

# PRESENT POSITION OF PASTURE ESTABLISHMENT RESEARCH IN NEW ZEALAND

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TO **ASSESS** the "Present Position of Pasture Establishment Research in New Zealand" objectively, time should be spent thinking about the seed, the germination process and the external conditions necessary for successful germination. However, because there are so many other aspects to consider in this assessment, it will be assumed that readers know exactly what a seed is, that they understand the physiology of germination, and that they are aware of the external conditions required for germination.

## GERMINATION AND EARLY SEEDLING GROWTH

It is well known **that** the precise and specific conditions necessary for successful germination of pasture seeds (Greenwood, 1950) are seldom approached in agricultural practice. There are a diversity of reasons for this. Most are related to practices employed **in** the preparation of the seedbed, in the application of seed to seedbeds, in the implements used in these operations, in the early grazing management, and to vagaries in weather. Some research has been carried out in New Zealand on certain aspects of these problems, but there are large areas where little or no work has been undertaken.

## **THE PREPARATION OF THE SEEDBED**

Nowhere in the New Zealand literature on pasture establishment is this lack of research result more obvious than on factors involved in seedbed preparation and the influence of these on seed germination. When the major operations of ploughing, fallowing, preparing a tilth and consolidating a seedbed are considered, this lack of knowledge leads one to query aspects of the organization **of** research programmes. Some of the questions that need answering are the following;

At what depth should existing vegetation be ploughed on different soil types to obtain the fastest rate of breakdown, and

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hence release of nutrients, and how does this vary with time of the year? What influence does fallowing have on this process and on weed, and pest populations? What degree of tillage is required for favourable germination of large as opposed to small seeds, and how does this influence soil aeration, crusting or water movement? How much consolidation should occur on different soil types and what is the effect of this on the availability of water for germinating seeds? There are many other questions such as these that will remain unanswered until people such as physicists, soil scientists, entomologists and chemists, to name a few, are organized to work with agronomists, seed physiologists, and farm machinery experts.

The only references on these aspects of pasture establishment that the writer could find recorded in the New Zealand literature over the last 15 or 20 years were those of Blackmore (1960) and Sears *et al.* (1955) who demonstrated the need for consolidation for more successful germination of sown species.

#### DEPTH OF SOWING

Similarly there are only two recent references in the New Zealand literature on depth of sowing as this affects germination and emergence of seedlings. The most comprehensive is that of Cullen (1966a), where cocksfoot, timothy, crested dogstail and white clover showed best emergence at a  $\frac{1}{4}$  in. sowing depth and 'Grasslands Ruanui' and 'Grasslands Manawa' ryegrass, lucerne and red and subterranean clover showed best emergence at  $\frac{1}{2}$  in. sowing depth. The latter three species also showed good emergence at a 1 in. sowing depth. At  $1\frac{1}{2}$  in. the emergence of most species was drastically reduced.

The other reference, that of Sears *et al.*, when compared with Cullen's results, suggests a relationship between sowing depth, soil type and percentage emergence. On pumice country Sears *et al.* placed the seed of ryegrass, cocksfoot and white clover at  $\frac{3}{4}$  to 1 in. depth and obtained much better emergence than with broadcast and harrowed sowings. Taken together, these results suggest that there is a need to investigate sowing depth in relation to emergence on different soil types. Such studies would need to be complemented with detailed measurements of soil physical conditions, availability of soil moisture and oxygen during germination, and endosperm availability until emergence.

#### METHOD OF SOWING

Sowing methods are discussed by Baker (1969).

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## OTHER FACTORS AFFECTING GERMINATION AND EARLY SEEDLING GROWTH

There are many other factors that affect germination and early seedling growth. For instance, the problem of legume germination and early seedling growth on acid soils has been highlighted by Adams (1964) and areas for further study adequately outlined. The need for further work on the problem of germination inhibitors is also warranted in view of findings by Campbell (1959) and Beggs (1961, 1964). Campbell recorded marked decreases in the germination of pasture seeds when sown to a previously cropped area of chommoellier and Beggs recorded an anti-nodulation factor for white clover when attempting to establish this species on the Wither Hills in Marlborough. This was later demonstrated by Parle (1964) to be a toxin probably associated with organisms hosting in danthonia roots, the main component of the existing vegetation.

The problem of legume nodulation is well known and cannot be adequately dealt with here. A good general review has been presented by Hastings et al. (1966). However, in reviewing the literature, it was interesting to record the districts where inoculation of legume seeds was considered necessary for successful establishment. These included Northland (Greenwood, 1961; Cumberland, 1966; Goold et al., 1967), Taupo-Rotorua (Sears et al., 1955), Nelson (Goodall, 1964; Crouchley, 1966), Westland (Dunne and Scott, 1964), Marlborough (Beggs, 1961, 1964), Canterbury (White, 1965), Central Otago (Ludecke, 1962) and the Te Anau District (During et al., 1962). It is also generally accepted that undeveloped hill country and tussock country have only isolated areas where rhizobia are present (Greenwood, 1964) so that inoculation of legume seeds in these areas is warranted.

