GORSE CONTROL ON UNPLOUGHABLE HILL COUNTRY

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SUMMARY

MANAGEMENT practices under trial in Raglan County have shown that the best method of controlling gorse on unploughable hill country is to confine the gorse to blocks and to wait until these become dense enough to enable a clean standing burn. This should be followed up by oversowing with a 30 lb pasture mixture accompanied by heavy topdressing with the correct fertiliser and minor elements if required. If this area is well fenced and continuously tight stocked with sheep from the time of the burn, no spot spraying to control regrowth will be necessary until the second summer following sowing. This approach, besides giving best results, was cheaper than either ground or helicopter spraying methods widely in use.

INTRODUCTION

Gorse (*Ulex europaeus*) is our most important weed by far. It covers about 100,000 acres of potentially highly productive land and has taken over many thousands of acres of low-producing country, mostly unploughable hill country where it is much harder to eradicate.

The control of gorse on unploughable land is the basis for this paper. My observations and subsequent recommendations are based on a farm-scale trial that has been running for the past three summers and, though many of the observations are not new, the results overall have been encouraging enough for me to confirm or refute the many assumptions surrounding this work.

THE TRIAL

By 1956 it was widely accepted that 3 to 4 lb acid equivalent of 2,4,5-T would kill gorse, usually at 1 gallon, containing 3.6 lb acid equivalent per acre. At that time 2,4,5-T was costing £4 9s. 6d. (now £4 16s. 6d.) a gallon, and also with aerial spraying coming into fashion large sums of money and quantities of chemicals were being spent on gorse control with, in many cases, very indifferent results. In order to find out why, the Director of the Extension Division let us select 32½ acres of reverted hill country, heavily infested with gorse, in the Te Uku area of the Raglan County for an experiment. The farm selected was a good one, because it was being developed under marginal lands assistance, with the farmer at that stage just completing the grassing of his tractor country out of gorse, and wondering how best to tackle his low phosphate, molybdenum responsive, steep greywacke hill country. We decided on four main lines of attack and fenced the 32½ acres up accordingly.

Block 1: 14½ acres of dense old-man gorse and bracken fern about 6 ft tall that had not been fired for at least five years.

Block 2: 4½ acres of moderately heavy regrowth gorse and bracken fern about 3 ft tall that had been burnt two years previously and subsequently left to revert.

Blocks 3 and 4: 7½ and 6 acres respectively of fairly dense gorse about 4 ft tall with some broom and bracken fern that had been burnt two years previously and oversown with clovers and topdressed but now rapidly reverting.

To avoid confusion all future discussion will refer to individual blocks. The trial got away to a good start on 4 March 1957 with an excellent burn on Block 1 because of dense dry cover assisted by a light drawing wind on a day of low humidity. Straight after the burn but before oversowing sheep were turned on to keep on top of seedling gorse and fern growth. Molybdenum superphosphate was aerially spread over the whole

32½ acres at 6 cwt per acre on 13 March, and on 11 April we oversowed Block 1 by hand at 30 lb per acre with the following mixture of Government certified seed: 3 lb of crested dogtail, 4 lb of cocksfoot, 4 lb of paspalum, 12 lb of perennial ryegrass, 2 lb of white clover, 4½ lb of tallarook subterranean clover, and ½ lb of *Lotus major*. The heavy clover seeding was part of the experiment to try to smother the gorse seedlings.

In the meantime Block 3 had been sprayed with 2,4,5-T at 3.6 lb acid equivalent per acre by helicopter during perfect weather on 7 March. The pilot crossing the area four times, twice each way, applied the hormone evenly in 60 gallons of water per acre. His boom was 24 ft 9 in. wide, and the hormone was forced through a jet size 49 D16 at 20 lb pressure, giving a swath width of 60 ft at a flying height of 10 to 12 ft. The whole job was completed in 35 minutes.

The ground spraying was to be done on the same day, but breakdowns delayed the contractor until 8 April. Six days' work saw first Block 4 then Block 2 completed, though with the lateness of spraying we stepped up the 2,4,5-T to 4.95 lb acid equivalent per acre. The plant was a high-volume one mixing 2.9 lb acid equivalent of 2,4,5-T to 200 gallons of water and applying usually 270 to 300 gallons of mixture per acre with a size 7 nozzle at a working pressure of 275 lb. A red dye, rhodamine, was used at ¼ lb per acre as a marker.

We had intended to oversow Blocks 2, 3, and 4 with clover the same autumn, but were too late.

