The influence of row spacing on grain yield in drill sown rice

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Abstract
Over the last two years there has been an increase in the number of growers drill sowing rice rather than aerial sowing. This change in rice sowing technique has been driven by a number of factors including, the opportunity to reduce input costs without reducing productivity, reducing the establishment risk from birds, wind and slime, and finally the most critical factor of reducing water use. Drill sowing also offers the opportunity to utilise existing farming equipment in another component of the rice farming system not available in the conventional aerial sowing system. However, during the recent drought years row spacing has increased with the expansion in no-tillage and stubble retention systems for winter cropping. The impact of wider rows in the winter cropping component of the farming system has been well studied by others however, there is no information on the impact that the wider rows established for winter crops may have on the rice component. Drill sown trials were established in the Murray Valley irrigation area to investigate the effect of varying row spacing on rice grain yield. Results show no significant difference in grain yield between row spacing, varieties or seeding rates.

Key words
Rice grain yield, drill sowing, seeding rate, plant number, tiller number

Introduction

In Australia rice is grown in a mixed farming system that includes winter cropping, livestock and often includes other summer crops. Rice has traditionally been an important part of the farming system because it offers advantages to the whole system. The rice crop is a disease break for soil borne diseases and weed break for weeds that impact winter crops. The large amount of plant and root residue that remains following the rice crops provides soil condition benefits in the heavy clay, rice suitable soils, for other crops in the system. Finally the residual soil moisture that remains following the rice crop provides enough sub-soil moisture to produce a following winter crop.

During the Millennium drought (1997 – 2009) rice farmers had to adjust their farming system because of significantly reduced irrigation water allocation and changes in the timing of the availability of the allocated water (www:murrayirrigation.com.au). With the reduction in the availability of water growers were forced to learn how to maximise production, as dryland farmers, in a low rainfall environment on heavy clay soils. This saw the introduction of minimum tillage technology, widening of row spacing away from the traditional 18cm (Smith and Martin 2011), and more emphasis placed on summer fallow management for the storage of soil moisture for winter crop production. Growers now commonly use row spacings between 22.5 cm to 30cm with some out as far as 35cm.

With the return of irrigation water to the farming system, with two solid years of rainfall, rice has returned to the system. However as a consequence of tight economic times as a continuing result of the drought and reduced returns from rice due to factors such as the high Australian dollar for the largely exported commodity, there is increased interest in drill sowing rice, rather than aerial sowing, as a means of reducing production costs. With the wide spread rain of recent years there was also a significant increase in duck numbers. This has increased the risk associated with aerial sown rice which has also influenced farmers to consider safer establishment methods such as drill seeding.

There is no local information on the influence of row spacing on rice grain yield in the high yielding, Australian rice growing environment. This work aims to starting filling that void.

Methods

Site selection
The site chosen was in the Moulamein district of the western Murray Valley because the grower had drill sown a rice crop in the preceding 2009/10 rice season. During this season the grower had used 31cm row

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spacing but had not achieved canopy closure in the rice; poor canopy closure provides the opportunity for late germinations of weeds.

A row spacing trial was conducted in the 2010/11 rice season in lasered contour irrigation layout, on a Neimur Clay soil which is characterised as a grey non-self mulching clay soil. These soils crust following irrigation but provide ideal rice soils because of low levels of deep percolation of water past the root zone.

Trial design
The trial was conducted as a split-plot design with row spacing as the main plot. Variety and seeding rate were randomised. Two varieties were used; Amaroo which has been used as the industry standard variety; and Reiziq which is new variety with a new grain type that satisfies the main export market for the Australian industry. Three seeding rates were used to determine the influence of seeding rate on grain yield in the drill seeding system. Seeding rates were calculated on weight per hectare equivalent (kg/ha). There were three replicates in the trial.

Data Collection
The number of established plants/m², tiller number at physiological maturity/m² and grain yield (t/ha) were measured for each of the treatments in the trial.

Data Analysis
An analysis of variance, examining the effect of row spacing, variety and seeding rate, was conducted using GenStat 10th Edition.

Results
Established Plant Number
There was a significant difference in the number of plants that established between the different row spacings (Table 1). The narrowest row spacing of 15 cm had the highest number of plants established at 181.9 plants/m². As the row spacing increased the number of established plants showed a consistent decrease with the widest row spacing of 30 cm having the lowest number of established plants at 95.6 plants/m²

The variety Amaroo had a significantly higher plant number at establishment compared to the variety Reiziq with 151.7 plants/m² and 118.8 plants/m² respectively. This is consistent with the variation in seed size with Reiziq having a larger seed than Amaroo.

The seeding rates of 80 kg/ha and 120kg/ha had an established plant number that was not significantly different to each other (115.0 plants/m² and130.5 plants/m² respectively) however both were significantly lower than highest seeding rate with a plant establishment of 160.2 plants/m².

