RESULTS OF RECENT EXPERIMENTS ON SURFACE SOWING

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INTRODUCTION

Surface 'sowing of hill-country pastures with clovers has been practised in New Zealand for many years and it is undisputed that the introduction of new and improved strains of clovers will assist in pasture improvement and increased production. Today with new facilities, such as the aeroplane and blower, available for topdressing and oversowing an enormous -increase is taking place in the area of hill country topdressed with phosphate. To achieve the maximum benefit from this topdressing it is essential that sufficient clover,is present in the sward to utilise the added phosphate. On large areas of hill country where topdressing is practised clovers are sparse, and under these conditions little response and benefit is derived from phosphate applications. With this fact in view considerable interest has been aroused regarding the most satisfactory methods of introducing clovers into unploughable pastures.

As the title suggests, this paper is primarily to bring together the results of recent investigations concerning surface sowing. It is proposed therefore to subdivide the paper into the following headings under which each topic will be discussed: Time of sowing, fertiliser treatment, pre-treatment, post-sowing treatment, insect and bird damage, natural reseeding.

TIME OF SOWING

Recently experiments were laid down to determine the best month for surface sowing. Trial areas were selected over a wide range of soil types and climatic conditions and almost without exception the March or, early autumn sowings were superior to those made in April or May and superior to the sowings made in 'the spring months of August, September, and October.

Large quantities of seed and fertiliser are being applied to hill country from the air. Unfortunately weather conditions prevent flying operations for much of the year, which inevitably delays sowing and top-dressing engagements. In consequence many farmers find that through circumstances beyond their control they are forced to sow late in the autumn and in the spring. Although results were definitely superior in March, reasonable success was obtained in the other months. The poorest results were observed during late autumn and early spring, although even then some clover struck. When sowing subterranean clover in the spring one should remember that this species is an annual, which barely becomes established before summer 'droughts cause premature deaths, often without reseeding. Autumn-sown subterranean clover, on the other hand, has ample time to become established and to reseed relatively profusely, thus perpetuating the species.

FERTILISER TREATMENT

Considerable emphasis has been placed on the importance of phosphate application at the time of surface sowing. Experimental work on this aspect of the main problem has shown that little benefit is derived from this practice. In all locations in which trials have been undertaken the application of phosphate at the time of sowing has had no significant effect on the early establishment of clovers. The results of these experiments indicate that topdressing with phosphates is not essential until the seedling plants are established and are able to give a return for the additional phosphate.

As a result of these observations it would appear that the important feature in hill country pasture improvement is the introduction of new and improved strains of clovers during the early autumn months and follow up with fertiliser applications at a later date as time and opportunity permit.

PRE-TREATMENT

One aspect of the surface sowing problem is the effect of grazing management in relation to the establishment of clovers. Does the existing sward protect seedlings during the establishment stage or does it. smother and reduce the chances of survival? There is no possibility of preparing a cultivated seed bed on which to sow clover species, but implements in the form of the grazing animal can be used to subdue the

vegetation, trample the sward and thus bare the ground. On the other hand, if long or laxly grazed pasture is a more favourable medium in which to establish clovers, then by judicious management one can readily achieve this condition. Pasture management and manurial treatments are the only control the farmer has in obtaining optimum conditions for the establishment of surface sown seed. There is considerable difference of opinion about the competitive effect of strong established pasture plants on the one hand and about their protective capacity on the other. Some consider that it is important to allow pastures to form a protective cover for clover seedlings to prevent losses during dry periods following germination, while others consider that competition is detrimental to establishment and outweighs any advantage arising from seedling protection by long pasture. The factors which determine the success or failure of surface sowings are not completely understood and hence the question arises : what are the most satisfactory pasture conditions for surface sowing? In an endeavour to answer this and other questions experiments were laid down at the Te Awa hill-country pasture research area during the autumn of 1951.

The results of these investigations indicate that pastures should be grazed short prior to sowing to open up the sward and thus allow the seed to reach the soil surface. All clover species with the exception of subterranean clover established significantly better when oversown on short pasture than on long. Long pasture had a decided suppressing effect on the smaller clover species such as white clover, red clover, and Lotus major. Subterranean clover on the other hand germinated and established equally well on both long and short grass, although in long grass the subterranean seedling is forced to grow a long stem in order that the cotyledon leaves may reach the light. When the long pasture was grazed losses were recorded due to complete defoliation below the crown.

