

Agronomic performance of dwarf milling oats in Western Australian environments

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Abstract

A series of field experiments were conducted in the Western Australian wheatbelt to understand Genotype x Environment interactions in comparing the agronomic performance (yield stability and quality) of new dwarf oat varieties against established varieties. Three new dwarf varieties – Kojonup, Possum and Mitika – are being evaluated for their potential to be used in the milling industry. Results from the 2004 and 2005 season suggest that Kojonup had a higher yield potential (3.3 t/ha) than the most widely grown non-dwarf, milling variety Carrolup (2.7 t/ha). Overall, Kojonup yielded 13 – 19 % more than Carrolup, and its yield was more stable as time of seeding and soil type were changed. The performance of the other two dwarf varieties Possum and Mitika was found to be satisfactory (3.0 and 2.9 t/ha, respectively) but not as good as of Kojonup. The minimum market receival standards for quality such as hectolitre weight (>51 kg/hl) and screenings (<10% of <2 mm) were successfully met by most of the varieties examined. Time of seeding and type of soil were found to have significant influence on both yield and quality but the effects were site specific. The grain quality of the three new dwarf varieties was found to be suitable for receival as milling but slightly inferior to Carrolup..

Key Words

Dwarf milling oats, non dwarf milling oats, grain quality, Genotype x environment, Biplot

Introduction

Oat production in WA is mainly export oriented and thus has a substantial economic influence on the agricultural industry. Currently only non-dwarf varieties such as Mortlock, Carrolup and Pallinup are received as WA milling grade whilst dwarf oats such as Wandering and Dalyup can only be received as feed grade. However, dwarf oats are generally higher yielding, have decreased lodging risk and reduced shedding risk than non-dwarf varieties. The development of dwarf “milling” oats, therefore, has the potential to offer growers improved yields and improved agronomy or crop management..

Three new dwarf varieties – Kojonup, Possum and Mitika – with potential to be received as milling quality– have become available to the WA oat industry. The questions are what benefit do they have relative to current non-dwarf milling varieties and what advantage are they over current dwarf feed varieties. Are their yield, grain quality and agronomic performance (yield and quality) more stable? The aim of this study was to evaluate the performance and stability of these new dwarf varieties to changes in time of seeding and soil type.

Methods

Three locations were sown each year in 2004 and 2005 with small plot (20 m x 1.8 m) field trials. At each location, twelve oat lines were sown at two times of seeding (usually three weeks apart) on two soil types contrasting in soil texture and moisture supplying capacity in the same paddock. Five lines were common to all trials – Carrolup, Wandering, Kojonup, Possum and Mitika. The trials were sown in the medium (325 mm) to high rainfall (500 mm) zones of Western Australia. The trials were harvested with a small plot header and a sub-sample kept for grain quality analysis. After cleaning, the grain was analysed for

hectolitre weight (kg/hl) and screenings (< 2 mm). Data was analysed for principal components and biplot was constructed using GGEbiplot (version 2.2.2.10) software (Yan and King 2003)

Results

A principal component analysis of the genotype x environment (year, location, time of sowing and soil type) data for grain yield shows that we were able to explain 85% of the variation with PC1 and PC2 (Figure 1). The biplot indicates that the varieties tested did not perform in a similar manner when tested in multiple environments due to the presence of G x E interaction. Wandering and Kojonup were consistently higher yielding (both 3.3 t/ha) with good stability across years, location, date of seeding and soil type, than the other varieties. This is evident in Figure 1 because those varieties are to the right of the mean yield and close to the mean yield axis. Possum had a higher average yield than Mitika but was more variable with respect to environments as it was further away from mean yield axis. Carrolup was found to be the lowest yielding and least stable variety. Overall the yield advantage of Kojonup over Carrolup was 19 ± 4 %, of Possum 8 ± 3 % and Mitika 6 ± 3 %. The yield advantage of Wandering was 20 ± 3 %.

