TREE RELEASE FROM GRASS

N. A. DAVENHILL

Forest Research Institute, Rotorua

Summary

Effects of grass competition on newly planted radiata pine (*Pinus radiata*) and Douglas fir (*Pseudotsuga menziesii*) are discussed. Releasing of individual trees by hand-cutting and chemicals have limitations which have led to the development of overall spraying from the air with a mixture of amitrole T and atrazine. Despite generally excellent grass control as well as a marked stimulation of tree growth, there is room for improvement in this work, both in cost and application technique.

INTRODUCTION

RELEASING newly planted trees from grass competition is a major task in New Zealand afforestation. An estimated 5,500 acres of State forest needed releasing in 1969, making grass the third most important weed after gorse (*Ulex europaeus*) and bracken (*Pteridium aquilinum* var. *esculentum*) in the establishment phase. The problem will increase because more poor pasture and grazing land is being used for afforestation and because cultivation of scrub-covered sites frequently induces a volunteer grass sward.

The most obvious effect of tall grass on seedling trees is physical smothering; in high rainfall areas in particular, heavy growth of saturated dense grass may collapse and form a mat which will eventually kill many of the trees. Lesser smothering can lead to malformation and butt sweep, especially in radiata pine (*Pinus radiata*), and may have some bearing on tree toppling. In dense grass cover, especially in areas of high rainfall, trees are often attacked by fungi which may cause the death of the leading shoot. As rainfall decreases, the effect of root competition for moisture and nutrients becomes more marked; in dry climates it is often impossible to establish trees unless grass is rigorously controlled or eliminated. Trees which survive grass competition are often retarded for two or three years and their needles have a pale green or yellowish appearance compared with the healthy colour and normal growth of trees which have been released and tended. Trees which have their growth retarded from any cause are susceptible to browsing by rabbits and hares for a longer period and, also, the time taken for the trees to mature is increased, with consequent increases in costs of production and a lengthening of the rotation.

In radiata pine plantations, grass is troublesome normally only for the first year and a single releasing is often sufficient to allow the trees to become established and overtop the grass. Competition for nutrients and moisture, however, may continue until the canopy closes over and suppresses the grass completely. Douglas fir (*Pseudotsuga menziesii*), on the other hand, may be severely checked by grass for several years and is likely to require several releasings before it gets away. The more troublesome grasses are Yorkshire fog (*Holcus lanatus*), tall fescue (*Festuca arundinacea*), cocksfoot (*Dactylis glomerata*) and browntop (*Agrostis tenuis*). Other species may present a problem in some places.

HAND RELEASING

Where grass dominates the planting site, for example on old pasture land, it is still common to screef or scalp the vegetation off before planting each tree. This temporarily keeps the grass back from the immediate vicinity of the tree, but unless the screef is at least 1 square yard in area, vegetation from outside is likely to encroach on to the tree by late summer or autumn. Screefing is time-consuming and significantly reduces the number of trees planted each day, thus increasing the cost of planting. The bare soil also tends to attract the attention of rabbits and hares with a consequent increase in tree damage. Other important disadvantages are that the complete removal of vegetation may accelerate dehydration in times of drought, and conversely, in heavy soils, water tends to collect in the screef holes and drown the trees, especially Douglas fir. This may also lead to toppling.

Hand-cutting with slashers and fern hooks is effective in freeing trees from long grass, but does nothing to remove the root competition. It is costly in manpower, which could usefully be employed in other more productive work. Hand-releasing by casual or inexperienced labour can result in an unacceptable percentage of tree damage by "Sheffield blight" particularly where grass has been allowed to overtop and smother the trees. Above all, in large remote areas, unless there is an extensive work force, it is generally quite impossible to keep on top of the work sufficiently to release every tree before the grass has grown enough to seriously inhibit growth.