The results of these experiments closely follow those obtained at Grasslands Division (1) where long pastures significantly caused serious losses of smothered clover seedlings during the establishment stage.

POST-SOWING TREATMENT

Various experimental management treatments following sowing showed no significant differences in the strike and establishment of the four species of clover.

Close continuous grazing following sowing was found to be equally as good as rotational or intermittent grazing. There were indications that where pasture is vigorous in growth during the autumn months long spelling has a detrimental effect. The smaller seedlings were found to be smothered by fast growing grass species although subterranean clover showed the highest survival rate. Subsequent grazing however again caused losses of this species due to complete defoliation when drawn up with the long grass.

These after-sowing management trials were found to differ in results from similar trials undertaken at Grasslands Division in one respect only, that is from the aspect of relative growth rate of flat land species compared with hill pasture species. On hill country there is little growth during the late autumn and winter months and consequently there is less competition from grass.

INSECT AND BIRD DAMAGE

Studies regarding the causes of losses in seedling establishment have revealed that the major factor is insect damage at an early stage in germination. Porina or subterranean caterpillar is prevalent on hill country and has proved to be a serious hazard in establishing clover seedlings in some districts. (In the Gisborne district slugs have been responsible for up to 100 per cent. loss in some oversowing trials.) It is possible through the use of insecticides to reduce seedling damage considerably, but these methods on large hill-country areas are too costly to be of practical use. It has been demonstrated, however, that close grazing of 'pastures before oversowing reduces the protective cover for insects and allows for a more efficient control of slugs and insects by birds. Losses due to birds were of little significance except where grass seeds were sown with the mixture.

NATURAL RESEEDING

Everyone agrees that clover establishment is difficult. Seed prices are high and as a consequence low seeding rates are being used. It is not surprising that establishment is normally sparse. The question arises, is the newly established clover going to survive and increase or gradually become eaten out? This question is one of considerable interest because of the large expenditure involved in the purchase and application of

seed to the hills. From an economic point of view the real purpose of oversowing will not be realised unless this thin initial strike can be built up into a clover stand sufficiently dense to give a profitable return from subsequent phosphate dressings.

Can the thickening of the clover stand be achieved by pasture management ? Experimental work being undertaken indicates that it is possible and decidedly practicable to achieve, this end by summer spelling, allowing the clover plants to reseed and so building up a supply of seed in the soil.

An experiment was undertaken in which four relatively steep IO-acre paddocks were managed differently to determine the reseeding capabilities of pastures under close grazing as against those which have been spelled to allow for reseeding purposes.

The individual pasture treatments were as follows : Pasture continuously close grazed with no improvement by way of seed or fertiliser applications ; continuous close grazing with improvement ; continuous close grazing with improvement and summer spelling for reseeding purposes ; continuous close grazing with no improvement but summer spell to allow for reseeding.

The improved pastures were oversown and top-dressed in autumn 1948 and soil samples were taken for buried-seed content in August 1950 and 1951, after the autumn germinations from the previous season's seed had occurred. Random soil samples for buried-seed determinations were taken'to a depth of 2in. on three separate topographical aspects : Stock camps, slopes and steep faces, terraces or stock tracks.

Table I gives a comparison of buried-seed content of pastures under various management systems for the years 1950 and 1951. Extraction and sampling techniques are described in a paper soon to be published. (2).

DISCUSSION ON TABLE

In will be seen from the figures that :-

1. Continuous close grazing of both improved pastures does not allow for reseeding of white clover, red clover, and *Lotus major.*
2. Continuous close grazing does not prevent subterranean clover from reseeding.

3. Oversown and topdressed pastures which have been spelled for reseeding purposes show great increases in hard seed content of all clover species present.

In lb. per acre of hard seed the figures are, 28lb. of white clover, llb. of red clover, 71b. of subterranean, 77lb. of suckling clover, $3^{2}/_{3}$lb. of *Lotus major,* and llb. of English trefoil.

