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Red fescue seed production: post-harvest management, nitrogen and closing date

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Abstract

Seed yields of 'Grasslands Cook' chewings fescue ***(Festuca rubra*** spp. ***commutata)*** and 'Grasslands Tasman' creeping red fescue ***(Festuca rubra)*** were increased by immediate post-harvest grazing or burning. Severe defoliation (3-5 cm from ground level) by burning, grazing or cutting in autumn and winter, decreased seed yields. Nitrogen increased seed yields, but there were no significant differences ($P<0.05$) between autumn and spring nitrogen.

Keywords red fescue, seed production, post-harvest management, burning, closing date, nitrogen, ***Festuca rubra, Festuca nigrescens***

Introduction

'Grasslands Cook' chewings fescue ***(Festuca rubra*** spp. ***commutata, F. nigrescens)*** and 'Grasslands Tasman' creeping red fescue ***(F. rubra)*** were bred in the mid 1970s to replace the uncertified New Zealand Chewings fescue that had been harvested in this country for over 90 years (Rumball 1982a,b). Both were bred for closely mown amenity areas such as lawns and parks.

The initial nucleus seed harvests of Cook and Tasman at the DSIR Grasslands Aorangi farm in the Manawatu produced seed yields of between 100 and 180 kg/ha. In the US (Youngberg 1980), Denmark (Nordestgaard 1986) and the Netherlands (Meijer 1984) red fescue seed yields of over 1000 kg/ha are common. Therefore, if Cook and Tasman were to become viable cash crops for seed growers, there was an urgent need to investigate management practices aimed at substantially increasing seed yields.

Post-harvest management of red fescue seed crops involving burning or close cutting has consistently maintained high seed yields in red fescue seed stands in the US (Chilcote ***et al.*** 1980; Youngberg 1980; Young *et al.* 1984a,b). Burning or close cutting increases seed yields by removing the shading effect from post-harvest residue accumulations and allowing sunlight penetration into the grass canopy (Ensign *et al.* 1983), resulting in a more rapid tiller emergence before the autumn. These tillers have a long autumn-winter period of vernalization, and so are more productive (more seeds per tiller) than tillers that emerge later in the autumn (Meijer 1984). No post-harvest management studies on grass species have been reported in New Zealand. The low yielding seed crops at Aorangi had not received any post-harvest management other than sheep grazing for weed control during autumn and winter. Studies at Aorangi and DSIR Grasslands Lincoln investigated post-harvest management in order to increase seed yields.

For many grass species, only spring nitrogen applied at stem elongation is necessary (Rolston *et al.* 1985; Hampton 1987). However, trials in Denmark and the Netherlands have shown that because red fescue flowers early, it responds to autumn nitrogen and that spring nitrogen must not be applied later than stem elongation. Split spring nitrogen is not necessary (Nordestgaard 1980, 1986; Meijer & Vreeke 1988).

Seed growers in New Zealand tend to be mixed cropping farmers, having livestock and seed crops on the same farm. Grass seed crops therefore provide important autumn and winter grazing for livestock. Tall fescue (Brown *et al.* 1988), cocksfoot (Bean 1978) timothy (Roberts 1965) and ryegrass (Roberts 1965) can be grazed during autumn and winter without any decline in seed yields. Seed yields are increased in many instances by increasing fertile tillers, reducing lodging and reducing the crop bulk at harvest (Hampton 1988). However, in the US and Europe, red fescue seed crops are grown in the absence of any livestock and with no autumn and winter defoliation at all following post-harvest management practices. Closing dates, therefore, could have been too late at Aorangi with sheep grazing in the autumn and winter, especially given that the most productive tillers form early in the autumn (Meijer 1984). A series of closing dates were imposed to find out how late in the season defoliation can be practised without decreasing seed yields.

Materials and methods

Manawatu

The trials were carried out at the Aorangi farm of DSIR Grasslands in the Manawatu on Cook and

Tasman red fescue nucleus seed stands. These stands were sown in the autumn of 1981 in 60 cm row spacings at a seeding rate of 5 kg/ha (Table 1) and in spring 1984 in 30 cm row spacings at 10 kg/ha (Table 2). All stands were on a Holocene quartzo-feldspathic silty alluvium soil (Kairanga silt loam) and were treated with herbicides. Insecticides were applied to all the trial plots from 1985 onwards to control grass grubs and porina.

In 1984 post-harvest treatments were imposed in mid March. The treatments were: burning the cut grass; cutting the grass to 1 cm from ground level and removing this cut grass; hard grazing the grass to 1 cm from ground level; control plots ungrazed and uncut from harvest. In 1985 post-harvest treatments were imposed in the first week of January. The treatments were: burning the harvested stubble; hard grazing the stubble 1-2 cm from ground level; leaving the control plots ungrazed and uncut immediately after harvest. In 1986 post-harvest treatments were imposed in mid January. The two treatments were burning the harvested stubble or cutting to 1-2 cm from ground level and removing the cut stubble. There were no control treatments. Nitrogen treatments were applied as subplots in 1985 and 1986.

