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MANAGEMENT OF NEW **CULTIVARS** FOR **DRYLAND**

J.A.LANCASHIRE and J.L.BROCK
Grasslands Division, DSIR, Palmerston North

Abstract

Some characteristics of seed quality, establishment rates, performance in mixtures and response to grazing management of 5 new pasture plants with potential in dryland are described.

On a dry hill country site in the Wairarapa, the contribution of the sown grasses established in separate plots with clovers under rotational grazing was 'Grasslands Wana' cocksfoot 65%; 'Grasslands Maru' phalaris 23%; 'Grasslands Matua' prairie grass 22%; and 'Grasslands Roa' tall fescue 13% after 2 years. The other main grass species was resident perennial ryegrass which established from buried seed (ca. 240 plants/m*) and had a major impact on the establishment and growth of the sown grasses.

On a seasonally dry Manawatu flat land soil 3 grazing managementsviz. set stocked all year (S); rotational all year (R); and combination (C) (set stocked from lambing to drafting and rotational for the remainder of the year) were applied to mixtures of the new cultivars (except that 'Grasslands Apanui' cocksfoot replaced Wana) with ryegrass and white clover stocked at 20 sheep/ha. After 3 years the contribution of the new cultivars was negligible under S and ryegrass was dominant. The R pastures became cocksfoot dominant and Matua (in winter) and chicory (in summer) contributed more than in the S system. The C system produced the most evenly balanced species contribution with only Roa remaining at < 5%.

A sub-trial with cocksfoot cultivars demonstrated that Wana maintained better production and tiller density (11,000/m^2) than Apanui (1000/m^2) under set stocking (S).

Although some of the newcultivars will require specialised management procedures to fulfil their potential in dryland, the increasing and widespread use of Matua prairie grass in farming suggests that these techniques can be adopted in commercial agriculture provided good technical information is available in a management package when the cultivar is released.

Keywords: Dryland, grazing management, mixtures, Matua prairie grass, Wana cocksfoot, Roa tall fesuce, Maru phalaris, Chicory

INTRODUCTION

Soil moisture deficits are a primary limitation to pasture production in New Zealand through their adverse effects on plant growth and survival (Corkill et *al.* 1981). The use of annual and biennial ryegrasses *(Lolium* spp) and subterranean clover *(Trifolium subterraneum* L.) for cool season growth, and cocksfoot *(Dactylis glomerata* L.), lucerne *(Medicago sativa* L.) and to a lesser extent red clover *(Trifolium pratense* L.) to combat the inadequacies of perennial ryegrass and white clover in dry conditions is well established,

However, the potential value of many plant types, particularly some of the grasses, has never been fully realised apparently because of management problems and/or the lack of reliable seed supplies of suitably adapted cultivars. For example, although numerous trials and farmer observations in New Zealand over many years have demonstrated the excellent drought tolerance of tall fescue *(Festuca arundinacea* Schreb.) (Baylis 1912; Tennent 1935; Allo 1965; Cullen 1965; Watkin 1975; Reeves 1975; Van der Elst 1979; Sheath & Greenwood 1982; Anderson et *al.* 1982) and phalaris *(Phalaris aquatica* L.) (McGillivray 1915; Allan & Zotov 1930; Blair 1937; Robinson 1952; Hill 1953; Blake 1956;

Iversen & Calder 1956; Bennett 1959; Rumball 1969) their current use in pasture mixtures is almost nil. Possible reasons for this lack of adoption by farmers are slow and/or poor establishment (Bell 1961; Brock 1973); low tolerance of hard grazing particularly during establishment (Robinson 1952; Allo & Southon 1967); poor quality seed lines (Rumball 1980) and fear of animal health problems (Wilson 1975; Bennett 1959).

