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NASA STUDIES AGRICULTURAL AIRCRAFT DESIGN

While many of its people still have their eyes set on the stars, researchers at NASA's Langley Research Center, Hampton, Va., are looking closer to Earth, focusing on the problems of agricultural aircraft.

First recorded use of an airplane in agriculture was Aug. 3, 1921, when a grove of trees was treated for an infestation of caterpillars. The test was successful and commercial dusting activity took off in a cloud of spray. By 1930, about 25 companies were operating with about 100 airplanes. By 1950, those numbers grew to 2,000 companies and 5,000 airplanes.

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Until 1950 airplanes had to be converted from some other purpose for agricultural use. Military trainers were the most widely used, and operators usually designed, built and installed dusting and spraying equipment themselves.

The first aircraft designed especially for agricultural use appeared in 1950. The industry has continued to grow. In 1976, there were approximately 8,500 fixed and rotary wing aircraft in agricultural service, flying about 2.5 million hours over some 250 million acres.

Agricultural aircraft have improved but they still rely on 1940s technology. The aerial applications industry recognizes this shortcoming and has asked NASA to study several problem areas. Drift, swath guidance, liquid and dry material distribution systems, and aircraft handling characteristics that cause pilot fatigue are some of the problems. Another major concern involves attempts to make the wake vortex of an airplane work for, rather than against, aerial applications. Aerodynamic concerns involve reducing drag for better fuel efficiency and developing appropriate high-lift concepts to improve takeoff, landing and turning performance.

Dr. Bruce Holmes, of the Safety and Operating Problems Branch, Flight Research Division, is manager of the Langley program.

He says that during this year the problem areas "will be studied through the Vortex Research Facility, Full-Scale Wind Tunnel and actual flight tests."

In the Vortex Research Facility, small scale models of agricultural aircraft are tested to study interactions of the aircraft wake with dispersed spray and granular materials. These interactions contribute to two of the most serious problems facing the agricultural aircraft community, drift of toxic chemicals from target areas and nonuniform applications within a swath.

Test methods to simulate aerial applications are being developed in this facility. Baseline data will be collected to determine wake characteristics of agricultural aircraft. Tests will then be performed to measure airborne dispersal and ground distribution. The scale model will disperse polystyrene particles or glass beads as it passes through the test section. The particles will stick to double-sided tape covering the floor and will be counted with the help of a microscope.

Distribution will then be plotted and analyzed for effects on dispersal patterns caused by aircraft speed, height and geometry.

Finally, methods will be developed to modify aircraft wakes and dispersal systems to obtain interactions more favorable to wide, uniform swath distribution patterns and reduced drift.

In the Full Scale Tunnel, full scale aircraft and dispersal systems for both liquid and solid applications will be tested. Baseline data collected from present technology will be used in analyses to improve aircraft aerodynamics and dispersal system efficiency.

In the aerodynamics phase, performance and stability and control tests will be conducted and several modifications designed to provide overall system improvement will be examined. Modifications to be investigated include leading-edge slats for high-lift improvement, and ring cowl and wing-to-fuselage fairings for drag reduction and improved wake characteristics. Wake modification concepts such as vortex attenuating splines and winglets, shown to have possible beneficial effects on wake-dispersal interaction in the Vortex Research Facility, will be evaluated for possible aerodynamics advantages.

Tests will be conducted on aircraft and dispersal systems separately and as a single unit to provide data for performance estimates and to identify interference problems.

Laser spectrometer studies will be conducted to analyze liquid droplet breakup from spray nozzles in the airplane's wake. The ultimate goal of this research is development of nozzle technology for improved control of droplet sizes, reduced amounts of very fine droplets and reduced drift.

The flight tests are scheduled to begin in the fall of 1978 at Wallops Flight Center, Wallops Island, Va.

The aircraft used in the Full-Scale Tunnel and flight tests will be an Ayres Thrush S2R-800, one of the largest agricultural aircraft. The Thrush has 800 hp, carries 1,520 liters (400 gallons) of liquid and costs about $80,000. Originally loaned to Langley by Rockwell International, ownership of the aircraft and Thrush manufacturing rights were sold to the Ayres Company, New York, earlier this year.

A photograph to illustrate this news release will be distributed without charge only to media representatives in the United States. It may be obtained by writing or phoning:

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