COMPETITIVE INTERACTIONS BETWEEN WHEAT AND RYEGRASS

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Summary. Experiments done over three years in central western New South Wales tested the effects of spatial arrangement (square, rectangular and traditional) and sowing rate of wheat (12, 22, 60 kg ha^{-1}) on ryegrass *(Lolium rigidum)* (0 to 300 plants m^{-2}) competition. These experiments showed a consistent relationship between wheat yields and ryegrass density that was unaffected by spatial arrangement of the crop.

However, with increasing density, ryegrass reduced wheat yields more at the lower crop sowing rates. This was explained by the plasticity in the response of ryegrass to competition from wheat; the relationship between ryegrass density and total biomass of ryegrass tops changed for the different wheat sowing rates. A single relationship $Y = 102.51e^{-0.0066x}$ ($r = -0.85$) between wheat yields and ryegrass biomass applied at high and low sowing rates.

We conclude that crop density influences ryegrass competition and this should be taken into account in developing a competition index based on weed density.

INTRODUCTION

Target weed species are rarely completely controlled by methods currently practised in broadacre wheat production. For example, with ryegrass these methods may result in significant weed control leading to economic gains, but a residual weed population often remains (Auld *et al.* 1977) that can cause wheat yield reductions (Reeves 1976) and also ensures perpetuation of the weed problem.

It was hypothesised that altering sowing patterns (Fischer and Miles 1973), to give more evenly spaced wheat plants and/or increased sowing rates would exert greater interspecific competition. If so, this could lessen the steep reductions in crop yield commonly reported for low weed populations and reduce the fecundity of individual weeds.

This paper summarizes the experimental testing of the hypothesis over three years using annual ryegrass as the target weed.

MATERIALS AND METHODS

Four experiments were sown over the years 1978 to 1980 into well prepared, ryegrass free seedbeds on loam soils near Cudal in central western New South Wales. All plots received a complete fertilizer including 18 kg P, 50 kg K and 40 kg N ha^{-1} at sowing. Sowing commenced on June 22 1978, July 2 1979 and on June 5 and July 15 1980. Rainfall between sowing and harvesting totalled 390 mm in 1978, 128 mm in 1979 and 147 mm and 88 mm for the two times of sowing in 1980. In 1979, plots were watered for two weeks after sowing to ensure uniform establishment.

The sowing arrangements were square, rectangular and traditional poisson distribution in rows at sowing rates of 12, 22 and 60 kg ha^{-1} and using the cv Condor (Table 1). The poisson and rectangular arrangements differed by sowing randomly or regularly along rows.

Table 1. Wheat sowing arrangements and rates used in the three years.

Arrangement		Sowing rate (kg ha^{-1})	Wheat Plants (no m^{-2})	Distance between rows (mm)	Distance within rows (mm)
Square	1980	12	40	159	159
	1978/9	22	74	116	116
	1978 to 80	60	200	71	71
Rectangular	1980	12	40	403[1]	63
	1978/9	22	74	180	75
	1978 to 80	60	200	180	28
Poisson	1980	12	40	180	-
	1978	22	74	180	-
	1978/80	60	200	180	-

[1] Wide rows were used to maintain the same rectilinearity of 1 to 6.4 that applied to wheat sown at 60 kg ha^{-1}.

Graded seed was hand sown approximately 50 mm deep using marine ply boards precision drilled for each treatment.

All arrangements included ryegrass populations of from 0 to 300 plants m^{-2}. Measured quantities of ryegrass seed were broadcast onto plots then raked in. Other weeds were removed by spraying with a proprietary mixture of bromoxynil plus MCPA and by regular hand weeding.

Plant counts were taken during the life of the crop and yields measured at maturity.

RESULTS

Wheat grain yields were depressed as ryegrass density increased but there was no significant ($p > 0.05$) effect of sowing arrangement on this relationship within any one experiment. This result was consistent over a range in wheat yields of 1.5 to 6 t ha^{-1} recorded for the four experiments.

The effect of ryegrass on wheat grain yield was similar ($p > 0.05$) for density counts made at establishment and maturity since these changed little during the life of the crops. Analyses henceforth were based on ryegrass densities at maturity.

The depression in wheat grain yields as a function of ryegrass density did not differ for crops sown at 12 and 22 kg ha^{-1} although a significantly different ($p < 0.05$) relationship was found for crops sown at 60 kg ha^{-1}. The exponential equations fitted to the data combined for all experiments and arrangements (Figure 1) showed that the proportional decline in wheat yields per unit increase in density of ryegrass was nearly three times as great for crops sown at low rates compared with those sown at the high rate. At low wheat sowing rates the yield of ryegrass for a given density amounted to more than double that found in crops sown at the high rate (Figure 2).

