The sowing depth response of Grasslands Gala grazing brome (*Bromus stamineus* Desv.)

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Abstract

A factorial trial was carried out to determine the response of Grasslands Gala Grazing Brome to 4 sowing depths at 3 sowing rates and with 3 rates of nitrogen fertiliser under moist fertile conditions.

The drill was set to sow at 5 mm, 15 mm, 30 mm and 60 mm but in practice the average depth of the treatments were 9 mm, 23 mm, 34 mm and 58 mm. The percentage emergence were 74, 83, 74 and 61% and the DM yields after 2 months were 41, 46, 53 and 51 g/m^2 respectively.

The percentage emergence was little affected by sowing rate but both plant numbers and dry matter yield at 10 weeks increased proportionately.

Nitrogen fertiliser reduced emergence slightly, probably due to being placed with the seed, and produced a large increase in yield.

These results would indicate that Gala is like many other dryland grass species in that sowing depth should not be between 5 - 25 mm for optimal establishment. Field observations suggest that this becomes more critical under cool conditions.

Introduction

Grazing brome (*Bromus stamineus* Desveax) is a new grass species recently introduced into New Zealand dryland agriculture. It is a highly palatable species closely related to prairie grass (*B. wildenowii*) with a similar winter growth pattern and summer drought tolerance. It differs by having a greater number of smaller tillers, an excellent tolerance to close and continuous grazing and resistance to head smut disease. Like prairie grass, Grazing Brome exhibits poor tolerance to wetter soils and is likely to be of most value on lighter textured soils in dry regions (Betin, 1982; Stewart, 1992).

The seed of Grasslands Gala grazing brome is similar in size to that of prairie grass but has a longer awn which requires processing to enable sowing by standard equipment.

In general, pasture yields in the first few months following establishment are below that of perennial ryegrass (Stewart, 1992) and it is therefore critical to ensure establishment is as rapid as possible. Like prairie grass the establishment has been found to be slow and often poor when sown into cool soils and the best results have been achieved when sown into soil temperatures above 10-12 $^{\circ}$C. Even when these conditions are meet speed of establishment can be unpredictable (Betin, 1982) and there have still been some establishment failures. Some farmers have sown Gala deeper than they would other pasture species because it has a large seed and initial observations suggest that in some circumstances seed has failed to emerge due to sowing too deep (M. J. Kelly, pers. comm.).

Materials and Methods

A factorial trial was sown with 3 replicates of 7.5 m^2 plots at 4 sowing depths, 3 sowing rates and 3 rates of nitrogen fertiliser. The trial was located at Ceres Research Station, Prebbleton, near Christchurch and sown on 25th October, 1991 into a light textured Waimakariri silt loam. The site had been fallowed for 6 months prior to sowing, pre-fertilised with 100 kg/ha superphosphate and 3 kg/ha of phorate insecticide and the final seedbed was compacted using a Cambridge roller. The seed was drilled using an Oyjord experimental plot drill fitted with Duncan coulters at the target depths of 5, 15, 30 and 60 mm. The site was irrigated prior to sowing because of low rainfall during the preceding month (12 mm). Prior to emergence, 6 days after sowing, 38.5 mm of rain fell over 3 days.

The 3 sowing rates were 35 kg/ha (304 viable seeds/m$^{2)}$, 25 kg/ha (217 viable seeds/m^2) and 15 kg/ha (130 viable seeds/m^2).

The nitrogen was applied in the form of urea granules and was mixed with the seed immediately prior to sowing, leading to placement in the same furrow at the same depth with the seed.

The seed used was a certified Basic line of Grasslands Gala with a germination of 97% and mean 1000 seed weight of 11.2 g which had been commercially processed to remove awns and improve sowing characteristics using the process developed by the New Zealand Agricultural Engineering Institute. The seed was not treated with any fungicide.

The actual sowing depth was determined 1 week after emergence on 10 plants in each plot by measuring the epicotyl length between the seed and the soil surface.

Plant counts were taken of the number of seedlings established 4 weeks after sowing on an area of 0.3 m^2 within each plot.

All plots were harvested on the 8th January 1992 by mowing to 25 mm to determine dry matter yields.

Results

The achieved sowing depths are presented in Table 1. This shows that the ranges of depths achieved varied around the target depth but that the mean depths were slightly different.

The analysis of variance summary is presented in Table 2, this shows that sowing depth, rate and nitrogen addition were all significant for both plant emergence and dry matter yields, in addition some of the interactions were significant.

The effect of sowing depth is shown in Table 3. This shows that maximum plant emergence occurred at a sowing depth of 23 mm and that maximum yield occurred by sowing at 34 mm.

Increasing the sowing rate increased plant numbers while the percentage plant emergence remained similar (Table 4). Dry matter yield increased proportionately with increased sowing rates.

Table 5 shows the addition of nitrogen fertiliser reduced emergence slightly and produced a large increase in DM yields.

Table 1. Achieved sowing depths.

Target depth (mm)	Achieved depth Mean (mm)	Achieved depth Range (mm)
5	9	5-15
15	23	15-30
30	34	30-35
60	58	47-70

Table 2. Analysis of Variance.

	df	Variance ratio Emergence	Variance ratio DM yield
Depth (D)	3	19.6 **	7.3 **
Sowing Rate (R)	2	237.7 **	20.0 **
Nitrogen (N)	2	11.3 **	20.3 **
D x R	6	3.5 **	0.6 ns
D x N	6	1.5 ns	1.7 ns
R x N	4	1.5 ns	1.9 ns
D x R x N	12	3.6 **	2.2 *
Replicates	2	1.0 ns	5.5 **
Residual	70		
CV%		14.4	19.6

Table 3. Effect of sowing depth on seedling emergence and yield.

