Time of sowing affects small grain screenings in wheat in a dry season

Darshan L. Sharma[1] and Walter K. Anderson[2]

[1]Department of Agriculture, Geraldton Regional Office, W.A. 6530, Australia
www.agric.wa.gov.au dsharma@agric.wa.gov.au
[2] Department of Agriculture, Albany Regional Office, W.A., 6330, Australia.
www.agric.wa.au wanderson@agric.wa.gov.au

Abstract

Based on field data from experiments over three years we conclude that time of sowing and weather conditions have a major impact on the proportion of small grain screenings. The level of screenings was greater in 2000, which experienced terminal drought, but less in 1999 with better soil moisture during grain filling, or 2001 despite dry conditions during early growth.

In a time of sowing trial at Mullewa in 2000, the level of screenings with later sowing was cultivar-dependent with Westonia, Carnamah and Wyalkatchem less affected than Arrino and Brookton. Westonia adjusted number of tillers and spike size, thus adjusting grains per m^2 without severe grain yield decline. Carnamah adjusted number of grains per spike, giving a more stable level of screenings. Arrino was most sensitive to screenings and this was associated with its lower tendency to adjust with later sowing for the number of grains per unit area, and per spike, than other cultivars.

Correlations among screenings, kernel weight, grain yield and the amount of rainfall were significant. General linear regression analysis indicated that yield level of the trial, kernel weight, and rainfall from 14 days before mid-anthesis to maturity accounted for most of the variance of small grain screenings during the hot dry finishing season of 2000.

Key Words

Small grain screenings, wheat, dockages, yield components, management

Introduction

Small grain screenings, an indicator of flour yield in wheat, is one of the most common causes of dockages that can severely reduce profitability. The factors that contribute to increased small grain screenings are also associated with lower hectolitre weight (Anderson et al. 1997). The ultimate aim is to maximise grain yield and minimise the risk of screenings.

Whilst agronomic management and seasonal conditions can affect screenings the net result is often influenced by cultivar features (Anderson and Sawkins, 1997; Pluske, 1998; Sharma and Anderson 2001). Bremner et al. (1978) and Lee (1991) reported spikelet position to be important in determining grain weight in wheat and barley, respectively.

Any cultivar can produce screenings but some cultivars are at higher risk of dockages due to their inherent characteristics. The traits associated with greater propensity to screenings cultivars need to be identified so that management can be adjusted appropriately. In this paper, we will present conclusions from three years of field experiments involving new wheat cultivars and sowing times.

Methods

Field trials

Seven field trials were conducted in the Northern Agricultural Region of Western Australia during 1999-2001. Each trial comprised cultivars (~9) and levels of time of sowing (three at 2-3 weeks interval) in randomised block design experiments.

Observations

Grain yield was recorded after harvesting with a plot combine. Half litre grain samples were taken from each plot yield and screenings assessed after passing over a 2mm, slotted screen. 10-20g of the small grain fractions from each plot was visually separated into broken and whole grains and the percentage of whole grain screenings was calculated. Plants from one of the positions marked in each plot were used to measure yield components (spike number, average grain weight, kernel number/spike and per unit area by calculation).

Statistical analysis

Each trial was analysed separately using analysis of variance. A row.column design in REML procedures of Genstat was used to detect and adjust for spatial variation if present. A general linear regression was used to assess the association between yield components and screenings.

Results

Seasons

Rainfall in 1999 was evenly distributed and adequate for the region. 2000 had a late start but had a characteristic dry finish. Season 2001 experienced an early drought but had a wet finish. Screenings were quite low in 1999 and very high in 2000. The early drought experienced in 2001 did not produce high screenings Further discussion will thus refer to year 2000 only.

Time of Sowing

Screenings for June sown crop were significantly higher than May sown crop at both sites. However further seeding delay (Early July) increased screenings at only one site. Cultivar differences were also apparent. Cultivars Westonia and Carnamah had lower screenings tendency compared to Arrino. Varietal differences for screenings sensitivity to time of sowing were associated with variation in yield components and grain yield.

