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THE RELATIVE INFLUENCE OF ABOVE AND BELOW GROUND COMPETITION  
ON THE GROWTH AND SURVIVAL OF RYEGRASS SEEDLINGS  
TRANSPLANTED INTO A HILL COUNTRY PASTURE.

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ABSTRACT

In many pasture improvement programmes, for example oversowing in hill country, seedling survival is influenced by competition from the existing vegetation. Competition between pasture plants occurs when resources are limited and may be for factors above or below ground, or both. Technically, the effective separation of above and below ground competition is difficult and considerable problems have been associated with previous studies. A technique developed for field studies combined the treatments of clipping herbage surrounding the transplanted seedling to prevent above ground competition and inserting a metal cylinder (root tube) into the ground to prevent below ground competition, resulting in conditions of shoot, root, full or no competition.

Ryegrass seedlings were transplanted in August 1986 into a pasture in summer dry hill country near Wanganui and subjected to shoot, root, full or no competition from the existing vegetation. The duration of the experiment was three months. The effect of competition on the growth of the ryegrass seedlings was assessed by non destructive measurements (plant height, tiller number) taken at approximately weekly intervals. On three occasions, destructive harvests were made and the dry weight of shoots and roots was recorded.

Below ground competition occurred before, and was more severe than above ground competition, as exemplified by changes in plant size. Ryegrass plants in the treatments with below ground competition were 80 % lighter, 64 % smaller and had 60 % fewer tillers than plants with either shoot competition or no competition. The distribution of plant size was highly skewed, and indicated that the stress plants encountered when subjected to below ground competition was severe. The effect of above ground competition on ryegrass growth was small except when root competition was also present. Shaded plants were usually taller than those that were unshaded. In conclusion, below ground competition, possibly for soil nutrients, was shown to be the major influence on growth and development of transplanted seedlings at the hill country site studied.

The survival of seedlings introduced into pasture was also dependent on environmental factors, especially soil moisture, and therefore important in summer dry hill country. In a second experiment during spring 1986, ryegrass seedlings were grown in tubes and transplanted into a hill pasture at Wanganui. The six treatments consisted of combinations of two planting dates, two tube lengths, two harvest dates and were arranged as a randomised complete block design. Seedling survival was high over all treatments (98 %), probably because rainfall during the experimental period was high.

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Chapter 1  
INTRODUCTION

Hill country farming is of major importance to New Zealand's economy in terms of land area, number of livestock carried and the volume of export meat and wool produced (Rattray, 1982). Nevertheless, the production, composition, quality and level of pasture utilisation by grazing animals, and moreover, the conversion of these to saleable products, is often capable of substantial improvement. Topographical constraints limit pasture development, renovation or improvement in steep hill country to oversowing by an aeroplane or helicopter (Lambert et al., 1985). The results of oversowing are unreliable due to the hostile conditions encountered by many seeds, these conditions include: environmental factors (mainly moisture and temperature), pest or fungal attacks and competition from the resident vegetation (Lambert et al., 1985). The experiments reported in this thesis were designed to investigate the effect of competition from the resident pasture on the survival and growth of establishing seedlings in hill country.

Many of the 'classical' competition experiments were based on the additive design (for example, Donald, 1958) or replacement design (for example, de Wit, 1960), but these were not considered appropriate. Instead, a recent technique developed by Cook and Ratcliff (1984) was used as this permitted separation of shoot and root competition between an establishing seedling and the resident vegetation. Perennial ryegrass (Lolium perenne L.) was transplanted into a hill country pasture at Wanganui, and the effect of above and below ground competition from the resident species (paspalum (Paspalum dilatatum Poir.) was of particular interest due to its high competitive ability) on ryegrass growth and development was studied. A concurrent experiment evaluated the transplanting technique and related seedling survival to environmental factors. A brief description of the growth characteristics of the species studied is given, followed by the experimental objectives.

The growth characteristics of perennial ryegrass in response to seasonal and management influences were described by Hunt and Field (1979). A survey of farmers in New Zealand by Sangakkara et al. (1982) showed that ryegrass was the most popular grass species used because 98 % of all seed mixtures incorporated one or more cultivars. Ellet, a ryegrass cultivar sown by 39 % of farmers (Sangakkara et al., 1982) was developed for its superior autumn and winter growth compared with older ryegrass cultivars, fast growth following rain after a dry summer period, as well as resistance to attack from Argentine stem weevil (Listronotus bonariensis (Kuschel)) (Barker et al., 1985). The cause of resistance to stem weevil was found in 1981 to be associated with the presence of an endophyte fungus (Acremonium loliae) in the ryegrass plant.

Paspalum, a perennial subtropical grass from South America was introduced to New Zealand in the early 1890's (Percival, 1977). Paspalum has a high potential for herbage dry matter production in summer because it is a C4 species and is therefore active in the warm season and resistant to drought, but is frost sensitive and dormant during the winter (Lambert et al., 1979). A survey of paspalum in New Zealand pastures by Percival (1977) indicated that the distribution limits were set by winter temperatures and in most districts, rapid growth of paspalum began in late November (range October to December) (Percival, 1977). A survey by Sangakkara et al. (1982) indicated that farmers considered the formation of a sod bound pasture (a dense mat of rhizomes and tillers at or just below the soil surface) was the least favoured characteristic of paspalum because other sward components were excluded. Thom et al. (1986a) demonstrated that paspalum offered severe competition to establishing plants due to its exceptional colonising ability, growth potential during summer and ability to withstand treading and grazing.

The experimental objectives were:

i) To determine whether above or below ground competition occurs first in the interaction between transplanted ryegrass and established paspalum plants in the field.

ii) To determine the rate of survival of ryegrass seedlings transplanted into a hill country pasture and to relate seedling survival to environmental factors.