Sowing depth (mm)	Days to emergence	Emergence (%)	Yield (g DM/m^2)
9	8	74	41
23	8	83	46
34	9	74	53
58	11	61	51
SEM	-	1.3	1.8

Table 4. Effect of sowing rate on emergence and yield.

Sowing rate (kg/ha)	Emergence (plants/m^2)	Emergence (%)	Yield (g DM/m^2)
15	98	75	41
25	162	75	48
35	216	71	53
SEM	3.8	-	1.5

Table 5. Effect of nitrogen fertiliser on emergence and yield.

Nitrogen (kg N/ha)	Emergence (plants/m^2)	Emergence (%)	Yield (g DM/m^2)
0	169	78	38
25	162	75	51
50	145	67	53
SEM	3.8	-	1.5

There was a 2-way interaction between sowing depth and sowing rate (Fig. 1), and a 3-way interaction between sowing depth, sowing rate and nitrogen fertiliser implying that response to nitrogen varied with sowing depth and sowing rate.

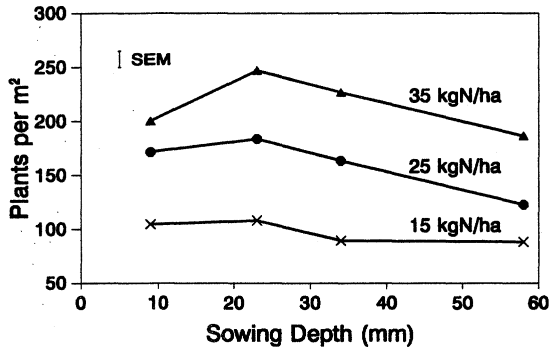

Figure 1. Interaction of sowing depth and sowing rate on plant emergence.

Discussion

It is generally accepted that the optimum sowing depth for most of the common pasture species used in New Zealand is around 12.5 mm (Woodman *et al.*, 1990). However, it is recognised that some species, particularly cocksfoot (*Dactylis glomerata*), are very sensitive to sowing depth (King and Bladen, 1989) while others such as *Bromus sitchensis* are less sensitive (Woodman *et al.*, 1990).

The results of this trial with *B. stamineus* are in general agreement with those reported for many other pasture species that emergence is reduced by sowing deeper than 25 mm (Moore, 1943; Murphy and Arny, 1939; Woodman *et al.*, 1990).

The delay in emergence from the deeper sowings in this trial were to be expected (Campbell, 1985a). Deeper sown seedlings are likely to use more of their food reserves in reaching the surface than those sown at shallower depths. Consequently, they are slower to develop and are probably more susceptible to diseases and to establishment failures.

At 4 weeks a difference in growth habit was noted between different sowing depths. Deeper sowings produced plants with few long erect tillers while shallow sowings produced more prostate plants with a greater number of shorter tiller.

As with other experiments of this type involving traditional seed drills the seed was placed at a range of depths around the target depth and the mean achieved depth varied slightly from the target depth. The measurement of actual sowing depth is difficult to determine (Kaviani *et al.*, 1985) and as seedlings were measured, rather than the seeds sown, the results are likely to be biased towards the optimal depths.

Applications of nitrogen increased dry matter yields at 10 weeks, but the mixing of the fertiliser with the seed lead to some damage and a reduction in percentage emergence. This would be less likely to occur when the fertiliser is placed at a different level from the seed as in a commercial seed drill.

Increased sowing rates lead to increased plant numbers and dry matter yield at 10 weeks.

A significant interaction occurred between sowing rate and sowing depth for plant emergence and a 3 way interaction was also found for both plant emergence and yield. This suggested that the higher sowing rates were more sensitive to sowing depth. At low levels of nitrogen and shallow sowing, the yield did not increase with higher sowing rates. While, it was only at high levels of nitrogen that the potential yield increase with higher sowing rates was achieved.

Although it is difficult to compare results from different trials, it is interesting to note that the results of *B. stamineus* in this trial compare closely with that obtained by Woodman *et al.* (1990) with the closely related and similar seed size *B. sitchensis*. This would suggest that *B. stamineus* is less sensitive to sowing depth than is cocksfoot.

As the best emergence of any treatment in this trial was 94% the conditions were near optimal, and it is likely that under difficult conditions deeper sowing could be even more detrimental to establishment (Murphy and Arny, 1939; Woodman *et al.*, 1990). However, this may be more complex in dry conditions, as deeper planting of seed allow access to moisture and better seedling survival (Campbell, 1985b). There is some suggestion that in this trial deeper sowings were beneficial to seedling yield at 10 weeks, as the maximum was achieved by sowing at 34 mm, in contrast to the best plant emergence at 23 mm. However, as the growth period was particularly wet it is unlikely that this was due to greater soil moisture at depth. It is more likely due to greater availability of nutrients such as nitrogen, particularly if the rainfall had moved the nitrogen down the soil profile. However, it may have also been due to the differences in growth habit allowing a greater proportion of harvestable yieldabove 25 mm.

The results of this trial suggest that *B. stamineus* has a similar response to planting depth to that of our more common pasture species and that for optimal establishment sowing depth should be within the range of 5 - 25 mm. The generally accepted target depth of 12.5 mm commonly used in New Zealand for pasture species (Woodman *et al.*, 1990) should also be optimal for *B. stamineus.*

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