

Unmanned Aircraft and Ag Aviation: Rules and Safety

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**National Alliance of Independent
Crop Consultants**

2017 Annual Meeting & Ag Pro Expo

January 19, 20167



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Agricultural Aviation Industry Overview

No. of aerial application operations in U.S.:	1,350*
No. of additional non-owner ag pilots:	1,430*
No. of aircraft per business:	2.1*
Percent of industry using airplanes:	87%*
Percent of industry using helicopter:	13%*
Speed across field:	80-160 mph
Price charged per acre:	\$7-\$14
Percent of all crop protection products applied aerially on commercial cropland:	18.75%
No. of cropland acres treated by air annually: (doesn't include pasture, rangeland or urban uses)	71 million
Price range of agricultural aircraft	\$100K-\$1.8M
Application height; ferrying height	10 ft.; 500 ft.

*From 2012 NAAA Survey

Importance of Ag Aviation

Allows for rapid treatment of large areas:

- Fastest way to treat (3-4 times faster than other application forms).
- Important when application is needed within a narrow timeframe.
- Pest Resistance can be addressed by aerial's ability to treat in multiple conditions; allowing for the application to be made at the most precise, efficacious window.
- Aerial application can reach remote, hard to reach areas, i.e. wet soil, rolling terrain inoperable to other forms of application.



Importance of Ag Aviation

- Aerial application can reach orchards and late stage crops or dense plant foliage without causing damage compared with other forms of application.
 - A Purdue University study claims crop loss due to ground trample from ground applicators ranges from 1.5% to 5.0%.

Managing Fungicide Applications in Soybean PURDUE EXTENSION

Table 1. Estimated impact of boom width on grain yield loss per acre from wheel-track damage in soybean at Farmland, Columbia City, and Butlerville, Indiana.

	Boom Width (feet)			
	30	60	90	120
	Yield Loss Per Acre (%)			
Farmland 2005	5.5	2.8	2.1	1.4
Farmland 2006	6.7	3.4	2.6	1.7
Columbia City 2006	4.3	2.1	1.6	1.1
Butlerville 2005	3.2	1.6	1.2	0.8
Average	4.9	2.5	1.9	1.3

Yield losses were the same at all three row widths (7.5, 15, and 30 inches).

- Schertz Aerial Service (IL) tests show ammonium nitrate fertilizer applications near the R2 full bloom stage increased soybean yields by 10 to 15 bushels over the 70-bushel base yield. Ag aircraft are well suited for late-timed fertilizer applications because they can deliver the product to the crop when needed without disruption.

Aerial Seeding

- Today aircraft are used to seed many crops such as rice and forests for regrowth after a fire.
- Aircraft are also used to seed cover crops.
- Aerially applying cover crops is a rapidly growing service to help farmers:
 - control erosion
 - retain/recycle soil nutrients
 - build organic matter to improve soil health
 - improve water quality
 - improve moisture availability
 - aerate soil



Precision Ag Services Provided by Ag Aircraft, Satellites and UAVs (limited)

- Crop Sensing/Aerial Imaging
 - Crop condition assessment imaging systems (using photos, GPS, GIS & flow control sys. for pest detection and making variable rate, input cost saving applications.
 - Airborne imaging systems offer advantages over satellite due to relatively low cost, high spatial resolution, easy deployment and real time availability of imagery for visual use.
 - At 500 ft. a pixel covers 1.4 in. and 500 ft. x 330 ft. of ground; at 10,000 ft. a pixel covers 28 in. and 1.9 mi. x 1.2 mi. of ground.



A color image acquired at 4,000 ft. AGL over a cotton field infected with cotton root rot using an ag aircraft. On the color image, healthy cotton plants have a dark green color, whereas infected plants have a grayish tone similar to bare soil.

UAV's Economic Potential

Market and Use Studies

- PwC
 - In a March 2016 report PwC estimates the addressable market of drone powered solutions in agriculture industry at \$32.4bn.
- Lux Research Study
 - Ag drones could generate \$350 million in revenues by 2025 from an estimated 330,000 U.S. units.
- Clemson University's Edisto Research & Education Center
 - A UAV can analyze a 10-acre field in less than 5 minutes, work that would take a person days or weeks to complete.

