THE KAINGAROA AIR SOWING ERA 1960-71

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SYNOPSIS

From 1960 to 1971 inclusive, 6500 ha were air sown at Kaingaroa with Pinus radiata. *Unsatisfactory seed application, seed predation and seedling frost-back were soon defined as problems. By 1968 the altitudinal and topographic limitations of sites suitable for air seeding had been described, but it was resolved that all areas sown would later have to be supplemented by planting. Improvements in controlling seed distribution from aircraft included the development of a modified helicopter seed slinger, and a new roller device to meter seed flow from fixed-wing aircraft. Seed frequency patterns across the swath sown and flight line espacement were rationalized for a fixed-wing aircraft with roller meter device, and navigational aids to facilitate flying were also developed. But analysis covering genetic gain, opportunity value, frost risk and tending expenses, together with direct costs, has resulted in a decision to curtail air sowing on Kaingaroa cutovers.*

GENERAL

Since 1960, 6500 ha of Kaingaroa State Forest have been air sown with *Pinus radiata* seed, usually at a rate of 2.24 kg/ha, applied in spring. The procedure was adopted after finding that natural regeneration on winter-logged cutover was too sparse to give a satisfactory stocking. Initially air sowing was successful, but it became less reliable over the years, possibly because of the increase of seed-eating birds and mice as the forest was opened up for felling and because of increased logging on the frost-prone southern reaches of the forest.

Attempts to poison birds and mice proved unsuccessful but investigations into the effect of frost on seedlings resulted in a definition of altitudinal and topographic limitations of the area considered suitable for air seeding. In spite of this, since 1968 it has been necessary to prescribe that all air sown areas should be walked by labourers in order to plant gaps in stocking with nursery seedlings. This meant that the major advantage of air sowing as a method of establishment — low demand on costly manpower — had been lost.

However, technical improvements in seed distribution promised to reduce the cost and increase the effectiveness of air sowing.

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TECHNICAL DEVELOPMENTS IN SEED DISTRIBUTION

Small-scale trials during 1958 and 1959 led to the first Kaingaroa air seeding operation in spring 1960. The Fletcher topdresser with fish-tail grass seeder that was used was blamed for the variable seed distribution which resulted. However, during the 1961, 1962 and 1963 air sowings, satisfactory seed distribution was recorded, and in all three operations the late J. van Bejyen flew a helicopter fitted with a modified spinning disc seed slinger. In its final form this slinger was mounted on telescoping linkage arms, and in flight it could be extended well below and parallel to the helicopter's skids. The metering device's gear wheels were ground down, grooved and fitted with fibreglass vanes. According to G. W. Hedderwick these modifications eliminated seed damage, and resulted in an even seed distribution throughout the swath breadth.

Unfortunately, between the 1963 and 1964 air sowings, the modified seed slinger disappeared from the scene. The company that owned it dissolved, and the engineer that had most to do with it, B. de Jong, left New Zealand. In any case, subsequent sowing operations carried out by helicopters involved the use of conventional seed slingers which meant a high percentage of seed was damaged against the skids in flight, and seed concentration peaks were produced at the extremities of the swath sown. This was an undesirable feature because it produced a banding effect in the resultant stocking.

Attention was then turned to fixed-wing aircraft, not only because of the poor performance experienced at that time by helicopters with seed slingers, but also because it was recognized that helicopters could work about only half as fast as suitable fixed-wing aircraft. Also the ability of helicopters to load on the spot was considered little advantage. When sowing at 2.24 kg/ha. more than 182 kg of seed is seldom required for an individual cutover area and this amount is easily held in the hopper of a fixed-wing aircraft.

In 1967, several aircraft fitted for air sowing were tested, and a fixed-wing aeroplane with gravity feed system and Swathmaster spreader designed for fertilizing farms was selected. In contrast to a helicopter with conventional spinning disc seed slinger, this gear did not damage seed and produced a single seed concentration peak in the centre of the swath sown. When swathes were overlapped, this resulted in a much better seed distribution. However, the gear had the disadvantage that the only way of regulating seed flow was by adjusting the size of opening formed in the floor of the seed hopper. This was unsatisfactory because flow rate changed depending on seed weight in the hopper, seed bridging effects, and in-flight vibration. In order to counter this calibration problem, a new method of controlling seed output was developed by Adastra Aviation Ltd working in conjunction with the Forest Service. Basically, seed was scooped out of the hopper from below by a rotating pitted roller, the speed of which was regulated by a pulley gear system and by adjusting the resistance in the electric motor powering the drive pulley. By 1971 the device had been tested to the satisfaction of the

Forest Service and the Civil Aviation Administration and is now in the process of being patented by Adastra Aviation Ltd, who hope it can be used for more precise fertilizer application and agricultural seeding as well as for pine seed sowing.

