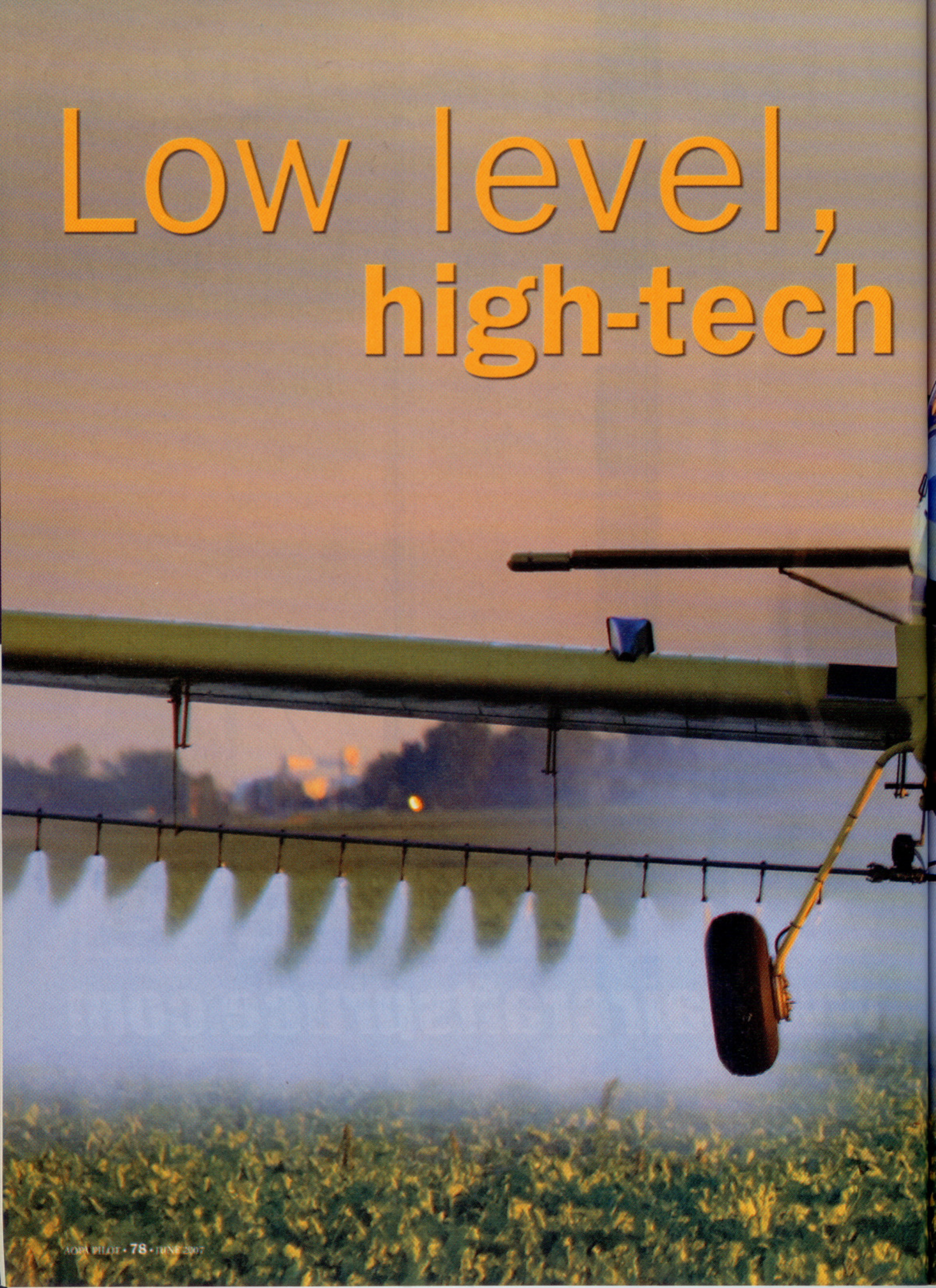
Low level, high-tech



Modern-day agricultural aviation

As I walked down a path near a line of trees last spring, I heard an airplane approaching from behind the tree line. I stopped, waiting for the first glimpse of the airplane—as any pilot might be compelled to do. Shortly thereafter, the big yellow airplane appeared above the tree line in a steep climb. The pilot initiated a slight turn to the right, and then quickly turned back to the left in a familiar pirouette that brought back memories from my childhood.