UAV's Economic Potential



May 25, 2016

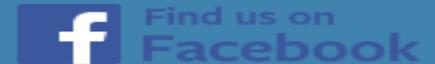
Air Tractor Makes Entry into UAS Market with Yield Defender Drones Acquisition



Air Tractor Inc. is expanding into the field of unmanned aerial systems. The Texas-based manufacturer has acquired Hangar78 UAV and its flagship aircraft, the Yield Defender unmanned aircraft system, to complement its agricultural and firefighting aircraft lines. [Read More](#)

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- **NAAA Secures Key Support for of Aerial Application Research in 2017 Senate Appropriations Legislation**
- **Drone with 35-Foot Wingspan Tested in Agriculture**

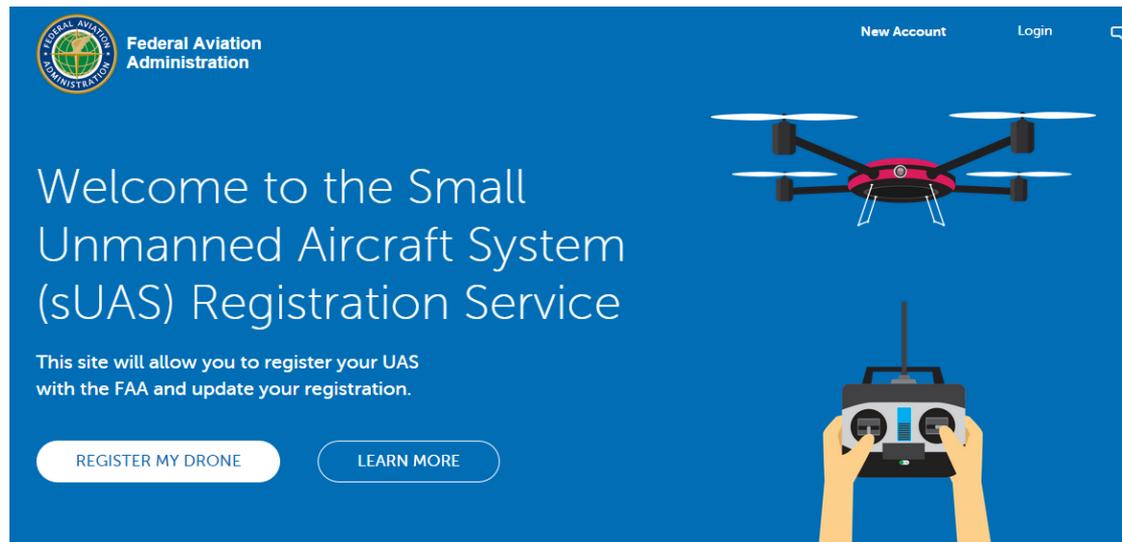
Air Tractor President Jim Hirsch on Hangar 78's 4.5 pound, Yield Defender drone:

"We are equipping Yield Defender with strobe lighting to improve safety, and we're now working on ADS-B. UAS will be used to tell the farmer not only how healthy their crops are, but also to tell the farmer exactly what the health issue is."

NAAA 2016 survey, 3% of aerial applicators currently use UAVs and 14% are considering using them.

Online UAS Registration (<https://registermyuas.faa.gov/>)

- **Applies to small UAS 0.55-55 lbs. flown outside**
- **Owner must provide name, address, email**
 - Non-recreational owners must provide make, model, and serial number (if available) of each sUAS



The Small UAS Rule (Part 107)

- First rules for routine operation of small UAS (<55 pounds)
- Took effect August 29, 2016
- Recreational operators may fly under Part 107 or Public Law 112-95 Section 336/Part 101



Part 107 Basics

- UAS operators must obtain a Remote Pilot Certificate
- Visual line-of-sight, daylight operations
- 400 feet or below in uncontrolled (Class G) airspace; other airspace use requires authorization
- UAS must weigh less than 55 lbs. and be registered



Becoming a UAV Operator under Part 107

- **Must be 16 years old or older**
- **Must read, write, speak English**
- **Must pass an aeronautical knowledge exam at an FAA-approved Knowledge Testing Center**
 - Part 61 certificate holders can take online training at faasafety.gov instead of the knowledge exam
- **Must undergo TSA background security screening**



Operating Rules

- Visual line-of-sight only
- Daylight or civil twilight only
- No operations over people
- Must yield right-of-way to manned aircraft
- One UAS per operator
- Max groundspeed of 100 mph
- External load operation only permitted if the load does not affect flight operations or control



