PROBLEMS OF HILL COUNTRY IMPROVEMENT

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In this paper it is proposed to discuss briefly the principal reasons for failures or indifferent results in pasture establishment on hill country observed. from. time to time in Southern Hawke's Bay,, Northern Manawatu, and the King Country. This will, best be done by separating the principal methods of sowing, namely, after cultivation by giant discs, sowing on the ash, and oversowing the existing poor grass sward.

REASONS FOR POOR RESULTS FROM GIANT DISCING

Giant discing will be dealt with first, it being the most effective and, if done properly, the safest and surest method, although the costs are, high.

The following remarks refer particularly to country run out to browntop and danthonia or light scrub. and fern.

Broadly speaking, the reasons for failures in giant discing may be classed under these main headings:-?

(a) Poor cultivation,
(b) Insufficient consolidation,
(c) Poor seeding,
(d) Insufficient fertiliser,
(e) Faulty management, and
(f) Pests.

These six headings will be dealt with briefly.. Being inter-related, they are all equally important.

POOR CULTIVATION

There seems to be an impression in the minds of many that because the giant discs are designed to do rough work, they are capable of making only a rough job. This is quite wrong. Giant discs, if worked prop-. erly, can equal the plough in the finished job, provided" a good fallow is allowed.

A large number of North Island farmers are' inclined to plough late and allow 2 or 3 weeks or less before sowing their crop or grass. This seems to work.

in the majority of cases in light soils anyway with a good rainfall. However, where the plough has the advantage of turning under turf, weeds, or anything else on the surface, leaving a reasonably clean soil for the seed-bed, with giant discing the turf is not necessarily turned over but may be lying in chunks in all directions after the first cut. To be in a hurry to sow would simply mean that a proportion of the browntop, sweet vernal, etc., would be transplanted and have a good hold by the time the young pasture became established.

Best results on poor clay soils, especially in dry summer climates such as Southern Hawke's Bay, have resulted from an initial cut with giant discs in late autumn, when the ground becomes moist enough for the blades to penetrate, followed by a second cut if necessary in early summer, and a, final working with tandems and harrows before sowing in autumn. The ground goes down to a fine tilth with a minimum of tractor work, at the ***same*** time gaining the benefit of nitrogen assimilated by azotobacter.

The above remarks apply to country which would not grow a payable fodder crop, but should the land be friable, with a reasonably good summer rainfall, it is advantageous to put in a crop of swedes or chou moellier in spring after the second cut. Although this means that grass cannot be sown until spring, approximately 18 months after the first cut, there are some advantages. Firstly, the ground is under cultivation longer, allowing extra mechanical treatment of fern or other persistent weed growth. Secondly, if the ground is reasonably clean after the crop, grass can be sown following a very light discing and harrowing. This method of sowing grass seed is most desirable in that the consolidation as a result of feeding off the crop is taken advantage of and the fertility deposited by the animal on the surface is in contact with, and readily available to, the germinating pasture species.

INSUFFICIENT CONSOLIDATION

In most cases insufficient consolidation is the result of much haste, and the fallow will be a great help in settling down the worked ground. The only alternative to fallowing for this purpose is a lot of extra working with packing implements such as harrows, leveller, and roller. The, fallow is usually the cheaper. Good standard practice should be adhered to in sowing down, with the roller being used where possible.

Stock are frequently used for consolidation. It has been noticed that sheep are preferable to cattle, the latter having a "scooping" rather than a packing effect on the hillsides. Where ground is very free it may be possible to wait until after a shower of rain for a much better effect. Another point to watch with using sheep when the ground is particularly loose is to put the sheep over before sowing the seed: otherwise a large proportion will be buried. Follow up with the sheep afterwards also to cover the seed. Sheep should always be driven in a mob and not simply turned into the paddock. Unless dry stock are available this method is of course more practicable for autumn sowing. No extra quantity of seed will compensate for poor consolidation.

POOR SEEDING

A good deal of so-called cheap seed is used for sowing down on these projects.

The following are suggestions for mixtures:—

	lb. per acre
(a) Certified P.P. perennial ryegrass	27
Certified P.P. cocksfoot	2
Crested dogstail	3
Certified P.P. (Pedigree strain) white clover	2
Certified Mt. Barker subterranean clover	3
Total	37lb.