Closing date treatments were applied in 1986 and 1987 (Table 2) and were imposed by cutting with a lawn mower to 3-5 cm above ground level.

Lincoln

The trial was carried out at the DSIR farm, Lincoln, Canterbury on a Tasman red fescue seed stand. The stand was sown in November 1985 in 30 cm row spacings at a seeding rate of 4.5 kg/ha. The stand was on a Holocene quartzo-feldspathic silty alluvium (Wakanui silt loam). Post-harvest autumn management treatments were applied at the end of April 1987 (Table 1). The Tasman stand had been hard grazed on 9 January following harvesting and then left untouched until the autumn. The treatments were grazing, tine harrowing, and no autumn grazing or harrowing (control).

Table 2 Closing date management trials: experimental information.

Year Site	1986 Aorangi[1]	1987 Aorangi[1]
Post-harvest management[2]	Grazed in first week of Jan. No further grazing	Grazed until first week of Mar
Closing dates	From harvest first week of Mar, Apr, May, Jun, Jul	First week of Mar, Apr, May, Jun, Jul, Aug
Plot size	4 x 4.5 m	4 x 4.5 m
Replicates	4	4
Nitrogen kg N/ha	40; May 2 80; Sep 3	80; Sep 3
Reproductive analysis date	Nov 20	Dec 8
Harvest date	Dec 17-18	Dec 11

[1] Cook and Tasman
[2] See Materials and Methods

Table 1 Post-harvest management and nitrogen trials: experimental information.

Year Site	1984 Aorangi	1985 Aorangi[1]	1986 Aorangi	1987 Lincoln[2]
Main plots Treatments[3]	Autumn burning, cutting, grazing	Summer burning, grazing	Summer burning, cutting	Autumn grazing, harrowing
Main plot size	6 x 4 m	16 x 4 m	20 x 8 m	40 x 8.5 m
Replicates	6	3	4	4
Grazing after treatments	nil	end of March end of April	early March	mid July for grazed treatment only
Nitrogen kg N/ha	30; Apr 30 60; Sep 14	Subplots	Subplots	60; Sep 14
Subplots:				
1) Size	–	4 x 4 m	5 x 4.8 m	–
2) Nitrogen kg N/ha	–	0N 80; Apr 22 80; Sep 8 40 + 40; Apr + Sep	0; 80; Apr 21 80; Sep 3 40 + 40; Apr + Sep	–
Reproductive analysis date	Nov 14	Nov 24	Nov 28	Nov 30
Hand harvested date	Dec 14	Dec 16-20	Dec 17-18	Dec 22

Cook and Tasman
[2] Tasman
[3] see Materials and Methods

Table 3 Effect of autumn (March-April) grazing, cutting and burning on red fescue seed yields and seed yield components.

Aorangi	Treatment	Reproductive tillers/m²	Spikelets/ tiller	Florets/ spikelet	Seed yield kg/ha
Cook	Control	1176	29.4	6.3	209
	Burnt	1330	26.5	6.6	182
	Graze	1618	23. I	6.2	173
	cut	1581	29.2	6.8	151
	LSD 5%	ns	3.8	ns	50
Tasman	Control	718	28.9	8.0	117
	Burnt	388	24.9	8.1	52
	Graze	460	24.3	8.9	92
	Cut	487	24.3	8.3	116
	LSD 5%	328	ns	0.84	32
Lincoln					
Tasman	Control	2572	18.8	5.4	281
	Graze	2699	17.4	5.6	277
	Harrow	3042	16.8	5.5	251
	LSD 5%	ns	ns	ns	ns

Results

Post-harvest management

Post-harvest treatments (burning, grazing or cutting) immediately after harvest had no affect on seed yields. Seed yields (kg/ha) across all treatments averaged for Tasman, 214 (1985) and 703 (1986); for Cook 454 (1985) and 645 (1986).

Burning, grazing, cutting or harrowing in autumn (March-April) decreased seed yields at Aorangi, but not at Lincoln (Table 3). Burning in the autumn severely reduced Tasman reproductive tillers and consequently lowered seed yields. Autumn cutting was more severe on Cook rather than Tasman, lowering Cook seed yields significantly.

Fertiliser

Only-Tasman showed-a-response to-nitrogen-with the spring nitrogen plots producing significantly

Table 4 Effect of nitrogen on seed yield and seed yield components of red fescue in the Manawatu.

