# The Effect of Sowing Rate on the Performance of Wheat in the Forbes and Parkes Districts.

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## Key Points

- Harvest results (grain yield and quality) are more closely related to plant density than sowing rates.
- Plant density can vary by over 50% for any given sowing rate. Correct sowing rate calculations that take into account seed size, germination % and expected emergence losses are needed to achieve target densities.
- A target density of 120 plants/$m^2$ is suggested as a good compromise for achieving good yield and quality in the local area.

## Background

Dryland wheat sowing rates in the Forbes and Parkes districts generally range from 35 to 70 kg/ha. Undersown crops will sometimes be sown as low as 20 kg/ha. Extension experience suggests that fanners often do not give consideration to plant density targets when sowing cereal crops, usually referring only to sowing rates in their calculations and analysis of crop production results.

Opinions vary widely between both growers and advisors on the effect of sowing rate on wheat yield and grain quality. Some believe that high sowing rates will result in more tillers and high screenings. In contrast, others suggest that higher sowing rates have higher yield potential and that high sowing rates reduce secondary tillers and will actually reduce screenings. Varieties also differ in their ability to tiller. This has fanners asking should they increase their sowing rate with varieties that tiller less.

Wheat sowing rate and plant population trials have been conducted in the Forbes and Parkes districts at the CWFS Regional Sites over the last 4 years. Previous trials have sought to provide further information regarding sowing rates for different wheat varieties (Roberts, 2003; Naughton *et al,* 2003; Roberts, Motley and Rice, 2004). This paper provides details from the 2004 trials and conclusions from the overall trial series.

The use of the wheat variety H45 in these trials does imply that it is currently a preferred variety. H45 is highly susceptible to stripe rust and as a result is not recommended for commercial sowing. H45 was originally included in the trials due to its unique 'restricted' tillering characteristic compared to other commercially available varieties. H45 has continued in the trial series to ensure consistency of results across the 4 years.

## Methods and Trial Design

3 trials were sown in 2004. These trials consisted of 2 wheat varieties (H45 and Diamondbird) sown at 4 target plant densities (50, 100, 150 and 200 plants/$m^2$). Sowing rates for each target plant density were adjusted individually for each variety based on seed size and germination. The trials were arranged as a randomised block design with 3 replicates. Plant counts were done at 6

post sowing. Plots were sown small cone seeder. Plots were ed using a small plot harvester. suits were statistically analysed analysis of variance and spatial where applicable.

esigns in the previous years have included H45 but not Diamondbird. Other varieties trialled in previous years have included Chara, Sunvale, Hybrid Mercury and EGA Wedgetail. The trials at Goonumbla in 2002 and 2003 were not statistically analysed at the time of publication in the relevant years. These trials will be analysed as part of a larger regional trial series.

Wheat density trial details 2004

| [1] | Gunning Gap | Wirrinya | Goonumbla |
|---|---|---|---|
| side early | 29-May | 16-Jun | 9-Jun |
| side late | 11-Aug Tristar + jaguar<br>1-Sep Tristar<br>16-Dec | 100kg/ha of DAP at all sites (18N; 20P)<br>11 -Aug Tristar + Jaguar<br>-<br>18-Dec | 11-Aug Tristar + Jaguar<br>-<br>17-Dec |
| (mm) | 167 | 163 | 191 |
| (Nov - Apr) | 212 | 210 | 259 |
| (May to Oct) | 428 | 482 | 503 |
| Annual | | | |
| **nited yield potential[A]** | 3.1 | 3.0 | 4.3 |

ed yield potential (t/ha) = ((Nov to Feb) X 30% + (Mar) X 50%)mm + (Growing season rainfall -110)mm) X 20(kg grain/mm) /1000

# Its and discussion

*in 2004*

ing plant density resulted in ant yield increases in H45 at a, and yield decreases in ldfoird at Wirrinya and H45 at g Gap (Figure 1). Plant density o effect on grain yield in ldbird at Gunning Gap and H45 amondbird at Goonumbla. The rib la data is not shown because /as no effect of plant density on 145 or Diamondbird found.

ielcled significantly higher than ldbird at Gunning Gap and a. However, Diamondbird significantly higher than H45 at nbla. The average yield at tibia was 3.3 t/ha for Diamondbird ) t/ha for H45. Stripe rust was present at the Wirrinya and Goonumbla trial sites in 2004. The very poor performance of Diamondbird at Gunning Gap is thought to be attributed to the timing of severe dry seasonal conditions in late September coinciding with crop flowering. It is though that the quicker maturing H45 variety may have partially avoided these tough conditions at flowering.