I couldn't help but smile—for my very earliest memory of airplanes is of spray planes. As a young boy, one of my farm chores was to hold a pole with a white flag on it as a swath marker for the spray pilots who worked our family farm. A lot has changed in agricultural aviation in those 50 years. In fact, nearly everything has changed since those days except the color of the airplanes. It seems that sprayers still favor the color yellow for their airplanes. I recently spent time inspecting some of the new generation of agricultural airplanes and discussing the ag aviation industry of today with sprayers in northwest Minnesota. The term "sprayers" or "spray pilots" seems to be more acceptable today than the terminology generally used in my childhood—"crop dusters." Many of the chemicals now applied are liquid, not solid, so the name change really does make sense, for several reasons.

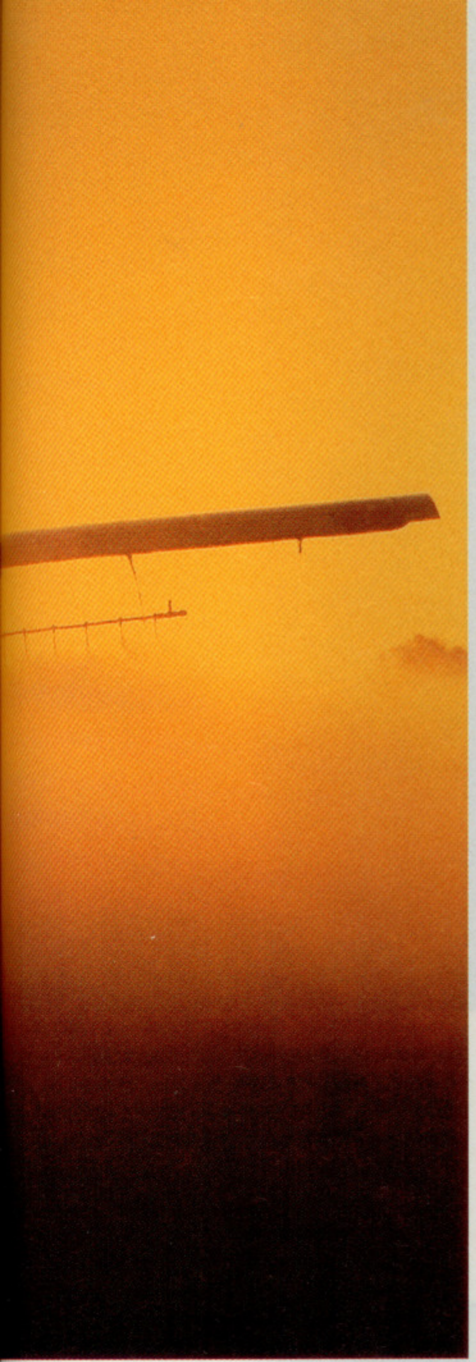
BY MICHAEL T. VIVION

PHOTOGRAPHY BY MIKE FIZER

Dan Geist (right) and his Air Tractor 502-B (above) spray a sugar beet field in Crookston, Minnesota.

Changes in planes

The spray planes exhibit perhaps the most significant evolution in agricultural aviation. The dusters that I flagged for as a boy were well-used biplanes, mostly the Boeing/Stearman Model 75 Kaydet, known in Army Air Corps flight training as the PT–17, and in Navy service as the N2S. These airplanes could be bought as military surplus after World War II for as little as $250 apiece. Hundreds of them were converted to spray planes in the postwar years. Operators often purchased several of these venerable training aircraft, working one or two while keeping another as a spare in the event of an accident. And accidents were fairly common.



