

EQUIPMENT FOR AERIAL FERTILIZATION

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ABSTRACT

Developing and testing of aerial fertilizer spreading systems have been extensive in the short history of forest fertilizing and efforts to improve these systems are continuing. Various methods of transporting, packaging, and handling the product from the supplier to the forest floor have been tried.

INTRODUCTION

Fertilizing the forest by air is a relatively new application that began on a large scale in the early 1970's. It is a demanding use of an aircraft, whether helicopter or airplane, but even more demanding are the logistics. A helicopter, especially one of the larger models, is hungry; over 40 tons of material can be applied in an hour. It has been my experience that flying and maintaining the aircraft are the easiest parts of the procedure; the difficult parts are organizing and coordinating the proper support to keep the aircraft supplied with fertilizer.

EQUIPMENT

What is required to fertilize our forest in the most efficient and cost effective way? When preparing to go out on a fertilizing project I look at the total system required. First, of course, you need an aircraft, then a spreading system, a loading rig, fertilizer, some type of navigation system, and, most important, trained personnel.

AIRCRAFT

In the Pacific Northwest, practically all fertilizer is applied by helicopter; airplanes have limited use because of the lack of suitably located airstrips and the roughness of the terrain where most applications are made. In Sweden, airplanes still are used extensively; however, because of the cost of building airstrips, helicopters are now being used there for over 50% of the work.

Nearly all types of helicopters being flown commercially have been or are being used to apply fertilizer, from the small three-place Bell or Hiller to the twin-turbine-powered Vertol or Sikorsky S-61. The Bell 205A-1 (Huey) helicopter without

question has applied more fertilizer than any other. This helicopter can carry up to 4500 lb of payload.

SPREADING SYSTEM

After you have selected the aircraft, you need a spreading system. With helicopters, the only system that has met with any degree of success is the underslung bucket. This bucket must first be aerodynamically matched to the helicopter. It must be designed and shaped so it does not transmit adverse movements into the helicopter flight characteristics. In addition, it must be able to counteract the torque effect that is induced when the gate is opened and fertilizer is dispensed. A wing is attached to the aft side of the bucket to counteract this torque.

The bucket must have power to rotate the spinner and a gate that can be controlled by the pilot to start and stop the flow of fertilizer. It is important to have a fast-opening gate so it can be opened and closed at the desired timber stand boundaries, since a helicopter applying fertilizer is moving at up to 100 ft/sec. The gate must also incorporate an adjustment control so that the flow rate can be calibrated. I know of only one bucket whose gate opening can be adjusted from the cockpit. We have found this to be an essential feature, as there are many times you need to change the flow to complete a swath run, since it is almost impossible to relocate a spot in the middle of a block of trees where the flow ceased. To avoid skips or excessive overlaps it is best to reach a boundary before you run out of fertilizer.

Many different power sources are used to drive a spreader, but the performance of any bucket in respect to flow rate and swath width is dependent on the horsepower applied. More horsepower increases swath width and also flow rate.

TRANSPORT AND LOADING

Once you have the spreading equipment and the aircraft, you must transport the fertilizer and have a loading system to fill the spreaders on the heliport. Fertilizer is handled in two ways, either in bags or in bulk. To have an efficient operation you must keep the helicopter in the air most of the time. We have

found that the only efficient way is to use large bags. If the operation is located only 20 mi from the nearest railhead and you are using a helicopter that dispenses 30 tons an hour, you need a minimum of six trucks for a straight bulk operation.

An operation with bulk fertilizer only is a "hot show." Rail cars must arrive on schedule, the truck must keep up with the helicopter, the conveyor at the railhead cannot break down, and the roads must hold up even during inclement weather. The total coordination required is amplified considerably compared with the bag method. With bulk, when weather does move in, the helicopter sits and so do the trucks.

Using the large bag, the product can be delivered in advance of the helicopter's arrival. Production per calendar day is greatly enhanced with bags over bulk delivery and there is considerably less spillage on the heliport. Fewer than half the trucks are required with bag delivery than with bulk since they can continue to travel when weather is not flyable.

FERTILIZER

Now we are ready for the product. Preferably, the fertilizer's particle size should be as large a granule as possible. You need material that will give you a wide swath. The broader the swath the more overlaps you can obtain at the same cost. The mass of the granules is more important than the specific weight. (Compare the distance you can throw a handful of sand with the distance you can reach with a handful of small gravel.) With small agricultural prilled material you are fortunate to have a 130-ft swath. With the larger material you can obtain over 200 ft. If you are maintaining the same fertilizer flow rate you can understand that an increased number of overlaps can be obtained at the same cost.

SKILLED PERSONNEL

All items are on the heliport now except for the skilled personnel needed to operate and maintain the equipment. It takes a season to make a good fertilizer pilot and to have well-trained ground employees who know the complete system well enough to keep it continually operating. When the spreader breaks down and the expensive helicopter sits, it can be costly.

Now that all the equipment and the skilled personnel are present and the weather is clear, we are ready to fly. But how do we fly? The pilot needs help. He needs some type of reference to keep him on the proper track over the forest and he

needs to overlap a maximum of three times. Overlapping more than three times becomes uneconomical.

I have been in this business for a long time and I dare say that any pilot that stands up and says he can maintain an even distribution of fertilizer across the forest floor without reference marks is not being honest with the customer. The use of reference marks is a necessity. This has been a program that we have found to be difficult to sell. It is an added expense but, compared with the total cost already committed to the project, it is a small addition. I might add that we have flown with two radio navigational systems but have not obtained satisfactory results with either.

CONCLUSIONS

As you can see, it takes a considerable amount of equipment to do a good fertilizing job, but it also requires planning. It is a shock for us as operators when we receive a bid that opens on September 20 and they want us to start fertilizing a week later.

I think we need to be careful, too, when we write specifications into our fertilizer contracts. I have seen contracts requiring that the applicator has no more than 10% variation in his fertilizer distribution across the forest floor. This is unrealistic. I hope I have been able to explain to you why that is not possible, at least at the present state of the art. I have read contracts that require the pilot to carry his load around the headwaters of a stream in order to reach an area that is located just across a drainage from the heliport. This could easily add over 50% to the total flight time.

A bucket that leaks fertilizer should definitely be grounded, but when you are ferrying a helicopter at 80 mph from the heliport to the area to be worked, the likelihood of dropping a loaded bucket in a streambed is extremely remote. I am not suggesting that we fly across the McKenzie River but I do think we must be realistic when we draw up contract requirements. We need to be able to live with what is written in the contract, or the contract should be revised.

We have invested heavily in fertilizing equipment so we want this to be an ongoing program; but I definitely feel that we need to be given a chance to improve in the area of the actual application. This is the most important step of all. It will add to the total cost to plan the project more carefully, but the important figure is return on investment. Anyone can dump fertilizer, but in time the results will speak for themselves.