The new device was used for the 1971 Kaingaroa air sowing operation. Lengthy calibration on the airstrip and the use of many small loads to keep a constant check on seed flow rate (routine procedure in the past with fixed-wing aircraft) were dispensed with. A flight espacement of 25.5 instead of 20 m was also adopted, because Forest Service tests had shown that this was possible without significantly increasing the co-efficient of variation of seed sown per square meter (about 20%). The rudiments of the two seed-sowing methods are shown in Fig. 1.

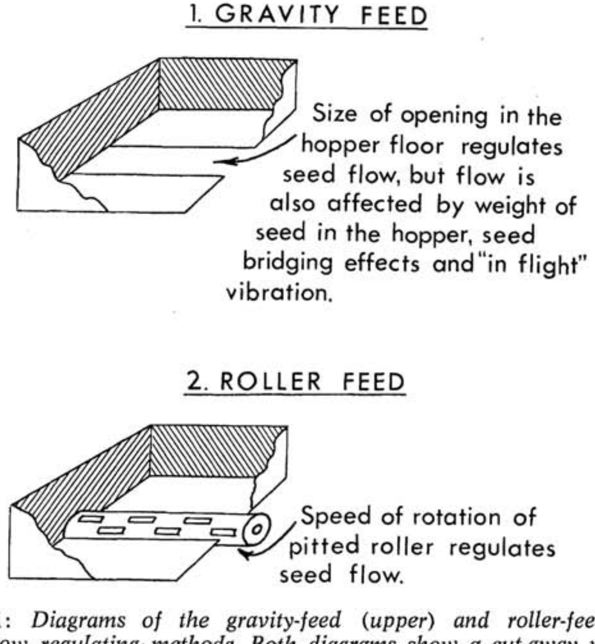

FIG. 1: *Diagrams of the gravity-feed (upper) and roller-feed (lower) seed-flow regulating methods. Both diagrams show a cut-away view of an aircraft hopper.*

Over the decade navigational aids improved also. From 1967, pilots were helped to achieve greater accuracy in spacing their flight lines by supplying them with suitably marked air photos of the areas to be sown; and in 1971, where possible, they were also helped by having each flight line marked by a ground controller waving a flag.

These improved seed distribution methods warranted investigations into the possibility of reducing the amount of seed sown per acre, but a recent cost analysis resulted in a decision to curtail investigations and Kaingaroa air sowing operations (see Table 1).

TABLE 1: 1971 COSTS OF RE-ESTABLISHING A "TYPICAL" KAINGAROA CUTOVER CLASS II* AREA WITH AND WITHOUT AIR SOWING

Method I (with Air Sowing)	$/ha	*Method II (without air sowing)*	$/ha
Air sowing			
Flying	2.37		
Seed (2.24 kg/ha bulk collection)	17.00		
Ground control	0.22		
Supplementation		*Planting*	
1100 stems/ha		1975 stems/ha	
Labour	18.50	Labour	35.80
ex-nursery trees	16.65	ex-nursery trees	32.10
Approx. cost of extending the rotation one year	39.50		
Slasher thinning	34.55		
	128.79		67.90

*Undulating country with a minimum slope of 2½°, below 670 m asl logged by tractor or mobile hauler.

Method I (with air sowing) has several hidden disadvantages:

(1) $17.00/ha is the price for radiata pine seed from unselect trees (hence the term bulk collection). If the seed for sowing had been collected from the 25 best forest trees per hectare it would cost $33.30/ha. In contrast, the ex-nursery trees in both models arise from the latter more expensive seed type (forest select seed). Hence Method II will give rise to more superior mature trees than Method I.

(2) With Method I there is a greater dependence on the weather. Out-of-season frosts will destroy young air-sown regeneration more readily than planted trees.

(3) By taking an extra year to re-establish (*i.e.,* Method I), the chances of having to release are increased.

(4) Using Method I the resultant stocking will be irregularly spaced and more variable in height and consequently tending will be more difficult.

CONCLUSION

Although air sowing has been a useful re-establishment procedure in times of less intensive management, it is opportune to discard it — especially in the light of the promise of re-establishment by planting of widely-spaced seedlings of high genetic quality.

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