Seed production of new grass cultivars

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ABSTRACT. Some aspects of the agronomy and seed production of four recently released Grasslands cultivars are described.

Matua prairie grass sown at 10 to 15 kg/ha in 50-60 cm rows has produced over 3000 kg/ha of seed from two harvests in one season. The problem of head smut can be overcome by treating the seed with 1% by weight of benomyl, but techniques for treating large seed lots still have to be developed.

Roa tall fescue sown at 2.2 kg/ha in 60 cm rows has produced over 1000 kg/ha of seed in the second season from sowing. Early defoliations should be very lenient or avoided altogether because the species is very slow to establish.

Maru phalaris has produced over 800 kg/ha of seed in the absence of defoliation between sowing and harvesting. Although the cultivar may be less prone to seed shattering than older types, it is still very important to harvest at the correct time.

Raki paspalum is a valuable grass for the northern areas of New Zealand, but ergot seriously restricts seed production, particularly in wetter years. The disease can probably be controlled within the crop by cultural and fungicidal methods, but it is very difficult to prevent reinfection from outside areas. The best prospect is to avoid the disease by growing Raki in suitable areas which have a reliable dry period each summer.

Key words: Seed production, *Bromus willdenowii*, *Phalaris aquatica*, *Festuca arundinacea*, *Paspalum dilatatum*, new grass cultivars.

INTRODUCTION

The recent release in New Zealand of five agricultural grass cultivars, only one of which is a ryegrass, offers possibilities for diversification by commercial seed growers. 'Grasslands Matua' prairie grass (*Bromus willdenowii* Kunth.) was placed on the New Zealand National List of Acceptable Herbage Cultivars in 1973 and has been fairly widely grown. However, there is little grower experience with the more recent releases, 'Grasslands Roa' (formerly G4710) tall fescue (*Festuca arundinacea* Schreb.), 'Grasslands Maru' (formerly G14) phalaris (*Phalaris aquatica* L.), 'Grasslands Raki' (formerly G15) paspalum (*Paspalum dilatatum* Poir.) (released subject to the development of satisfactory seed production techniques), and 'Grasslands Moata' (formerly G4709) tetraploid Italian ryegrass (*Lolium multiflorum* Lam.).

Other local populations or cultivars of some of these species or related species have been grown in different parts of the country, and so growers and seed merchants should not be completely unfamiliar with some of the required techniques. For example, F. G. Butt of Marlborough grew prairie grass for many years (Crawford, 1960), while the species has also been frequently harvested off roadsides (Rumball, 1974). Canary grass (*Phalaris canariensis* L.) has been very widely grown for bird seed in recent years, and *Phalaris aquatica* L. was grown for many years by D. Craw at Linton. Moata tetraploid Italian ryegrass will not be considered here because the features outlined by Brown (1980), Moore (1980) and Trought (1980) are applicable to this cultivar.

MATUA PRAIRIE GRASS

AGRONOMY

Matua is generally used in pasture mixtures because of its excellent growth in the cool season (Baars and Cranston, 1978), but in drier areas and during recent droughts it has also shown an excellent capacity for growth in summer and early autumn (Lancashire, 1978). It has also been used as a companion grass for lucerne, although it may be too competitive to form a stable high-yielding combination with this species (Fraser and Vartha, 1980). The cultivar generally performs best on drier, free-draining soils and may establish very slowly (Lancashire, 1978) and fail to persist on heavy soils which are wet in winter and early spring. It is generally regarded as a "high fertility" grass and may respond more than ryegrass to high applications of nitrogen fertilizer (Baars and Cranston, 1978), and will not stand over-grazing (Rumball, 1974).

SEED PRODUCTION

Before planting it is essential to treat the seed with a fungicide to control head smut (*Ustilago bullata* Berk.). Although Matua was selected for resistance to this disease during the breeding programme (Rumball, 1974), the development of new races of the pathogen has resulted in the cultivar now being susceptible to the disease, with consequent severe effects on seed production (Table 1). Smutted crops are rejected from certification, and plant emergence and growth from smutted seed is reduced (Falloon, 1976).

The results from the second harvest also demonstrate that mature plants free of the disease can become infected by other diseased plants (Falloon, 1979).