This mixture, which at the time of writing would cost approximately £4 6s. per acre, would be suitable for poor hill country, inclined to be dry. This is considered a fairly light sowing but would be sufficient with a high-germinating seed and good consolidation. Cocksfoot and ryegrass could be increased if desired and 1½lb. each of the Tallarook and Mt. Barker subterranean varieties used on hard country.

On more fertile country or areas with a better rainfall the following mixture at the present cost of approximately £4 10s. per acre would be more suitable:—

	lb. per acre
(b) Certified P.P. perennial ryegrass	25
Certified standard short-rotation ryegrass	7
Certified P.P. cocksfoot	2
Certified P.P. white clover	3
Certified Mt. Barker subterranean clover	2
Crested dogstail	1
Total.	40lb.

On newly brought-in pumice country, particularly when the rainfall is good, red clover and *Lotus major* are always worth sowing. White clover could be reduced and subterranean clover omitted to allow Montgomery red clover and *Lotus major* to be included without increasing the cost. If sowing in spring, hold the subterranean clover separate and oversow in the autumn.

There is another approach to the grassing down of poor hill country, particularly if infested with blackberry; ragwort, gorse, or lupin, and that is to sow down temporarily in a simpler mixture perennial ryegrass, crested dogstail and plenty of clovers. Stock very heavily and come back again 2 to 3 years later when the weeds have been more or less stocked out, work up, and sow down with a better mixture which can be given better treatment. In the meantime the clover and stock have built up a certain degree of fertility. This method has something to commend it, particularly in the early stages of development of a rough farm when the first-sown pasture, being the only good grass on the farm, is severely punished.

Yet another method of establishing a pasture on very light hill soils difficult to consolidate is to sow cocksfoot at about 51b. or more and Montgomery red clover at 2 to 31b. per acre with the swede crop and, after feeding off, sow the remainder of the mixture following a good harrowing. This is quite effective when there are no bad perennial weeds.

INSUFFICIENT FERTILISER

Three hundredweight of phosphate at sowing, followed by a further dressing of 2 to 3cwt. within 6 months and another 3cwt. 12 months after sowing is the proven recommendation for pasture established on pumice soils. Subsequent annual dressing of 2 to 3 cwt. of phosphate would be the ideal.

FAULTY MANAGEMENT

Management of a young pasture is, therefore, largely commonsense. If the leafage of the grasses is continuously kept grazed to the ground, the root system will suffer and it will require months of spelling to rejuvenate the young pasture. On the other hand, a tall growth of short-rotation ryegrass or a cover crop can mean death to white clover.

Common mistakes noticed are failure to have fences stockproof or to have water available in the

newly sown area. If these points are not attended to, it becomes impossible to institute a proper system of management.

A system of mob stocking and intermittent grazing and spelling should of course be the objective with any pasture, assisted always by, adequate fencing.

PESTS

Rabbits present a very difficult problem, especially for farmers adjacent to large blocks of neglected country. Intensive poisoning before sowing anything is advisable, because once the crop or new grass comes through the ground, the rabbits are less likely to take the poison.

Grass-grub and porina caterpillar are the other pests, giving concern, but it would seem that with the availability of D.D.T. and B.H.C. a comparatively cheap and effective control is in the hands of the farmer.

POOR. RESULTS FROM SOWING ON FERN. AND SCRUB BURNS

With the amount of burning and sowing that has been done in New Zealand, one would think that we should have the technique perfected. Some farmers have done, very well, but in making observations it is evident that failures can be attributed to three main causes:—

Sowing poor seed,
Misjudgment of the time of sowing, and
Bad subsequent management.

There are numerous failures due to sowing poor seed. The low price of some bush-burn mixtures seems too great a temptation. Typical of this class of seed was one mixture analysed recently and found to contain 24 different weeds, totalling 14.2 per cent;, as well as chaffy matter, earth particles, dead insects, ergot, etc., totalling 6 per cent. Germination of the useful species ranged between 20 per cent. and 62 per cent. This was an expensive mixture at 1s. 4d. per lb., although to the purchaser it looked good seed, being quite bright.

The use of such seed is known to be one of the causes for the rapid reversion to fern of large areas in New Zealand.

