Evaluation of oat varieties for hay production in Western Australia

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Abstract

Recently new specialist hay varieties such as Wintaroo, Brusher and Kangaroo have been made available to Western Australian growers. We have been investigating the performance of these new varieties in the Western Australian environment in response to agronomic factors (i.e. time of sowing and cutting date).

The results indicate that specialist hay varieties yielded substantially higher than Carrolup (9 – 22 % more hay) and that Wintaroo yielded the most (up to 11.5 t/ha). However, Wintaroo and Kangaroo have some issues in meeting the target quality traits for acid detergent fibre and neutral detergent fibre. Delayed sowing generally reduced hay quality and in some cases this may affect their acceptance into premium hay grades.

Key Words

Oats, Oaten hay varieties, Genotype x environment interaction, Biplot

Introduction

Western Australia produced 50% of Australia's export hay delivering around 350,000 tonnes in 2005/06 worth around $100 million. As such, oaten hay is an important part of the Western Australian cropping system. The return from growing oaten hay for the export market is principally governed by quality and yield. Oaten hay growers require varieties that achieve consistent high yields whilst the exporters need the hay to have certain quality traits. Cutting stage mainly determines the ultimate hay yield and quality. To obtain the best compromise between hay yield and quality, the crop should be harvested at an appropriate vegetative stage (generally the watery ripe stage). Specialist cultivars for hay production are being developed to meet export quality specifications for Western Australia's growing oaten hay export trade. Currently grain varieties such as Carrolup and Wandering are the dominant varieties being cut for export hay.

The National Oat Breeding Program based in South Australia has recently released three hay varieties, Wintaroo, Brusher and Kangaroo, for south eastern Australia. We are conducting trials to investigate the adaptation of these hay varieties (alongside current hay varieties) into the Western Australian environment. The findings from these trials will increase the amount of knowledge and information on oats grown specifically for hay production.

Methods

Time of sowing trials were conducted in the medium and high rainfall areas of Western Australia in 2004 and 2005. At each location, plots were sown at two dates of seeding (usually three weeks apart). Varieties were hand-cut at ground level on reaching watery ripe. Hay samples were then oven dried and weighed to determine hay yield. Sub-samples were milled (<1mm) and analysed for hay quality using a NIRS6500, calibrated by DAFWA. The hay yield and hay quality assessments were done using protocols approved by the Australian Fodder Industry Association. Data were analysed with the help of ANOVA and Principle Component Analysis (Yan and Kang 2003).

Results

A principal component analysis of the genotype x environment (year, location and time of sowing) data for hay yield shows that we were able to explain 78% 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. The hay yield of Wintaroo was similar to the older specialist hay varieties Winjardie and Swan. Hay yield from Wintaroo was however more stable than Swan across years, locations and times of sowing and similar in variability to Winjardie. This is evident in Figure 1, where Wintaroo and Winjardie are to the right of the mean yield and closer to the mean yield axis than Swan. Hay yields of Wintaroo were between 12 to 16% greater than Carrolup at all yield levels, especially when the crop was sown in late May.