The effects of a range of seed treatments with different fungicides shown in Table 2 indicate that benomyl applied as a dust or slurry at a rate of 1% by weight successfully controlled the disease in the first year.

TABLE 1: EFFECT OF HEAD SMUT ON SEED PRODUCTION OF MATUA PRAIRIE GRASS

Fungicide[1] Treatment	Rate	Plants/ Row	% Smutted Plants	Seed Yield (g) per Plant	Seed Yield (g) per Row
Nil	—	28.4	86.5[2] (100)[3]	9.9	275
Mancozeb	0.25	30.2	54.5 (92)	16.3	474
Benomyl	0.1	26.8	13.8 (93)	28.7	759
Benomyl	0.5	25.8	0.0 (89)	35.9	893
L.S.D. (5%)		n.s.	19.6[4]	9.5	206

[1] Applied as a dust to naturally infected seed carrying 8.2×10^{-3}g teliospores/g of seed.
[2] Smut assessed 5 December 1978, seed harvested 20 December 1978.
[3] Smut assessed at second harvest on 27 February 1979.
[4] L.S.D. only between treatments with smut. Analysis on arc sine transformed data.

TABLE 2: EFFECT ON FUNGICIDES ON HEAD SMUT IN MATUA PRAIRIE GRASS

Treatment	Rate	% Plants Emerged	% Plants Flowering	% Smutted Plants
Nil[1]	—	35	28	87
Nil + 1.6% smut spores by weight	—	25	23	92
Benomyl dust	0.5	36	26	0
Benomyl slurry	0.5	42	35	0.5
Benomyl dust	1.0	36	29	0
Benomyl slurry	1.0	34	31	0
Mancozeb slurry	0.5	36	29	23
Benomyl + Thiram slurry	0.6	34	31	0
L.S.D. (5%)		7.5[2]	6.2	13.9[3]
Date (100 seeds sown /5 m row)	9 May	30 Jun.	14 Nov.	5 Dec

[1] Treatments applied to naturally infected seed carrying 8.2×10^{-3}g teliospores/g of seed.
[2] Analysis on arc sine transformed data.
[3] Refers only to those treatments with smut.

However, it has proved very difficult to develop routine seed treatments on a large scale. The major problem is that the large (12 g/1000 seeds) awned prairie grass seed does not flow easily, and there is an urgent need to develop better large-scale procedures. On the farm, small lots can be quite adequately treated in a concrete mixer. Finally, it appears that the seed can be treated with fungicide and stored for at least 15 months without adverse effects on germination (Table 3).

TABLE 3: EFFECT OF THE STORAGE OF FUNGICIDE TREATED SEED ON GERMINATION

Treatment	Rate	% Laboratory Germination Months after Treatment 0	6	15
Nil	—	98	94	94
Benomyl dust	1.0	98	94	93
Benomyl slurry	1.0	96	94	91
Mancozeb slurry	1.0	96	93	93
Benomyl + Thiram slurry	0.6	95	93	94
L.S.D. (5%)		n.s.	n.s.	n.s.

Brown (1980) suggested that the optimum plant density for Matua seed production in Canterbury was 100 to 130 plants/m^2, which was achieved by a seed rate of 20 to 25 kg/ha in 15 cm rows. In the Manawatu, seed yields of over 3000 kg/ha (from two harvests in one season) have been obtained from seed rates of 10 to 15 kg/ha precision seeded in 50-60 cm rows. In the past a set of agitators has been used to prevent bridging in the box, but mixing the seed with an equal weight of dry untreated sawdust has overcome this problem (Horrell, 1979).

There is little published information on the optimum grazing management and fertilizer requirements of Matua seed crops, but Brown (1980) has emphasized the importance of nitrogen applications at the commencement of stem elongation in spring. This can occur early in September, 3 to 4 weeks before ryegrass, and the first crop is generally ready to harvest by mid-December. The cultivar is extremely free-flowering, and provided further nitrogen is applied after harvest an excellent second seed crop is usually obtained by mid-February, 60 to 70 days later. In particularly favourable seasons a third crop may be obtained, but harvesting conditions in mid-April are generally not suitable. The seed sheds readily when the crop is completely ripe, and it is important to cut just before this stage.