Another species which is well adapted to dry conditions is cocksfoot, but although it is the most commonly sown grass species after the ryegrasses (Sangakkara et *al*. 1982) its contribution to annual pasture production is often very low (Lancashire & Latch 1969). This may be associated with slow establishment (Sears 1961), susceptibility to treading (Edmond 1966) and rust diseases (Lancashire & Latch 1969), but the major factor is probably the intolerance of the older erect growing types like C23 and Akaroa (Saxby 1956) and Apanui (Brougham 1960) to hard grazing. A recently released cultivar of prairie grass 'Grasslands Matua' has also shown considerable potential in drier areas and for summer production (Lancashire 1977; Rys et ***al.*** 1978; Fraser 1982). but is intolerant of frequent grazing (Pineiro & Harris 1978) and winter wet soils (Lancashire 1977) and may be very aggressive to other species particularly in the establishment phase (Sangakkara ***etal. 1982).***

Another species chicory ***(Cichorium intybus*** L.) has shown good drought resistance (O'Brien 1955) with excellent production in summer under rotational grazing at Palmerston North (Lancashire 1977) and on dryland sites in Hawke's Bay (P.Lycette, pers. comm.). However it can be very aggressive in mixtures and requires long spells between grazings for maximum productivity (Anon 1918, Rumball, pers. comm.).

Although the recently released cultivars 'Grasslands Roa' tall fescue, 'Grasslands Maru' phalaris and 'Grasslands Wana' cocksfoot may overcome some of the problems of these species outlined above, their optimum use in grassland farming will still depend on an understanding of their management requirements. In particular, relationships with, and differences from, perennial ryegrass are important because this species is sown in nearly all pasture mixtures in New Zealand (Sangakkara et ***al. 1982).***

However, the development and management of perennial ryegrasses more suitable for dryland will not be discussed in detail here because the topic has been well covered elsewhere (Vartha & Hoglund 1983) and management practices for this species are generally much better understood.

In this paper management of cultivars is defined in the broadest sense, i.e., to make proper use of the cultivars.

SEED CHARACTERISTICS

The first essential is to use certified seed of known purity and germination. This is particularly important in the case of Matua where uncertified seed infected with smut *(Ustilago bullata* Berk.) can seriously reduce plant growth in both pure swards and mixtures (Falloon 1976; Lancashire et ***al, 1982). As a*** further insurance seed should be treated with fungicide before sowing. e.g. Benlate (50% benomyl) as a dust or slurry at 6 g/kg of seed, or Vitaflow 200 (thiram and carboxin) at 15 ml/kg seed.

Imported phalaris seed of older cultivars has often contained immature seed low in germination, because of the difficulty of assessing the optimum time to harvest the crop which shatters easily (McWilliam & Shroeder 1974; Lancashire

et al 1980). This problem is not so serious in Maru but germination should still be checked because locally grown commercial crops are showing a fairly wide range in viability (Table 1). The mean value of 72% is below that obtained at Palmerston North in nucleus crops (mean of 83%) and well below those commonly obtained with good lines of perennial ryegrass (90%+).

The wide range of seed weights and the approximate numbers of seeds per kilogram of the lines under discussion are shown in Table 2.

Table 1: GERMINATION OF SOME COMMERCIAL MARU PHALARIS SEED CROPS (%)

Interim (10 days)	Final (21 days)	Remainder
62	78	20
61	69	26
70	75	23
74	79	19
48	59	33

Table 2: RANGE OF 1000 SEED WEIGHTS (g) AND APPROXIMATE NUMBERS OF SEEDS PER KILOGRAM

	1000 seed weight (g)	Seeds/kg
Matua prairie grass	11.50 – 13.27	81 000
Roa tall fescue	2.56 – 3.52	330 000
Nui perennial ryegrass	1.87 – 2.48	450 000
Maru phalaris	1.69 – 2.00	540 000
Chicory	1.34 – 1.59	640 000
Wana cocksfoot	0.65 – 0.85	1 300 000

ESTABLISHMENT FROM SEED

The next stage in successful plant establishment is the production of a vigorous seedling with a high percentage establishment rate. This is especially important in oversowing hill country where establishment rates particularly of grasses are often extremely low (Suckling 1949; Cullen 1966). The range of situations shown in Table 3 illustrate that generally better results are obtained with full cultivation and that Wana cocksfoot has relatively low and slower emergence rates than the other lines. Chicory was notably high, while the results for Matua were rather uneven with bird predation on poorly covered seed apparently reducing the strike in the spring sowing in the Manawatu. This also appeared to be an important factor in the relatively low establishment rates in the Taupo oversowing in August (Baars *et al.* 1982) which is the period when wild birds are extremely short of feed (R.E.R.Porter, pers. comm.). In an attempt to overcome this problem the pelleted seed was coloured green but with no apparent

Table 3: INITIAL PLANT ESTABLISHMENT FROM SEEDS BROADCAST SOWN (%)

