

The Centennial Of Aerial Application

Bill Carey August 03, 2021



An Air Tractor AT-502B treats a field.

Credit: Air Tractor

A century after an Army pilot helped spread a powder of lead arsenate dust from a Curtiss biplane to stop a caterpillar outbreak—logging the first recorded aerial application flight in the U.S.—aviation remains a steadfast component of the agricultural economy.

August marks the 100th anniversary of agricultural aviation in the U.S.

“The state of the industry, the state of the business is good,” said Jim Hirsch, president of Olney, Texas-based Air Tractor, the leading U.S. manufacturer of agricultural airplanes.

“Long-term, people still need to eat, and to feed the world the U.S. and other countries must practice modern, highly productive farming techniques,” explained Hirsch. “You cannot produce the amount of food and fiber the world needs without modern ag techniques that include aerial application of plant nutrients and plant-protection products.”

Ag airplanes and helicopters treat 127 million acres, or almost a third of commercial cropland in the U.S., the [National Agricultural Aviation Association](#) (NAAA) estimates. They treat rangeland used for grazing and forests for growing timber, and support aerial firefighting and mosquito abatement efforts. A Texas A&M University study found that for five commodity crops—corn, wheat, cotton, soybeans and rice—farmers would lose \$23 billion in revenue if aerial spraying were no longer available.

There are 1,560 agricultural aircraft operators in the U.S., counted as businesses that hold certificates under the [FAA's](#) Part 137 regulation governing aircraft that dispense chemicals designed to treat soil or crops, including firefighting aircraft. Based on a 2019 NAAA survey, they operated 3,588 aircraft (3,014 fixed-wing and 574 helicopters), or an average of 2.3 aircraft per business. Eighty-one percent of the aircraft had turbine engines; 19% were piston-powered.

“For the most part, it is smaller businesses that probably average six employees,” said NAAA CEO Andrew Moore. “You might have two pilots, a couple ground crew and maybe a mechanic and someone in the office.”

Hirsh concurred: “Typically, in the States, it’s mom-and-pop operators, owner-flown [businesses],” he related. “We see more of those mom-and-pop operators selling out, particularly as they get close to retirement, to some bigger operators that are combining those businesses. The bigger companies will operate 12-15 airplanes. Still, by-and-large, it’s mom-and-pop operators.”

Flying at 120-160 mph, ag airplanes lay down liquid pesticides from 8-12 ft. above a crop or tree canopy to limit off-target drift; they operate somewhat higher—at around 40 ft. above ground level—to dispense dry fertilizer and seeds.

“Ground rigs spray 70%+ of all the spraying that goes on in this country,” said Hirsh. “The airplane has turned into the ‘911 service’ for the farmer. If suddenly he’s got a fungus problem or an insect problem, and he’s on the verge of an economic impact at harvest, he has to have somebody tomorrow to cover that whole 3,000 acres and an airplane is the only way to get that done in that kind of timeframe.”

The industry experienced 6.87 accidents per 100,000 flight hours in 2019, compared to a rate of 5.43 accidents per 100,000 hr. for general aviation overall, according to the NAAA. Agricultural aviation had a lower rate of fatal accidents in fiscal 2019—0.68 per 100,000 hours—than general aviation at 0.95, according to the [FAA](#).

An Industry Is Born



Etienne Dormoy (l) and Lt. John Macready. Credit: NAAA

It started with a catalpa tree grove near Troy, Ohio, on Aug. 3, 1921. Catalpa trees were a cash crop; their timber was used in making utility poles and fenceposts, but this grove was infested with Catalpa Sphinx caterpillars. According to a photo-copy of a pamphlet from that time, state entomologist C.R. Nellie suggested that an airplane “might be used advantageously as a means of distributing poison on tall trees.” To test the proposition, researchers with the Ohio Agricultural Experiment Station, supported by officials at McCook Field, an Army Air Service airfield in Dayton, jury-rigged a World War I-era Curtiss Jenny biplane to disperse lead arsenate dust over the affected grove.

Lt. John A. Macready, the chief test pilot at McCook Field, flew the modified Jenny trainer. He was accompanied by engineer Etienne Dormoy, a Frenchman who designed the hopper for the mission—a funnel-like metal container bolted to the right side of the fuselage—and operated it from the passenger cockpit using a hand crank.

“[U]pon its release from the hopper, the powder was introduced into the ‘slip stream,’ the violent air current set up by the moving propeller, and by this tremendous force was thrown out behind the moving plane in a violently swirling mass, which floated out in a beautiful trail to mark the path of the moving plane,” wrote the author of the pamphlet.

The six passes over the catalpa grove were just a footnote for Macready, who would later achieve an altitude record in a Packard-LePere Lusac-11 biplane in September 1921; an endurance record with Lt. Oakley Kelley in a Fokker T-2 monoplane in 1922; and the first non-stop transcontinental flight with Kelley in a Fokker T-2 in 1923. Nevertheless, the “dusting plane” mission was deemed a success, leading to the birth of agricultural aviation.