None of the interactions were significant for established plant number

Tiller number at physiological maturity
There was a significant difference in tiller number between the row spacing treatments (Table 1). The narrowest row spacing (15cm) produced the highest number of tillers/m² with 827. As the row spacing increased the number of tillers produced on a square metre basis decreased with the widest row spacing having the lowest number of tillers.

There was no significant difference in tiller number between the varieties or between the seeding rates.

There were no significant interactions for tiller number.

Grain yield
There were no significant differences between the row spacings, varieties, seeding rates or the interactions for grain yield with the range being from 10.5 t/ha to 10.9 t/ha (Table 1).

Table 1: Plant number at establishment, tiller number at physiological maturity and grain yield for the different row spacings, varieties and seeding rates used the trial conducted in the 2010/11 rice season at Moulamein.

Experiment treatment	Plant number/m² at establishment	Tiller number/m² at physiological maturity	Grain Yield (t/ha)
Row Spacing			
15cm	181.9	827.0	10.8
22.5cm	128.3	715.0	10.6
30cm	95.6	629.0	10.7
LSD (5%)	31.2*	42.1*	ns
Variety			
Amaroo	151.7	750.0	10.5
Reiziq	118.8	698.0	10.9
LSD (5%)	20.9*	ns	ns
Seeding rate			
80 kg/ha	115.0	710.0	10.6
120 kg/ha	130.5	713.0	10.8
160 kg/ha	160.2	748.0	10.6
LSD (5%)	25.6*	ns	ns
Row spacing.Variety	ns	ns	ns
Row spacing.Seeding rate	ns	ns	ns
Variety.Seeding rate	ns	ns	ns
Row spacing.Variety.Seeding rate	ns	ns	ns

Discussion

Changing row spacing from 15cm to 30cm did not produce a significant change in grain yield. This result differs from that of Frizzell et al (2005) and Chauhan and Johnson (2011) who both showed reductions in rice grain yield, as much as 30%, when row spacing was increased from 15-18cm to 25-30cm. However, given that plant number at establishment and tiller number at physiological maturity were significantly reduced when row spacing increased the results suggest that consistency in grain yield was achieved in a different manner.

Grain yield is a function of the plant components that contribute to the total number of grains per hectare, as well as final grain weight (Lewin et al 2005), these include; panicle number/m²; florets/panicle; percentage of filled grain; and weight of the individual grains. Two of the factors are plant number and tiller number and given that these have been influenced by row spacing then it appears the plants have compensated by increasing panicle size or individual grain weight or there have differences in the percentage of the florets that filled within the panicle.

The grain yield result between the varieties is consistent with industry average yields over the last 10 years with little difference in the performance of the two varieties (Smith et al 2011).

Varying the seeding rate did not produce a significant difference in tiller number at physiological maturity or grain yield. However plant number was significantly reduced in the lower seeding rates when compared to the higher rates. The results showed that tiller number was compensated for with the lower plant number producing more tillers per plant to achieve a similar number of tillers/m² as the highest sowing rate. Lewin et al (2005) considered that high seeding rate and the subsequent high plant numbers were not required to obtain high yields but were used as insurance against factors affecting uniform plant establishment.

It must also be noted that only two medium grain varieties have been used in the trials to date. The different plant types associated with each variety could play a major role on the plants ability to compensate with number of tillers per plant, number of panicles per plant and number of florets per panicle. Another trial was conducted during the 2011/12 rice season however was not harvested at the time of writing.

Conclusion

The results indicate that if growers have widened row spacing from the traditional 18cm out to 30cm to suit there winter cropping program, the rice varieties Amaroo and Reiziq have the ability to compensate and

produce grain yield the same as the narrower spacing. Similar yields can be produced from much lower seeding rates than recommended however, there is an increased risk of insufficient plant numbers if difficulties are experienced during the establishment period with the lower rates.

References

Chauhan B and Johnson D (2011). Row spacing and weed control timing affect yield of aerobic rice. Field Crops Research 121, 226-231.

Frizzell D, Wilson C, Norman R, Slaton N, Richards A, Hill J, Branson J and Runsick S (2005). Influence of row spacing and seeding rate on rice grain yield. In: Rice Culture: BR Wells Rice Research Studies 2005. Arkansas Agricultural Research Station, Fayetteville Arkansas, USA.

Lewin L, Williams R, Subasinghe R and Reinke R (2005) The rice plant. In: Production of quality rice in south eastern Australia. Rural Industries Research and Development Corporation, Kingston ACT, Australia.

Smith J, Reinke R, Snell P, Lacy J (2011). Rice Variety Guide – 2011. NSW Primary Industries Primefact 1112, August 2011. www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/401358/Rice-variety-guide-2011-Primefact-1112.PDF

Smith J and Martin P (2011). The influence of seeding rate and row spacing on grain yield in irrigated wheat. In: Proceedings of GRDC irrigated update, 10 August 2011, Barooga, NSW, Australia.