High Sowing Rates Reduce Seed Weight in Canary Seed (*Phalaris canariensis* L.)

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Abstract

Canary seed (*Phalaris canariensis* L.) is a potential winter crop for southern Victoria. However, canary seed is intolerant of current grass herbicides and has poor early vigour. Increasing plant density and delaying time of sowing are potential agronomic solutions to control annual grass weeds such as annual ryegrass (*Lolium rigidum* Gaudich.). This paper reports the results of experiments that investigated the effect of increasing plant density and delaying time of sowing on average seed weight. Increasing plant density from 120 to 308 plants m^{-2} and delaying sowing did not significantly ($P<0.05$) change average seed weight. However, increasing plant density from 120 to 213 plants m^{-2}, significantly ($P<0.05$) reduced average seed weight. Delayed sowing from June until August resulted in larger yields, but higher sowing rates had little effect on yield.

Introduction

Crop species diversity in cropping rotations provides an important means for minimising environmental, economic and agronomic risks. Currently, cropping rotations in southern Victoria include wheat, barley, peas, beans and canola. The addition of canary seed (*Phalaris canariensis* L.) to southern cropping rotations will give farmers an additional option to help broaden crop rotations and in particular, reduce disease risks.

Southern Victorian farmers use triazine tolerant (TT) canola cultivars at the start of their cropping rotation to reduce numbers of *Vulpia bromoides* Gray, (silver grass), *P. minor* Retz.,(annual phalaris), *P. paradoxa* L.(annual phalaris), and *Lolium rigidum* Gaudich. (annual ryegrass) in subsequent crops. Because of this opportunity to reduce weed burdens, the area planted to TT canola has increased from an estimated 3,050 ha in 1995/96 to an estimated 9,130 ha in 1998/1999 (1, 2). Canary seed is susceptible to available pre- and post-emergent grass herbicides (5), and the widespread use of TT canola provides a niche in rotations with low annual grass weed pressure that may suit canary seed.

Canary seed is a poor competitor against grass weeds. Increasing plant density to improve early vigour and delaying time of sowing to allow for non-selective weed control being investigated for use in southern Victoria. However, both these practices may reduce seed weight, which is an important quality criterion for the birdseed market (3). This trial was established to assess the effect of sowing rate and time of sowing on yield and average seed weight.

Materials and Methods

The experiment was located at Dooen, Victoria (36?40’07 S, 142?18’05 E) in 1999 on a Wimmera grey clay soil (6). The experiment was a randomised complete block with four replications for each of three sowing rates (15, 30 and 45 kg ha^{-1}) at two sowing dates (June 22 and August 05, 1999) using two cultivars (CDC Maria and Moroccan). CDC Maria is a glabrous line from Canada while Moroccan was selected in Queensland for the northern grain belt and is widely grown across Australia.

Prior to each sowing, glyphosate (675g a.i. ha^{-1}) was applied to kill existing weeds. Seeds were sown directly into standing wheat stubble using a seeder fitted with press wheels. Plots were 20 m long with 8 rows spaced on 175 mm spacing.

Broad leaf weeds were controlled at the four-leaf crop stage, using a mixture of 412.5 g ha^{-1} of bromoxynil and 300 g ha^{-1} of MCPA.

One metre of row per plot was harvested at the four-leaf stage to determine dry matter and plant density. A sub-sample of 10 plants was randomly taken to determine leaf area. Plots were harvested once all heads had ripened (seed moisture content 12 %) a sample of 5 m of drill row was harvested to determine biomass and seed yield. A sub-sample of 200 seeds per plot was used to determine average seed weight.

Rainfall was recorded at Longerenong College, three kilometres south of the experimental site. The May to October total was 199 mm which placed it in decile 2 based on 110 years of rainfall data.

Results and Discussion

Plant density was 120 (15 kg ha^{-1}), 213 (30 kg ha^{-1}) and 308 (45 kg ha^{-1}) plants m^{-2} by increasing sowing rates. In barley (*Hordeum vulgare* L.), increasing plant density has been shown to suppress weedy species while maintaining economic yield (7, 9). Increased density in this trial from high sowing rates is expected to improve the poor early vigour of canary seed (8).