## ESTABLISHMENT OF EMERGED SEEDLINGS

The second phase in pasture establishment is the fate of seedlings once they have emerged and are self-sufficient in terms of water and nutrient uptake and in their capacity to photosynthesize and respire.

When establishing as single-spaced plants, these processes are very seldom impeded, but where mixtures of plants are growing in close proximity to one another competition for external factors occurs. Depending on establishment practices employed, such competition can be intense, resulting in the death of large num-

bers of establishing plants. The degree of competition is determined by the aggressiveness of individual plants which can be controlled. These aspects of establishment have received more intensive study by New Zealand workers, some of which is assessed in what follows.

#### TIME OF SOWING

The aim at sowing is to sow seed at a time when external factors are favourable for the germination and subsequent establishment of all sown species. In moister and warmer areas, considerable latitude is possible, and sowing time is more usually related to other farm practices such as cropping and pasture renewal sequences, feed demands of the herd or flock, or weed ingress. In colder and drier areas, however, the range of sowing times is much more restricted.

It is probably because of this that the only recorded results on time of sowing experiments have come from the lower half of the South Island. At Te Anau, Cullen (1966b) demonstrated that time of sowing was not important for the establishment of cocksfoot, Ruanui ryegrass, timothy and dogstail. However, for white clover in the same environment, During *et al.* (1963) considered that a sowing time of between July 15 and September 1 was critical. The only other reference on sowing time over the last 15 to 20 years is that of Ludecke (1962) who demonstrated the need to autumn-sow lucerne and cocksfoot in Central Otago. Unpublished data of K. R. Brown, Grasslands Division, Gore, have shown the advantages of spring sowings for more successful clover establishment.

In the easier environments of New Zealand, extensive research effort on time of sowing does not appear to be warranted because of the latitude possible.

The practice of staggered sowing times for the establishment of special-purpose pastures could be profitably investigated in certain environments. An example is that quoted by Allio (1967) in the Bay of Plenty where it was shown that the best method of obtaining a mixed pasture of S.170 tall fescue, white clover and ryegrass was to sow tall fescue and white clover in the autumn or spring and oversow the ryegrass later.

#### RATE OF SOWING

The significance of reduced seeding rates of the more aggressive species in mixtures on the establishment of the slower estab-

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TABLE 1: INVESTIGATIONS ON SOWING RATE AND EFFECTS OBTAINED

| <i>Investigators and districts</i>    | <i>Reduced sowing rate of</i> | <i>Better establishment of</i>    |
|---------------------------------------|-------------------------------|-----------------------------------|
| Brougham (1954a) ;<br>Manawatu        | Manawa ryegrass               | Red & white clover                |
| Cullen (1958) ; Invermay              | Ryegrass                      | White clover                      |
| Cross (1959) ; Manawatu               | Ryegrasses                    | White clover                      |
| McLeod (1962) ; South Canterbury      | Ruanui ryegrass               | Cocksfoot, timothy & white clover |
| Ludecke (1962) ;<br>Central Otago     | Lucerne & cocksfoot           | Lucerne & cocksfoot               |
| Sears & Brougham<br>(1963) ; Manawatu | Ariki ryegrass                | Red & white clover                |
| Cullen (1966a) ;<br>Invermay          | Ryegrasses                    | Cocksfoot, timothy & white clover |
| Goold (1966) ;<br>North Auckland      | Ariki ryegrass                | White clover                      |
| Lynch (1966) ;<br>throughout country  | Ariki ryegrass                | White clover                      |

lishers has been frequently demonstrated over the last 15 to 20 years. The results of these studies are summarized in Table 1.

A typical result is that shown in Fig. 1 where data of Cullen (1966a) are reproduced.

Although the significance of sowing rate in reducing competition from more aggressive species in pasture mixtures has been adequately demonstrated in a number of districts, there is still scope for this type of investigation as sowing methods alter through the introduction of improved implements or as new varieties of pasture plants are introduced into farming.