Over the winter of 1957 the subdivisional fences were completed. Block 1 had a most impressive strike of dark green vigorous pasture which compared most favourably with an adjoining sickly area sown by the farmer with the usual 40 lb of grass seed and 3 cwt of superphosphate. Continual heavy sheep stocking was keeping on top of the vigorous fern and gorse regrowth.

Blocks 2 and 4 were very slow in showing any effect from the ground spraying; not until mid August could one observe some 70 to 80 per cent of the bushes browning off. Block 3, sprayed by the helicopter in March, by contrast, was browning one month after treatment and by mid June looked like a 95 per cent kill. With fern growth dense by mid August, 1 acre was burnt and oversown with clovers out of interest. Government certified seed was used, the mixture comprising 4 lb of tallarook subterranean clover, 2 lb of white clover, and ½ lb of cowgrass.

Through September and October the pasture on Block 1 strengthened, with lotus and white clover forming a dense mat in the shady places and subterranean clover on the sunny faces running over the bare patches. Continual heavy sheep stocking was controlling regrowth and not harming the pasture. Blocks 2 and 4 were opening up as the gorse died back and allowed the stock to push through. There were no spring gorse flowers showing. Block 3 had such a dense fern base by now that it was decided to burn it in the summer. With some misgiving we noted the odd flowers and green lower growth appearing on many plants. The small area burnt and oversown with clovers in the spring was having a real struggle with only self-sown lotus making much headway against the competition of slugs and fern fronds.

By 20 January 1958 Block 1 was still outstanding with remarkably heavy sheep numbers carried in the spring. On the 14½ acres we had 200 for two months continuously and later 400 for three weeks as the fern became a problem. Regrowth was worst in any place where the sheep could or would not graze readily. At this time we subdivided this area to compare continual hard grazing at the expense if necessary of the sward, with nursing the pasture even if the regrowth looked like getting away. The experiment was of short duration, as the regrowth grew and hardened quicker than we could get the pasture up to cattle size, causing us to return to continual tight stocking. Blocks 2 and 4 by January had a final kill from the ground spraying of about 50 and 90 per cent respectively, the difference being put down to colder temperature during spraying. Block 2 was oversown with the same 30 lb pasture mixture in the autumn, but Block 4, with only

Block 3 being sprayed by helicopter.

A good pasture was obtained on Block 1 by oversowing and ample topdressing after the burn, with heavy sheep stocking controlling gorse regrowth.

Block 1 foreground showing the good pasture obtained by oversowing and ample topdressing after the burn, with heavy sheep stocking controlling gorse regrowth.

30 to 40 per cent open ground, was oversown with clovers only and crushed with stock. We tried burning before oversowing, with about 50 per cent success in Block 2, but none in Block 4 where stock tracks formed fire breaks.

Block 3 had by now deteriorated until 90 per cent of the bushes were putting out strong regrowth. Fortunately stock had not pushed through the dense fern bottom and we had a successful fire on 12 February which was immediately oversown with our 30 lb pasture mixture. The remaining 3 cwt per acre of serpentine superphosphate was spread over the 32½ acres in the autumn of 1958, thus completing our capital topdressing.

By December 1958 Block 1 had settled down to a balanced ryegrass-white clover pasture, but regrowth had beaten us during the very wet, strong-growing spring. Scattered bushes up to 18 in. high had hardened and following closing for 10 days to let fresh tip growth appear spot spraying started on 20 January by the same contractor now using a proprietary material containing 4 lb acid equivalent of mixed isomers of trichlorophenoxyacetic acid. An average of 2.9 pints or 1.4 lb acid equivalent of trichlorophenoxyacetic acid were used during the 2½ man-hours taken per acre. Blocks 2 and 3 also required spot spraying by this time, with an average of 2.66 pints or 1.3 lb acid equivalent of trichlorophenoxyacetic acid and 2.8 pints or 1.4 lb acid equivalent of trichlorophenoxyacetic acid respectively being used in the 2 man-hours taken per acre. Block 4 at this stage had very little regrowth showing, as 40 per cent of the area was densely covered by bracken fern, young broom, and manuka.

COSTS INVOLVED

The costs are extremely important to anyone contemplating this work, as in this trial we had every opportunity to keep them to a minimum. Records were kept of all the work, and the costs were then corrected to the figures prevailing had the farmer paid for the job under good conditions. I have brought the costs up to date since prices are still rising.

