YORKSHIRE FOG SEED PRODUCTION

1. Effects of Closing Date, Nitrogen Application and Harvest Date on Seed Yield and its Components

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Abstract

Seed production by 'Massey Basyn' Yorkshire fog (*Holcus lanatus* L.) was greatest (mean 323 kg/ha) with early closing (June 30), but lodging occurred on these plots and commercial harvesting would be difficult. With later closing (July 31 and August 31), lodging did not occur and average yields of about 250 kg/ha were obtained. Very late closing (September 30) resulted in a severe yield depression. Application of nitrogen fertilizer either at closing or at inflorescence initiation increased seed yields by an average of 30%. Peak seed yields occurred later at harvest time as closing was delayed. With the optimum combination of treatments, yields of 400 kg/ha were achieved and it is suggested that yields of at least 200 kg/ha could be obtained commercially.

INTRODUCTION

'Massey Basyn' Yorkshire fog (*Holcus lanatus* L.) is a synthetic variety bred by W. A. Jacques and his colleagues at Massey University. In recent years the agronomic assessment of this variety has received increasing attention as its potential has become apparent. An important requirement of any pasture grass is good seed production. Commercial seed yields of locally-adapted Yorkshire fog strains in New Zealand are not known as it is normally a component of the "cleanings" during the dressing of other species grown for seed production. Consequently, no research appears to have been conducted on the agronomic factors likely to influence the. seed yield of this species either in New Zealand or overseas. The aim of the work described in this paper was to provide information on the seed yield of 'Massey Basyn' Yorkshire fog, and on the effects of some of the agronomic factors known to affect seed yield of other pasture grasses.

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EXPERIMENTAL

The experiment was carried out on the site previously described (Watkin and Robinson, 1974; Clements and Easton, 1974) at "Tuapaka", a Massey University farm near Palmerstan North. The area with sown in 1966 with a seed mixture consisting of 8 kg 'Massey Basyn' Yorkshire fog and 3.4 kg 'Grasslands Huia' white clover (*Trifolium repens* L.) per hectare. Until the experiment commenced in June 1973, the pasture was grazed closely and almost continuously by sheep, and regularly fertilized with potassic superphosphate.

A split-split-plot design with three replicates was used to examine the effects of closing date (*i.e.,* date of exclusion of sheep), nitrogen application and harvest date on seed production. The main-plot treatments were four closing dates (June 30, July 31, August 31, September 30) . Each main plot was 0.02 ha, and was grazed continuously until the plot was closed. Four subplots, each 40 m^2 in area, contained the nitrogen treatments in each main plot. These were a control treatment (no nitrogen) ; 126 kg urea/ha applied at closing; 126 kg urea/ha applied at inflorescence initiation; and a split dressing of 63 kg urea/ha at closing and 63 kg/ha at initiation. Initiation, defined as the stage at which spikelet primordia were observed 2.5 cm from the stem bases, occurred from mid-September (June-closed plots) to late October (September-closed 'plots) .

Subplots were again split for sequential harvest dates (January *4,* 8, 12, 16, 19) . This procedure was adopted because it was expected that the date of peak seed yield would vary according to the treatments imposed. On each occasion except January *4* (when only the June-closed plots were sampled), a random area of 0.5 m^2 was cut in each subplot. The material harvested was removed and allowed to air dry under cover. Each sample was then hand-threshed, the yield of clean seed measured, and the weight of 1 000 seeds determined. The remaining yield component (number of seeds per head) was calculated from the observed yield, 1 OOO-seed weight and number of heads. A standard germination test was then carried out on each seed lot according to the method prescribed in the International Seed Testing Association Rules (1966) .

RESULTS

The analyses of variance indicated that very few interactions between treatments were significant for any of the variables measured. The effects of closing dates, nitrogen treatments and harvest dates are therefore presented independently in Tables 1, 2 and 3, respectively, and the few significant interactions are noted below.

TABLE 1: EFFECT OF CLOSING DATE ON SEED YIELD AND ON YIELD COMPONENTS

Closing Date	*Maximum Seed Yield (kg/ha)*	*Heads/m²*	*Seeds/ Head*	*(mg/1 000 seeds)*
June 30	323 a	803	110	246
July 31	260 a	749	115	254
August 31	234 b	648	110	268
September 30	111 c	316	131	246
LSD ***(P = 0.05)***	***68***	165	(NS)	(NS)

a January 8; b January 12; c January 19.

Closing date had a major effect on seed yield, mainly because numbers of heads per unit area decreased with later closing (Table 1). Closing date had no effect on the number of smds per head or seed weight. Seed germination percentages (mean 74.6%) although not presented here, were not significantly different between closing dates. The most marked reduction in head numbers and seed yield occurred at the latest closing date (September 30), and seed yield was greatest with early closing (June 30). Because there was a significant closing date x harvest date interaction ($P < 0.001$) for seed yield, maximum seed yields obtained with each closing date are given in Table 1. These are the appropriate yield data to present, since in practice a seed producer would harvest the crop at about the point of maximum yield. The interaction in fact showed that peak seed yield occurred later as closing was delayed. There was also a significant interaction ($P < 0.01$) between closing date and harvest date for numbers of heads, owing to declining numbers of heads with time in June-closed plots. This effect was probably due to the high level of seed shattering from the earliest heads in these plots.

