine whether it is sensitive to the material being applied.
- Use online resources to help identify and locate sensitive crops and areas near the application site.
- Communicate with local landowners, growers, and community members to avoid any potential problems.
- Know the forecasted temperature that is expected to follow the application of volatile materials.

7 Chapter 7 Security

- 7.1 Aircraft and Operations
- 7.2 Materials Applied by Aerial Application

7.1 Aircraft and Operations

Recommendation

All agricultural aircraft and aerial application operation sites should be secured to prevent unauthorized access or theft.

Discussion

Since the terrorist attacks of September 11, 2001, agricultural aircraft have come under close scrutiny as a platform that could be used by terrorists to damage infrastructure and/or cause mass destruction. An agricultural aircraft being used successfully in this manner is very unlikely to be effective according to scientists who work with agricultural aircraft. However, the negative public relations impact from an attempt to use agricultural aircraft to cause terror would be detrimental to the industry. Because of potential terrorist use implications, as well as protection from theft and vandalism, it behooves every aerial applicator to properly secure the aircraft under their control. Aerial operations and agricultural aircraft are located in many different settings, ranging from being on public use airports to rural, privately owned airstrips. Different locations require different methods for security. Each operator should consider which of the Suggested Management Practices will work best for his or her location.

Suggested Management Practices

- Install hidden security switches on aircraft: This is a switch that cuts power from the battery with its location only known to the operator of the aircraft. The Federal Aviation Administration approves of these switches; a “Form 337 Field Approval” is not required for installation, but a log book entry is required.
- When practical, store aircraft in locked hangers with a security system.
- Consider the use of propeller locks or locked aircraft tie downs.

- Park or disable heavy equipment in front and behind the aircraft to prevent it from being moved.
- When aircraft are not being used for a long period of time, remove the batteries or other components that would prevent the engine from operating.
- Consider video and other effective security systems with ample lighting to maintain adequate visibility for monitoring aircraft, storage facilities or aircraft hangars.
- Be aware of individuals who have no reason to be at or near your location, or who seem to be inexplicably monitoring your operation.
- Be vigilant for individuals not familiar with agricultural aviation who are asking detailed questions about operations.
- Establish relationships and ongoing contacts with local law enforcement, neighbors, other airport users and other area aerial application operators, thus providing an informal overlapping security awareness network.
- Call local law enforcement for immediate threats to individuals, aircraft or airfield security (typically “911”).
- Report suspicious activity to the General Aviation Security Hotline at (866) 427-3287, also known as [866 GA Secure].

7.2 Materials Applied by Aerial Application

Recommendation

Crop protection materials applied by aerial application should be secured to prevent misuse or theft.

Discussion

Materials applied by aerial applicators are usually pesticides and fertilizers. Most crop protection materials are relatively safe, but some materials can be hazardous if misused. In the application process, these materials are under the control of the aerial applicator for a period of time. The theft and misuse of even safe materials from an aerial applicator is detrimental to the industry.

Suggested Management Practices

- Store materials in a locked, well-lit storage facility;
- Have a security system for your storage facility;
- When transporting materials, constantly monitor or otherwise secure transport vehicle at all times; and/or
- Maintain and conduct a regular inventory of any stored crop protection materials.

8 Chapter 8 Application Records

- 8.1 FIFRA, Federal Aviation Administration and State Application Record Keeping
- 8.2 National Pollution Discharge Elimination System Permit (NPDES) Applications

8.1 FIFRA, Federal Aviation Administration and State Application Record Keeping

Recommendation

An accurate record of the application should be maintained for an appropriate amount of time. In accordance with state and federal law, each applicator bears full responsibility for determining the regulations that apply to his/her business.

Discussion

The application record is required to be maintained for a period of time to satisfy state and federal regulations. Proper application records will protect the applicator and the business. Section 11 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and 40 CFR Part 171 require dealers and commercial applicators to maintain records of sales, distribution and application of restricted-use pesticides (RUPs). Electronic data generated by GPS and mapping systems need special consideration.