CHEMICAL RELEASING

Release cutting from grass competition has been largely replaced by the use of chemicals which are applied from equipment ranging from the ordinary knapsack pump and lance to the more sophisticated "Arbogard" and various types of inverted cone sprayers. The weedicides used in this type of spraying are non-selective, so it is necessary to protect each tree with a shield or cone while spraying the grass immediately around it. A recent innovation is the inverted cone sprayer which has nozzles spaced evenly around its rim. A single stroke of the handle or trigger permits a predetermined amount of spray to be applied accurately to a defined area around each tree. The main advantage of the inverted cone is that it enables the grass to be sprayed right to the base of the tree, giving more complete weed control than is possible with the upright cone which leaves an unsprayed circle of grass just where it is least wanted. Spraying individual trees is a slow operation, but it is faster and more effective than hand-cutting. It should not be considered as a cure for long grass, but as a preventive of grass competition so, for optimum results, grass should be short, preferably no taller than about 4 in. If spraying is done when the grass is short and before competition has become established, no time is lost in searching for seedlings. The main disadvantage of releasing individual trees (whether by hand cutting or chemical treatment) is that to be effective it must be completed over a short period of time. Using inverted cone equipment, rate of progress is about two acres per man-day. The ideal period for treatment extends over about two months and preferably less: therefore, where extensive areas require spraying with hand equipment, it is essential to start the work as early as possible after planting to ensure that the maximum area is treated before the spring flush of grass and herbaceous weeds begins.

The standard chemical treatment is a mixture of simazine, 2,2-DPA and amitrole. The commercial product is mixed in water at a rate of about 2 oz per gallon with the addition of 0.25% of a non-ionic surfactant. One gallon of spray will treat about 100 to 150 trees, and, provided the grass is short, certainly not above 6 in., control should be effective throughout the first growing season apart from a few resistant weeds which may occur locally. In addition, the dead herbage forms a useful mulch around each tree. If the grass is tall and rank, the effectiveness of the chemical is likely to be reduced, and there is a danger of the chemical being shed on to the tree causing considerable damage, particularly if the trees are growing actively. The best way of keeping grass short is to graze hard with store stock up to the time of planting, if possible.

Selective herbicides for grass control were not used in forest establishment operations in New Zealand prior to 1969. In 1967-8, trials were laid down by the Forest Research Institute to test chemicals that had recently appeared on the market, both for their effectiveness in weed control and to determine the susceptibility of trees, in particular radiata pine and Douglas fir. The first trial was a comprehensive screening of 23 different chemical formulations which were applied in mid-February to trees planted the previous winter. The treatments were applied with a CO₂ pressurized boom sprayer to simulate aerial spraying at 20 gal per acre. The most promising formulations were then selected for a second trial in which radiata pine and Douglas fir were planted in a closely-grazed browntop-dominated pasture. Results from the two trials indicated that three chemicals, namely, atrazine, prometon and amitrole T, stood out as having a marked inhibiting effect on grass and herbaceous weeds without appearing to cause any appreciable tree damage, although amitrole T did induce some temporary bleaching of needles. Used independently, none of these chemicals was sufficiently versatile to maintain complete freedom from grass weeds unless applied at rates which would be quite uneconomic or cause damage to trees. When used in combinations, at relatively low rates, grass control was generally very satisfactory. Prometon has not been used operationally because it is not commercially available in New Zealand, but many organizations are now using a mixture of amitrole T and atrazine. At present there is no commercial product containing these two herbicides in New Zealand—it is, however, marketed in Australia. At present, New Zealand forest managers make up their own mixtures at rates found to be effective in local conditions.

A general prescription, suitable for most conditions, is approximately 2 lb amitrole T and 4 lb atrazine. These are applied in 30 gal of water per acre. Overall releasing from the air using these chemicals on radiata pine has been carried out successfully in several private and State forests since 1969. However, because the tolerance range of the trees is limited, and because application rates, to be effective, should not vary greatly, there have been partial failures. These have been due to a number of causes. Amongst them: leaving spraying until too late so that grass control is inadequate while damage to trees, which by that time are actively growing, is unacceptably high; inaccurate flying, leading to some areas being untreated and others sprayed at too high a rate—sometimes twice the prescribed quantity; attempting operations in unsatisfactory weather conditions, leading to uneven coverage and excessive drift. These are some of the factors which have to be considered for any aerial spraying operations, but for releasing they become especially critical for success.

Amitrole T contains ammonium thiocyanate as an activator. This interferes with chlorophyll production and needles of sprayed trees become

white. This looks alarming, but is only a temporary effect and is of little practical significance.