FENCING

An average hill farm will have 1 chain of fence for every acre developed this way. Fencing costs vary from £2 a chain for the suggested 4-wire sheep electric fence to £8 + for the standard 7-wire fence. As half of the cost can be fairly charged against the block, I have taken the highest figure £4.

TOPDRESSING

A total of 9 cwt of phosphate per acre has been spread over the first 18 months of development. This is on accepted capital quantity, and working on an average figure of 15s. per cwt aerially spread we find the total per acre is £6 15s.

AERIAL SPRAYING

Helicopter hire at the time of treatment (1957) ranged from £6 to £9 an acre. A fair figure for today would be £8 for helicopter and about £5 10s. for the more promising "Swathmaster" spray boom on the fixed wing aircraft. I have taken £8.

GROUND SPRAYING

The contractor charges 30s. an hour for the hire of himself and his plant, but when on the job, for half the time he employs a man to assist him, at 10s. an hour. Therefore I have allowed 25s. an hour. Actual times taken per acre for each block are used.

COSTS OF MATERIALS

Isomers of trichlorophenoxyacetic acid, rhodamine, and seeds are all based on ruling prices.

WHAT THE COSTS SHOW

The costs show that the man who has surplus capital available from a clean property, run in association with a gorse hill block, is best fitted to take on this work and that any method involving a preliminary spraying increases the cost by £10 an acre besides being of doubtful value.

DETAILED COSTS PER ACRE FOR EACH BLOCK

Block 1—Burnt, oversown, and spot sprayed

	£	s.	d.	£	s.	d.
Topdressing and fencing				10	15	0
Oversowing, 30 lb pasture mixture	6	0	0			
Labour	10	0				
				6	10	0
Spot spraying						
Labour, 2½ hours @ 25s.	3	2	6			
2,4,5-T, 2.9 pints @ £4 13s. 6d.	1	13	6			
Rhodamine dye @ 42s. lb	2	0				
				4	18	0
Total to developed stage				22	3	0

Block 2—Ground sprayed, part burnt, oversown, and spot sprayed

	£	s.	d.	£	s.	d.
Topdressing and fencing				10	15	0
Ground spraying						
Labour, 4½ hours @ 25s.	5	12	6			
2,4,5-T, 1 gallon	4	16	6			
Rhodamine dye @ 42s.	10	0				
				10	19	0
Oversowing, 30 lb pasture mixture	6	0	0			
Labour	10	0				
				6	10	0
Spot spraying						
Labour, 2 hours @ 25s.	2	10	0			
2,4,5-T, 2.66 pints @ £4 13s. 6d.	1	10	0			
Rhodamine dye	2	0				
				4	2	0
Total to developed stage				32	6	0

Block 3—Helicopter sprayed, burnt, oversown, and spot sprayed

	£	s.	d.	£	s.	d.
Topdressing and fencing				10	15	0
Helicopter spraying						
Hire of plane	8	0	0			
2,4,5-T, 1 gallon	4	16	6			
				12	16	6
Oversowing, 30 lb pasture mixture	6	0	0			
Labour	10	0				
				6	10	0
Spot spraying						
Labour, 2 hours @ 25s.	2	10	0			
2,4,5-T, 2.8 pints @ £4 13s. 6d.	1	12	6			
Rhodamine dye @ 42s.	2	0				
				4	4	6
Total to partially developed stage				34	6	0

Block 4—Ground sprayed, oversown clovers only

	£	s.	d.	£	s.	d.
Topdressing and fencing				10	15	0
Ground spraying						
Labour, 5 hours @ 25s.	6	5	0			
2,4,5-T, 1 gallon	4	16	6			
Rhodamine dye		10	0			
				11	11	6
Oversowing, 6½ lb of clover only	1	10	0			
Labour		10	0			
				2	0	0
Total to partially developed stage				24	6	6

STOCKING

One cost not accounted for is the intangible one, loss of profit on sheep. Despite the fact that we had the benefit of an extra two years' grazing on Block 1 we still lost an estimated 5s. a head on our sheep. With some 30 sheep required per acre at times 5s. for an average of 15, or £3 15s., an acre gives a good idea. This loss has been due to three reasons:

1. Because we were working with hoggets and ewes.
2. Because this was probably the best sheep paddock on the farm with sheep turned out after crushing going on to inferior feed.
3. Market fluctuations.

