

COMPETITION BETWEEN 'NUI' RYEGRASS, 'MATUA' PRAIRIE GRASS AND 'APANUI' COCKSFOOT DURING ESTABLISHMENT AND EARLY GROWTH

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Abstract

The emergence, productivity and competitive effects that occur in the early growth period between 'Grasslands Nui' ryegrass, 'Grassland Matua' prairie grass and 'Grassland Apanui' cocksfoot when grown as pure swards and in binary mixtures are examined. The results indicate that the species compete for the same environmental resources and prairie grass suppresses the growth of the other two species while ryegrass has a similar effect on cocksfoot. Prairie grass and mixtures containing a major proportion of prairie grass outyield all other sward types and the yields of mixtures are seen to be between the monoculture yields of the component species over the period of study. Practical implications of these results are considered.

INTRODUCTION

Seeds and sowing costs can comprise up to 20% of the total cost of establishing a new pasture. Thus it is important to obtain successful establishment and subsequent high performance from sown pastures. Research has shown that the early growth patterns and competition that frequently occurs during the seedling phase between grass species or varieties in an association, can have a major effect on later stages of plant growth and productivity (Harris, 1973).

Perennial ryegrass (*Lolium perenne* L.) cultivars have long formed the basis of New Zealand's pastures (Langer 1973), and a survey in the southern regions of the North Island showed that all pasture mixtures sampled contained ryegrass (Harris 1968). Of the other components, cocksfoot (*Dactylis glomerata* L.) was seen in 54% of the pasture mixtures (Harris 1968) and it is considered to be a species adapted to dry areas and a useful summer producer (Langer 1973). Prairie grass (*Bromus catharticus* Vahl) has been recognized as a valuable species for dairy pastures in warm and fertile areas (Burgess 1951, Moss 1962), with its main value in higher cool season activity, rapid establishment and apparent resistance to insect pests (Langer 1973, Rumba 1974). Watkin (1975) and Baars & Cranston (1977) have shown its usefulness as a pasture species when grown with legumes. More recently its potential as a summer producer has been highlighted. (Lancashire 1978, Sithamparanathan 1979).

As these three species are important grasses in New Zealand's pastoral farming, a series of studies was formulated to assess their performance in the early growth phase when sown in mixtures and as pure swards.

EXPERIMENTAL

The trials was located on a Tokomaru silt loam soil type at Massey University. Seed mixtures containing two species in combination were made up from 'Grasslands Nui' Perennial Ryegrass, 'Grasslands Matua' Prairie grass and 'Grasslands Apanui' Cocksfoot in proportions of 1:0; .75:.25; .50:.50; .25:.75 and 0: 1 according to the replacement series principle of de Wit (1960). Thus nine mixtures and three monocultures were used for the study.

The trial was sown in spring 1979, onto a seedbed of uniform texture prepared by discing, rolling and levelling. A basal fertilizer application of 12:10:10 N:P:K at 500 kg per hectare was applied prior to sowing. The seed mixtures were broadcast sown behind a V-ring roller and the soil lightly harrowed. Seed rates were calculated to obtain 400 plants per square metre, which is considered to be similar to normal pasture conditions (Hill & Shimamoto 1973).

A randomized block design with three replicates was used for the study. Individual plot size was 3.5 x 13.5 metres.

Soil moisture levels were monitored at depths of 5, 10 and 20 cms, using gypsum blocks. Adequate rain fell during the experimental period and soil moisture was considered to be non-limiting throughout the trial.

Seedling emergence rates were evaluated by making daily seedling counts for 21 days on two randomly sited fixed quadrats (0.1m²) in each plot. Seedling establishment and survival was assessed 4 weeks after sowing on the same quadrats.

Dry matter yields of the swards were obtained by mowing to 2.5 cm above ground level at 9, 13 and 17 weeks after sowing. Prior to each harvest, randomly selected 0.1 m² quadrats were cut to the same height to obtain data on the botanical composition and dry matter production per plant.

The competitive abilities of the species were calculated by using the concept of Relative Yield total (RYT) (de Wit & van den Bergh 1965, McGilchrist & Trenbath 1971). The RYT was estimated by comparing the dry matter production per plant of each species in the mixture with that in the pure sward.

Crowding coefficients which indicate the aggressiveness of the species were calculated using the replacement diagrams of de Wit (1960) based on the method of Thomas (1970).

RESULTS

SEEDLING EMERGENCE and ESTABLISHMENT

The time of 75% emergence for all species in the mixtures did not differ significantly from their monocultures. While ryegrass and prairie grass emerged within 7 and 9 days respectively, cocksfoot was seen to emerge after 14 days which was a significant lapse of time from the other two species. The establishment of the species shown by plant counts were within the range of 355-395 plants per square metre for all sward types, which was not a significant deviation from the expected population of 400 plants per square metre.

DRY MATTER YIELDS

Weights of herbage harvested over the experimental period and the contribution of each species to the total dry matter yield are presented in figure 1. The yield of prairie-grass was greater than the other species both in monoculture and in mixtures. Its contribution to the total yield of mixtures was greater than the proportion of seeds sown. Cocksfoot yielded the lowest dry matter in its pure swards and contributed less in mixture than the proportion of seeds sown. The performance of ryegrass in mixtures was depressed by the presence of Prairie-grass, but ryegrass outyielded cocksfoot in the ryegrass-cocksfoot mixtures.

The yields of mixtures were intermediate between those of the individual monocultures (fig. 1).

COMPETITIVE EFFECTS

The relative yield totals based on per plant yield at every harvest did not deviate significantly from unity (.978-1.005), indicating that the species competed for the same environmental resources. The crowding coefficients (K) based on the replacement diagrams of the yield components (Fig. 1) show similar effects, and indicate the aggressiveness of prairie grass compared with the other two species and of ryegrass compared with cocksfoot. The higher K value denotes the more aggressive species.