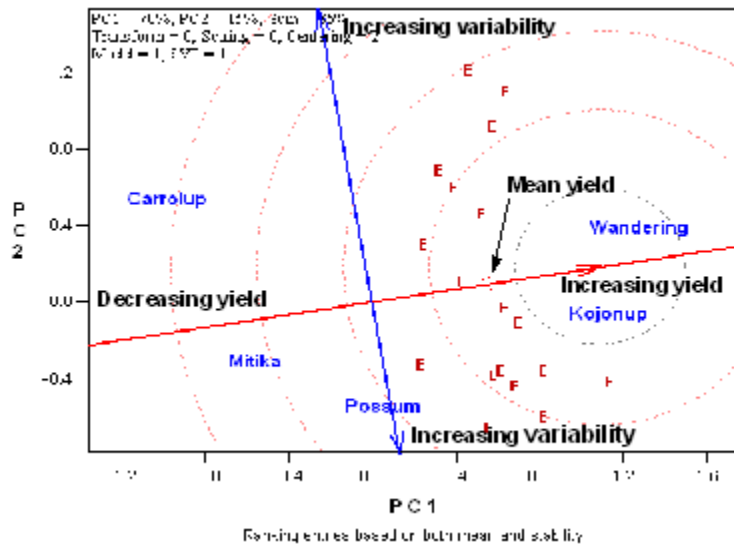


Figure 1. Biplot showing mean yield and stability of oat varieties grown in different environments.

Table 1. Influence of year, time of seeding and soil type on hectolitre weight (kg/hl) and screenings of five oat varieties grown at Calingiri.

Year	Calingiri - 2004				Calingiri - 2005			
	Loamy gravel		Shallow loamy duplex		Deep sand		Loamy earth	
Variety	27-May	17-June	27-May	17-June	18-May	22-June	18-May	22-June

Hectolitre weight (kg/hl)

Carrolup	55.2	53.7	55.7	56.2	56.4	56.0	59.8	57.7
Possum	50.5	50.2	51.3	51.9	55.0	54.0	55.4	54.2
Mitika	51.1	51.5	52.9	53.7	55.8	53.3	57.5	55.9
Kojonup	53.2	52.5	53.0	54.0	54.8	54.2	56.8	55.1
Wandering	50.9	51.3	52.0	53.2	54.0	54.2	55.8	55.6

Screening (<2.0 mm)

Carrolup	3.2	5.1	1.4	1.0	3.2	7.1	2.2	5.2
Possum	2.6	3.6	1.1	1.2	2.8	5.3	2.3	4.1
Mitika	1.7	2.6	1.0	0.9	1.8	3.2	0.8	1.8
Kojonup	2.6	4.4	0.8	0.8	1.9	3.0	1.0	3.5
Wandering	1.3	3.5	0.5	0.5	1.6	3.0	0.6	3.9

Seeding time and soil type had a profound effect on grain quality, although it was location and year specific. Table 1 shows an example of how the hectolitre weight of the new dwarf “milling” varieties is different to that of the standard milling variety Carrolup. Carrolup consistently met the minimum hectolitre weight industry standard for delivery into the milling grade of 51 or above kg/hl regardless of year, time of sowing and soil type whereas Possum struggled to do so in some situations (2004 loamy gravel soil). Kojonup also met the industry standard but had an average hectolitre weight of 54.2 kg/hl less than Carrolup. The low hectolitre weight of Possum on the loamy gravel at Calingiri in 2004 suggests that growers may have more difficulty meeting industry standards with this variety than with Mitika, despite it having a higher potential yield. Results also suggest that screening standards (<10% of <2.0 mm) were met by all varieties regardless of time of sowing and type of soil.

Conclusion

Of the three dwarf “milling” varieties being evaluated, Kojonup was found to be the best performing variety on terms of yield stability and grain quality. Time of seeding and soil type experiments can be very useful in providing information on the stability and risk assessment of new lines being released for the milling market.

References

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