INCREASED CROP DENSITY REDUCES WEED SEED PRODUCTION WITHOUT INCREASING SCREENINGS

Sally Peltzer
Agriculture Western Australia,
444 Albany Hwy, Albany, WA 6330

Abstract Results from a series of related field trials confirm that Western Australian crop varieties do not increase screenings with increased seeding rates contrary to the general belief held by farmers. This has management implications for weed control as increasing the crop density can substantially reduce weed growth and seed production in the absence of in-crop herbicides.

In one trial, seeding rates of up to 400 kg ha\(^{-1}\) of 4 cereals (oats, barley, wheat and triticale) were investigated as a management tool to control annual ryegrass and wild radish. All 4 cereals were successful in reducing weed seed production to manageable levels at high seeding rates. The yields of both wheat and triticale decreased when seeding rates increased, due to the extremely dry finish to the season in 1998, but only triticale increased screenings. The earlier maturing oats and barley were unaffected.

Other trials investigating seeding rates and/or seeding pattern and row spacing with different varieties of wheat have corroborated the uniformity of screenings with seeding density.

INTRODUCTION

With the advent of herbicide resistance, weed management strategies other than herbicides are becoming increasingly more important to control both in-crop weeds and their seed production for the following year. Crop competition is one method of agronomic weed control and can be used in combination with other techniques.

Plants compete for limited resources in the environment (light, water, nutrients etc.). Increasing the crop seeding rate or the number of crop plants in a given area reduces the amount resources available to each individual plant (Radosevich 1988). As a consequence, the contribution to yield from each individual plant is diminished. For cereals, higher plant densities result in reduced tillers and grain numbers per plant even though the overall yield per area can remain the same (Lemerle et al. 1996). Higher crop seeding rates can also reduce the amount of these resources available to weeds, which in turn reduces their size and seed production. Increasing the seeding rate of wheat reduced the biomass and seed production of annual ryegrass dry matter (Lemerle et al. 1996 and Fee 1997) and of wild oats (Avena fatua L.) (Radford et al. 1980, Carlson and Hill 1985).

Farmers however, are reticent to increase seeding rates to levels that will control weeds due to the risk of reducing grain size. This has major impacts on grain quality and the ability to deliver within premium grades. In WA, the price for received for wheat is reduced if more than 5% of the grain passes through a 5 mm sieve. The series of trials reported here studied the effect of crop seeding rate on weed control and crop yield and quality.

METHODS

A series of competition trials were implemented over 2 seasons (1997 and 1998).

Trial 1 Located at Newdegate in 1998 (approximately 400 km SE of Perth with an annual rainfall of 370mm) on sandy gravel over ironstone. It examined the effect of increased seeding rates of 4 cereal species on the suppression of annual ryegrass (Lolium rigidum Gaud) and wild radish (Raphinus raphanistrum L.). The 4 crop species; Westonia wheat, Hotham oats, Stirling barley and Tahara triticale were sown at 4 seeding rates (50, 100, 200 and 400 kg ha\(^{-1}\)). Each crop was grown with either annual ryegrass (420 plants m\(^{-2}\), wild radish (60 plants m\(^{-2}\)) or without any weed burden. They were fertilized with 40kg N ha\(^{-1}\) and 8kg P ha\(^{-1}\) at seeding.

Trial 2 This trial at Newdegate (1998) investigated the growth of Westonia wheat sown in 3 seeding patterns (18 cm, 36 cm and 18cm-cross-seeded) and 2 seeding rates (50 and 150 kg ha\(^{-1}\)), with or without 450 annual ryegrass seeds m\(^{-2}\) and with or without trifluralin (400g ha\(^{-1}\)). The trial was fertilized with 40kg N ha\(^{-1}\) and 8kg P ha\(^{-1}\) at seeding.

Trial 3 Another trial at Newdegate in 1998 examined the effect of 5 different seeding rates of different wheat varieties on the suppression of annual ryegrass as part
of a national multisite trial. There were 5 wheat varieties; Janz (early maturity, short semi-dwarf); Trident (late maturity, medium height); Dollarbird (medium maturity, semi-dwarf) Pulsar (a hybrid from Qld) and Westonia (early maturity, medium height). Each variety was seeded at 25,50,100,150 or 200 kg ha\(^{-1}\) and grown with or without 450 annual ryegrass plants m\(^{-2}\). This was a repeat of a 1997 trial located at Wongan Hills (200 km NE of Perth, with an annual rainfall of 450mm) on deep sandy loam. The 1997 trial included Amery (early maturity, semi-dwarf) as one of the wheat varieties and excluded Dollarbird. The ryegrass density was 230 plants m\(^{-2}\).