	Manawatu flat land		Dry hill country	
	Full cultivation		Wairarapa	Taupb
	Autumn	Spring	Autumn, Sprayed, cultivated, trodden	Spring, Sprayed, trodden
	At 4 weeks		5 weeks	7 weeks*
Matua	70	23"	66	17
Maru	51	45	36	18
Wana	16 (25 at 8 weeks)	10	10	6 (10 at 9 weeks)
Roa	54	40	39	14
Chicory	86	85	-	-
Nui	-	-	45	21

* Bird. Strike

deterrent effect. Although the overall results for Matua were good the initial seedling vigour of this large seeded species does not appear to be high as emergence can be severely reduced at sowing depths greater than 2 cm (T.Fraser, pers. comm.). This effect was quite marked at the Taupo site where emergence in one 'soft' plot was reduced by nearly 40% compared with 'harder' plots where seed was not buried so deeply by sheep treading.

EARLY GROWTH RATES

Following the successful initial establishment of the seedling the next factor which may influence the contribution of a species to a pasture mixture is its early growth rate. Figure 1 illustrates the much lower growth rates of pure mown swards of Wana and Roa than Nui and Maru in the first 6-8 months from sowing in April in the Manawatu. Matua is not shown but in other trials at Palmerston North has shown similar or superior early growth rates to Nui and Maru on free draining soils. However, despite their slow establishment, in the absence of competition from other species, both Wana and Roa were able to express their potential to outyield ryegrass over the summer. The high yield of Maru at this period is rather misleading as it is inflated by the plant's continued production of flowering stems during the summer.

A different situation is shown in Fig. 2 where grazing and mixtures with other species are involved. The main grass cultivars were oversown in separate plots (see Table 3) onto a sprayed, cultivated North facing slope in dry hill country in the Wairarapa (annual rainfall ca. 800mm) in March 1980. All grasses were sown with white and subterranean clover and there was a considerable strike of ryegrass from resident buried seed (ca. 240 plants/m^2) in all plots. The initial growth rates of the grasses under rotational grazing in separately fenced plots were broadly in line with other trials with Wana being well behind Matua, Maru

