APPLICATION OF ULV AERIAL TRIALS USING SMALL-PLOT EQUIPMENT

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Abstract

Application of pesticides, particularly insecticides, in once-refined cottonseed oil is a technique which is widely used in South Texas. However, only small quantities of available experimental test substance are available for testing. In this paper, we present our solution to ULV aerial application.

Introduction

Aerial application of insecticides in once-refined cottonseed oil is a very attractive application technique in South Texas cotton production. This method of application reduces the amount of evaporation of the carrier, thereby enhancing the deposition on the target. Aerial applicators can apply large acreages with a relatively small load of spray mixture. Total finished volumes (insecticide + carrier) range between twelve ounces per acre and three pints per acre. However, there are drawbacks to conducting experimental work with this method of application. Small aircraft such as this Pawnee require a minimum of three gallons of spray mixture to fill the booms and pump. Mixing of smaller volumes than eight gallons of spray mixture significantly changes the ability of the pump to consistently deliver fluid to the boom. Commercial applicators with larger aircraft require equal or larger amounts to keep the system operating properly. Where pesticides are registered, material which is brought back in the aircraft can be consolidated and disposed of by spraying over a crop on which the material is registered. However, this is not possible with experimental materials. Retention and storage of mixtures of experimental compounds and application at a future date is not usually an alternative because storage stability data are not usually available. Therefore, large quantities of spray mixture must be shipped back to the sponsors, or disposed of illegally by the applicator.

An additional problem is the availability of test substance itself. When small amounts of total finished volume are applied per acre, even small gallonages contain significant quantities of active ingredient. This leads to the need for production of relatively large quantities of test substance in plants which are not designed for that purpose. Storage and retention of large numbers of containers at testing facilities are considerations as well.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1157-1158 (1998)
National Cotton Council, Memphis TN

To reduce the severity of these problems, some solution is necessary which will allow the testing of aerial ULV applications of candidate pesticides.

Materials and Methods

Although this method of aerial application can be adapted to any fixed-wing aircraft, we have used a Pawnee PA-25 aircraft with a wing span of approximately 33 feet. We use a five-pound compressed-gas bottle equipped with a regulator for the propellant rather than the pump. In our aircraft, this bottle is secured just aft of the engine in a small storage compartment. A reinforced three-eighths inch hose carries the propellant gas from the bottle through the cockpit to the spray container. A valve in the cockpit allows the pilot to turn the gas off or on into the spray container.

The spray container is located in a storage area directly behind the pilot's seat. We have used either three-gallon or five-gallon stainless steel beverage cans as spray containers. However, these do not produce satisfactory agitation for the spray mixture. This year, we solved that problem by using a three-liter plastic spray bottle with an inverted header. As the propellant gas enters the bottle, the spray mixture is agitated. A short piece of aluminum pipe with access holes and supporting flexible wire immobilize the three-liter bottle in the compartment. A short piece of three-eighths inch hose carries the pressurized spray mixture from the spray container to the on-off valve which the pilot controls. From the valve, pressurized spray mixture goes downward through a small hole in the bottom of the cockpit. We use three-eighths inch clear hose for this purpose, as well as for the boom. A tee underneath the airplane directs spray through the hose boom which is tie-wrapped directly onto the conventional boom of the aircraft. We attach nozzles to the hose using diaphragm shut-off nozzle bodies. We have found that it helps to remove the springs from the nozzle bodies and clip a small amount from the spring to slightly reduce the amount of pressure required to open the nozzle. This does not eliminate the ability of the nozzle body to shut off the flow of the spray mixture. We have used flat fan nozzles, either 8002, 8003, or 8004 nozzles for all applications. Our nozzle size chosen has depended upon our desired carrier volume.

Calibration

We perform a static calibration before each application of test substance. Our experience has taught us to calibrate with a mixture of cottonseed oil and test substance rather than with only cottonseed oil. This is because the mixture flows at a much more rapid and uniform rate than the cottonseed oil alone. We catch the total delivery of each nozzle for a time period between fifteen and thirty seconds. We measure this delivery and calculate the total delivery of the system in one minute.

Our next step is to determine the ground speed of the airplane during calibration. Swath width can be determined by spraying across tape stretched across a flat surface. The pilot flies at least three swaths without spraying over a course which measures at least one-half mile in length. Observers on each end of the known course team up to measure the time required to travel the length of the known course. From these data we calculate the number of acres the airplane covers in one minute and the airspeed. We then calculate the amount of carrier volume per acre and the number of seconds needed to properly apply the spray mixture.

Plot size is generally three swaths forty feet in width by 300 to 473 feet in length. Most protocols require plots cover at least one acre. We have never applied upon a treated plot which exceeded 1.3 acres. We mark the ends of the centers of each of the three swaths of the treated plot with white buckets hung on short posts. We position an observer where he can clearly see both ends of the treated plot. Using binoculars and a stopwatch, he measures the number of seconds required by the airplane to travel over the treated plot. Since the speed of the airplane varies between 92 miles per hour and 96 miles per hour, pass time over the plot varies between 2.20 seconds and 3..55 seconds depending upon plot length.

After the application ends, we calculate the delivery on the target by multiplying total seconds over the plot times total delivery per second during calibration. Very seldom are we more than 5% from our target application rate.

Cleanup is very simple. We place a mixture of water, acetone, and dish- washing detergent in the spray bottle and spray this mixture through the system into the same buckets into which we calibrated. We then follow this by spraying clean water into the buckets. Especially after this water rinse, we make sure that propellant gas is blown through all nozzles for several seconds.

Discussion

Application accuracy has been very good with this method of application. Based on pass times, 1997 applications were within 3.5% of desired carrier volume based on pass times measured in the plots. In 1996, only one of six applications was off by as much as six percent. The other five applications were off from the target rate by 3.6% or less.

Table 1. Equipment settings for ULV trials conducted, 1992-1997.

Total Finished Volume, fl. Oz./A	Pressure on Regulator, psi	Size of Nozzles	Number of Nozzles
8	58	8001	5
12	34	8002	5
32	62	8004	8
*64	100	8004	10

*We applied only a 30-foot wide swath in this trial.