It is often difficult for the forest manager to decide whether or not to use aerial releasing in grass. The decision has to be made in good time to avoid spraying long grass and growing trees, but, in late winter or very early spring, grass is not much in evidence and there is a temptation to discount it. Local knowledge can be of prime importance and it must always be remembered that the cheapest and most effective control is obtained where ground is bare, or almost so. In situations where the ground is virtually bare, say, following intensive cultivation, atrazine alone has been used effectively, prior to planting, in grass-prone areas. Atrazine will normally prevent grass seeds from germinating long enough to allow the trees several months of unimpeded growth. Atrazine, too, has been shown to have a marked stimulating effect on tree growth (see Table 1) which may improve the chemical's cost efficiency.

TABLE 1: HEIGHTS OF TREES TREATED WITH ATRAZINE, ALONE AND IN COMBINATION WITH OTHER HERBICIDES (in inches)

<i>Treatment (lb/ac)</i>	<i>Radiata Pine</i>		<i>Douglas Fir</i>	
	<i>1st yr</i>	<i>2nd yr</i>	<i>1st yr</i>	<i>2nd yr</i>
atrazine 4	29.2	82.7	15.2	40.4
atrazine 8	29.8	83.1	12.1	33.4
atrazine 4/2,2-DPA 2	27.1	83.8	11.7	33.8
atrazine 4/prometon 2	28.6	85.3	10.9	31.5
atrazine 4/prometon 4	28.6	83.1	10.5	22.4
atrazine 4/prometon 8	25.6	84.3	5.7	20.6
atrazine 4/amitrole T 2	29.6	81.8	10.4	33.4
Control	16.3	57.3	8.2	23.4

The trees were planted in closely-grazed, predominantly browntop pasture in July 1969. Treatments were applied as a simulated aerial spraying on August 22, 1969.

N.B.: Radiata pine 2nd year heights were measured in April 1971, while still actively growing.

Little operational release spraying from the air has been applied to Douglas fir as yet, but FRI trials indicate that, if the trees are dormant with no suggestion of bud swelling, they are equally as tolerant as radiata pine to atrazine/amitrole T formulations.

Some forest managers are still hesitant to apply herbicides directly over the tops of newly-planted trees and prefer to use a pre-planting treatment with a non-selective material such as paraquat. With this practice, there is, of course, no direct risk to the crop, but owing to rapid inactivation there would be no long-term control. Residual herbicides such as atrazine may lose much of their effect because some disturbance of the soil surface is unavoidable during subsequent planting.

The granular formulations of chlorthiamid and dichlobenil have been widely screened at FRI for tree tolerance and for their effects on individual grasses. These chemicals, applied at 6 lb per acre completely killed and maintained long-term control over browntop, tall fescue, cocksfoot and Yorkshire fog which were specially sown in a trial at Rotorua. The granules were applied in late September, six months after sowing when

the grass was in active growth. The kill was so effective that indications are that 5 or even 4 lb per acre would ensure adequate release from these grasses—this is being currently tested. In another trial, these granules were placed directly around the bases of radiata pine and Douglas fir planted on bare ground. Weed growth was almost entirely prevented with no damage to trees attributable to the herbicides. Earlier trials were less conclusive, probably because insufficient attention was given to the time of application. These herbicides must be applied in cool temperatures to minimize volatilization. Large-scale use of granules has been hindered because of their high cost and because no satisfactory method of applying them accurately from the air has been devised.

DISCUSSION

Hand-cutting or spraying individual trees are costly methods of releasing. The development of effective aerial techniques, although they may not be much cheaper in money, allow large programmes to be completed in a short time and markedly reduce manpower requirements. Aerial spraying is, however, far from efficient at present, the main drawbacks being:

- (1) *Cost*: The cost per acre for aerial releasing from grass in 1970 was approximately \$22-23 per acre. A cheaper herbicide is urgently needed, and with several chemical companies now showing increased interest in forestry problems, there are hopes that a more economical material will be introduced.
- (2) *Limited Season for Treatment*: At present spraying needs to be carried out in late winter or early spring while the grass is short and the trees not actively growing, but our unstable weather conditions make it often difficult for timetables to be adhered to. Several new herbicides are currently undergoing screening and tolerance tests at FRI, and some show a high degree of selectivity to trees even during periods of active growth.
- (3) *Failures*: Unsatisfactory results from poor flying techniques, incorrect nozzle calibration, imperfect equipment, lack of sufficient ground control, and unsuitable climatic conditions are all too common. Aerial companies are now becoming increasingly aware of the need for educating their pilots in the critical standards required for successful releasing, and also of the necessity to improve and maintain their equipment. Forest managers are also becoming aware of the critical limit that must be specified in aerial application of chemicals.

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