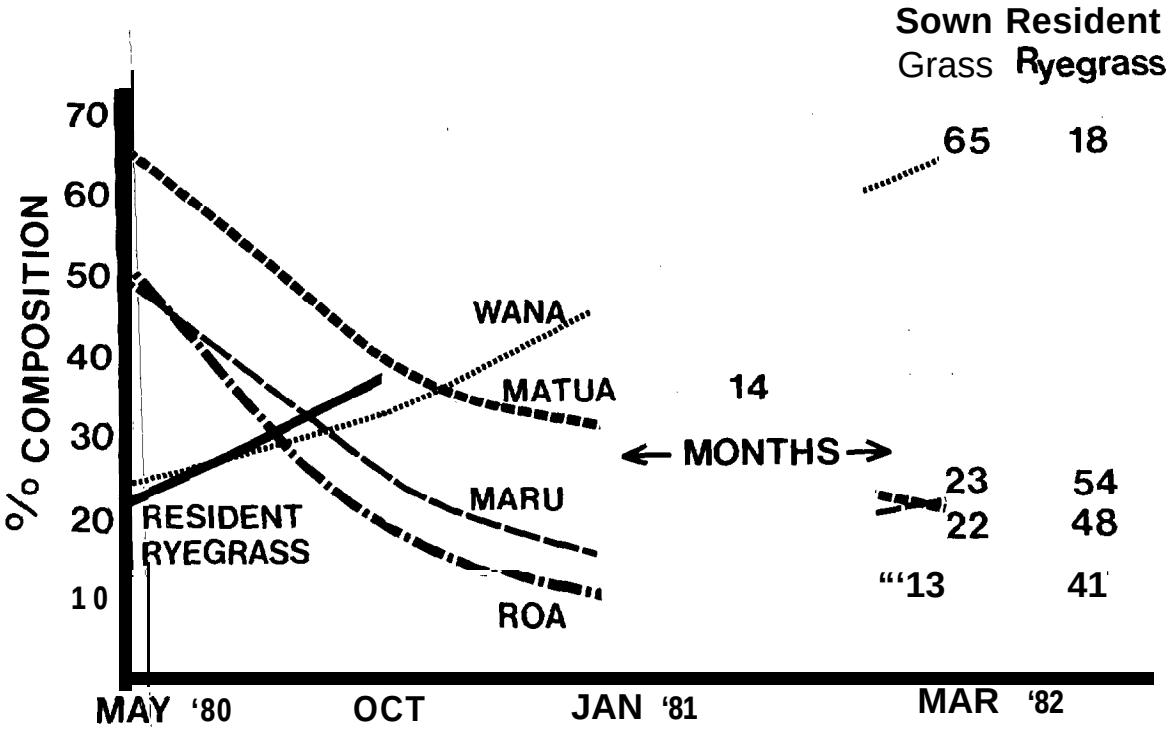

Fig. *2: Percentage contribution of major grasses in dry hill country. N.B. Resident ryegrass is shown graphically as the mean for* all sown plots until October *1980. Subsequently it differed significantly (P<0.5) between treatments.*

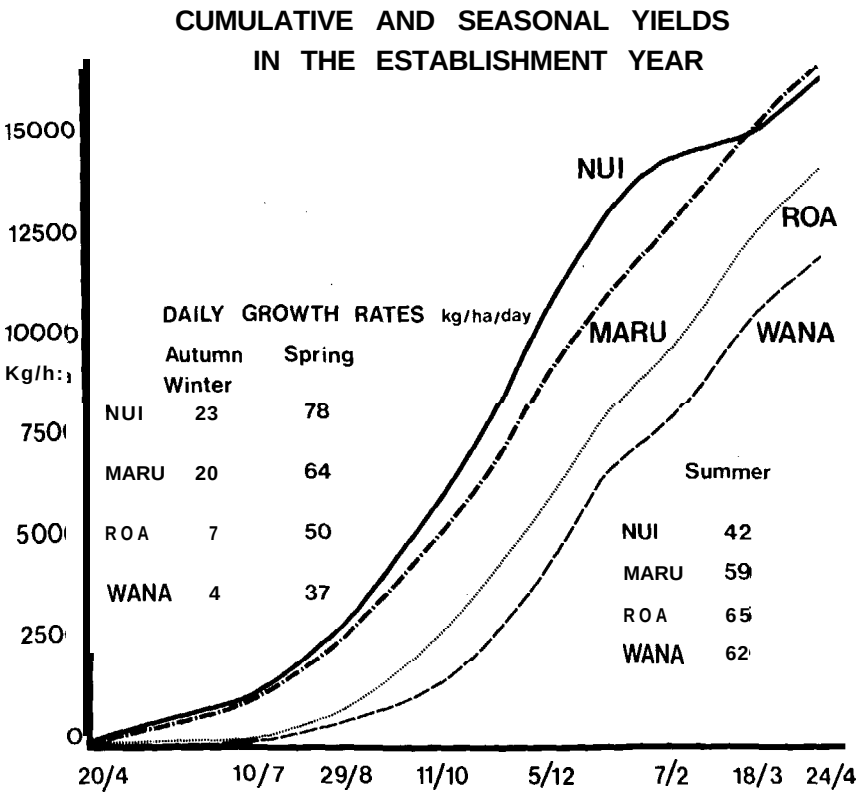

Fig. 1 *Growth rates of four cultivars under mowing in the establishment year.*

and Roa. However, the competitive influence of the resident ryegrass became very obvious during the first winter and spring and the contributions of all the sown grasses except Wana had fallen quite markedly by the first summer. After two years Wana has maintained its dominant position while the resident ryegrass is the main contributor to yield in the other plots. However, it is too early to write off the other grass cultivars in this environment particularly as a severe drought has not been experienced since the start of the trial. Clearly Roa is in serious trouble and has well known difficulties of establishment in mixtures with perennial ryegrass (Brock 1983). The proportion of Maru has fluctuated quite widely between seasons and plots but is now showing an overall increase partly as a result of underground spread by rhizomes. Both Matua and Maru have contributed 30-40% to total yield during the past winter and early spring, and Matua has given a 70% response to increased applications of phosphate and nitrogen fertiliser.

In addition to the sowing method and the companion species, the time of sowing will also have an effect on the relative early growth rates of different species and thus the composition of a pasture mixture. The pastures shown in Figure 3 were sown at Palmerston North on a Kairanga silt loam with the same

combination of species and sowing rates (Matua 15; Roa 10; Maru 6; Wana 5; Pitau 3, Chicory 1 kg/ha) in either autumn or spring, (and rotationally grazed with sheep in either autumn or spring,) and rotationally grazed with sheep during establishment. In the spring chicory established very quickly and was strongly dominant through late spring, summer and autumn. However as this species is virtually dormant during winter it contributed very little to the autumn sown pasture in the first few months which was dominated by the fast establishing winter active Matua. In both cases the relatively slow establishment of Wana and Roa compared with Maru and Matua was again demonstrated.

