Current methods of controlling gorse (*Ulex europaeus* L.) in New Zealand

G.W. Ivens
Agronomy Department, Massey University
Palmerston North, New Zealand

SUMMARY

Gorse is the most serious brush weed problem in New Zealand and this paper reviews existing control measures. The insects so far released for biological control have had little effect. For clearing established gorse, root raking is effective but expensive. Other methods involve mechanical, burning, chemical or combined treatments. The principal herbicide used is 2,4,5-T, alone or mixed with picloram or dicamba. Aerial spraying is common but relatively high volume rates are needed. U.L.V. mist-blower application from the ground is also popular. After clearing, treatment of stump regrowth is necessary and, whatever initial clearing method is used, reinvasion from seed is a problem. Pasture and stock management play a large part in overcoming this. Current developments in control methods and in biological studies of gorse are discussed briefly.

INTRODUCTION

When Charles Darwin visited the Bay of Islands in 1835 gorse was already well established, having been grown for shelter, fencing and fodder (Allan, 1940). By 1859, however, planting had been forbidden in Taranaki and the plant was one of the first species to be declared a noxious weed in 1900 (Moss, 1960). Matthews (1975) recently estimated that at least 13 million ℓ of 2,4,5-T had been sprayed on gorse in New Zealand, in spite of which it remains the country's most serious brush weed on an estimated 500,000 ha of hill country (Mason, 1973), of concern both to pastoral farmers and foresters.

Gorse is tackled by a wide variety of biological, mechanical and chemical methods. The popularity of the latter, however, has increased considerably with the introduction in 1975 of the subsidy scheme under which the farmer can reclaim 75% of the costs of chemical used in approved control operations.

The present paper reviews current methods of clearing, indicates the type of follow up measures needed to prevent reinvasion of cleared areas, and outlines some of the research being undertaken in New Zealand to develop improvements on existing methods.

Existing control methods

(i) Biological control

Efforts to control gorse biologically have centred largely upon the introduction in 1931 of the seed-eating weevil *Apion ulicis* (Miller, 1970). This insect has established successfully

and is now widely distributed but its effects are very limited. It destroys large numbers of seeds at some times of the year but plenty of viable seed is produced at other times when the weevil is not active. Even if production of seeds were to be entirely prevented, existing stocks in the soil would probably suffice to maintain a gorse problem for at least 50 years.

Alternative and possibly more effective insects investigated by the Commonwealth Institute of Biological Control in the 1960s included another weevil (*Apion scutellare*), which forms galls on the stems, and a moth (*Depressaria umbellana*) with stem-feeding larvae (Zwölfer, 1965). The investigation ceased in 1965, however, and although inconclusive releases were made in Hawaii the insects were not released in New Zealand.

(ii) Control of established gorse

On gorse infested land the thickets are commonly 3 to 4 m high and, although providing useful shelter for sheep and a certain amount of browse, contain little or no grazing. Such thickets must be cleared if the land is to be developed for pasture or forestry and a variety of methods are used.

Of the mechanical methods available, root-raking is the only one which disposes of the bushes in a single operation. Considerable skill is needed to operate the machines on steep slopes but, although the method is expensive (of the order of $200/ha), it avoids the problem of stump regrowth and can provide good conditions for the rapid establishment of oversown pasture.

With other mechanical operations involving cutting, burning is also necessary for the removal of the cut material. Slow, hot burns can kill a proportion of the stumps but normally burning is followed by much stump regrowth which must later be sprayed. In Forest Research Institute work hot burns resulting in relatively little stump regrowth have been obtained successfully after pre-treatment with heavy roller-crushers (Page, 1975).

Instead of being used as a follow-up to cutting or crushing, burning frequently forms the first stage of a clearing program. Gorse more than 5 years old with sufficient dry litter beneath it burns well under good conditions. In a cool, wet summer it may be necessary to apply a pre-burn spray of 2,4,5-T plus diquat three months in advance to permit satisfactory burning, especially on shady faces (Anon, 1974). The aim of this treatment is desiccation rather than kill of entire bushes so that, as with cutting or burning without preliminary spraying, follow-up spraying of stump regrowth is normally needed.

The third possible way of starting a gorse control program is to attempt to kill the bushes with the initial chemical treatment and to follow up by burning when the bushes are dead. If successful, no treatment of stump regrowth is needed but seedling regrowth must still be dealt with.

(iii) Chemical treatments

The standard herbicide for controlling gorse has long been 2,4,5-T in high-or low-volatile ester formulations (Matthews, 1951) and doses of the order of 4 to 8 kg/ha are normally used on

established stands. More recently mixtures of 2,4,5-T with picloram or dicamba have been introduced and are claimed to give more reliable results than 2,4,5-T alone, especially outside the most susceptible summer spraying period (Upritchard, 1969; Taylor and Patterson, 1969).