4. Spelled pastures which have not received additional clover seed or fertilisers show an increase in, white clover buried-seed content and similarly an increase in suckling clover and English trefoil. However the fact that the white clover on the area was of a poor type detracted from the improvement which should be expected.

DISSEMINATION OF SEED BY STOCK

Suckling (3) in a paper presented at the Grassland Conference in 1950 pointed out that the ability of stock to disseminate seed on hill country could be exploited. The natural impermeable condition of clover seed is of significance not only in regard to survival in the passage through the animal, but also because of its intermittent germination spread over a long period of time. Under- unfavourable seed-bed conditions frequently encountered on hill country it was pointed out that some advantage may be achieved by having seed germinate over a long period rather than all together on the first occasion when temperature and moisture conditions are favourable.

With these thoughts in mind determination of hard-seed quantities being returned to spelled pastures were investigated. Fifty random samples of cow dung were taken over each of the two spelled pastures at the time when all seeding clover had been eaten by stock.

A representative sample of dung from the two paddocks was treated for seed extraction purposes and Table II shows the seed quantities per lb. of dung returned to the soil. As the seed which passes through the animal is largely hard seed it is reasonable to assume that germination of this seed will occur over a long period, thus ensuring a continuity of clover supply, particularly of those species which are not able to reseed themselves under close grazing conditions.

TABLE I

Comparison of Buried Clover Seed Content of Hill-country Pastures under Various Treatments. Improved Pastures Sown Autumn 1948.

Treatment	Month and Year	Location of Sample	'Clover seeds per sq. ft. in top 2in. of soil. White	Red	Suckling	Sub-terranean	Lotus major	English trefoil
1.								
(a) Continuous close grazing no seed or manure	August 1950	Slopes	0	0	270	0	0	0
		Tracks	0	0	380	0	0	0
		Stock Camp	30	0	150	0	0	0
		Average	10	0	266	0	0	0
(b) Continuous close grazing no seed or manure	August 1951	Slopes	5	0	300	0	0	0
		Tracks	0	0	290	0	0	0
		Stock Camp	30	0	130	0	0	0
		Average	12	0	240	0	0	0
2.								
(a) Continuous close grazing + seed and manure. Sawn autumn 1949	August 1950	Slopes	20	0	385	0	0	0
		Tracks	5	0	340	0	0	0
		Stock Camp	10	0	100	0	0	0
		Average	12	0	275	0	0	0
(b) Continuous close grazing + seed and manure. Sown autumn 1949	August 1951	Slopes	10	0	270	40	0	0
		Tracks	20	0	290	0	0	10
		Stock Camp	0	0	160	20	0	0
		Average	10	0	240	20	0	3

TABLE II

Seed Content of Cow Dung from Unimproved and Improved Spelled Pastures

Species of Clover	Seeds per lb. of Dung		Lb. per acre of seed*	
	Unimproved	Improved	Unimproved	Improved
White	350	1775	0.8	4.5
Red	—	115	0	0.5
Subterannean	—	130	0	2.0
Lotus **major**	—	480	0	1.0
Lotus hispidus	—	20	0	0.1
Suckling	59	910	0.1	2.0
English trefoil	5	110	0.02	0.5
Totals	414	3540	0.92	10.6

*Calculated on basis of 401b. of dung per cow per day.

It will be seen from the figures presented in Tables I and II that it is possible through summer spelling to achieve a rapid build up of clover seed in the soil. It may be that species, such as red clover, which are rapidly eaten out of a pasture when close grazed can be perpetuated indefinitely. The small quantity of seed sown initially is handsomely increased by management, with little cost and great satisfaction to the farmer. It would appear from experience that spelling should be done after the spring flush of growth has occurred and when the bulk of roughage and seed head has been consumed by sheep and cattle. In this way the hill farmer can simulate the seed grower who takes a crop of hay from the seed area and harvests the aftermath of clover.

REFERENCES

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(3) Suckling, F. E. T. (1950) : "The Passage of White Clover Seeds through the Bodies of Sheep and the Effect on Germination Capacity." Proceedings of New Zealand Grassland Association.