ROA TALL FESCUE

AGRONOMY

Tall fescue has shown potential in drier areas where perennial ryegrass does not persist well (Watkin, 1975). It is also tolerant of grass grub (*Costelytra zealandica* White) (East *et al.*, 1980) and maintains feed quality better than most other grasses during winter in the high country (Vartha and Clifford, 1971). In addition, Roa is very acceptable to stock (Anderson, 1975), and Goold and Hupkens van der Elst (1980) demonstrated good liveweight gains with the cultivar particularly in the summer.

The main agronomic disadvantage of the species is slow establishment, and thus it is unusual to obtain a good seed crop in the first year. Sowing depth should be 1 to 2 cm (Table 4), and hard grazings (< 5 cm) during the first summer may drastically reduce stand density and encourage heavy infestations of weed grasses (Table 5). Established crops may withstand harder grazing (Watkin, 1975; Brock, 1980), but it is recommended that, during the early establishment of a stand for seed production, grazing or mowing should be extremely lenient or avoided altogether.

TABLE 4: CULTIVAR × DEPTH OF SOWING INTERACTIONS
(Brock, 1973)

Cultivar and Sowing Depth (mm)	*Shoot DW (mg)*
Ruanui:	
0	39.9
12.5	45.2
25.0	32.5
37.5	27.4
S170:	
0	17.9
12.5	26.4
25.0	21.1
37.5	17.2
Roa:	
0	14.0
12.5	20.3
25.0	20.3
37.5	17.1

TABLE 5: SPRING YIELDS (kg/ha) AFTER HARD SUMMER GRAZING DURING ESTABLISHMENT
(Brock, 1980)

	Total	*Sown Grass*	*Volunteer Species**
S170	6 650	3 100	3 030
Roa	6 720	2 280	3 905
Ruanui	6 450	5 000	885

*Mainly *Agrostis tenuis*, *Holcus lanatus* and *Poa annua*.

SEED PRODUCTION

Experience in the U.S.A. (Heath *et al.*, 1973) and the U.K. (Bean, 1978) suggests that thin broadcast stands or rows are most suitable for seed production. In the Manawatu, precision-seeded rows at 2.2 kg/ha at 60 cm centres have produced yields in excess of 1000 kg/ha. The use of rows also facilitates the control of troublesome weeds such as annual grasses and ryegrass, whether these are controlled by herbicides or inter-row cultivation.

There are no comparative data available in New Zealand on the effects of variable closing times, fertilizer applications and grazing managements on tall fescue seed production. However, Roa flowers 2 to 3 weeks earlier than ryegrass, and experience in the Manawatu suggests that the crop should be closed no later than mid-August and that a dressing of 40 to 50 kg/ha of nitrogen at this time is beneficial. Marked reductions in the seed yield of Demeter and S170 tall fescue because of late closing have been demonstrated in Australia (Williams and Boyce, 1978) and in the U.K. (Roberts, 1961). Earlier management should be designed to encourage the maximum development of fertile tillers during the cool season, and grazings in autumn and early winter have been shown to be beneficial to established stands in the U.K. (Green and Evans, 1957). Nitrogen dressings may also be of particular value at this time of year with this early-flowering species (Bean, 1978).

Harvesting procedures are similar to those used for ryegrass.

MARU PHALARIS

AGRONOMY

Although phalaris is commonly used in many dryland areas in Australia (Hutchinson, 1970) and the U.S.A., it has not made much impact in the drier areas of New Zealand (Robinson, 1952). However, recent studies in the Wairarapa (Rumball, 1969), Canterbury (Fraser and Vartha, 1980), and Northland (P. J. Rumball, pers. comm.) show that Maru phalaris may have better persistency and production than perennial ryegrass in these environments. As in the U.S.A., it also has great potential in soil conservation programmes (Heath *et al.*, 1973).

Although phalaris is generally regarded as slow to establish, Maru was slower than Nui perennial ryegrass (*Lolium perenne* L.), but much faster than Ruanui perennial ryegrass and Roa tall fescue in 1979 autumn sowings in the Manawatu (Table 6). However, it is generally slower growing than ryegrass in the spring, and thus sowings at this time of year may be harder to establish.