To convert these biplanes to sprayers, the front seat was replaced with a chemical hopper, and a spray boom or spreader was installed. A popular modification replaced the original Continental 220-horsepower radial engine with a 450-horsepower Pratt & Whitney R-985 Wasp Junior. Lifting heavy loads in midsummer is a job that lives and breathes power—and more is better in this world.

Other early operators replaced the rear seat of the Piper J–3 Cub and later, that of its successor, the Super Cub, with a chemical hopper to convert these airplanes to agricultural service. In fact, Piper built the PA–18A model of the Super Cub specifically as a sprayer, the letter A designating it as an agricultural model, with a flat hatchback and no rear stick in order to accommodate the hopper. Like many of the biplanes, most of the surviving A-model Super Cubs have now been converted to recreational uses.

These airplanes soldiered on for many years, but they exhibited significant limitations, and more than a few liabilities. Although a big-engine Stearman could carry a decent load, the Cubs were very limited in load capacity. Neither airplane could compare favorably with any of the modern agricultural aircraft in that regard. Load-carrying ability is everything in today's large-acreage agribusiness climate.

Agricultural chemicals are often corrosive, and the early spray planes were of steel-tube and fabric construction. Airframe corrosion was a significant maintenance problem, and difficult to detect and treat in fabric aircraft. Virtually all the modern spray planes, including the Air Tractors, the Thrush, and the Ag Cats, have steel-tube frames like their predecessors, but are covered with quick-detachable metal fuselage panels. Frequent cleaning and inspection are a simple matter of removing the fuselage panels for access to the fuselage frame. This feature also facilitates rigorous scrutiny of the airframe during periodic inspections.

The early biplane's open cockpit placed the pilot above and behind the spray boom. Pilots of that era could probably tell by taste what chemical they were applying. These early airplanes had no robust structure to protect the pilot, nor were they equipped with rollover or wire-strike protection. In short, these weren't the safest platforms from which to fly these low-level missions. Accidents were common, and the Stearman cockpit opening could turn into a guillotine if the airplane's back was broken in an accident.

The agricultural aircraft of today are a very different breed than those surplus biplanes. Today's agricultural airplanes, such as the Air Tractor 502 I watched last spring, have many pilot-friendly and production-oriented features built in. Pilot seats are designed to absorb impact in an accident, and mounted high for superb visibility. A robust steel cage surrounds the pilot, providing rollover protection. Wire cutters are a common feature. Cockpit air conditioning is common, and fresh-air inlets are located in ways that prevent the chemicals being applied from being inducted into the cockpit. Although the hopper on a Stearman sprayer might hold 150 to 200 gallons of chemical, the AT–502's hopper holds 500 gallons. The 502's big brother, the Air Tractor 802, carries 800 gallons of chemical and has a maximum takeoff weight of 16,000 pounds.

Turbine engines have become common in agricultural aircraft primarily because of their power, but also because of their reliability. The radial engines used on most of the early airplanes require a fair amount of routine recurring maintenance, but turbines generally require very little maintenance. In the middle of a busy spray season, an airplane down for maintenance is a serious liability. Although Air Tractor still manufactures aircraft with reciprocating engines, the bigger models are powered by the faithful and powerful Pratt & Whitney PT6 turbine engine. Many Grumman Ag Cats have been converted to turbine power, as have a number of Rockwell Thrush sprayers. Lindley Johnson of Argyle, Minnesota, specializes in refurbishing used Thrush aircraft and re-powering them with Walter turbine engines produced in the Czech Republic.