A. small quantity of good seed is recommended,; this need not necessarily be of high germination, providing sufficient is sown. Ample clovers with a light

sowing of desirable grasses, including some rapidly establishing short-lived species such as Italian or short-rotation ryegrass, is aimed at. The heavier the seeding the quicker the results, but the following mixture at approximately 3s. per lb. has given good results :—

	lb. per acre.
Perennial ryegrass	10
Italian or short-rotation rye&ass	5
Cocksfoot	2
Crested dogstail'	2
White Clover	2
Cowgrass	1
Montgomery red' clover	1
'Subterranean clover	1
Suckling clover	1
Total	251b.

This can be amended to suit the country by replacing the subterranean clover with *Lotus* major or a more simple mixture may be sown.

Regarding the actual sowing, there seem to be two schools of thought. You either sow on the ash directly after the burn, or wait until the weather breaks in autumn. The, latter gave by far the best results observed last autumn. A big percentage of early-sown seed usually perishes. in the hot, dry, weather following an early burn. Another real danger lies in the seed being washed or blown off.

Should it be possible to follow the sowing with a mob of sheep this also is added insurance to a good strike. The same applies to harrowing or light discing where this is possible. Actually the fern regrowth between burning and sowing will probably call for some stocking. It is usual to turn young sheep on to a burn within a month of the fire for this purpose.

The question of subsequent management is usually well understood by the average hill-country farmer, but too often he has not the fences to carry out the work. The extent of subdivision depends on the numbers of sheep and cattle available to concentrate on the area: It also depends on the topography of the area—whether there are defined sunny and shady faces or otherwise. The use of the electric fence for cattle manipulation has possibliities and is being used by some farmers.

If possible, phosphate should be applied in the spring following the burn or even with the seed if there is not much ash.

RESULTS FROM OVERSOWING CLOVERS

. The oversowing of clovers on relatively clean hill country reverted to browntop, danthonia, chewings fescue and moss has become generally recognised as sound practice where topdressing is done. It is estimated that a least 20 tons of high-grade certified white, red, and subterranean clover was sown in southern Hawke's Bay district alone last autumn and spring.

Suckling and Madden presented papers on their experimental work with this method of hill country improvement in southern Hawke's Bay, Wairarapa, Rangitikei, and Gisborne districts to the 1949 Grassland Conference,. providing valuable basic information on the subject.

In the past few years operations and results have,. in general, been very successful.

The grass species generally have been disappointing except on bare or very open ground such as slips. Species such as ryegrass will not make any worthwhile contribution, ***in any case, until the country is*** carrying more stock following the build-up from clovers.

The main points contributing to the success of clover establishment may be listed as follows:—

1. Rainfall and other climatic factors,
2. Choice of species to suit climate and fertility,
3. Topdressing,
4. Rate of seeding,
5. Time of sowing,
6. Preparation of country for oversowing, and
7. Grazing management.

These points will be dealt with individually.

1. **Rainfall and Other Climatic Factors:**

It is evident that where there is a well-distributed rainfall extending through summer, the success of oversowing is assured over a wide range of soils throughout the North Island. 'With perennial clovers such as white and Montgomery red, the severe check sustained in a prolonged dry period greatly retards the growth for the rest of the year. That does not mean, however, that without good summer rainfall the practice is not worth while; in fact, in the relatively dry

climate of southern Hawke's Bay oversowing is probably more' extensively done than anywhere else in New Zealand.

Desiccating winds common in some districts may also be troublesome and particularly in these areas the aspect of the country being oversown could determine the choice of species used.

2. Choices of Species to Suit Climate and Fertility:

The principal clovers are white clover, Montgomery red clover, subterranean clover, and *Lotus major*. These are used more in the form of mixtures than singly. The most suitable, mixtures for any farm or part of a farm can be determined easily enough by considering the requirements of the various species mentioned above together with past observations of their thrift or otherwise in the district. Briefly,' the requirements are as follows:—

White Clover prefers well distributed rainfall, but will grow in most soils and climates. Prefers reasonably high fertility or else regular top-dressing.' In the writer's opinion it is important to sow the Pedigree strain, which means that Mother seed would generally be used.