Ag Aviation Goes Commercial



Huff-Daland Dusters was the first commercial aerial application business. Credit: NAAA

Starting in 1922, the U.S. Department of Agriculture (USDA) conducted hundreds of crop-dusting tests at Scott Field, outside of Tallulah, Louisiana, to combat boll weevil infestations of cotton fields, according to the NAAA. Huff-Daland Co., a predecessor company of [Delta Air Lines](#), in 1924 built the first dedicated crop-dusting airplane, a derivative of its military Petrel 5 biplane nicknamed the “Puffer,” which Huff-Daland Dusters of Monroe, Louisiana, deployed as the first commercial aerial application business.

Richard “Dick” Reade, who flew the Lockheed P38 Lightning in the Pacific Theater during World War II, then founded MidContinent Aircraft Corp., of Hayti, Missouri, “with three Stearmans and a dream,” in 1949, served as the first president of the NAAA in 1966. MidContinent announced Reade's death in April.

The association coalesced to advocate for the industry at a time when Rachel Carson’s *Silent Spring*, published in 1962, had raised public awareness of the dangers of using DDT as a pesticide. Suburbs were encroaching on land that had historically been used for farming. “We were dealing with two challenges—public concern over the use of pesticides and people who weren’t familiar with ag life,” said Moore.

Under President Richard Nixon, responsibility for the regulation of pesticides shifted from the USDA in 1970 to a new entity—the Environmental Protection Agency, which cancelled all remaining crop uses of DDT in 1972.

The NAAA was instrumental in amending Part 137, introduced in 1966, and helped establish the USDA’s Aerial Application Technology Research unit, said Moore.

“We feel that the judicious use of pesticides and nutrients actually has a positive environmental effect in the sense that you’re going to get more yield per acre,” said Moore. “When you get more yield per acre, you’re going to need less land to produce food/fiber bioenergy, which means more land can go toward carbon sequestration forests or water-filtering wetlands or endangered and threatened species habitat. We in the field of modern agricultural production feel that we are having a positive effect on carbon sequestration.”

A Common Heritage



Leland Snow designed the Snow Aeronautical S-1. Credit: Air Tractor

The enduring U.S. manufacturers of ag aircraft have a common heritage. Aeronautical engineer and pilot Leland Snow started designing his first aircraft while he was a junior at Texas A&M, as part of a special project to build a new ag plane. After graduating in 1952, Snow flew his S-1 on crop dusting and spraying jobs in the Rio Grande Valley and in Nicaragua through 1957. He founded Snow Aeronautical Co. in Olney, Texas, in 1958, which produced the S-2A and S-2B models.

In 1965, Snow sold his company to Rockwell-Standard and became vice president of its Aero Commander division. During that time, Rockwell developed the S-2R, a single-seat, low-wing taildragger powered by a radial piston engine, which it named the Thrush Commander. In 1970, Rockwell moved the production line to Albany, Georgia, and in 1977 sold the division to Ayres Corporation. Ayres continued building Thrush Commanders, developing two-seat and turboprop versions, into the early 2000s before it went bankrupt.

Former Albany mayor Larry Bays and business partner Payne Hughes acquired the assets of Ayres Corporation in 2003 and renamed the company Thrush Aircraft, today the second-leading U.S. manufacturer of agricultural airplanes. Thrush reorganized under Chapter 11 bankruptcy in 2019 and named former [GE](#), AAR Corp., [Rolls-Royce](#) and EDAC Technologies executive Mark McDonald as president and CEO.

Leland Snow resigned from Rockwell in 1970 and within two years founded a new company, Air Tractor. “Actually, Leland developed the Thrush airplane here, after the sale to Rockwell,” recounted Hirsh. “The first Thrushes were built in Olney before they moved [the operation] to Georgia. That’s when [Snow] left the company and started designing the Air Tractor. That sale forced him into a clean-sheet design. It is interesting that our biggest competitor is still the old design.”

Hirsh worked with Snow for 20 years, the last several years as his chief engineer. “What an amazing guy he was to persevere—similar to guys like Clyde [Cessna](#) and Bill Lear,” Hirsh said of his former mentor. “He was very similar, just in a different segment of aviation.”

Following Snow’s death in 2011, his family asked Hirsh to take over the company’s management. With 315 workers currently, Air Tractor is 100% employee-owned through an employee stock ownership plan.

Technology Advancements



Cockpit of a Thrush Aircraft 510G. Credit: NAAA

With the transition to gas turbine engines, the performance of agricultural aircraft changed dramatically in the 1990s, said Hirsh. Air Tractor introduced a [Pratt & Whitney Canada PT6](#) turboprop-powered Model 402, alongside its radial-piston-engine 401. “There was a drastic difference in price, but the airplane was that much faster and more efficient; the power-to-weight ratio was that much better that it would more than pay for itself,” said Hirsh. “We haven’t built a new 401 in probably 7-8 years and the writing is starting to become clearer on the wall that we probably never will.”