	Treatment (kg N/ha)	Reproductive tillers/m'	Spikelets/ tiller	Florets/ spikelet	Seed yield kg/ha
1985					
Tasman	No N	635	24.1	7.0	178
	80 A[1]	708	24.1	6.8	221
	40 A + 40 S[2]	721	24.8	7.2	202
	80 S	529	26.2	7.0	255
	LSD 5%	ns	ns	ns	70
Cook	No N	1821	21.3	5.3	429
	80 A	1294	27.9	5.6	431
	40 A + 40 S	1561	26.9	5.6	466
	80 S	1675	25.9	5.9	488
	LSD 5%	ns	4.6	ns	ns
1986					
Tasman	No N	1080	22.2	5.8	605
	80 A	951	27.4	6.4	701
	40 A + 40 S	1430	22.6	6.1	726
	80 S	1681	28.3	6.3	783
	LSD 5%	ns	4.5	ns	135
Cook	No N	1036	21.0	4.7	613
	80 A	1016	23.5	4.7	630
	40 A + 40 S	950	22.0	4.Y	702
	80 S	1001	25.7	4.9	702
	LSD 5%	ns	ns	ns	ns

A — Autumn
[1] S — Spring

(P<0.05) higher seed yields than plots receiving no nitrogen (Table 4). There were no significant (P<0.05) differences in seed yields between the amounts of nitrogen, and when it was applied to Tasman. Cook did not respond significantly to nitrogen at all.

Closing date

In the Manawatu mid to late winter closing (July and August) lowered seed yields of red fescues (Table 5). In 1987 spikelets/head were significantly (P<0.05) reduced from 21.8 (March closing) to 15.6 (August closing) for Tasman, and from 20.1 to 18.4 for Cook closed at the same times. In 1986 Tasman and Cook seed numbers/m' were significantly (P<0.05) reduced by the July closings (data not presented).

Table 5 Effect of closing date on seed yields of Tasman and Cook red fescue.

	Tasman		Cook	
Closing dates	1986	1987	1986	1987
From Harvest	760	—	456	—
March	793	440	453	550
April	797	534	487	577
May	716	562	449	639
June	680	416	304	457
July	382	430	236	437
August	—	348	—	396
LSD 5%	284	124	130	192

Discussion

One of the most important findings was the substantial increase in seed yields from the' early trials, in which-the-average-yields-were 150-kg/ha, to the latest trials, in which yields were well over 500 kg/ha. While still below the 1000 kg/ha reported for red fescues in other countries (which may be a cultivar subspecies difference), the yields now achieved will make Tasman and Cook red fescues viable cash crops for New Zealand farmers.

The main management practices to improve these yields has been the elimination of hard autumn grazing and insecticide application. Grazing grass grub and porina can harm the most productive tillers (Meijer 1984) emerging in the autumn. Once autumn grazing was eliminated and insects controlled, seed yields immediately increased to over 500 kg/ha, and even up to 700 kg/ha. Furthermore, the trials involving autumn burning, cutting or grazing lowered seed yields by up to 60% (Table 3). Chilcote & Youngberg (1974) also found that burning autumn regrowth on red fescue lowered seed yields substantially (over 300 kg/ha), compared to burning straight after harvest.

In the closing date trials, late winter cutting decreased seed yields, because the tillers that emerged in the autumn were cut in July and August and the later emerging tillers were less productive. This productivity varied between spikelets per tiller

(1987), and seed number per reproductive tiller (1986). However, the autumn closing date cuts (March to May) did not decrease seed yields, probably because the cuts were not low enough (3-5 cm above ground level) to destroy tiller growing points; whereas grazing, burning and close cutting did.

The immediate post-harvest management treatments did not increase seed yields. Grazing and cutting were just as effective as burning. The results may have been different if all the treatments had not been grazed in the early autumn as a general management practice. This grazing may have eliminated any advantage that burning and grazing had over the control plots. However, these findings do show that, to remove post-harvest residues, farmers in New Zealand can use sheep just as effectively as burning. Where residue drying is difficult, grazing is therefore an effective post-harvest practice.

There were no significant differences between the plots receiving nitrogen, but in all plots the highest seed yields did come from spring nitrogen. In our trials we may have got a different result if more spring nitrogen (80 kg N/ha) had been applied to the autumn nitrogen plots (Meijer & Vreeke 1988). Nordestgaard (1980, 1986) and Meijer & Vreeke (1988) recommend split autumn and spring nitrogen applications for red fescue. We have found that in ageing stands, the seed crops can be very yellow in the autumn if no nitrogen is applied then. We therefore apply 30 kg N/ha in the early autumn and another 80 kg N/ha in early spring at stem elongation, which is in agreement with rates used in the Netherlands (Meijer & Vreeke 1988).

Conclusions

From these research trials, management practices can be identified for long-term seed productivity of red fescue seed stands in New Zealand.