TABLE 6: EARLY GROWTH (kg/ha) OF FOUR GRASSES UNDER MOWING IN THE MANAWATU (SOWN 30 MARCH 1979)

	April-August	*September-10 October*
Maru phalaris	3 119	2 678
Nui ryegrass	3 506	3 385
Ruanui ryegrass	2 299	2 932
Roa tall fescue	1 163	2 139

SEED PRODUCTION

Although phalaris seed crops have been successfully grown in New Zealand, little published information is available. In the U.S.A. (Heath *et al.*, 1973) and Italy (Talamucci, 1978), row widths of 60 to 90 cm are recommended, but much commercial seed in the U.S.A. is harvested from solid stands. In the Manawatu, spaced plants at 60 cm centres have produced yields of almost 800 kg/ha in the absence of grazing between planting in the autumn and harvesting. As the crop is very erect it can be direct-headed, and the problems of seed shattering appear to be less severe in Maru and the Australian cultivar 'Seedmaster' (McWilliam and Shroeder, 1965) than in older cultivars and local populations. However, it is still important to choose the time of harvesting carefully, and work in Australia (McWilliam and Shroeder, 1974) suggests that the maximum yield of high-quality seed will be obtained by harvesting 30 to 33 days after peak flowering. Earlier harvesting results in lighter seed with poor germination, while later harvesting increases the loss of seed from shattering (McWilliam and Shroeder, 1974). In the Manawatu the seed harvest of Maru has generally been about 2 weeks later than ryegrass.

RAKI PASPALUM

AGRONOMY

A survey by Percival (1977) showed that paspalum is present as a major species in large areas of grassland in the Auckland province and as a minor species throughout much of the remainder of the North Island and the north-western South Island. The main value of paspalum lies in its summer producing ability (Lambert, 1967), and when combined with perennial ryegrass and white clover, production is greater than from ryegrass/white clover alone in the Waikato (Baars *et al.*, 1976) and Northland (Percival *et al.*, 1979). However, even in Northland, winter production of the species is extremely low (Lambert, 1967), and thus establishment from autumn sowings will be very slow.

Seed Production

All seed currently used in New Zealand is imported from eastern Australia. Purity averages 85 to 90%, with empty glumes and ergot being the main problem. Germination varies from 60 to 80%. Seed yields can be extremely variable and in the U.S.A. are between 90 and 500 kg/ha with 12 to 72% of viable seed. Much of this variation appears to be caused by ergot (*Claviceps paspali* Stev. & Hall), which is also common in New Zealand, particularly in wetter seasons (Hamblyn, 1936), and has proved a serious drawback to successful seed production at Kaikohe and in the Manawatu.

A combination of field burning after harvest and fungicides (Table 7), particularly sodium azide (Hardison, 1977), applied in spring, appears to control overwintering sclerotia the primary cause of reinfection in the crop. However, it is impossible to control the spread of conidia by wind and insects from outside the area (Table 8), resulting in reinfection.

TABLE 7: SCLEROTIA BEARING CLAVAE OF *CLAVICEPS PASPALI* (%) 1978

Treatment[1]	*Burnt*		*Not Burnt*	
	Rotary Hoed[2]	*Not Rotary Hoed*	*Rotary Hoed*[2]	*Not Rotary Hoed*
Benomyl, 6.6 kg/ha	1.5[3]	0.0	5.5	2.0
Triadimefon, 6.6 kg/ha	0.0	0.6	0.0	0.5
Urea, 112 kg/ha	0.6	—	5.6	—

[1] Applied to ground 22 November 1978.
[2] After treatments applied.
[3] Counted 15 December 1978.

TABLE 8: EFFECT OF BURNING ON ERGOT IN HARVESTED SEED (%) 1979

	Burnt	*Not Burnt*
Benomyl, 6.6 kg/ha (hoed)	45.9	48.5
Triadimefon, 6.6 kg/ha (hoed)	46.8	47.3
Nil	44.2	45.2

In the Manawatu the highest yields and least ergot have been obtained in drier years. Therefore it appears that Raki seed crops should be grown in areas which are warm enough for reasonable growth of paspalum and have a reliable dry spell each summer.

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