**RESULTS**

**Trial 1** Increasing the seeding rate of all 4 cereal species dramatically decreased the seed production of annual ryegrass by up to 400% (Figure 1) and its dry matter at anthesis (p<0.05). At 50kg ha\(^{-1}\), barley and oats were the most competitive (p<0.05), but there was no difference between the cereals at the higher seeding rates in their suppression of seed production. Wild

![Figure 1](image1.png)

**Figure 1.** The effect of increasing seeding rate of 4 cereal species on the number of annual ryegrass seeds produced (mean of 4 reps). (LSD (p=0.05) : 2600)

![Figure 2](image2.png)

**Figure 2.** The effect of seeding rate and pattern of Westonia wheat and trifluralin on the annual ryegrass seed numbers and wheat screenings (mean of 4 reps). (LSD (p=0.05): Rye no. (Trifluralin = 2700, Seeding Rate = 4700); Screenings = 2.1)
radish followed the same pattern of reduced growth with increased seeding rate (p<0.05).

Ryegrass and radish reduced the yield of all 5 crops at the lower seeding rates with oats the least affected (p<0.05). Increasing the seeding rate of the cereals compensated for this reduction in yield. There was however a very dry finish to the season and the yields for triticale and wheat were reduced when seeding rates were increased offsetting the percentage reduction in yield loss due to weeds. The yields of oats and barley, which tend to finish earlier, were unaffected by increasing seeding rate. The screenings were relatively high for all of the cereals due to a dry finish but there was no difference in the screenings due to seeding rate except for triticale.

**Trial 2** Increasing the seeding rate of wheat from 50 to 150 kg ha⁻¹ decreased ryegrass seed production (Figure 2). The addition of trifluralin decreased ryegrass seed numbers except in the cross-seeded treatment where trifluralin did produce any further benefit. Again the screenings were high due to the dry finish to the season but there was no difference between the treatments (Figure 2). The screenings ranged from 7-9% regardless of the treatments.

**Trial 3** The shorter season varieties did not increase their screenings at high seeding rates despite yield restrictions due to low water availability at seed fill. In 1997, with a longer season, increasing seeding rates decreased ryegrass without yield loss or increased screenings of any of the same cultivars.

**DISCUSSION**

Increased cereal seeding rates were successful in reducing the weed burden and weed seed production of both annual ryegrass and wild radish. Although no work has previously been done with seeding rate and wild radish, a doubling of the seeding rate of wheat to 110 kg ha⁻¹ decreased the biomass of annual ryegrass by 25% (Lemerle et al. 1996). Similarly, an increase in the seeding rate of wheat from 50 to 200 kg ha⁻¹ resulted in a 3-fold reduction in annual ryegrass seed production (Fee, 1997). Oats and barley were found to be more competitive than wheat and triticale at the lowest seeding rate (50kg ha⁻¹) but there was no difference between the cereals in their ability to suppress weeds at the higher seeding rates. This contradicts results from NSW where barley (at 55 kg ha⁻¹) was found to be less competitive in terms of ryegrass seed production and yield loss (Lemerle et al. 1995). This could be due to varietal differences between the states.

Grain screenings or screenings did not increase at the higher seeding rates, regardless of the season. A short season with a dry finish as in 1997 gave rise to low yields and tended to produce high screenings but there was no further increase due to seeding rate. This corresponds to other work on wheat from WA (Anderson and Sawkins, 1997) where screenings were affected by sowing time, fertiliser levels, cultivar and site factors but not by increased seeding rates. It has been suggested that the high screenings associated with elevated seeding rates encountered by some farmers could be due to marginal copper deficiency which may not occur at the lower plant densities (Ross Brennan, Agriculture WA, pers. comm.)

Crop competition can be an effective alternative weed management strategy. With early sowing and good agronomic practices, it is possible to use high seeding rates to suppress weeds and reduce their seed set for the following season without sacrificing yield and quality.

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**REFERENCES**