Despite the small loss debited to Block 1, the return from grazing is far in advance of the other blocks, where practically no sheep have been carried for the first two years. The farmer and myself are convinced that wethers would be the desirable sheep, and further we are sure that if this was an ordinary farm with the associated good pasture blocks, we could have made money with our sheep. Stock would have been kept in good store condition by alternating tight grazing with a spell on good pastures and with any profit coming from wool not fattening. Cattle have never been used on the blocks.

THE RESULT

Since drawing up the costs a final inspection was made on 3 June before writing this paper.

Block 1 is still outstanding. Isomers of trichlorophenoxyacetic acid have given a very quick browning off, with most plants now five months after treatment grey and brittle. Ninety-five per cent of the regrowth has been sprayed, with hard-grazed plants most resistant. The sward is dense with strong ryegrass on the poorest faces, and a high proportion of white and subterranean clovers, with paspalum and cocksfoot showing up. Gorse seedling numbers are only a fraction of the previous years' strike, and bracken fern is almost eliminated after two years' tight grazing. Old-man gorse sticks, from half of which basal regrowth was noted, have mostly fallen over and disintegrated. I call this block developed and consider that topdressing and stocking will provide further improvement. Rotational grazing was commenced in April and good returns are expected in the future. This block illustrates the cheapest and soundest solution of the problem of gorse on unploughable hill country.

Block 2 illustrates what can be expected on any area let go for two years following a burn. Spot spraying has picked up 95 per cent of the regrowth and this spring the farmer will harrow with horses and burn the top hamper. Though the pasture is nowhere near the standard found on Block 1, it is improving all the time as fog and browntop are replaced by ryegrass, cocksfoot, and the clovers. There are very few gorse seedlings and I now call this area developed. We have lost one year's grazing and paid £10 more per acre and ended up with an inferior result to Block 1.

Block 3 has completed one year in pasture and still has bare ground showing. Spot spraying has picked up 80 per cent of the regrowth, but

there are still plenty of gorse seedlings. They may have been encouraged by the open sward, but certainly the helicopter has been of no apparent value as a suppresser of gorse seedlings. There is a fair clover base with ryegrass only on odd fertile patches and fog the dominant grass. The method tried on this block has little practical value, having cost the most to date and still requiring a further year's work before it can be considered developed.

Burning in spring and oversowing seems inadvisable on this heavy clay country, as despite the good burn that is possible, the subsequent oversowing invariably fails.

Block 4 has shown some of the pitfalls peculiar to this work. Only 40 per cent of this block is reasonably open with a sprinkling of oversown clovers in these patches and Yorkshire fog the only grass in any quantity. No spot spraying was attempted this autumn as, though gorse regrowth up to 18 in. is now appearing, it is difficult to locate among the heavy regrowth of bracken fern and broom. Our first mistake was opening up the area by feeding hay to cattle. This provided good tracks for the ground spray man, but defeated the all-important follow-up fire. Then we did not have enough cattle to crush with and what few we had were loathe to push their way through dying gorse. Our sheep were mainly concentrated on Block 1 and were not interested in this tough going.

We have ended up two years after a practically 100 per cent initial kill of gorse by ground spraying, with a dirty block needing considerable work on development. Even worse, gorse is coming back, and this season patch burning, oversowing, crush stocking, and follow-up spot spraying will be essential. We have learnt several lessons from this area, namely, that opening up an area before burning is unwise, that one should not take on more country than one can stock, and that reliance on volunteer pasture species is not sound.

AERIAL SPRAYING

The results obtained by us and by others in the Raglan district with the helicopter have been unsatisfactory. The claim of a minimum kill of 50 per cent has applied in our case to each bush, but not to the whole stand, which, of course, is useless. Why then has it failed? In fairness to the helicopter the gorse should have been sprayed as we intended before it hardened in March. However, the contractors were willing to accept payment at that time. Further, I am convinced that 60 gallons of water is insufficient as a carrier, as contrary to our expectations the weakest effects were obtained not in the fern-protected dense areas but with the exposed bushes that received the full treatment. The fringes and gullies were also hardly affected, but air currents played a big part in this. The "Swath-master" spray boom attached to a fixed wing plane shows promise in trial work, because it will apply 1 gallon of 2,4,5-T in 100 gallons of water for £10 an acre.

Aerial methods have no place where gorse can be confined to dense blocks and burnt, but they may have some place in follow-up spot spraying of inaccessible localities despite the check to clovers from an overall application. Old-man gorse plants with green growth only at the exposed heads also appear susceptible. The time factor will favour this method, but on current prices the dearest spot spraying we had done was £5 per acre, and this is half the cheapest aerial application.