Ground application is employed mostly for the treatment of small clumps or individual bushes. With hand guns dilute herbicide (0.1 to 0.2% a.i.) is applied at volumes of 2000 to 4000 ℓ/ha. The large amounts of water needed, however, are a disadvantage and increasing use is being made of motorized knapsacks. With standard mist-blowers concentrations of the order of 0.8 to 1.7% a.i. are applied, thereby reducing the volume of water to one eighth of that needed with hand guns. Further economies in diluent are achieved with an ultra-low-volume or Micron attachment and some operators achieve good results with concentrations of 5 to 10% a.i. (down to about one fiftieth of the volume used with hand guns). With such treatment, experience is needed to obtain complete and even coverage with a more or less invisible mist.

Aerial spraying is the only practical possibility for larger areas and may be done with fixed-wing aircraft or helicopters. Recent experience suggests that the best results on gorse are obtained using the relatively high volumes of 200 to 400 ℓ/ha (Naish, 1976) and, as these rates can only be achieved with slow flying aircraft, the use of helicopters is increasing. It is recognized that aerial spraying of gorse more than 1.5 m tall is chancy so that this method of application is mostly employed either as a pre-burn treatment on taller bush or for the control of smaller regrowth.

(iv) Control of stump regrowth

After the initial clearing a greater or less amount of regrowth from the stumps commonly occurs. In the early stages it may be possible to check the growth of the shoots by browsing with sheep, or better, goats. In the great majority of cases, however, the regeneration must sooner or later be sprayed. Spraying the regrowth after burning (with or without preliminary cutting or desiccation) is generally regarded as more effective and economical than spraying mature gorse and is the commonest type of treatment. The same range of chemicals and application methods is employed but the greater ease of getting into regrowth increases the number of situations in which spot spraying from the ground is practicable.

Spraying when the shoots have grown to 50 to 100 cm normally gives good results. When treating younger growth there is a danger of dormant stumps sprouting after the spray application while, with more advanced growth, larger volumes of spray are needed and complete coverage is more difficult. The commonest time for gorse burning is the March-April period, before the first autumn rains, and the regrowth is commonly sprayed in November or December of the following year, 20 months later. Whether spraying relatively advanced regrowth at this time is, in fact, superior to treating smaller regrowth in the late summer, 10 or 11 months after burning, has yet to be determined by experiment and may well depend on the season.

(v) Control of seedlings

Once established gorse plants have been controlled, prevention of re-invasion from seed is necessary. The reservoir of seed in the soil after clearing ranges from 2500/m^2 (Moss, 1959) to 10 000/m^2 (our experimental site). There is a high degree of dormancy and the seed can remain viable for at least 25 years (Moss, 1959).

Following clearing a flush of germination occurs which may be accentuated by burning, though fire may also be expected to kill some of the shallower seeds. Germination of gorse seed continues as long as moisture and temperature conditions are suitable but slows or ceases as a ground cover is re-established.

Seedlings exposed to a regrowth spray are killed as readily as shoots from stumps. If the regrowth spray is applied as a spot treatment, however, many seedlings survive and, even after overall spraying, further seedling emergence generally occurs before the ground cover becomes dense enough to prevent it.

The control of gorse seedlings at this stage is the main key to successful pasture establishment and must be achieved by encouraging the rapid development of pasture species and by livestock management. Attempts have been made to find herbicide treatments which will kill seedlings selectively. Even as young seedlings, however, good kills are given only by 2,4,5-T, alone or in mixtures (Ivens, 1977) and such materials are very damaging to clovers.

It is important to get the sown pasture species established as quickly as possible after burning, so that high seed rates (40 kg/ha of ryegrass/clover mixtures) are recommended combined with generous superphosphate applications (750 kg/ha). More needs to be learnt about the ability of different pasture plants to suppress gorse seedlings and about responses to fertilizer. For example, in association with ryegrass, gorse responds to phosphate in much the same way as white clover. Application of nitrogen, to which the grass shows a much stronger response than gorse (Mlowe, personal communication) could well result in increased suppression of gorse seedlings and could, perhaps, be combined with delayed oversowing of clover.

Livestock management is equally important. The sown pasture should be grazed lightly as soon as possible and, after about 6 months, mob-stocking with about 500 sheep/ha for 2 to 3 days is recommended. Brief periods of heavy grazing followed by 3 to 4 week rests have been found to kill much larger numbers of gorse seedlings than set stocking but care is needed to avoid overgrazing. Mob-stocking should be continued for at least 3 years and must be combined with adequate top-dressing, thistle control and spot spraying of any surviving gorse plants (Anon, 1974).

