The significance of genotypes when selecting for early forage production in dual-purpose cereals

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ABSTRACT

Early forage production is an important requirement from dual-purpose winter cereals. As part of a study of selection objectives for dual-purpose oats and triticale genotypes, the effect of genotype on early forage production was compared with seeding rate. Although in some field and growth-house experiments the choice of genotype significantly influenced forage production, the differences between genotypes were inconsistent and they were always smaller than the responses to seeding rate/plant density. The findings indicate that dual-purpose cereal breeders could place less emphasis on breeding for early forage production and more on selecting for a high yield of quality grain.

Key words

Early forage, dual-purpose cereals, seeding rate and oats.

INTRODUCTION

Each year in New South Wales, more than 200,000 ha of dual-purpose cereals, especially oats (*Avena sativa*) and triticale (*X Triticosecale*), are grown for grazing during the main period of the winter feed deficit (May-July) and then harvested for grain production. Early forage production from dual-purpose crops is an important selection objective, along with herbage recovery after grazing to produce high yields of quality grain. However, while genotype (1) and agronomic factors (2, 3) such as time of sowing and seeding rate influence early forage production, there has been little in the way of a critical evaluation of strategies for selecting for forage productivity. The purpose of the experiments reported here was to compare, in terms of their relative effect on early forage production, genotypes and a key agronomic factor (seeding rate).

MATERIALS AND METHODS

In southern NSW, 4 experiments were conducted during the 1998 and 1999 growing seasons, 2 in a growth-house at Wagga Wagga and 2 at a field site near Temora. The following treatments were studied in different combinations: (i) 5 dual-purpose oat genotypes (Blackbutt, Cooba, Eurabbie, MA5107 and MA5204), 2 dual-purpose wheat (*Triticum aestivum*) cultivars (Currawong, Rosella) and 2 grain-only wheat genotypes (Vig. 18 and Janz), 2 dual-purpose triticales (Maiden and Empat) and 1 dual-purpose barley (*Hordeum vulgare*) (Yerong); and (ii), 3 seeding rates (50, 100 and 200 kg/ha, field) or density (100, 300 and 900 plants/m^2, growth-house) treatments.

RESULTS

While in 2 of the 5 measurement times (Table 1) there were significant ($P<0.05$) differences in early dry matter production between genotypes, these differences were less than ? 25% of the mean DM value recorded at the time of the assessment. Furthermore, the ranking of the genotypes in one experiment was not necessarily in accord with another. For example, compared with MA5107, Eurabbie seedlings grew more slowly at Wagga in 1999 than in 1998. In contrast, the increases in early DM production due to seeding rate (50-200 kg/ha, average establishment of 49-169 plants/m^2) or plant density (100-900 plants /m^2) were always significant ($P<0.01$) and consistently large across the experiments (Table 1).

DISCUSSION

Breeders of dual-purpose cereals must select for semi-winter or winter plant types which, when sown relatively early, do not prematurely initiate reproductive development in order to protect tillers from grazing damage. The selection for winter habit is possible, even if the mechanism(s) for delayed reproductive development are not known precisely for each cultivar. However, selection for enhanced early DM production is more difficult - part of the problem lies in the multitude of genotypic and environmental factors that can affect the germination and early growth of cereals. Evidence from the experiments reported here are in line with the experience of one of us (GR) that there are few obvious genetic factors for early growth that should be encouraged or avoided, at least in oat breeding. In the Temora oat-breeding program, there are a small number of winter-habit crossbreds with a very slow-growing phenotype - these genotypes are rejected. Another factor that appears to reduce dry matter production is infection with the barley yellow dwarf virus.

Table 1. Effect of genotype and seeding rate/density on early forage production.

Field sites	Temora 1998		Temora 1999	Box trials	Wagga 1998	Wagga 1999
Weeks after sowing	4 weeks (kg/ha)	8 weeks (kg/ha)	4 weeks (kg/ha)	Weeks after sowing	4 weeks (g/m^2)	4 weeks (g/m^2)
	Genotype (G)				**Genotype (G)**	
Blackbutt	218	1349 ^{abc}	571	Janz	-	20.7 ^{d}
Cooba	251	1472 ^{a}	750	Vig 18	-	25.0 ^{c}
Eurabbie	243	1395 ^{ab}	813	Eurabbie	37.1	26.4 ^{c}
MA5107	192	939 ^{d}	987	MA5107	36.6	30.1^{b}
Maiden	229	1034 ^{bcd}	924	Maiden	36.3	32.7^{a}
l.s.d. (P<0.05)	n.s.	357***	n.s.	l.s.d. (P<0.05)	n.s.	2.2**
	Seeding rate (SR) (kg/ha)				**Density** (D) (Plants/m^2)	
50	118 ^{c}	704 ^{c}	-	100	11.6 ^{c}	-
100	209 ^{b}	1069 ^{b}	924	300	33.0 ^{b}	13.3 ^{b}
200	338 ^{a}	1791 ^{a}	-	900	64.4 ^{a}	44.3 ^{a}
l.s.d. (P<0.05)	33***	253***	n/a	l.s.d.(P<0.05)	3.7***	1.3***

G x SR	n.s.	n.s.	n/a	**G x D**	n.s.	3.1***

n.s. = not significant (P<0.05) n/a = not applicable

Although progress with early vigour is theoretically and practically possible, our results indicate that the gains may be small compared with those achievable through increasing seeding rate. The use of high seeding rates to reduce the lag phase and encourage active growth was crucial in this investigation and in earlier ones (3). Other agronomic factors that are likely to be influential include high quality seed, timely sowing after early autumn rain, and equipment to enhance the contact between seed and moist soil. Such factors could thwart or impede the efforts of breeders to select for superior genotypes.

CONCLUSION

Breeders of dual-purpose cereals might usefully place less emphasis on breeding for early forage production and more on overcoming the current limitations of dual-purpose genotypes, in terms of their lower grain yield and/or poorer grain quality compared with mainstream cereal cultivars. Farmers growing dual-purpose cereals need to adopt the best agronomic practices.

ACKNOWLEDGMENTS

We acknowledge the provision of a postgraduate studentship and financial support from GRDC toward this research, and assistance from NSW Agriculture field staff at Temora.

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