Hyper Yielding Crops Projects - Focus Farm

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KEY MESSAGES:

- **The two Rockstar seeding rate trials resulted in differing levels of yield response, resulting from the different environmental conditions they were seeded into.**
- **There was no yield response from seeding rate in the Frankland River Kinsei trial.**
- **The Mobrup and Kojaneerup South trials were impacted by severe waterlogging which limited yield potential across all trial plots.**

INTRODUCTION

As part of the FAR Australia hyper yield cropping program three wheat sowing rate trials were established to determine optimal rates to maximise grain yields in the Albany Port Zone (APZ). The FAR Australia project focuses on the upscaling of research conducted at the hyper yielding research centres at Frankland (Gunwarrie) and Esperance.

The aim of the three trials was to assess the impact of differing seeding rates on Rockstar and Kinsei wheat yields. This was a broadscale trial set within an existing paddock, where the wheat plots would be integrated into the existing agronomic system. The trials aimed to determine if higher seeding rates would improve yields without making any changes to the agronomic package planned for the rest of paddock. Seeding rate recommendations are often based on broad parameters that are not tailored to specific environmental and agronomic conditions. This trial aimed to provide farmers with clarity as to how differing seeding rates perform in the APZ.

Each of the three trials were subject to waterlogging to differing degrees throughout the season, however the Kojaneerup South site was more severely affected than the other sites. It is likely that yields across all sites were affected by waterlogging. As a consequence of each site undergoing prolonged periods of waterlogging (>20 days above field capacity), we were presented with a unique opportunity to assess how seeding rates are affected by or mitigate waterlogging on a paddock scale. Given the nature of the constraint, there is limited paddock scale research around the relationship between seeding rate/plant population and waterlogging.

METHOD

The three trials were located at Kojaneerup South, Mobrup and Frankland River. These three locations capture differing soil types that are commonly found within the APZ. The Mobrup site is located on forest gravel, the Frankland site is typified by loamy sand, and Kojaneerup South is located on a low lying sandy duplex.

This trial was a fully replicated field scale trial which aimed to determine the optimum seeding rate for Kinsei (noodle) and Rockstar (AH) to maximise yields in the HRZ of WA. The three trials were agronomically managed in line with the surrounding crop, which was seeded at 90kg/ha for the Frankland River Kinsei and 110kg/ha for the Mobrup and Kojaneerup Rockstar sites. The seeding rates within each trial ranged from a low to high rate. This allowed us to assess how higher seeding rates perform under existing agronomic management strategies.

It should be noted that a frost event affected the Mobrup trial site, with portions of the second replication being adversely impacted. Given the plots were 300m in length the second replication was able to be adjusted to form a more indicative data pool.

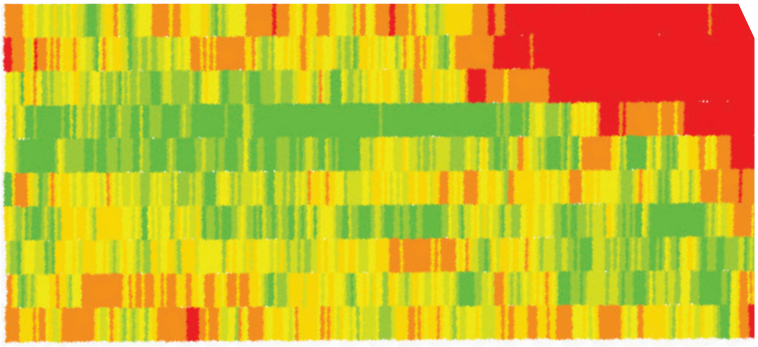

Figure 1: Mobrup Rockstar trial yield map, the red zones indicate a significant area affected by a frost event late in the season, in which yields were significantly penalised.

GROWING SEASON RESULTS:

The results differed at each trial site, and we found that there was no uniform yield response to seeding rate across all three of the sites. This was not unexpected, given each site was managed individually and was subject to differing environmental conditions.

The Frankland River (Kinsei) trial resulted in no significant difference in yield or grain quality resulting from the changes in seeding rate (figure 2). The 90kg/ha plot which was seeded at the same rate as the surrounding paddock yielded approximately 0.5t/ha better than the heavier seeding rates. Plant establishment counts taken before tillering followed a linear trend (figure 3), which suggests that there has been failure among the higher seeding rates to convert early season biomass to grain yield.

Within each Kinsei plot there were areas that had been significantly affected by waterlogging with lower lying points in each run suffering periods of stress, however this did not result in any noticeable yield penalty in these zones of the plots at the end of the season. This could suggest that the Kinsei variety of wheat is able to recover from periods of waterlogging stress without a major yield penalty.