The application of nitrogen resulted in increased seed yields, irrespaotive of the timing of the application (Table 2). The beneficial effect appeared to be due largely to an increase in head numbers when nitrogen was applied at closing, although the number of seeds, per head: did increase significantly in the treatment receiving nitrogen at seedhead initiation. The average yield improvement due to the nitrogen treatments was 30%. A signifi-

TABLE 2: EFFECT OF NITROGEN APPLICATION ON SEED YIELD AND ON YIELD COMPONENTS

	Seed Yield (kg/ha)	*Head/m²*	*Seeds/Head*	*Seed Weight (mg/1 00 seeds)*
Control (no nitrogen)	141	559	107	253
126 kg urea/ha at closing	192	712	113	257
126 kg urea/ha at initiation	182	609	130	253
Split dressing*	176	635	118	252
LSD ($P = 0.05$)	29	95	15	(NS)

*63 kg urea/ha at closing and 63 kg urea/ha at initiation.

cant interaction ($P < 0.05$) between nitrogen treatments and closing dates for seeds per head was probably spurious, being due entirely to unaccountably low values for August-closed control plots. Nitrogen treatments had no significant effects on seed weight or percentage germination,

TABLE 3: EFFECT OF HARVEST DATE ON SEED YIELD, YIELD COMPONENTS, AND SEED GERMINATION

Harvest Date	*Seed Yield (kg/ha)*	*Heads/m²*	*Seeds/Head*	*Seed Weight (mg/1 000 seeds)*	*Germination (%)*
January 8	204	690	133	216	79.3
January 12	194	635	139	242	79.9
January 16	132	608	84	287	83.2
January 19	161	582	111	270	74.4
LSD ($P = 0.05$)	28	(NS)	18	17	4.8

Harvest date significantly influenced seed yield, seeds per head and seed weight. The decline in seed yield with later harvesting occurred mainly because of seed losses from shattering (decline in seeds per Bead in Table 3 and, as previously noted, disintegration of entire heads in June-closed plots). Such yield reduction occurred despite increases in the weight of individual seeds. It is worth noting that the largest decrease in seed yield in Table 3 — i.e., the yield, reduction of one-third between January 12 and 16 — resulted from a severe windstorm occurring soon after the sampling of January 12.

Harvest date was the only treatment having a significant effect on germination. The data in Table 3 indicate no linear relationship between seed weight and germination percentage, although it may be significant that germination only declined when seed weight began to decline after reaching maximum weight on January 16.

The significant drop in number of seeds per head at the harvest of January 16 may well have been due to the loss of mature, heavy seed in the windstorm already mentioned, while the increase in seeds per head between January 16 and 19 suggests that the proportion of immature seeds on January 16 may have been higher than on earlier occasions.

The results as a whole indicate that seed yield responded markedly to the three major treatment variables, and that control of all three would be necessary to achieve maximum yields. In this experiment, the highest yields achieved (approximately 400 kg/ha) were obtained when paddocks were closed at the end of June, fertilized with urea at closing, and harvested during the first week of January.

DISCUSSION

In this experiment, closing date was the factor having the greatest influence on seed yield. In particular, closing in late September caused a drastic reduction in yield. This latter result agrees well with the work of Hill (1971) on 'Grasslands Ruanui' ryegrass (*Lolium perenne* L.) , where he noted a reduction in yield when grazing continued after this date. However, the highest yields in the present experiment were achieved with very early closing — *i.e.,* June 30. These early-closed plots lodged and became overgrown and tangled, and would have been difficult to harvest mechanically, whereas those closed on July 31 remained upright. The yield difference between these closing dates would therefore probably be reduced under commercial conditions. It appears that closing in late July or in August would be a reasonable recommendation. This implies that, in practice, a seed producer might have to be content with a production level somewhat below that potentially obtainable. Further plant breeding would probably increase the seed yields that could be achieved commercially.

The effects of applying nitrogen are in good agreement with results for other species (Wilson, 1959; Ryle, 1964; Davies, 1969; Hill, 1970, 1972). These results, and the obvious herbage yield responses to nitrogen during the experiment, are of interest in that they confirm the ability of 'Massey Basyn' Yorkshire fog to respond well to an improvement in the soil nitrogen status (R. S. Scott, pers. comm.) . However, seed weight was not affected by nitrogen application, in contrast to the increases occasionally observed for other grasses (e.g., Lambert, 1956; Calder and Cooper, 1961; Hill, 1972). Seed weight was in fact a relatively insensitive component of seed yield, and this broad stability of seed weight agrees with the concept of a relatively stable mean seed weight within a species growing in diverse environments (Harper et *al.,* 1970).

Ritchie (1972) found germination to be positively correlated with seed weight in Yorkshire fog. Though no such correlation was observed here, it should be noted that the present seed weights are at the heavy end of the range examined by Ritchie, where the relationship between the two characters appears from his data to be much weaker than at the light end.

The susceptibility of Yorkshire fog seeds to shattering seems likely to be a serious problem in seed production. Windy days such as occurred in this experiment are common in New Zealand. Unless and until a greater degree of seed retention can be incorporated into improved strains, severe losses due to shattering will probably remain a risk during seed ripening.

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