DISCUSSION AND RECOMMENDATIONS

Gorse can be controlled on unploughable hill country, but anyone taking on this work must realise that it will cost a minimum of £22 an acre at current prices, and that to get the best value from 2,4,5-T the surface area of the gorse bushes to be sprayed should be reduced to a minimum.

On an average gorse farm spot spraying will soon have the gorse confined to the dense blocks after which the number of acres able to be tackled will be entirely governed by the number of sheep available. In our experi-

ence cattle were never necessary, but up to 30 sheep per acre were required for a period of up to three weeks at the height of the spring seedling regrowth. If we have a 20-acre block being developed, we will require 600 wethers and straight after this nearly all these 600 wethers will have to be elsewhere. On a hill farm carrying two sheep per acre a balance of 300 acres of grass would be required if we were not to lose money on our stock. It is far better to take a small block and do the job properly.

A dense three-year-old block of gorse should be selected early and closed to let a tinder dry, thick fern and grass undergrowth build up by February. At the same time the block must be ring fenced to keep the stock out while the undergrowth thickens and to crush sheep on after the burn. I believe the £2 a chain four-wire sheep electric fence has a great potential for this work.

The best burn will be obtained in February or March on a day of low humidity combined with a light drawing wind. Oversowing in the ashes is not critical, but seed oversown must be Government certified and have a high proportion of clovers to compete vigorously with the gorse seedlings and fern fronds, and all the required fertilisers must be spread. Immediately following the burn, and even before oversowing, heavy stocking with sheep is essential. Pasture establishment following gorse is usually very good and it is largely a matter of good husbandry, both field and animal, to keep those seedlings out. It is better to sacrifice your paddock by stocking too heavily and too long rather than to nurse the pasture. Sheep must be done harder on many occasions than one would like to as a good stockman, but this is absolutely necessary when you realise that every seedling that hardens is lost to stock control and must be sprayed.

By the second or third summer after burning the odd regrowth bushes will beat you, but spot spraying with 2,4,5-T will kill these provided care is taken with the application. The period immediately following flowering, between late October and the middle of January, is the time when all plants are growing vigorously and are most susceptible. Good kills can also be obtained in the autumn growth period. Where possible the area should be closed long enough for fresh tip growth to appear on the bushes before spraying, but once the ground dries out in February and March the growth hardens and absorption is poor. Having selected a growthy period and provided you avoid cold, wet weather and get a complete foliage and stem cover, you are well on the way to success. From there on it is a matter of keeping the fertility up knowing with confidence that gorse will not strike and compete with a thrifty pasture.

ACKNOWLEDGMENT

I wish to thank Mr A. M. Till, as without his practical experience this trial could never have been successful.

DISCUSSION

Q.—Have cattle alone been used for gorse control after burning; for example, cattle winter fed with hay?

A.—No cattle were available for this trial and in any case if the block had been closed long enough to provide cattle feed, the gorse growth would harden and control by grazing would become less likely. Winter use of hay and cattle sounds reasonable.

Comment: Cattle pug the ground in winter.

Q.—Was the helicopter block biased because of fern infestation?

A.—Blocks were comparable at the start and the trial indicated that the preliminary spraying by helicopter was not warranted.

Q.—In burning did you rely solely on dry weather and the encouragement of dense undergrowth or did you use diesel oil or some other aid to burning?

A.—No treatment was applied to aid burning except that growth of fern and grasses was allowed to accumulate and a dry period with a day of low humidity was selected.

Q.—Was 2,4,5-T super used on gorse seedlings?

A.—It was tried at quite high rates without success.

Q.—Did much seedling gorse appear on the burnt 1 acre portion?

A.—Yes, probably more than on the remainder of that block. Much seedling growth also appeared on the helicopter-sprayed block.

Q.—Experience elsewhere has shown that new bushes of gorse may be killed by fire, but old ones are not. Do not sticks prevent sheep from controlling regrowth from these bushes?

A.—In this trial about 50 per cent of the old bushes were killed by the fire. Light stocking with sheep broke down many of the sticks and surviving bushes were spot sprayed.

The importance of adequate fertiliser cannot be over-emphasised.

Q.—Fencing to allow stock concentration is often not feasible, as patches frequently occur on large blocks of land and the cost of fencing individual patches would be prohibitive.

A.—The four-wire electric sheep fence costs only £2 per chain.