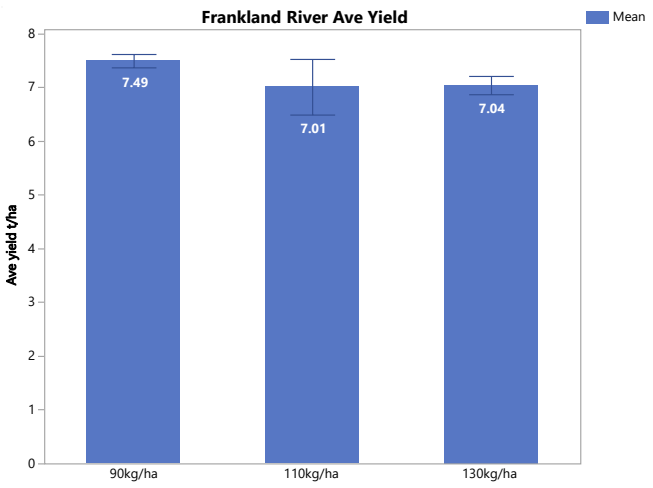

Figure 2: Frankland River harvest yields (t/ha) by seeding rate, yields were taken from calibrated yield monitor

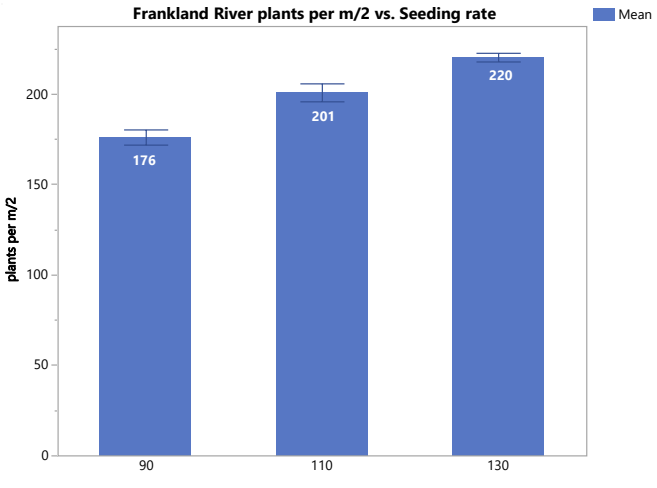

Figure 3: Frankland River plants per m/2 by seeding rate at GS20

MOBRUP RESULTS:

The Rockstar trial site at Mobrup saw the greatest response of yield from seeding rate. With a clear pattern emerging whereby as the seeding rate increased, so did the yield response, excluding the 160kg/ha plots (figure 4). The yield results largely follow the trend observed in the plant counts conducted throughout the season (figure 5). It was observed that among the two highest seeding rates (140 & 160kg/ha), there was a lot of dead plant material and failed tillers at the time of flowering, which speaks to the failure of the 160kg/ha plot to convert plant establishment to grain yield.

The Mobrup results suggest that a higher seeding at a rate of 140kg/ha would result in a yield that is statistically greater than rates of 80 and 100kg/ha. The 140kg/ha rate also appears to be the upper limit for seeding Rockstar in Kojaneerup and Mobrup.

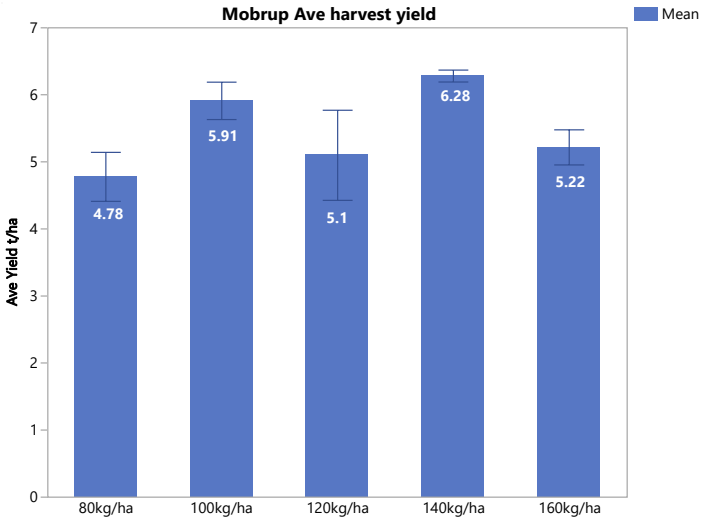

Figure 4: Mobrup harvest yields (t/ha) by seeding rate (kg/ha), yields were taken from calibrated yield monitor, and include the frost effected zones.

