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Agricultural aircraft: the future
By IAN PARKER

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ONSIDER a man firing a machine
gun at five rounds a second: he
starts firing on February 1 and con-
tinues, 24hr a day, until March 1 when he finally hits his target. No military organisations, of course, would tolerate such a low kill rate. But sub-stituting droplets for bullets is the kind of efficiency that aerial spray-ing operators have to contend with. Admittedly, much of the fault is in-herent in the spraying process, but a great deal can and is being done to improve the efficiency of aerially applied chemicals.
The basic problem is quite simple. A spray consists of droplets of liquid that vary in size depending on the applicator nozzle. Small droplets float down through the atmosphere slower

than large ones, but they all eventu-ally reach the ground in still air. Of course, the air is rarely still and tur-bulence is common. The two most problematic sources of turbulence from the aircraft are wingtip vortices and propeller wash.
If the spray is deposited from a spraybar underneath a low wing, much of the chemical leaving the ends of the bar is caught in the tip vortices and rotated high into the air. Spray near the centre is likewise caught in rotating air from the propeller. The ducted fan offers reductions in noise and tip disturbance, but can hardly be placed in front of the pilot block-
ing his vision. Moving the fan behind
and above the pilot not only improves
visibility, but moves the source of

This Dollar Air Services Bell 47 was photographed by the Royal Agricultural Society of England as it demonstrated agricultural flying techniques at the recent conference

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noise and turbulence away from the pilot and spraybar.
The Cranfield Institute of Tech-nology has been working on tip vortex reduction by means of wingtip sails. These consist of a number of small aerofoils protruding from the tip and set at different angles of incidence. They redirect the rotating air back-wards. Although some spray still flows through this system, it too is directed backwards and falls with the rest of the spray. Other modifications to wing design are also helpful in reducing tip vortices. Increasing the aspect ratio and taper of the wing are examples. This allows the use of a full span spraying boom, and the wing exten-tions can be used as tanks, relieving the wing-bending moment and keep-ing unpleasant fluids away from the pilot.

While the increased span will change the wing loading, there is un-likely to be a large weight penalty. High aspect ratio and nose camber of the extended wing would allow the aircraft to fly slowly for spraying, but maintain a good cruise speed for transit. Powerful roll control associ-ated with extended wing ailerons and possible use of wing tip drag rudder devices should allow rapid turns at the end of each spray run. Wingtip sails have been investigated by the Ciba-Geigy Agricultural Research Unit at Cranfield. Ciba-Geigy built a set of sails onto a pair of Sportsman wingtips which give the Piper Pawnee a square-cut tip.

The varying camber and twist across the spans of the sails is essen-