Suggested Management Practices

- Determine the minimum amount of time a record of the application should be maintained. FAR part 137 requires 12 months; FIFRA requires two years from the date of the application. State agencies may require a longer period of three years or more. Nothing contained herein should be construed as relieving the applicator from the responsibility for determining and abiding by all applicable record-retention periods.
- Determine where the records must be maintained. Some states require a copy of the record to be sent to the grower in addition to being maintained at the base of operations.

- Determine in advance of the application who owns electronic data that is generated by GPS and mapping systems. Bear in mind that electronic data may be corrupted by changing formats and may not appear accurate when reproduced. Consider maintaining the original database of electronic data in your possession.
- Determine what information should be included. This usually includes but may not be limited to: the customer's name and address, crop treated, target pest, legal description of the property treated, total mix per acre, date and time application started and completed, wind direction and velocity, temperature, applicator's name and certification number, Worker Protection Standards notification, product information including name, EPA number, rate and supplier, etc.
- A graphic representation of the field and application is desirable.
- Retain written application records and GPS logs as required.

8.2 National Pollution Discharge Elimination System Permit (NPDES) Applications

Recommendation

When an application falls under the NPDES permitting process, extra record keeping should be obtained and maintained as required.

Discussion

The following Suggested Management Practices should be considered when an applicator falls under the “non-decision maker” category. In addition to Federal regulations, each state may have its own requirements in this area. Good record keeping will protect the applicator and business.

Suggested Management Practices

- Determine if the application falls under the state and/or federal permitting process.
- Keep accurate and complete written records as required by the permit for all discharges covered. You may rely on records and documents developed for other obligations, such as requirements under FIFRA or FAR part 137 and state or local pesticide programs, provided that all requirements of EPA's NPDES or the state general permit are satisfied.

- More detailed information about NPDES record keeping requirements may be found at the EPA or the state's regulatory agency. Information may also be found at www.agaviation.org.
- No attempt is made here to provide guidance for those who fall under the "Decision Maker" category. Their record keeping requirements are much more rigorous. The guidance may be found in Section 7 of EPA's PGP or at www.agaviation.org.

Appendix A. Regulatory Compliance

Introduction: This appendix is designed to provide applicators with a partial list of regulations that affect the aerial application of crop protection products. Information is divided into general sections on aviation-related information, pesticide-related information and other sources. Links to individual sites and documents may be obtained from the digital version of NAAA's Professional Operating Guidelines available online at www.agaviation.org or by using the Links section of the website.

IMPORTANT: This list may not be complete. Each operator is responsible for operating in full compliance with all federal, state and local laws.

Aviation-Related Information

Federal Aviation Administration (FAA)

- Federal Aviation Regulations (FARs)
 - Part 1 Definitions and Abbreviations
 - Part 21 Certification Procedures for Products and Parts
 - Part 23 Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes
 - Part 27 Airworthiness Standards: Normal Category Rotorcraft
 - Part 43 Maintenance, Preventive Maintenance, Rebuilding, and Alteration
 - Part 61 Certification: Pilots, Flight Instructors, and Ground Instructors
 - Part 67 Medical Standards and Certification
 - Part 91 General Operating and Flight Rules
 - Part 137 Agricultural Aircraft Operations
- Civil Aeronautics Regulations (CARs)
 - Some agricultural aircraft in operation today reference the CARs for the initial certification or operation. Civil Aeronautics Manual (CAM) 8 Aircraft Airworthiness – Restricted Category may allow for weight increases above the listed gross weight.
 - Check the Type Certificate Data Sheet (TCDS) for your aircraft or contact the aircraft manufacturer to see if CAR 8/CAM 8 applies.
 - If CAM 8 applies it may require a log book entry in accordance with Civil Aeronautics Manual (CAM) 8.10-3e.