1. Post-harvest management of burning or grazing must be done immediately after harvest.
2. Any severe treatment (burning, cutting, harrowing or grazing) in the autumn or winter will lower seed yields.
3. Spring nitrogen application at stem elongation is necessary. However, if the crop looks yellow in the autumn up to 30 kg N/ha can be applied to keep the crop green during the winter.
4. Autumn insecticides must be applied, as Cook and Tasman are very susceptible to grass grub and porina attack.

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REFERENCES

Bean, E.W. 1978. Principles of herbage seed production. Second edition. Welsh plant breeding station. Plas Gogerddan, Aberystwyth.

Brown, K.R.; Rolston, M.P.; Hare, M.D.; Archie, W.J. 1988. Time of closing for Grasslands Roa tall fescue seed crops. New *Zealand journal of -agricultural research 31: 383-388.*

Chilcote, D.O.; Youngberg, H.W. 1974. Field burning techniques and alternatives. Oregon State University Research on field burning. *Circular of information,* 647. Oregon State University, Corvallis.

Chilcote, D.O.; Youngberg, H.W.; Standwood, P.C.; Kim, S. 1980. Post-harvest residue effects on perennial grass development and seed yield. pp. 91-103. In Hebblethwaite, P.D. (ed.), Seed Production. London: Butterworths.

Ensign, R.D.; Hickey, V.G.; Bernards, M.D. 1983. Effects of sunlight reduction and post-harvest residue accumulations on seed yields of Kentucky Bluegrass. *Journal of applied seed production 1:* 19-20.

Faithful, W. 1948. Seed production in New Zealand: Chewings fescue. New *Zealand journal of agriculture* 76: 331.

Faithful, W. 1957. Seed production in New Zealand Chewings fescue. *New Zealand journal of agriculture* 95: 293-299.

Hampton, J.G. 1987. Effect of nitrogen rate and time of application on seed yield in perennial ryegrass cv. Grasslands Nui. *New Zealand journal of experimental agriculture 15:* 9-16.

Hampton, J.G. 1988. Herbage seed production. *Advances in research and technology of seeds II:* 1-28.

Hardison, J.R. 1976. Fire and flame for plant disease control. *Annual review of phytopathology 14:* 355-379.

Meijer, W.J.M. 1984. Inflorescence production in plants and in seed crops of *Poa pratensis* L. and *Festuca rubra* L. as affected by juvenility of tillers and tiller density. *Netherlands journal of agricultural science 32:* 119-136.

Meijer, W.J.M.; Vreeke, S. 1988. Nitrogen fertilisation of grass seed crops as related to soil mineral nitrogen. *Netherlands journal of agricultural science 36:* 375-385.

Nordestgaard, A. 1980. The effects of quantity of nitrogen, date of application and the influence of autumn treatment on the seed yield of grasses. pp. 105-119. *In* Hebblethwaite, P.D. (ed.), Seed Production. London: Butterworths.

Noordestgaard, A. 1986. Investigations on the Interaction between level of nitrogen application in the autumn and time of nitrogen application in the spring to various grasses grown for seed. *Journal of applied seed production 4:* 16-25.

Roberts, H.M. 1965. The effect of defoliation on the seed producing capacity of bred varieties of grasses. 3. Varieties of perennial ryegrass, cocksfoot, meadow fescue and timothy. *Journal of the British Grassland Society 20: 283-289.*

Rolston, M.P.; Brown, K.R.; Hare, M.D.; Young, K.A. 1985. Grass seed production: weeds, herbicides and fertiliser. pp. 15-22. In Hare, M.D.; Brock, J.L. (ed.), Producing herbage seeds. *Grasslands research and practice series* No. 2. Palmerston North: New Zealand Grassland Association.

Rumball, W. 1982a. Grasslands Cook chewings fescue (*Festuca rubra* L.) — bred for amenity areas. *New Zealand journal of experimental agriculture 10:* 167-168.

Rumball, W. 1982b. Grasslands Tasman creeping red fescue (*Festuca rubra* L.) — bred for amenity areas. *New Zealand journal of experimental agriculture 10:* 169-173.

Stuart, A. 1955. Renovation of chewings fescue stands. *New Zealand journal of agriculture 90: 589.*

Young, W.C. 111; Youngberg, H.W.; Chilcote, D.O. 1984a. Post-harvest residue management effects on seed yield in perennialgrass seed production, I. The long term effect from non-burning techniques of grass seed residue removal *Journal of applied seed production 2:* 36-40.

Young, W.C. III; Youngberg, H.W.; Chilcote, D.O. 1984b. Post-harvest residue management effects on seed yield in perennial grass seed production. 2. The effect of less than annual burning when alternated with mechanical residue removal. *Journal of applied seed production 2: 4* 1-44.

Youngberg, H.W. 1980. Techniques of seed production in Oregon. pp. 203-213. In Hebblethwaite, P.D. (ed.), Seed Production. London: Butterworths.