Increasing plant density resulted in significant screening reductions in H45 and Diamondbird at Wirrinya (Figure 2). Plant density had no effect on screenings in FI45 or Diamondbird at Gunning Gap or Goonumbla. H45 had significantly lower screenings than Diamondbird at Gunning Gap. Screenings were less than 10% at both Gunning Gap and Goonumbla.

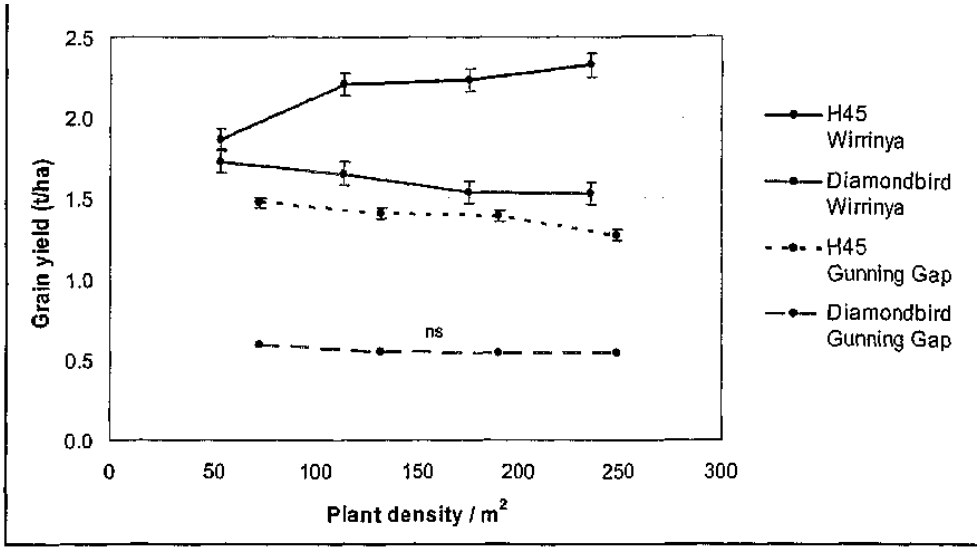


**Figure 1: Plant density effects on the grain yield of H45 and Diamondbird wheat at Wirrinya and Gunning Gap 2004. Error bars indicate Isd (P<0.05).**

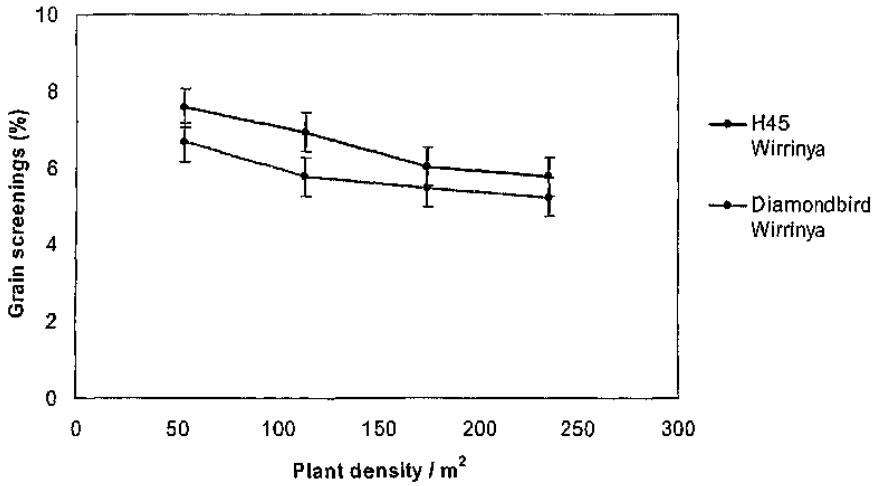


**Figure 2: Plant density effects on the grain screenings of H45 and Diamondbird wheat at Wirrinya 2004. Error bars indicate lsd (P<0.05).**

***Summary of results (2001-2004)***

*Sowing rates and plant density* Figure 3 represents the best (maximum density achieved line) and worst (minimum density achieved line) establishments from 2 sowing rates trials in 2001 and 3 sowing rates trials from 2004. These outer limit lines have been derived by doing 720 plant counting sequences. This graph indicates that sowing rates ranging from 43 to 110 kg/ha can result in a density of 120 plants/$m^2$. Correspondingly a sowing rate of 43 kg/ha resulted in plant densities ranging from 47 to 120 plants/$m^2$.