Montgomery red clover needs similar conditions to white clover, but it 'will persist under lower fertility. Although it establishes well, this species is not clover, but will persist under lower fertility. Although it establishes well, this species is not permanent and cannot be expected to persist under hard grazing for more 'than 4 to 5 years unless some seeding takes place. As a fixer of nitrogen, Montgomery red clover is not very efficient, but the improved growth in the sward alone makes it worth while sowing, especially on pumice or in high rainfall.

Subterranean Clover thrives on free soils and, being an annual, has an advantage over perennials where summer droughts are common. Does not require high fertility, therefore a useful pioneer even in good rainfall districts, provided soils are. free draining. Mt. Barker strain is the most popular. Tallarook strain sometimes better for very hard conditions. It becomes rather aggressive on better subterranean clover country.

Lotus, major: The results from *Lotus major* have varied considerably. Poor strikes have been common in the southern part of the North Island,

although on pumice and wet sandstone it has long been recognised as a most useful species where topdressing is limited.

3. Topdressing:

This is unfortunately becoming a costly operation, especially where there are long road hauls, but no oversown clovers will give worthwhile results without it. An application of 2cwt. per acre in the year of sowing is the usual recommendation, repeated once or twice in successive years. Annual dressings of phosphate are highly desirable, but a dressing every 2 or 3 years accompanied by good grazing management will hold the better species. Spectacular strikes and establishment of clovers have been observed following applications of phosphate up to 5cwt. to the acre at the time of sowing. This aspect of topdressing could be investigated.

Discussion often centres around the point that some topdressing should be done to raise the fertility of the country concerned for say a year or two before the clover is sown. Experience to date shows that in the initial application of fertiliser special attention should be paid to subsequent dressings. Top dressing will encourage a mass of annual clovers and trefoils, with which the oversown species must compete, if much topdressing is done before the year, of oversowing. The pasture is also more closely grazed and does not provide the cover for the young seedlings.

4. Rate of Seeding:

The mortality rate of seed sown must naturally be greater than in the case of a ploughed and worked field, so that it would be unreasonable to expect anything spectacular from sowings of less than 31b. per acre. It is interesting at this stage to note the number of viable seeds per pound of pure, high-germinating clover seed and compare this with the establishment counts in trials expressed here as a percentage of the seed sown in southern Hawke's Bay.

Species	Approx. Seeds per lb.	Est. Viable Seeds per Sq. Ft. at 1lb. per acre	Approximate Average Rate of Establishment
White clover	670,000	15.4	12.22%
Montgomery red clover	240,000	5.5	25.33%
Mt. Barker sub. clover	60,000	1.36	40.52%
Tallarook	60,000	1.36	35.40%
Lotus major	900,000	20.6	0 - trace

One would expect that with the small seeds a lower rate of seeding would be satisfactory but although the number of seeds per pound is high, the establishment is poorer than with larger seeds. Bates of seeding should therefore be kept up to. about 31b. per acre.

As a guide the following are suggested as mixtures :—

High Rainfall Areas: 21b. white clover, 21b. Montgomery red clover, or if fertility is low with little prospect of regular topdressing, replace the red clover with llb. of *Lotus major*.

Medium Rainfall: Low fertility, 21b. white clover, 1lb. Mt. Barker subterranean clover.

Low Rainfall: 2 to 31b. Mt. Barker subterranean clover, llb. white clover. In very dry and hard situations replace white clover with Tallarook subterranean clover.

Some farmers are sowing llb. of seed per acre with the fertiliser for 3 successive years instead of sowing 3lb. in 1 year. The disadvantage of this method is that no one area can be given any special treatment before or after sowing.

5. Time of Sowing:

There is a tendency today to sow seed just when the aeroplane arrives to do it. There are some very poor strikes as a result. From trials in southern Hawke's Bay it was found that there are right and wrong times to sow. March sowings gave best results, with April and May being a fair second. August, September, and October were only fair. When there are dry summers the main point to watch is. that seed is not sown until the weather breaks in autumn, usually towards the end of March or early April. Earlier sowings may strike with a shower of rain and be killed by a dry period following. On the other hand seed must be sown as soon as possible to avoid frosts.

