Effect of Temperature on Performance of NSW Rice

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Introduction

Commercial rice production commenced in NSW (Australia) in the Murrumbidgee Irrigation Area in 1925. The area gradually expanded with addition of new production areas in the Murray Valley Areas and the Coleambally Irrigation Area. Area sown to rice reached a maximum of 184,000 ha in 2001 but has declined since that time, largely as a consequence of water reform.

Rice growing has been commercially successful due to the high potential yield. Yields gradually increased with highest commercial yield of 11 tonnes.ha^{-1} achieved in the 2010 and 2016 crops.

Yields are not always so high. Low minimum temperatures during the January and February reproductive period have led to yield reduction of more than 2 tonnes.hectare^{-1} in the 1996, 2005 and 2009 crop years. There is additional variation due to the impact of temperature on growth (Farrell *et al*, *2001*).

Milling quality is also variable in the NSW Industry. This was particularly evident in the 2013 crop year when there were very low whole grain yields.

The current study has updated some data on the effect of temperature on the yield of some Australian rice cultivars and on milling quality.

Materials and Methods

The relationship between temperature and yield is presented for commercial production of cv 'Amaroo' (medium grain) and cv 'Langi' (long grain). Amaroo is no longer grown commercially but was the principal cultivar from 1988 to 2010 and was grown on nearly 30% of the area in 2011. Langi, produced commercially from 1994 is still grown and has ranged from 30% of the area in 2000 to less than 10% in 2002.

Yield data were provided by SunRice. The yields are reported in four distinct regions (Murrumbidgee Irrigation Area (MIA), Coleambally Irrigation Area (CIA), Eastern Murray Valley (EMV) and Western Murray Valley (WMV)). Yields are generally highest in the MIA and lowest in the WMV. These yield statistics are very accurate as they are derived from survey and aerial imagery while yields are recorded at delivery. Yield statistics were not included where the area for any cultivar in any region was below 1000 ha.

Temperatures for Griffith were collected from the CSIRO weather station. These were used for comparisons in the MIA and CIA. Deniliquin temperatures were from the Australia Bureau of Meteorology station at Deniliquin Airport and they were used for the EMV and WMV comparisons.

Temperature averages were used in the analysis and these were average temperature 15th October to 31st December (establishment and vegetative period) and average minimum 16th January to 14th February (reproductive period).

Whole Grain Milling results were also provided by SunRice and are derived from their grower and bin appraisal studies.

Analysis was by multiple regression in the Excel Spreadsheet.

Results and Discussion

Grain Yield

Yields tended to be affected by temperatures in both the vegetative and reproductive period so multiple regression was used. It appeared that high temperatures during reproductive growth could also reduce yield potential so a quadratic equation was fitted for this character.

Table 1. Regression results for grain yield vs temperature for two cultivars in four regions of NSW

	n	r	Equation
Amaroo			
MIA	22	0.84**	Y= 0.38X1**+4.63X2**-0.13X3** - 38.12
CIA	22	0.82**	Y= 0.46X1** + 4.64X2** - 0.05X3* -40.62**
EMV	21	0.71**	Y = 0.38X1* + 3.69X2ns -0.10X3ns -31.62 ns
WMV	20	0.85**	Y = 0.56X1** + 0.54X2** - 0.13X3** - 47.24**
Langi			
MIA	19	0.65*	Y= 0.28 X!* + 1.83X2 ns -0.05X3 ns – 12.66 ns
CIA	18	0.64 ns	
EMV	12	0.84**	Y= 0.49X1** + 4.65X2+ - 0.13X3 ns – 42.76*
WMV	10	0.95**	Y = 0.35X1 ns + 4.90 X2* - 0.13X3* - 44.63*

X1 = average temperature 15th October to 31st December
X2 = average minimum temperature 16th January to 14th February
X3 = X2 * X2

Relationships tended to be stronger for Amaroo than for Langi. This was surprising as, for the period 1004 to 2003 the relationship was very strong for Langi (MIA, r= 0.88, CIA r= 0.96, EMV r= 0.96, WMV r= 0.96).

The relationships are close, however, given that individual crop yields will be influenced by many factors including time of sowing, nitrogen supply, weed control, duck and other bird damage.

Milling Quality

Milling quality (% whole grain (WG)) was provided for 1990 to 2013. It varied from 47.1% to 59.9% for medium grain and 49.2% to 59.9% for long grain. Temperatures were the average maximums from Griffith from 15th February to 15th March which covers most of the ripening period.

There appeared to be a linear relationship for medium grains but milling quality of long grains appeared to be also reduced by lower temperatures. The relationship for medium grains was (n=24, R = 0.51*): WG= 100.16 ns – 1.38T*. The relationship for long grains was (n=24, r= 0.60*): WG = 27.24T * - 0.47 T^2 * -339.34.

The whole grain results are averaged over crops and cultivars. There would be some variation between cultivars and crops vary with many factors including time of drainage, time of harvest , soil conditions and evaporative demand (Clampett *et al*,).

Conclusion

Temperature has a significant impact on both rice grain yield and milling quality in the NSW. It is well recognised that yields can be significantly reduced by low temperature in the reproductive stage but there is also an influence of temperature on growth.

The results for Amaroo are unlikely to be representative for newer cultivars. 'Sherpa', in particular has greater cold tolerance so would not be so affected by cold during reproductive growth. The influence of temperature during the vegetative stage for the newer cultivars is also unknown.

Maximum temperatures also have an impact on milling quality. There are many factors influencing milling quality at an individual crop level, but it also appears that there is a general effect.

References

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