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Flaggers

The dusters of my childhood relied on young boys, the farmers, or their own flaggers to mark each end of the swath. After the airplane passed, the flaggers moved their flags to the edge of the next swath. Although I was thrilled at the opportunity to serve in this capacity as a young boy, I recall being sprayed occasionally by the sloppier pilot. The chemicals used in those days possessed names we now

consider infamous—such as DDT. My wife thinks that this may explain a few things about me.

A device called the "automatic flagman" replaced human flaggers. At the push of a button on the control stick, this device releases a cardboard "flag" with streamers from a tube mounted on the trailing edge of the wing. As the pilot starts and ends a swath, he drops a flag. Completing his turnaround, he looks for the last flag, which provides a reference for the next swath. The flags are biodegradable.

Just as the automatic flagman replaced the human flagger, the Satloc system has now virtually precluded the need for flags. Peering into the cockpit of a modern sprayer, such as the Air Tractor 502 operated by Dan Geist of Crookston, Minnesota, reveals a rather unfamiliar (to the uninitiated, at least) collection of equipment installed in the panel. Just as the PT6 has become the heart of the modern sprayer, the Satloc system has become the brain of the modern spray airplane's systems.

The Satloc system is a GPS-driven, computer-controlled system that serves a number of important functions for the pilot and operator. Basic GPS does not provide adequate navigational accuracy to reliably locate a swath for chemical application purposes. For a time, many operators used differential GPS to achieve adequate accuracy for their operations. Although differential GPS can provide centimeter accuracy, most operators in this part of the country now use the Wide Area Augmentation System, which provides adequate precision (one-meter accuracy) at considerable savings in cost and manpower compared to that required by differential equipment. So, although the IFR crowd is just starting to use GPS for precision approaches (see "On Display: Going the WAAS Way," page 139), sprayers have been using precision GPS for many years with great success.

The brain of the Satloc system is its computer. The pilot enters the metes and bounds of the field to be sprayed, the desired spray pattern, the desired application rates, and many more parameters into the computer prior to working a field. The primary pilot interface with the Satloc in flight is a light bar mounted atop the cowling of the airplane, in the line of sight of the pilot. A series of lights forms a course devia-

Ben Halstenson of Agrimax sprays with his Air Tractor 301 in Fisher, Minnesota (above). The Air Tractor 502 has a packed panel that includes a GPS-driven computer-controlled system (below).

Days can be long in this business, and time is money.

tion indicator, which provides precision guidance to the pilot. The pilot selects the desired work pattern, such as side-by-side swaths working across a field, or virtually any other pattern that terrain or obstacles might dictate. The system can be programmed to turn the spray on and off, and it can regulate the chemical application rate to meet the demands of today's precision agricultural operations. Many farmers are using satellite imagery to detect problem areas in crops, and the Satloc system offers the precision to increase application rates in certain areas and decrease them in healthier areas of a given field. If the pilot needs to reload or refuel in the middle of the field, the computer "remembers" where he left off and directs him back to that point to finish the field.

Finally, the Satloc system provides a downloadable and printable portrait of each application. This feature alone can save thousands of dollars in liability when a neighboring farmer claims that a sprayer allowed chemical to drift onto his crop, causing damage. The Satloc record clearly shows wind conditions at the time of the application, and other environmental parameters, and indicates where the chemical was placed and at what rate. This record also can be a benefit to the applicator in his relationship with his customer, by providing a clear record of the work done, including application rates.

Modern operations

The aircraft and its equipment aren't the only improvements in agricultural aviation. Geist operates an efficient and modern business at Crookston Municipal airport. Geist's hangar is equipped with large bifold doors on each end of the hangar and a taxiway leading to each door. Geist starts his day with his Air Tractor 502 inside the hangar and positioned over a recovery basin built into the floor. Outside the hangar are large chemical storage tanks and a fuel tank for the Jet A that the PT6 burns. Hoses run from manifolds in the building to quick-connect fittings that attach to the fuel and chemical fittings on the side of the aircraft. With the airplane loaded and preflighted, Geist climbs aboard, straps in with a four-point harness, dons his helmet, and engages the starter. After engine start, he taxis onto the taxiway leading to Crookston's 4,300-foot runway.