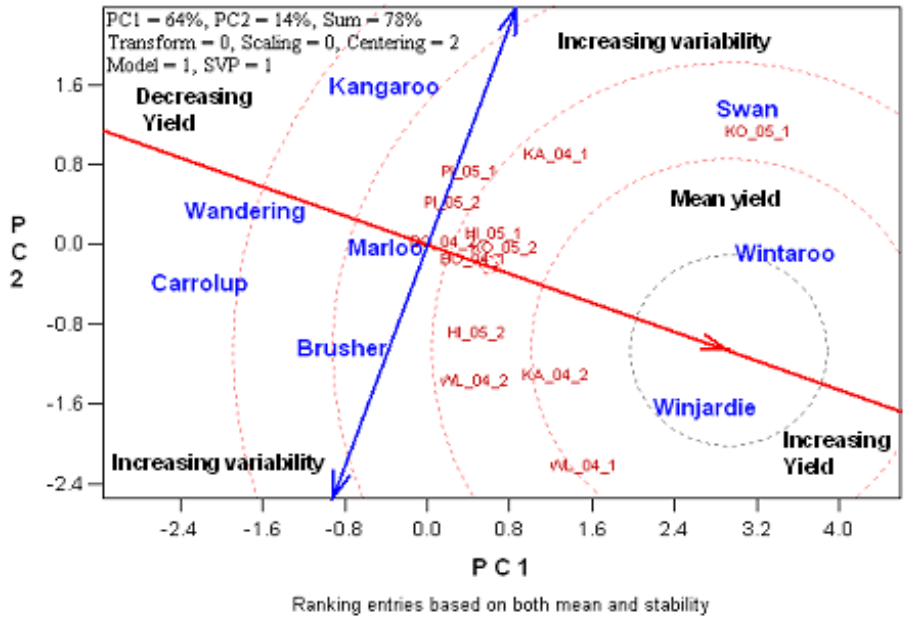

Figure 1. Biplot showing mean yield and stability of hay varieties grown in different environments when cut at watery ripe (BO = Brookton, WL = Williams, KA = Katanning, KO = Kojonup, Pingrup = Pingrup, Hi = Highbury; 04_1 and 04_2 = Year 2004 May and June sowing; 05_1 and 05_2 = Year 2005 May and June sowing).

The hay yield of Brusher was generally greater than Carrolup and Wandering, with a similar variability across sites of Carrolup. The yield of Kangaroo was slightly higher and more variable than Carrolup and Wandering. Kangaroo outyielded Carrolup at some sites and was lower yielding at others. In general, Wandering, Brusher and Kangaroo produced more hay than Carrolup, at sites where Carrolup yields were below 7 t/ha. At higher yielding sites there was little difference in the hay yield of those four varieties.

Table 1: Average hay quality of selected oats varieties measured by NIR from cuts at watery ripe (Z71) (data averaged from time of sowing at 3 locations - Brookton, Williams and Katanning, 2004; and Kojonup, Pingrup and Highbury, 2005)

Cutting stage	Watery ripe (Z71) 2004

Variety	Stem diameter mm	Crude protein %	ADF %	NDF %	IVD %	Est ME MJ	WSC %
Carrolup	5.1	3.2	27.8	47.4	60.5	8.6	34.4
Wandering	5.5	3.9	25.6	45.3	63.7	9.1	34.5
Wintaroo	5.2	3.2	31.2	51.4	59.2	8.4	29.2
Brusher	5.1	3.8	26.8	46.7	62.1	8.9	33.0
Kangaroo	4.9	3.8	29.7	51.5	60.3	8.6	28.4
Marloo	5.3	3.4	29.4	50.6	60.0	8.6	27.6
			Watery ripe (Z71) 2005				
Wandering	5.4	5.3	25.7	45.3	62.7	9.0	35.4
Carrolup	5.1	4.6	27.6	47.4	59.6	8.5	34.2
Wintaroo	5.4	3.9	30.0	48.6	58.8	8.3	33.4
Brusher	4.9	4.3	26.9	45.2	60.4	8.6	37.0
Kangaroo	5.3	3.9	30.2	51.7	57.3	8.1	30.8
Marloo	5.5	4.4	29.6	50.6	58.4	8.3	30.3
Kojonup	5.5	4.1	23.2	40.6	63.2	9.0	40.3

The data (Table 1) showed that premium hay quality targets of stem thickness <8 mm, Acid Detergent Fibre (ADF) <33%, Neutral Detergent Fibre (NDF) <57%, Intro Vitro Digestibility (IVD) >58% and Water Soluble Carbohydrates (WSC) >18% were generally met by all varieties. As with hay yield, differences in hay quality were noted across sites and years (data not shown). Carrolup and Wandering met target quality standards in all trials cut in 2004 and 2005. Wintaroo, Brusher and Kangaroo however did not meet target standards in all trials. The greatest problems were noted with Wintaroo and Kangaroo, especially for IVD. Whilst Wintaroo had the greatest overall hay yield, it had slightly lower quality than the other varieties in the study. Brusher had the better hay quality of the new varieties when cut at watery ripe.

Conclusion

Wintaroo, Kangaroo and Brusher have been bred as hay varieties. Industry feedback has indicated that while experienced hay growers are achieving high yields, particularly with Wintaroo, they require more management than WA varieties such as Carrolup, Wandering and Winjardie. Wintaroo requires close monitoring around cutting time as it tends to stay greener longer. Care must be taken to monitor the stems as they tend to turn white while the top remains green. Experienced hay growers with cutting, conditioning and bailing equipment or access to a contractor will be advantaged in achieving maximum potential from these varieties as they reach cutting stage.

Cutting at watery ripe will achieve optimum quality in all varieties; however there is a window of five to seven days before quality will fall below premium quality. This enables growers to ensure that contractors can cut on time. Rain periods need to be taken into account as rainfall events of 10 mm or over can drastically reduce quality.

References

Yan Y and Kang MS (2003). GGE Biplot Analysis: A graphical tool for breeders, geneticists and Agronomists. CRC press.