Clearly with a better understanding of the different early and seasonal growth patterns of these species in different dryland environments manipulation of seeding rates, dates of sowing and grazing management can be used to obtain the desired species combination. However, the long-term contribution of these species to pasture production on dry soils can only be determined by grazing management studies over a number of years.

GRAZING MANAGEMENT

In spring 1978 several pasture mixtures were established at Palmerston North on a Manawatu fine sandy loam topsoil overlying deep sands and gravels. This is a seasonally dry soil which reaches permanent wilting point in most summers and in dry years has remained in this situation for 2-3 months. Cultivars and seed rates (kg/ha) were Nui/Ruanui 4; hybrid ryegrass 2; Matua 11; Roa 7.5; Maru 4; Apanui 3.5; white clover 2.3; Pawera red clover 2; Chicory 1. Three self-contained management systems with a common stocking rate of 20 wethers/ha (ewes and lambs since 1980) were imposed on all pasture mixtures in spring 1979. These were:

(1) Set stocked all year
(2) Rotational grazing (12 paddock system) all year
(3) A combination of set stocking from lambing to drafting and rotational grazing for the-remainder of the year.

Under set stocking the pasture has become strongly ryegrass/white clover (20% in March 1982) dominant (Fig. 4). Apanui cocksfoot contributed about 10% of the annual yield while the other sown species have been reduced to very low levels. Chicory disappeared by the end of the first summer under this treatment and Matua never contributed more than 5% before finally disappearing in the winter of 1982. Maru and Roa survive but only at <5%. Severe feed shortages have developed in winter resulting in sleepy sickness in the ewes in late winter, while feed deficits are also evident in the summer dry period.

The rotational system had become strongly cocksfoot (Apanui) dominant by the second summer with higher contributions from both chicory (in summer) and Matua (in winter) than in the set stocked system. Both Maru and Roa remained at <5% with white clover at 10% in March 1982. In this system feed shortages occurred in winter because of the dominance of cocksfoot which is a poor winter grower, and in summer because of the low feed quality of rust (*Puccinia graminis* Pers) infected cocksfoot.

The contribution of the sown species was more evenly balanced in the combination treatment with ryegrass tending to dominate in the cool season and cocksfoot in the summer. Both Maru and Matua have maintained a steady contribution throughout the year peaking at 10% and 15% respectively in the