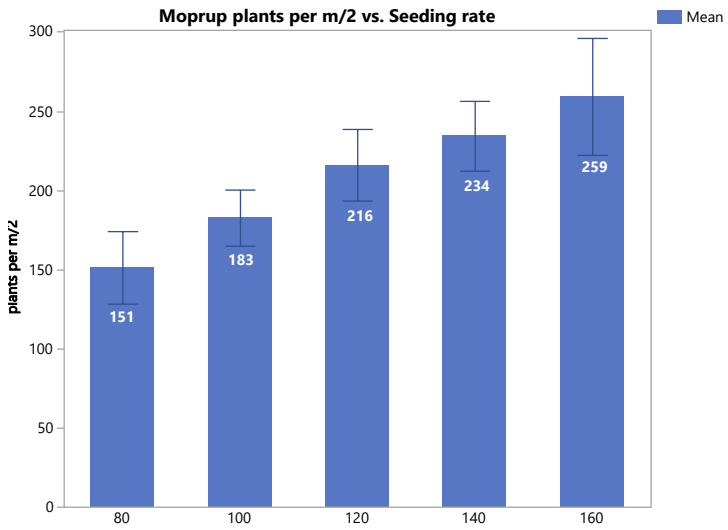

Figure 5: Mobrup plants per m/2 by seeding rate (kg/ha) at GS20

KOJANEERUP SOUTH RESULTS:

The preliminary results showed no significant relationship between seeding rate and yield found at Kojaneerup South. However,at the time of print the data is still being analysed. The plots at Kojaneerup south were heavily impacted by waterlogging, which likely limited yield potential irrespective of the seeding rate. Early in the growing season a linear relationship between plant numbers and seeding rate was observed pre-tillering similar to the other two sites, albeit with a greater standard deviation (figure 6). This greater variance was due to large areas within the plots being subject to significant waterlogging from the time of sowing. The plant count and yield results for Kojaneerup South were overall lower than that of Mobrup and Frankland River.

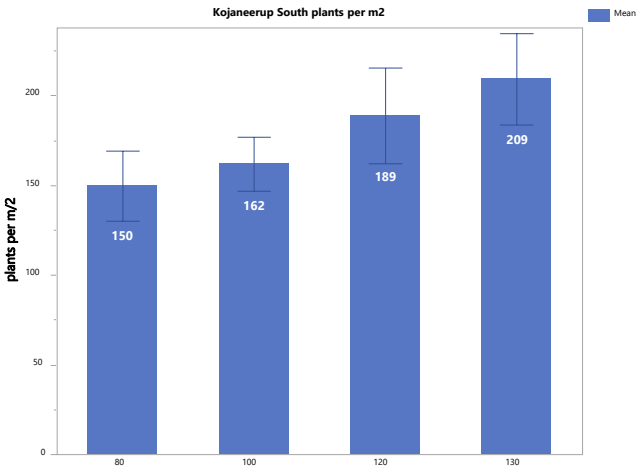

Figure 6: Kojaneerup South plants per m/2 by seeding rate (kg/ha) at GS20

DISCUSSION

The results from these trials show that the relationship between yield and seeding rate is variable and is dependent on a range of factors. Environmental conditions and agronomic management play a significant role in the final yield outcomes, irrespective of the seeding rates. Whilst the Mobrup trial showed there was an advantage to be gained from sowing heavier, the same relationship was not replicated at Kojaneerup South. Whilst the Kinsei trial suggested the optimal seeding rate could be 90kg/ha, it would be interesting to further explore how lowering the seeding rate would impact yield, given the lowest rate trialed resulted in the greatest yield.

The extensive waterlogging allowed us to study the relationship between waterlogging and sowing rate. We hypothesized that the heavier seeding rates would result in a greater yield response in the waterlogged conditions, given plant available water would not a be limiting factor irrespective of the increased demand resulting form the higher seeding rates. However, the results from these trials show increased seeding rates failed to significantly outperform the typical rates (90 kg/ha for Kinsei, 110kg/ha Rockstar).

The trial sites were exposed to extended periods of waterlogging that would limit the yield potential of the crops irrespective of the seeding rate. At times throughout the growing period the plot trials looked nitrogen deficient. Nutrient deficiencies were likely induced by a combination of waterlogging impacting root hydraulic conductivity and increased nitrogen losses through leaching and runoff. On top of this, excessive waterlogging reduces photosynthetic rates and carbon fixation through stomatal closure. These factors likely combined to reduce yields across all the plots at all the trial sites. Environmental constraint became the foremost yield determining factor irrespective of the seeding rate. It would be informative to conduct these rate trials under a typical year where waterlogging was not a major environmental constraint. This would provide greater clarity as to what the optimal seeding rate for the HRZ is. It should be noted, the nutrient package for each treatment was tailored to the control seeding rate (90kg/ha Frankland River, 110kg/ha Mobrup, and 110kg/ha Kojaneerup South), and this invariably would have impacted the plant available nutrients, with lower seeding rates potentially benefiting from ample available nutrients, whilst the higher seeding rates would be impacted by less than adequate nutrition to support the number of plants that emerged.

CONCLUSION

This trial demonstrates that the relationship between seeding rate and yield is one that is multi-faceted and although there is a potential for yield gains from upping seeding rates in Rockstar wheat, this would be reliant on other agronomic and environmental factors.

ACKNOWLEDGEMENT

Thank you to Mark Preston, Ashton Hood and Jon Beasley for hoting these trials in 2021.
Thank you to FAR Australia & the GRDC for collaborating and investing in this project.