Agricultural aviation was among the first industries to fully adopt satellite-guided GPS navigation. Systems are customized with software and hardware to present a moving-map display to the pilot, allowing he or she to pre-plan the flight and application to a field and have GPS guide the mission. An integrated, forward-mounted light bar provides a visual representation of the position of the aircraft in relation to the swath it is spraying, allowing the pilot to correct for off-track errors.

Aircraft size and performance increasingly mattered. “The airplanes keep getting bigger and more productive,” said Hirsh. “It’s all about how many acres you can cover in a day or in a minute. There is nobody farming 100 or 200 acres; if they’re not farming 1,000-to-3,000 acres, they’re probably struggling to make a living. [Cessna](#), Piper, Grumman AgCat, Weatherly—those were smaller airplanes. They held 200, maybe 250-gallon [payloads], and that’s why they’re not here anymore.”

Other ag airplanes over time have fallen by the wayside. The [Cessna CE-188 Agwagon](#), the Grumman G-164 Ag Cat and the Piper PA-25 Pawnee are among U.S. models that are no longer being manufactured, although an Argentinian company, Lavia S.A., reports that it has revived production of the Pawnee as the PA-25 Puelche. Weatherly Aircraft Co. had plans to resume production of its 620-series ag plane after relocating to Newton Municipal Airport, Kansas.

Noteworthy among enduring manufacturers of agricultural aircraft is Brazil’s [Embraer](#), which in early March announced that it had already sold 27 EMB-203 Ipanemas this year. The Ipanema is powered by a Lycoming IO-540-K1J5 piston engine that runs on ethanol. [Embraer](#) has delivered 1,500 Ipanema-series aircraft since the model entered commercial service in 1972, including 600 flying in Brazil.

Seven Models



An Air Tractor AT-802A treats a field. Credit: Air Tractor

Air Tractor builds seven models of four different-sized aircraft types, designed for hopper capacities of 400, 500, 600 and 800 gallons. The smallest is the AT-402B, powered by a 680-shp [Pratt & Whitney Canada PT6A-15AG](#) turboprop engine; the largest is the AT-802A, powered by a 1,295-shp PT6A-65AG engine. An AT-802F Fire Boss air tanker variant, equipped with Wipaire floats, can scoop water from a lake or river to dispense over wildfires.

Garmin supplies the core navigation and communications systems of the airplanes, which feature Hartzell propellers. Air Tractor's worldwide network of 12 dealers works with operators to integrate GPS with precision flow-control and spray or application systems.

The factory-new list price of a 2020 AT-402B was \$942,000 and an AT-802A was \$1.68 million, according to the summer 2021 edition of the Aircraft Bluebook.

The airplanes are rugged but sporty single-engine workhorses. "The design intent [of Air Tractor models] was absolutely for grass fields, dirt strips, gravel roads," said Hirsh. "You will find these guys operating temporarily off of turn rows out in the middle of the farm field, off of gravel county roads with permission of the country commissioner. It is definitely an austere environment."

In the U.S., he said, "we have seen an evolution where most of the operators are operating off of the local city or county airport and/or have been in business long enough to develop their own infrastructure where they may have 2,000 ft. of pavement for the takeoff run."

Delivery Milestone



Air Tractor delivered its 4,000th airplane in March. Credit: Air Tractor

Air Tractor shipped 123 airplanes in 2020, four more than in 2019, according to the [General Aviation Manufacturers Association \(GAMA\)](#). In the decade that GAMA has tracked agricultural aircraft manufacturers (2011-20), Air Tractor shipped 138 airplanes on average each year, including some military/government shipments. Thrush Aircraft shipped 20 airplanes in 2020, six less than the previous year. Thrush has delivered 37 airplanes a year on average.

In March 2020, with the onset of the COVID-19 pandemic, the U.S. [Department of Homeland Security](#) designated food and agriculture support workers, including those engaged in the maintenance and manufacture of equipment, as part of the nation's essential critical infrastructure workforce. Hirsh said Air Tractor implemented steps to prevent the spread of the virus and managed through the first half of 2020 with no employees testing positive. Through the latter half of the year and the first half of 2021 "we had a few [employees] go out and a few come back," after testing positive, but operations continued. The company probably would have built 140 airplanes last year had it not been for the pandemic, said Hirsh, but he believes it has managed well enough during the crisis.

This March, Air Tractor celebrated the delivery of its 4,000 airplane since 1972, presenting an AT-502XP to Mike and Tiffany Rivenbark, the owners of Moore's Aerial Applicators, of Clinton, North Carolina, during a barbecue luncheon at the factory.

Asked to describe his company's biggest challenges, Hirsh said: "It's absolutely the supply chain and costs. We scratch and claw every day to make sure we have the raw materials, the parts, the pieces, that we need to build airplanes. It is a constant, vigilant effort. We've got airplanes at the back door right now that are missing a fuel pump, for instance. We'll get fuel pumps in and the next week, we'll have airplanes on the production line that don't have a window wiper switch, or something. It's raw materials, overhead, people—the micro switch for whatever. We're seeing it across the board."

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