Clearly many factors such as seed size, germination %, soil structure, sowing depth and seasonal conditions influence plant establishment. Sowing rate calculations need to take into account these factors when targeting a certain plant population.

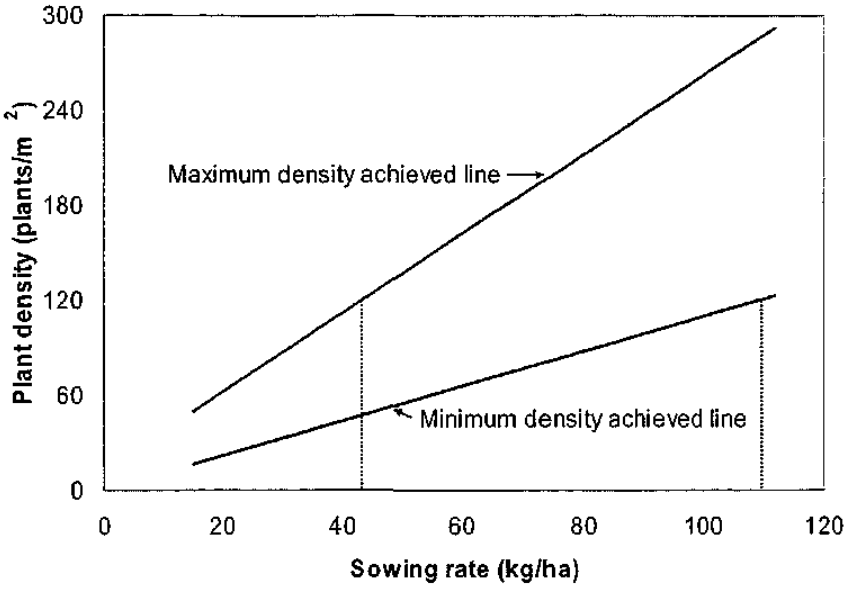


**Figure 3: The maximum and minimum wheat plant densities achieved in relation sowing rate - Parkes / Forbes trials 2001 and 2004. Combined data for H45 and Diamondbird.**

*Probability of grain yield and quality responses*

Almost every combination of effects on grain yield and grain screenings was observed during the four years of wheat sowing rate / plant density trials in the Forbes and Parkes districts. A summary of the probability of grain yield or screenings response to increasing plant density occurring in the overall data has been collated (Table 2) to help understand the proportion of the different responses. This summary suggests that increasing plant density increased grain yields in the wetter year of 2001. However, in the drier years the effect on grain yield was less consistent. In most cases increasing plant density had no effect on screenings, and in some cases it decreased screenings. Only in a small number of situations did increased plant density increase grain screenings

## Conclusion

These trials have shown that harvest results are more closely related to plant density than sowing rates. A plant density of about 120 plants/$m^2$ appears to be a good compromise between good yield potential in the better seasons, without losing too much grain quality in the very dry seasons. These trials have also highlighted that no one single sowing rate can reliably produce the desired plant population. Sowing rate calculations need to take into account seed size and quality, soil type, machinery and seasonal conditions.

**Table 2: A summary of the probability of grain yield or screening responses to increasing plant density of wheat to 250 plants/m$^2$ (pooled cultivar results). Gunning Gap, Wirrinya and Alectown CWFS sites 2001 to 2004.**

*Please note the data from Goomimbla in 2002 and 2003 used in this summary have not been statistically analysed. As such this summary should only be used as a guide to the responses achieved in the trial series.*

| Yield or screenings response | Probability of response | | | | Average |
|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2004 | probability |
| Yield response | | | | | |
| Increase yield | 100% | 71% | 33% | 17% | 55% |
| Decrease yield | 0% | 0% | 11% | 33% | 9% |
| No effect on yield | 0% | 29% | 56% | 50% | 36% |
| Screenings response | | | | | |
| Increase screenings | 0% | 0% | 33% | 0% | 9% |
| Decrease screenings | 0% | 7% | 56% | 33% | 24% |
| No effect on screenings | 100% | 57% | 11% | 67% | 52% |
| Screenings unknown | 0% | 36% | 0% | 0% | 15% |

The effect of plant population on the yield and quality of wheat is a complex interaction, being affected by seasonal conditions, and variety maturity, tillering ability, grain size and grain shape. The trials conducted at CWFS regional site represent a simple analysis of this complex interaction.

From these trials we can assume that plant density can increase (to less than 250 plants/m$^2$) with a small probability of a detrimental effect (i.e. decreased yield or increased screenings).

## References

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