6. Preparation of Country for Oversowing:

If drastic harrowing could be done on dense brown-top sward, it would be desirable, but as this, is usually impracticable, the only alternative is to use cattle. The treatment suggested would be as follows for autumn sowing:—

Close in summer, say, from mid-November to mid-January, and allow a, certain amount of "top" to come away. Follow up from this time onward with

heavy stocking of cattle and reduce the growth to a short, open stubble, say 1½in. to 2in. in height.

The sward should now be fairly open and the surface of the ground well cut up by the hooves of cattle, especially if heavy beasts are used. This open sward will permit the seed sown to fall directly on to the ground, and not lodge in the grass. At the same time, if the area is not grazed too hard, the stubble remaining will offer some protection to the young clover plants from birds, winds, and dry conditions while in the cotyledon stage, when it is particularly susceptible to this type of damage. A follow up for several days with sheep would probably result in a better coverage of the seed, but overstocking should be avoided at this stage, to prevent destroying the cover.

7. Grazing Management :

It is advisable to remove all stock while the clover is germinating, which should be from 3 to 4 weeks in good conditions, but from this period onward little damage can be done except by extreme overgrazing or undergrazing. The rank grass growth during the following winter will do as much harm to the young clover seedlings as extreme hard, close, and continuous grazing. The only advantage in prolonged spelling would be to allow seeding of the sown species. This is best done as follows:—

White and red clover: Close January-February and even into March after a period of close grazing. This spell will allow flowering and ripening of the seed. With these species the spell should not be given until the second year after sowing or later. Once the area has been seeded in this manner, it should not be necessary to repeat the operation unless with the purpose of spreading seed by stock to other areas.

Subterranean clover: The spell for subterranean clover should be from early November to early or mid-December, depending on how much seed has been buried. The spell should be given in the summer following sowing and from that time onward it will be quite unnecessary.

A, point worthy of note is that although the animal is not efficient in the spreading of seed, it certainly can be used if the flower head is allowed to die down and the seed to ripen. In the case of sheep, experimental work shows that approximately 30 per cent. of the hard seed in a line of white clover will germinate

after passing through the animal. Scarified subterranean clover seed or red and white clover with high interim counts on analyses certificates are digested to a very large extent by the animal. It may be worth while purchasing lines with a high percentage of hard seed for the purpose of oversowing.

REFERENCES:

Suckling, F. E. T. (1950), N.Z. Jour. Sci. and- Tech., Section A. Vol. 32, No. 2.

DISCUSSION

Mr Levy. In the days of bush burning no No. 1 white clover or subterranean clover and little *Lotus major* was sown. Therefore, there is a wide need for over-sowing. Phosphate top-dressing is largely wasted if good clovers are absent. Subterranean clover sowings should! be confined to sunny faces in Taranaki. Hills must carry three to four sheep, with cattle, per acre before the land till hold ryegrass. It is suggested that 10lb. of ryegrass (perennial) and 3lb. crested dogstail should be sown on hills, where good ryegrass has not been established already and the pasture is sufficiently open.

Q. What clovers and grasses does Mr Holden recommend for "slippy" country in the northern Manawatu after fern or scrub burns ?

A. On slips sow, as soon as the slip comes out, a light general pasture mixture including white clover and *Lotus major.* It is not worthwhile sowing subterranean clover if there is not a high rainfall.

Q. Would suckling clover help ?

A. Suckling clover is not usually necessary for sowing in that district as it occurs naturally. However, if available cheaply enough it could be sown.

Q. (Mr Levy) Would Mr Holden please give his reason for leaving browntop out of the mixtures in his paper?

A. I find that after burning there is usually a good regeneration of browntop anyway, but it is suggested that browntop would be added to the mixture if it was not in evidence. Another question to consider when sowing browntop is the price factor; this species was 9s. *a* pound last year, although it is cheaper now.

Q. What is the place of strawberry clover?

A. Strawberry clover has not been spectacular in our sowings to date, but. can be sown to advantage on wet sandstone slips, or on the, valley floors.

Q. Has Mr Holden a method for sowing small quantities of seed? I find that there is a likelihood of missing large areas when sowing by hand.

A. -There is less error if sowing is done in a wide strip. Small hand broadcasters are available which will sow a strip of 15 to 18ft. in width. There is less error and a more even distribution with such a machine. It is questionable, in any case, whether. it is important to gain a perfect cover, as one would have to do if sowing ploughed country..