In developing gorse country for forestry the problem of preventing re-invasion from seed is different. Advantage cannot be taken of the competitive effects of pasture species, the planted trees provide little competition for a number of years and the grazing activity of livestock cannot be utilized. On the other hand young *Pinus radiata* can be selectively sprayed with 2,4,5-T after planting out, while they are dormant (Davenhill and Preest, 1976)

and once a closed canopy has been formed, remaining gorse has little effect on tree growth. Nevertheless gorse infested land is regarded as the most expensive for forest development and made up only 6.3% of the total area planted in 1974/75 (Preest, 1976).

Current research developments

During the past few years interest in gorse research has revived and many aspects are under active investigation. Work on biological control with *Apion scutellare*, *Depressaria umbellana* and other insects was resumed by D.S.I.R. in 1976 and field releases are planned after further safety testing. Further information is being sought by Forest Research Institute workers on the timing and techniques of burning, and on the effects of various mechanical and chemical pre-burn treatments.

On the chemical side 2,4,5-T is expected to remain the mainstay for treatments but several new additives are being investigated. A mixture of 2,4,5-T and 2,3,6-TBA is provisionally registered for field assessment. Chemicals at the preliminary testing stage include glyphosate and benazolin, a product thought to have a synergistic action in combination with dicamba.

Biological studies at Massey University are being directed towards an improved understanding of the factors involved in the germination and establishment of gorse in competition with pasture species. Attempts are being made to find the reasons behind the flush of germination which follows clearing and gradually declines as grasses and other plants cover the ground. Competition is being studied both in the glasshouse and in the field. In replacement series trials using combinations of gorse and Nui ryegrass, the ratio of gorse to grass growth is low but increases with cutting. In the field, a high degree of seedling gorse suppression has been recorded by sowing in combination with various pasture species but grazing has had an even larger effect. Completion of the current research program should greatly facilitate specification of the conditions under which seedling re-invasion can be kept to a minimum.

REFERENCES

Allan, H.H. (1940).- A handbook of the naturalized flora of New Zealand. D.S.I.R. Bull. 83.

Anonymous (1974).- Weeds Committee, Wanganui Agric. Advisory Committee. Gorse eradication pp 16.

Davenhill, N.A. and Preest, S.A. (1976).- Tolerance of radiata pine, douglas fir and some eucalypts to herbicides. *N.Z. For. Res. Inst. Symp. No.* 18. *The use of herbicides in foresty in New Zealand*, 41-44.

Ivens, G.W. (1977).- Susceptibility of seedling gorse to herbicides. *Proceedings 30th N.Z. Weed and Pest Cont. Conf.* 61-65.

Mason, G.W. (1973).- A review of chemical control of brush-weeds on agricultural land in New Zealand. *Proceedings 4th Asian-Pacific Weed Sci. Conf.* 339-346.

Matthews, L.J. (1951).- Hormone weedkillers for scrub control. *N.Z. J. Agric.* 82 : 11-13.

Matthews, L.J. (1975).- Weed control by chemical methods. M.A.F. Bull. No. 329. Govt. Printer, Wellington.

Miller, D. (1970).- Biological control of weeds in New Zealand 1927-48. D.S.I.R. Inf. Ser. No. 74 pp 104.

Moss, G.R. (1959).- The gorse seed problem. *Proceedings 12th N.Z. Weed Cont. Conf.* 59-64.

Moss, G.R. (1960).- Gorse a weed problem of thousands of acres of farm land. *N.Z. J. Agric.* 100 : 561-567.

Naish, R.W. (1976).- *N.Z. For. Res. Inst. Symp. No.* 18. *The use of herbicides in forestry in New Zealand,* 70-72.

Page, A.I. (1975).- Gravity rolling at night. *For. Ind. Rev.* 6 (10).

Preest, D.S. (1976).- The magnitude of vegetation control operations in New Zealand forestry. *N.Z. For. Res. Inst. Symp. No.* 18. *The use of herbicides in forestry in New Zealand,* 273-276.

Taylor, R.L. and Patterson, J. (1969).- Control of scrub weeds with 2,4,5-T plus dicamba. *Proceedings 22nd N.Z. Weed and Pest Cont. Conf.* 178-179.

Upritchard, E.A. (1969).- Formulations of picloram with 2,4,5-T for brushweed control. *Proceedings 22nd N.Z. Weed and Pest Cont. Conf.* 180-186.

Zwölfer, H. (1965).- Rep. Commonwealth Inst. Biol. Control *Ulex europaeus* project pp 4. C.I.B.C., Delémont, Switzerland.