Increasing plant density from 120 to 308 plants m^{-2} significantly ($P<0.05$) increased leaf area index (LAI) from 1.6 to 2.7 respectively (Figure 1). Higher LAI's are a characteristic of improved crop vigour (10) and improved weed competitiveness. However, LAI of plant densities of 213 and 308 plants m^{-2} were similar, suggesting that sowing rates to achieve plant densities greater than 213 plants m^{-2} did not improve the crops competitiveness against annual weeds in this experiment.

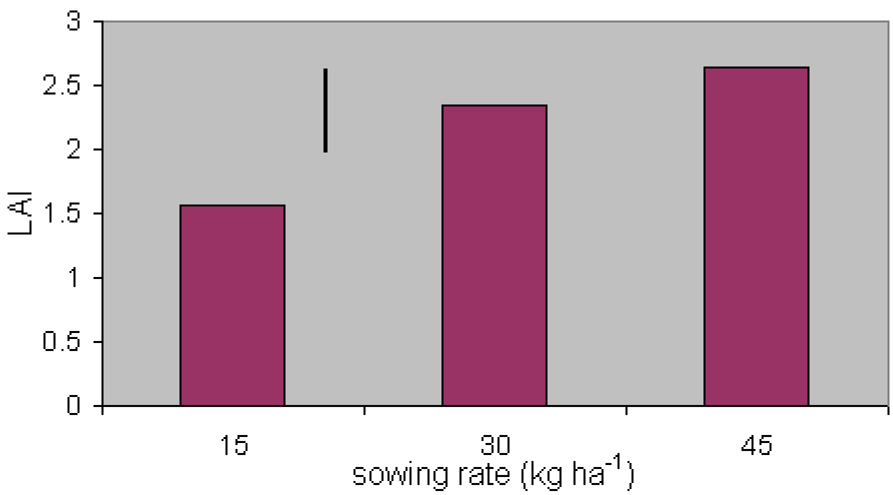

Figure 1. Leaf area index (LAI) at 4-leaf crop stage for two canary seed cultivars at three sowing rates. The size of the bar indicates the LSD (0.59, P=0.05).

The yields of canary seed from each of the three seeding rate treatments were similar (Table 1). The average yield of Moroccan was significantly larger ($P<0.05$) at 535 kg ha^{-1} than 496 kgha^{-1} for CDC-Maria ($P = 0.008$). CDC–Maria has been reported to be lower yielding when compared to the Canadian varieties Keet and Elias in Canadian experiments (4). Despite this yield penalty, the absence of the silicified trichomes on the seedcoat of CDC-Maria makes it a more desirable cultivar, as these trichomes are intensely irritating and there are reports of adverse health affects during harvest and handling (11).

The average canary seed yields were 571 kg ha^{-1} and 460 kg ha^{-1} respectively for the August and June sowing dates (Table 1). The 5 August sowing was able to take advantage of additional rainfall in October and out yielded the 22 June sowing time. The average canary seed yields in 1999 (a decile 2 year) were around 500 kg ha^{-1}, much less than reported Wimmera yields of up to 2000 kg ha^{-1} that have been achieved in years of higher rainfall (data unpublished).

Table 1. Treatment means for seed yield and harvest index measured on two canary seed cultivars at two times of sowing. Values are the average of three sowing rates. Values within the same column or row marked with an asterisk are significantly different from each other (P=0.05).

	Seed Yield (kg ha^{-1})			Harvest Index		
Time of Sowing	CDC Maria	Moroccan	**Mean**	CDC Maria	Moroccan	**Mean**
June 22	451	542	460*	0.21	0.25	0.23
August 05	469	601	571*	0.21	0.26	0.23
Mean	496*	535*		0.21*	0.26*	

The harvest index of Moroccan was significantly greater than that of CDC-Maria (0.21 and 0.26, respectively $P<0.001$). This indicates that the cultivar Moroccan is more efficient at converting dry matter into grain, which may be a consequence of an earlier flowering (*ca.* 2 days) in Moroccan. The harvest index (Table 1) and the biomass at harvest of 22 June and 5 August time of sowings did not differ significantly. The early sowing time flowered earlier and so was unable to take advantage of October rains, which coincided with grain filling in the later sowing.