When the reduction in wheat grain yield was plotted against final ryegrass biomass (Figure 3) there were no significant differences between crops sown at the high and low rates. One exponential relationship could describe the overall effects.

DISCUSSION

Crop agronomy packages are commonly developed under weed free conditions and it is usually assumed that management practices can eliminate all weeds. However very often residual ryegrass populations of the order of 50 plants m^{-2} (Auld *et al.* 1977) remain. The data presented here confirm that such populations can depress wheat yields significantly.

This research has shown that the effects of these residual ryegrass populations are best countered by an increase in wheat sowing rates - a finding common to many weed-crop studies (see e.g. Zimdahl 1980) - and that varying spatial arrangements are unlikely to improve the competitiveness of wheat over ryegrass. Wheat yields in these experiments varied considerably yet even in the drought years of 1979 and 1980 yields were not depressed at sowing rates of 60 kg ha^{-1}. It therefore seems advisable to increase sowing rates of wheat to this level to minimise the effects of residual ryegrass populations.

Wheat arrangement did not influence ryegrass competition possibly because in the weed free situation square arrangements only gave an 8 to 10% yield advantage over rectangular (Kemp *et al.* 1980). Such a small effect of arrangement may have been masked by the variability in response to ryegrass (Figures 1 and 3).

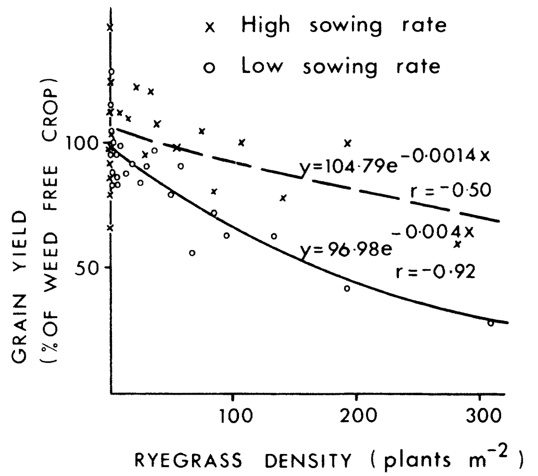

Fig. 1. Grain yield response to ryegrass density at maturity with different sowing rates of wheat.

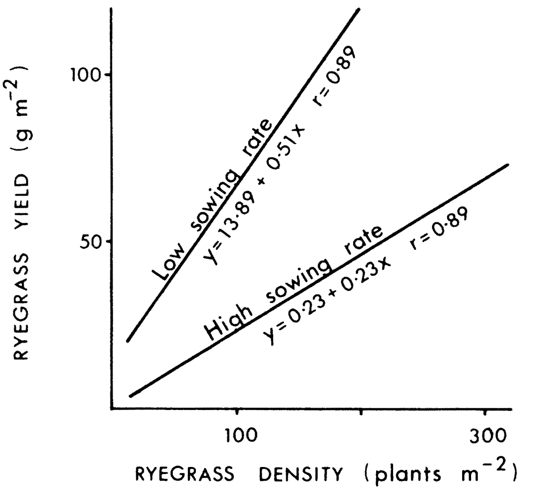

Fig. 2. Relationship between density and biomass of ryegrass at maturity for different sowing rates of wheat.

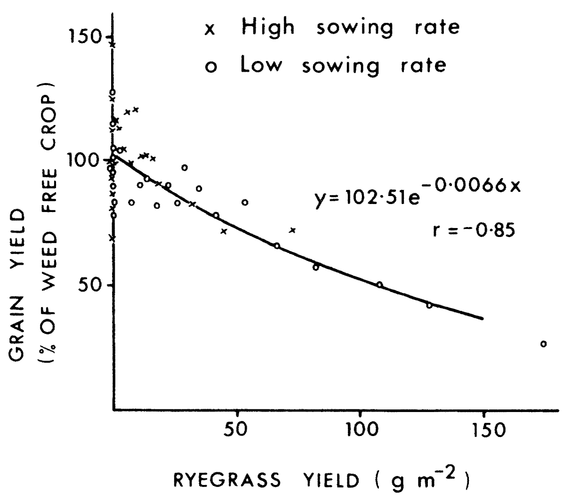

Fig. 3. Grain yield response to ryegrass biomass.

Weed density is commonly used as an index to weed competition (Dew 1972; Hamman 1979). An implication from these studies is that competition indices are constant for a range of environments and cultural systems. With ryegrass however, density effects have been shown to vary with time of sowing (Reeves 1976). Our experiments indicated that crop density, because of its effect on ryegrass biomass, should also be taken into account in developing a competition index.

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