Yield Components

Screenings rise due to late sowing for cultivars Westonia and Carnamah was less than Arrino and Brookton. Both these cultivars efficiently adjusted number of tillers and number of grains per spike, thus adjusting for number of grains per m^2, and yet showed less grain yield decline. Carnamah showed a remarkable tendency for adjusting number of grains per spike. Arrino was most sensitive to screenings and this was associated with its lower tendency to adjust with time of sowing for the number of grains per unit area and per spike than other cultivars.

Correlation and Regression analysis

Percentage of screenings was negatively and significantly influenced by kernel weight (Table 1).

Table1. Correlation matrix of small grain screenings, grain yield and grain yield components in two cultivar x time of sowing trials in the Northern Agricultural Region of Western Australia

Traits	Screenings	Kernel	Kernels/	Kernels/	Tillers/m^2	Tillers/	Grain	Rainfall 14 days before

		weight	m^2	spike		plant	Yield	anthesis to maturity
Screenings	1							
Kernel weight	**-0.81**	1						
Kernels/m2	-0.24	0.20	1					
Kernels/spike	-0.44	0.25	0.52	1				
Tillers/m2	0.11	0.01	0.65	-0.29	1			
Tillers/plant	-0.21	0.22	0.53	-0.19	0.78	1		
Grain Yield	**-0.78**	**0.91**	0.52	0.43	0.19	0.32	1	
Rainfall 14 days before anthesis to maturity	**-0.77**	**0.91**	0.36	0.16	0.26	0.43	**0.89**	1

Significantly negative correlations with grain yield and the amount of rainfall during the period from two weeks before mid-anthesis to maturity suggests that water scarcity during grain filling was the reason of low grain yield, low kernel weight and high screenings. Inconsistent correlation of number of grains with screenings is probably a reflection of the fact that all cultivars tend to curtail the number of grains in response to water stress but the reduction in these trials was not enough.

In a general linear regression procedure in Genstat, 81.8% of the variance of screenings was accounted when fitted model was *kernel weight x cultivar + rainfall from 14 days before mid-anthesis to maturity :Trial.* The term *trial* probably accounts for soil type and location specific climatic variations during grain filling. Soil type at Mullewa was a red sandy loam while that at Mingenew was a gray to yellow sandplain. More research is needed to clearly define such factors.

Conclusion

Small grain screenings increased in a dry finishing season only. Cultivar differences for response to time of sowing are mainly though adjustment of yield components.

Acknowledgment:

The authors are thankful to Mrs. Anne Smith and Ms Sheena Lyon for technical support, and the GRDC for funding the research project *Optimising management for new crop varieties* (DAW563 WR).

References

(1) Anderson, W.K., G.B. Crosbie and W.J. Lambe (1997). Aust. J. Agric. Res. 48: 49-58.

(2) Anderson, W.K. and D. Sawkins (1997). Aust. J. Expt. Agric. 37: 173-80.

(3) Bremner, P.M. and Rawson, H.M. 1978. Aust. J. Plant Physiol., 5, 61-72.

(4) Lee, S.H. 1991. Causes and control of high screenings in barley. PhD, Lincoln Univ., NZ.

(5) Pluske, Wayne, Wayne Crofts and Frank Ripper (1997). ‘Phosphorus Placement Can Influence Availability to Plants in Minimum Tillage’. Pp. 101-2 in Highlights of Cereal Research and Development in Western Australia, Eds W.K. Anderson and John Blake. Agriculture Western Australia.

(6) Sharma D.L. and Anderson W.K. 2001. Agronomic responses of new wheat cultivars in the northern wheatbelt. In ' Crop Updates 2001: Cereal Updates' (Eds. Roslyn Jettner and Jessica Johns) pp 41-42. (Agriculture Western Australia).