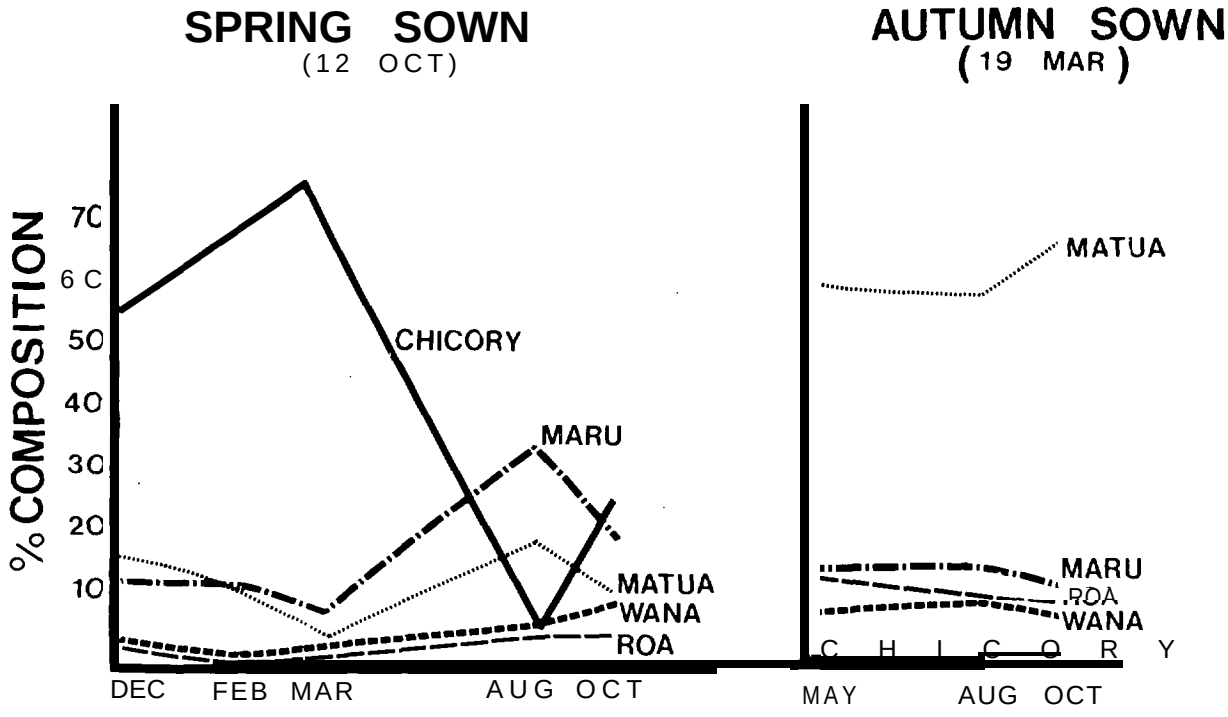

Fig. *3: Effects of time of sowing on species composition (White clover not shown).*

winter. As in the rotational system chicory was tending to decline over time but still maintained almost 10% of total yield in summer. Roa was again the lowest of the sown species. This grazing system maintained the best balance of species, the best feeding level and the best quality feed. Although set stocking over spring reduced the 'spring flush' it also developed high pasture density which subsequently gave strong vegetative growth on the return to rotational grazing in summer. Adequate pasture growth then continued right through to the end of winter without feed shortages.

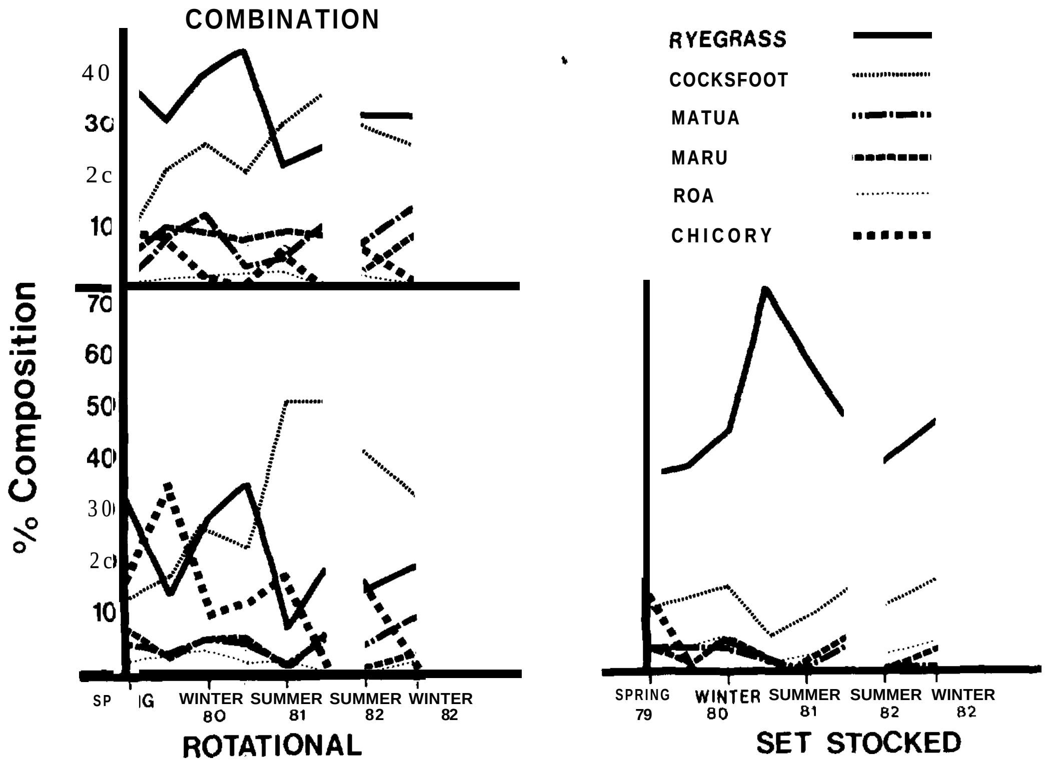

Fig. 4: Effects of 3 grazing systems on species composition (legumes not shown).