When averaged across all sowing times and seeding rates, the seed weight of CDC-Maria (7.00 µg) was significantly ($P<0.05$) greater than that of Moroccan (6.76 µg) (Figure 2). Even under the dry conditions experienced, these data indicate that CDC-Maria is capable of producing larger seed than the Australian canary seed cultivar Moroccan. Large plump seed is demanded by bird seed markets (3).

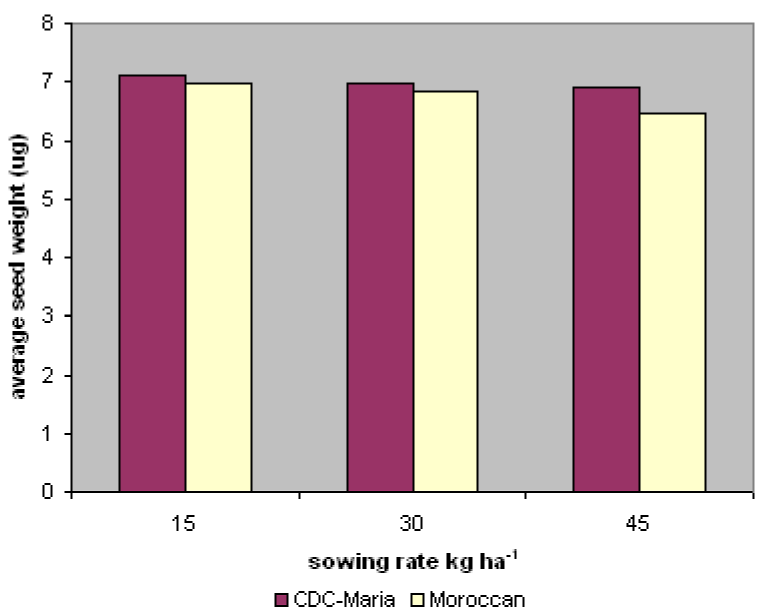

Figure 2. Single grain weight for canary seed at three sowing rates. The size of the bar indicates the LSD (0.17, P = 0.05).

There were no differences in seed weight between the 15 and 30kg ha^{-1} seeding rates, but at the highest seeding rate seed weight was significantly ($P<0.05$) reduced (Figure 2). It is likely that the highest sowing rate and highest LAI used more water earlier than treatments with lower plant densities and lower LAI resulting in lower grain weights. In wetter seasons, these differences may not be seen (5). Summer drought during grain fill is a potential threat to seed quality as late sown crops may deplete soil moisture before finishing grain fill. In this experiment, seed size was not affected by the later sowing, probably because adequate rain fell in late spring to allow the August sowing treatment to maintain seed size in spite of the higher yield in comparison to the June sowing. There were no significant interactions between time of sowing and density, suggesting that sowing rates for canary seed in late winter could remain the same as for crops sown in early winter. Further work is being done to confirm this result.

Conclusion

The early vigour of canary seed was significantly improved by increasing sowing rate to 30 kg ha^{-1}. Further increasing sowing rate to 45 kg ha^{-1} did not increase early crop vigour but did depress seed size. Therefore, these preliminary results suggest that seeding rates need not exceed 30 kg ha^{-1}, irrespective of sowing time. In this experiment, sowing in late winter increased seed yield over an earlier sowing, although these results are thought to be highly dependant on the occurrence of late spring rains.

The Canadian canary seed cultivar CDC-Maria yielded significantly less than the Australian cultivar Moroccan, but its larger seed size, coupled with its lack of trichomes, may make it more appealing to the bird seed trade.

It can be concluded that the existing cultivars can be managed to be more competitive with weeds and still maintain a large seed size demanded by the market.

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