Part 107 Airspace Requirements



- Operations in Class G without ATC authorization
- Operations in Class B, C, D & Class E surface areas require ATC authorization
- Phased approach to airspace authorizations
- Online portal available at https://www.faa.gov/uas/request_waiver/

Aeronautical Knowledge Exam Topics

- **Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation**
- **Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation**
- **Aviation weather sources and effects of weather on small unmanned aircraft performance**
- **Small unmanned aircraft loading and performance**
- **Emergency procedures**
- **Crew resource management**
- **Radio communication procedures**
- **Determining the performance of small unmanned aircraft**
- **Physiological effects of drugs and alcohol**
- **Aeronautical decision-making and judgment**
- **Airport operations**
- **Maintenance and preflight inspection procedures**

Obstacles Compromising Aerial Application Safety

Unmarked Towers

- From 2007-2016: 14 accidents (6.8% or 5 fatal accidents) occurred in the ag aviation industry from collisions with towers—many unmarked.
- From 2007-2016: 212 accidents (65.8% or 48 fatal accidents) occurred in the aerial application industry from collisions with obstacles (wires, trees, towers, etc.)
- A 2014 legal settlement: \$7 million to ag pilot widow. Wind energy, tower, landowner and farming entities liable for not marking and not informing pilot of tower
- Congress enacted legislation requiring towers between 50-200 ft. be marked and logged in a public database of locations.



Fatal Air Tractor collision with a meteorological evaluation tower (MET). August 2013.



UAV-like Obstacles Compromising Aerial Application Safety

Bird Incidents

- Birds are the second leading cause of aviation fatalities.
- 142,000 wildlife strikes with civil aircraft between 1990 and 2013, with 25 fatalities according to the FAA

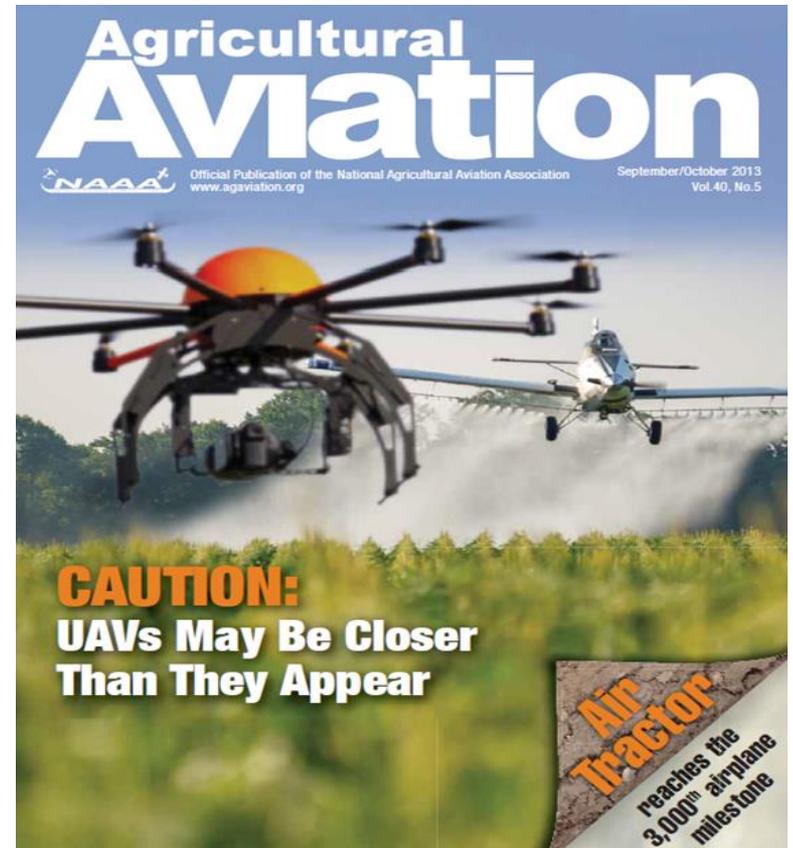
The weight of this red-tailed hawk is 2.4 pounds.



Obstacles Compromising AgAviation Safety

Unmanned Aerial Systems?

- FAA data collected between August 2015 and January 2016 revealed near misses taking place on average 3.5 times a day, up from less than one a day in 2014.
- FAA predicts 2.5 million UAVs were sold in 2016, and that 4.3 million hobbyist drones will be sold annually by 2020.
- FAA has registered over 600,000 hobbyist UAV owners and 35,000 commercial UAV owners as of January 2017.