Table 4: YIELD CONTRIBUTION (%) AND TILLER DENSITY (per m^2) OF COCKSFOOT CULTIVARS IN MARCH 1982 UNDER DIFFERENT GRAZING SYSTEMS

	Apanui		Kara		Wana	
	Yield	Tillers	Yield	Tillers	Yield	Tillers
Rotational	39	3400	39	3650	39	6820
Set stocked	3	890	5	1310	18	10960
Combination	18	2270	25	2940	52	6470

Cocksfoot cultivars

Strips of three cocksfoot cultivars — Apanui, Kara and Wana -were sown in each grazing treatment to assess possible differential management effects. No differences were seen before January 1981 but the marked advantage of Wana under set stocking was very clear by March 1982 (Table 4). The prostrate habit and greater rust resistance of Wana compared with the more erect growing Apanui and Kara gave the cultivar a big advantage which also resulted in a far higher tiller density in all grazing treatments (Table 4).

CONCLUSIONS

At the start of this paper the question was asked why a number of species apparently well suited to dryland were not more widely used in pasture mixtures. The recent release of a number of cultivars better adapted to New Zealand conditions partly answers this question, and reasonable supplies of certified seed of Matua, Roa and Maru will be available in the current season. A number of Wana seed crops will be harvested in the 1983/84 season while initial multiplication of a Grasslands chicory selection will be made this year (Rumball 1983). Limited supplies of unselected chicory can also be obtained locally.

As far as the authors are aware the only animal health problems associated with these lines have been some isolated occurrences of phalaris staggers and poisoning (Hartley 1978) on relatively pure stands of Maru in the autumn (Wright *et al.* 1981; N.Thomson, pers. comm.), although one outbreak occurred in the late summer following irrigation of regrowth after a seed crop (E.W.Vartha, pers. comm.). Therefore it is important that measures are taken to limit the intake of rapidly growing strongly dominant Maru swards following autumn rains. However, it is not expected that this will be a serious problem in practice because some therapeutic measures are also available (Goodwin 1981), and the cultivar will generally be diluted in mixtures with other grass cultivars like Wana and Roa, and also clovers and probably ryegrass which do not pose similar hazards.

In addition both Maru and Roa have shown the capacity to produce amounts of liveweight gain and milk at least comparable to perennial ryegrass (Goold & Hupkens van der Elst 1980; Wright *et al.* 1981; Wilson 1975; G.F.Wilson, pers. comm.).

The summary of the major agronomic features in Table 5 indicates the potential for combining the contrasting seasonal growth patterns of the different cultivars in a single mixture, while the results from the combination treatment

in Fig. 3 confirm that this is a realistic goal. However, this will not be achieved if the standard easy care management of perennial ryegrass pastures is adopted. Some of the more specialised management procedures outlined in this paper will be required, and the increasingly widespread and successful use of Matua prairie grass in different parts of the country (Sangakkara et *al. 1982)* suggests that these techniques can be readily adopted by farmers.

Clearly more information is required on the optimum species combinations and managements for the different dryland areas of the country, but it is extremely important that all the available information is presented in a good extension package to both the buyer and seller of the seed. Only in this way will it be possible to realise the undoubted potential of these more specialised cultivars in New Zealand grassland farming.

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Table 5: AGRONOMIC CHARACTERISTICS OF NEW CULTIVARS

	Establishment from seed	Early growth	Main period of growth	Management	Mixtures with perennial ryegrass (PR)
Matua	Very good in most situations	Excellent in Autumn Good in Spring	Autumn Winter Early Spring	Infrequent Hard	No more than 5 kg/ha PR
Wana	Moderate	Slow	Late Spring Summer Autumn	Flexible	Up to 15 kg/ha PR Care at establishment
Maru	Good	Excellent in Autumn Good in Spring	Autumn Winter Early Spring	Lax early then flexible	No more than 5 kg/ha PR
Roa	Good	Slow	Late Spring Summer Autumn	Very lax early then flexible	No way
Chicory	Very good	Very slow in Autumn Excellent in Spring	Summer Autumn	Infrequent	<15 kg/ha PR Care at Autumn establishment
Nui	Very good	Very fast	Autumn Winter Spring	Flexible	-