As Geist returns to the airport after applying a load of chemical, he lands and taxis around his hangar and through the "back door," again positioning the airplane over the containment pit. The prop is put into

feather at ground idle, and a loader plugs the quick-connect fittings into the side of the airplane to refill the hopper while Geist cleans the latest collection of bugs off the windshield. In the time it takes to clean his windshield, Geist will be loaded and taxiing out the other door of the hangar, on his way back to the field. Fast turnarounds are vital to minimize run time, and to take advantage of suitable working weather when it prevails. Days can be long in this business, and time is money.

Loading under a roof prevents rainwater from entering the required chemical catch basin. Any water in the catch basin must be assumed to be contaminated and will be disposed of as contaminated waste. Waste disposal is by volume, so cost savings of this roofed design are significant. Hot loading minimizes cycles on the turbine and reduces the possibility of hot starts. Again, speed and efficiency are vital to be competitive.

Accidents still occur, of course—this is a higher-risk endeavor than most flying, after all. Wires and towers are still rated by spray pilots as the greatest threat to their safety. Many of the airplanes have indentations in the wing leading edges—evidence of wire strikes. In the past, many operators landed on roads near the field they were working to load chemicals and fuel from trucks. Modern, strict regulations regarding the handling of chemicals, and the size of the aircraft, have discouraged, if not precluded, this type of operation today, probably improving the overall safety record. Because of the cost of these machines, insurance is a requirement, and accidents increase insurance rates. That is bad for business.

Different breed

Finally, the agricultural pilot of today is a rather different breed. Geist holds a bachelor of science degree in agricultural aviation from the University of Minnesota, Crookston. Sprayers are required to possess applicator licenses in most, if not all, states. These licenses require completion of courses in chemical mixing, safety, and other important agricultural subjects. Many sprayers are one-man operations, requiring that the operator be an expert in ag chemicals, marketing, accounting, and other business practices, as well as being a highly proficient pilot.

About 30 miles north of Crookston is the small town of Warren, Minnesota. Warren is home to another agricultural spray company, Radium Air Spray. Dwight and Aaron Peterson own Radium. The father-son team operates matching refurbished Thrush aircraft, both equipped with Walter turbine engines. The operation is very similar to the one that Geist operates in Crookston.

Aaron Peterson, at 27, is young as sprayers go, but his enthusiasm for, and dedication to, aviation, and agricultural aviation in particular, is readily apparent in even a casual meeting. Aaron's goal until last summer was to be the first deaf commercial pilot to complete an instrument rating. Another pilot beat him to that goal, so Aaron's new objective is to be the first instrument-rated deaf helicopter pilot.

Just west of Crookston, a corporate-owned company called Agrimax operates several aircraft, including AT–302s and Ag Cats. Ben Halstensen of Agrimax is another of the younger breed of spray pilot, flying a reciprocating-engine AT–302 this past summer for the company.

With acquisition cost of a new turbine aircraft running to three quarters of a million dollars or more, the ag operator of today simply has to run a highly professional operation. The "cowboy" reputation of the old-time crop dusters has largely gone by the wayside. Professionalism is apparent throughout an outfit like Geist's in both its design and operation.

The 2006 season was very dry in Minnesota, so many farmers were able to spray their own fields with ground equipment. Aerial applicators weren't as busy as usual here, but there is always work somewhere for these hard-working pilots. Aaron Peterson spent much of the fall and winter near Yuma, Arizona, working cool-weather crops there.

Whether they are applying pesticides or fertilizer in Minnesota, defoliating cotton in Texas, or spraying lettuce in Arizona, the hard-working spray pilots and spray planes of today are a very different breed than those of 50 years ago. Although their work is always low level, their equipment is definitely very high-tech. AOPA

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