UAV Operations Responsibility & Liability

- UAV Insurance currently offered by certain insurance providers .
- Part 107 states: “...the small unmanned aircraft must give way...and may not pass over, under, or ahead of [all aircraft] unless well clear. No person may operate a small unmanned aircraft so close to another aircraft as to create a collision hazard.”
- Farmer insurance policies typically only cover between \$100,000 and \$300,000 in damages, and only in limited circumstances if at all when it comes to aviation.
- \$6.7 million settlement demonstrates liability.

UAS Outreach and Education



I FLY SAFE

All drones are aircraft—even the ones at the toy store. So when I fly a drone I am a pilot. Before I fly I always go through my pre-flight check list. I regularly check the safety guidelines at faa.gov/uas

FLY SMART, FLY SAFE, AND HAVE FUN! knowbeforeyoufly.org
faa.gov/uas

PRE-FLIGHT CHECKLIST

- I fly below 400 feet
- I always fly within visual line of sight
- I'm aware of FAA airspace requirements: faa.gov/go/uasfr
- I never fly over groups of people
- I never fly over stadiums and sports events
- I never fly within 5 miles of an airport without first contacting air traffic control and airport authorities
- I never fly near emergency response efforts such as fires
- I never fly near other aircraft
- I never fly under the influence

Federal Aviation Administration



<http://knowbeforeyoufly.org/>



UAVS CAN BE HAZARDOUS TO LOW-FLYING PILOTS

Don't Bet the Farm by Putting UAV Operations Above Pilot Safety.

Small UAVs can be virtually invisible—and potentially lethal—to agricultural pilots, emergency medical helicopters, law enforcement and other low-flying aircraft operating in the same airspace. Birds smaller than many UAVs have collided with aircraft, blowing through cockpit windows, disabling engines and killing pilots in the process.

Here's what you can do as a safe and responsible UAV operator:

- Get certified and well-trained in operating a UAV
- Equip UAVs with strobe lights and tracking technology, like an ADS-B Out system
- Follow the law—always give the right-of-way to the manned aircraft
- Coordinate with local aircraft operators about your UAV operations
- Carry sufficient UAV liability insurance

A UAV collision could have far-reaching consequences. An ag pilot's fatal collision with an unmarked meteorological tower resulted in millions of dollars in liability for the farmer, landowner and tower manufacturer. UAV operators could be similarly culpable for a midair collision.

Fly with care. Don't put your livelihood and pilots' lives at risk.



A message brought to you by your local aerial applicator and

Learn more at AgAviation.org/uavsafety | Knowbeforeyoufly.org | Thinkbeforeyoulaunch.com



SEE AND AVOID

Manned Aircraft Must See a UAV to Avoid It.

The ability to see and avoid obstructions and other aircraft is the backbone of safety for aerial applicators and all air traffic operating under visual flight rules. All aircraft, including UAVs, have a responsibility to abide by this aviation safety principle. Small UAVs can be virtually invisible—and potentially lethal—to agricultural pilots, emergency medical helicopters, law enforcement and other low-flying aircraft operating in the same airspace.

Be smart about deploying a UAV over your fields.

- Equip UAVs with strobe lights and tracking technology, like an ADS-B Out system
- Get certified and well-trained in operating a UAV
- Follow the law—always give the right-of-way to the manned aircraft
- Coordinate with local aircraft operators about your UAV operations
- Carry sufficient UAV liability insurance

Fly with care. Make sure you can be seen and tracked by low-flying, manned aircraft. Keep a safe distance from them or land until aircraft have left the area.

A message brought to you by
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Conclusion

- NAAA supports the safe integration of UAVs into the NAS.
- ADS-B-like tracking, Visible Lighting, Sense and Avoid (Automatic Grounding) are key safety technologies.
- Considerable liability risk for UAV operators and providers.
- UAVs will likely not be used for mass ag spraying anytime soon, but have crop sensing, aerial imaging and other non-application capabilities. Manned aircraft, such as ag aircraft are able to conduct crop sensing and aerial imaging services too.
- Find an Aerial Applicator near you function of NAAA website: http://www.agaviation.org/af_AerialDirectory.asp

Questions?



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www.agaviation.org

http://www.agaviation.org/af_AerialDirectory.asp

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