DISCUSSION

The primary objective of this study was to investigate the comparative performance of the three species when grown in mixtures and as pure swards.

The emergence of seedlings depends on many soil factors and on the species sown. McWilliam & Dowling (1970) and Brock (1973) have shown that while root extension rates are different in different species, they can be affected by soil water content, soil compaction and depth of sowing. In this experiment, the seedbed was well prepared and as rainfall ensured adequate available water during establishment, it is considered that environmental factors had no effect on the emergence rates and establishment of the three species. This was verified by emergence rates being similar to those obtained in laboratory germination tests. Thus emergence rates can be considered a species characteristic which gives prairie grass and ryegrass an advantage over cocksfoot in earlier growth and greater exploitation of the environmental resources.

The superior growth and aggressiveness of prairie grass over ryegrass and of both these species over cocksfoot during the experimental period is correlated with relative differences in seed weight (1000 seed weights of prairie grass, ryegrass and cocksfoot were 9.73, 2.27 and 0.899 gms respectively) plus the earlier emergence of prairie grass and ryegrass (7-9 days) when compared with 14 days for cocksfoot and more rapid seedling growth. However, earlier emergence and more rapid seedling growth shown by greater dry matter

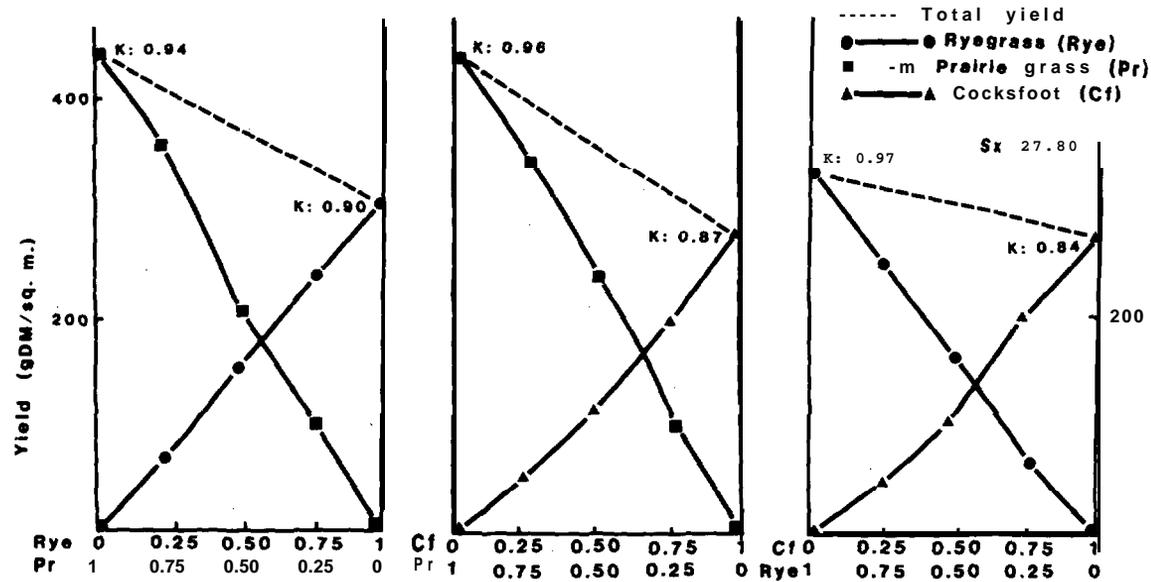


FIG. 1: Replacement diagrams based on cumulative dry matter yields of ryegrass (Rye), prairie grass (Pr) and Cocksfoot (Cf) and the relative crowding coefficients (K) for each species.

accumulation can be considered the major factors as seed size is not necessarily related to rapid seedling growth when comparing species (Wright 1970). The more rapid seedling growth of Matua prairie grass over ryegrass has been shown by Hill & Pearson (1981), and can be considered to be the main factor contributing to the dominance of prairie grass over ryegrass, although ryegrass emerges 2-3 days earlier. The superior growth and dominance of ryegrass over cocksfoot has long been established (Stapledon & Davies 1921) and this also can be attributed to more rapid seedling growth and faster tillering rates of ryegrass. Thus the more aggressive species can obtain their requirements for growth from the environment more efficiently and at the expense of the less aggressive species. This competitive effect is substantiated by the RYT values which do not deviate significantly from unity even at this early stage of growth.

PRACTICAL IMPLICATIONS

When devising the composition of pasture seed mixtures, the purpose for which the pasture is to be used must be the deciding factor. Management factors and environment must be defined first and then the most suitable species selected. Data such as presented in this trial can be an important tool in the selection process. For instance, prairie grass has been shown to be an aggressive species and will provide early feed while suppressing weeds and other slower growing desirable species, but it has well defined management limitations. This large but low tillering plant with high palatability is particularly susceptible to selective grazing and therefore it is more suited to rotational grazing systems (Langer 1973). Prairie grass will dominate in the establishment phase when incorporated in mixtures and unless management and/ or seeding rates are adjusted to maintain the required balance the other desirable companion species will be reduced or excluded.

Cocksfoot, when incorporated in mixtures should be managed with consideration given to its slow growth over the establishment phase. However, the final decision lies with the farming situation as seen by the individual.

ACKNOWLEDGEMENTS

The authors are grateful to Mr C. C. Arnold, Department of Mathematics and Statistics, Massey University and Dr V. J. Thomas, Applied Mathematics Division, D.S.I.R. for computational assistance, and Professor B. R. Watkin and Mr P. N. P. Matthews (Agronomy Department, Massey University) for the advice and guidance during this study.

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