- FAA's Regulatory and Guidance Library and Other Information
 - Advisory Circulars (AC)
 - Airworthiness Directives (AD)
 - Flight Standards Information Management System (FSIMS)

FAA Order 8900.1 in FSIMS provides guidance for FAA aviation safety inspectors on their responsibilities for certification, technical administration and surveillance of operators conducting operations under the appropriate regulations, certificated airmen and other aviation activities. By searching this site, operators and pilots can learn what FAA inspectors expect for compliance with the regulations and policies of the FAA.
 - Special Airworthiness Information Bulletins (SAIB)
- Reference Materials for FAA Guidance
 - Certification Process for Agricultural Aircraft Operators – AC 137-1A
 - Congested Area Plan Requirement – FAR §137.51(b) and additional guidance in FSIMS FAA Order 8900.1; Volume 3; Chapter 52; Section2)
 - Pilot Knowledge and Skills Requirement – FAR §137.19(e)

State Aviation Regulations

- State Department of Aeronautics
- State Transportation Department

Pesticide-Related Information

Environmental Protection Agency (EPA)

- Clean Water Act (CWA)
- National Pollutant Discharge Elimination System (NPDES) program
- Pesticide General Permits (PGP)
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- Pesticide Container and Containment Regulations (PCC)
- Spill Prevention Control and Countermeasures (SPCC)
- Worker Protection Standards (WPS)

Department of Agriculture (State and Federal) or State Plant Board

Department of Homeland Security (DHS)

- Chemical Facility Anti-Terrorism Standards

Department of Labor

- Occupational Safety and Health Administration (OSHA) rules requiring availability of Safety Data Sheets (SDS – formerly MSDS)
- Workplace Poster Requirements

Department of Transportation (State and Federal)

- Hazardous Material Transportation
- Licensing of Drivers (CDL)

**Emergency Planning and Community Right-to-Know Act (EPCRA)
(commonly known as SARA Title III)**

- Emergency Response Planning
- Emergency Release Notification (spills)
- Tier II Hazardous Chemical Annual Reporting

State Lead Agency (SLA) for pesticide licensing

- List of state pesticide control officials

USDA-ARS Aerial Application Technology Group

- Source of information on Atomization Models, ASABE/NAAA Technical Sessions, current research projects, publications and smartphone apps.

Other Regulatory Jurisdictions

- County Pesticide Regulations
- Local Pesticide Regulations
- Tribal Pesticide Regulations

Reference Materials for Guidance

- Aerial Applicator's Manual: A National Pesticide Application Certification Study Guide
- Application Records (see Professional Operating Guidelines, Chapter 8)
- EPA WPS "How to Comply" Manual

Appendix B.

Acronyms and Abbreviated Phrases

AC – Advisory Circular

AD – Airworthiness Directive

AGL – Above Ground Level

ALSE – Aviation Life Support Equipment

ARS – Agricultural Research Service

Applicator(s) – Aerial Application Operation or Business or those performing aerial applications

CAM – Civil Aeronautics Manual

CAR – Civil Aeronautics Regulation

CFR – Code of Federal Regulations

DHS – Department of Homeland Security

EMT – Emergency Medical Technician

EPA – Environmental Protection Agency

FAA – Federal Aviation Administration

FAR – Federal Aviation Regulation

FIFRA – Federal Insecticide, Fungicide, and Rodenticide Act

FSDO – Flight Standards District Office

FSIMS – Flight Standards Information Management System

GMO – Genetically Modified Organism

GPS – Global Positioning System

Material(s) – Crop Protection Materials, Treated Seed, Plant Nutrients, Any material applied by aircraft

MSDS – Material Safety Data Sheet (see SDS below)

NAAA – National Agricultural Aviation Association

NAAREF – National Agricultural Aviation Research and Education Foundation

NPDES – National Pollution Discharge Elimination System

NIMS – National Incident Management System

PAASS – Professional Aerial Applicators' Support System

PGP – Pesticide General Permit

PPE – Personal Protective Equipment

RUP – Restricted Use Products or Restricted Use Pesticide

S.A.F.E. – Self-regulating Application and Flight Efficiency

SAIB – Special Airworthiness Information Bulletin

SDS – Safety Data Sheet (formerly known as MSDS - Material Safety Data Sheet)

SPCC – Spill Prevention Control and Counter Measures

System(s) – mixing and loading system(s)

TCDS – Type Certificate Data Sheet

USDA – United States Department of Agriculture

WPS – Worker Protection Standards

Notes

Notes

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