#### EARLY MANAGEMENT

Early grazing management has also been demonstrated by a number of researchers to have marked effects on aggressiveness and establishment of all sown species. All references except one have demonstrated that frequent grazings for the first six to nine months from sowing result in enhanced establishment of the slower establishers, particularly the legumes (Sears, 1950; Brougham, 1954b; McLeod, 1962; Cullen, 1966a; Goold, 1966; Lynch, 1966). The exception was the result obtained by Ludecke

hits per 100 points

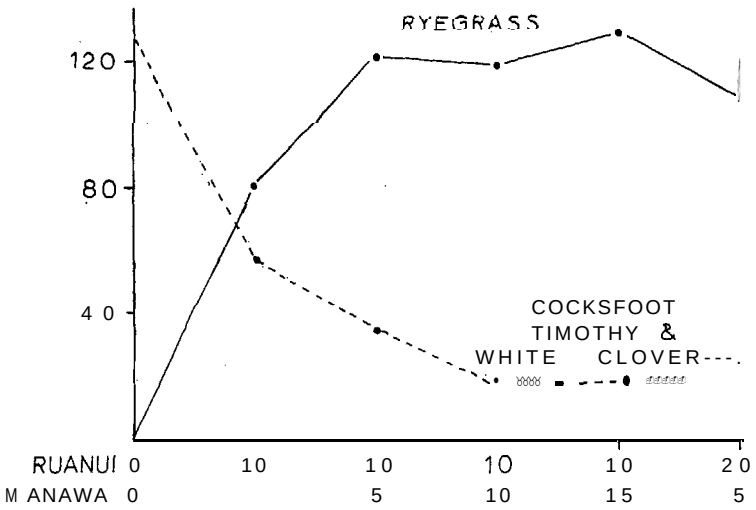


FIG. 1: Effect of seeding rate of ryegrasses on the establishment of cocksfoot, timothy and white clover (reproduced from Cullen, 1966a).

(1962) ; who showed that early spelling of lucerne and cocksfoot mixtures in Central Otago was vital for successful establishment. This result suggests that the effect of early management on establishment of sown species in more difficult environments is less well understood and warrants further investigation.

#### FERTILITY LEVEL AT SOWING

As the slower establishing legumes are very quickly self-sufficient for nitrogen, another successful method of combating early aggressiveness of some grasses is by reducing soil nitrogen levels by prior cropping (Sears and Brougham, 1963; Goold, 1966). Obviously this approach to establishment must be related to the economies and success of cropping in any district and to the time lag in fertility build-up following cropping. In many districts this is a difficult process, and to purposely set about reducing these levels for enhanced clover establishment when other approaches can achieve this could be of doubtful agronomic value.

## OTHER PRACTICES

There are many other ways of controlling aggressiveness of pasture species in establishing pastures. All have the same objective and all warrant further study. Two examples are given. The use of nurse crops for the provision of early feed can lead to establishment problems. Only two investigations are recorded in recent literature and both (Brougham, 1954c; Cullen, 1964, 1966a) have shown that, although feed obtained from such pastures in the first 3 to 6 months from sowing is enhanced, subsequent production is markedly reduced because of poor clover establishment. The second example is the approach to establishment problems being undertaken by Harris (1968). Based on plant competition studies, valuable information is being obtained on the compatibility of species when sown in mixtures and on production potentials. Such approaches should put more objectivity into the compilation of seeds mixtures.

## FINAL COMMENT

A review such as this would not be complete unless part of the discussion considered the question: "Is ploughing and re-sowing necessary at present-day farm production levels?" There are, of course, situations where this question is easily resolved. Where extensive cropping is practised, some form of pasture renewal is necessary, be this ploughing up and re-sowing, sod sowing on the crop stubble, or oversowing on the disced up crop surface. Again, where pastures are completely run-out, to browntop or sod-bound *paspalum* dominance, or have been ravaged by insects such as porina or army-worm, the plough is an essential tool in pasture renovation. In other situations, and this applies to very large areas of New Zealand, a plough-up and re-sow policy is frequently and sensibly questioned. What is needed are some long-term studies comparing production levels of new-sown pastures with older pastures. Such production figures should be in terms of both pasture and animal production at high stock carrying capacities. Until these data are obtained, the question of whether to plough up and re-sow, or to first look after other aspects of pasture production such as fertility build-up, fertilizer requirements and improved management is still unresolved. I would suggest that, this is probably one of the most important unresolved questions in farming practice in New Zealand at this time.

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## DISCUSSION

Asked whether phalaris could be used as a companion **crop** for lucerne, Brougham replied that there was no published work on that particular mixture and he would not like to comment on either the clover or the lucerne situation. It was a great pity that much work had been done but had not been documented.



To a comment on the cost of such research as he had advocated for Wairarapa, Brougham said that many of the establishment problems had been looked at in some areas. Many aspects had been covered in the lower part of the South Island where there was much difficult country. There was no basic information from much of the rest of the country. However, some results from work oarried out in the drier parts of the east coast of South Island could well be useful if applied to the **Wairarapa**.

Concerning grazing at establishment, he thought that the work that had been done suggested that such treatment was best, except that Ludecke had shown an opposite effect with **lucerne** in lower fertility country. Here Ludecke commented that spelling in dry areas **allowed** for better development of root systems which reduced the effects of drought.

Butler stated that work was being undertaken by **Applied** Biochemistry Division to ascertain whether there were any interactions among soil microflora. This was a follow-up to a survey of areas where difficulty had been experienced in establishing clover.