NSW GOVERNMENT Department of Primary Industries

primefact

Yield response of wheat varieties to sowing time 2013

January 2014, Primefact 914, Fourth edition
Peter Martin, Research Agronomist, Wagga Wagga
Peter Matthews, Technical Specialist Grain Services, Orange

Summary

- Varieties differ in their ability to achieve high yield from different sowing times.
- There are typically three types of variety response to sowing time:
  - higher yield when sown early (negative slope)
  - higher yield when sown late (positive slope)
  - similar yield over all sowing times (flat slope).

This document outlines the response of wheat varieties to sowing time, allowing producers to make better informed planting decisions.

Introduction

The autumn break in NSW can occur between March and June. The wide range of maturity available in wheat varieties in NSW allows growers to choose a variety that best suits the timing of the autumn break and their farming system.

Varieties suited for sowing in NSW range in maturity from 'winter' to early 'spring' types. This presents the opportunity to plant wheat crops from late March until the end of June and still have the crop flowering when risks of frost and heat stress are acceptable. Varieties differ in their ability to achieve high yield from different sowing times.

Variety trials in NSW are divided into very-early (long season), early and main season sown sets. Varieties are allocated to groups based on their relative maturity. Those with late-winter or winter habit are included in the very-early sown set. Those with winter or facultative spring habit are included in the early sown set and those with spring habit in the main season sown set.

Over a period of years the sets of variety trials are sown across a range of sowing dates. Consequently, it is possible to estimate yield response of a variety to changes in sowing date. This Primefact reports variety yield response to sowing date estimates.

National variety wheat trial at Coonamble, northwest NSW.

Trials and years

The analysis includes data from trials conducted in NSW by Enterprise Grains Australia breeding program, NSW Department of Primary Industries variety evaluation program, Variety Specific Agronomy Packages (VSAP) project and the National Variety Testing (NVT) program from 1998 to 2012.

Trials were grown across four NSW wheat regions: North East (NE), North West (NW), South East (SE) and South West (SW).

Sowing times

Sowing dates, or times of sowing (TOS), are expressed as year-day which is the number of days after 1 January. Year-day/date equivalents are presented in Table 1. Sowing dates across all years ranged from 13 April (year-day 103) to the 14 August (year-day 225). The bulk of trials were sown between the middle of May (year-day 135) and the middle of June (year-day 165).

Table 1. Year day and date equivalents.

Year Day	Date
100	10 April
120	30 April
140	20 May
160	9 June
180	29 June
200	19 July

Genotypes (variety)

In order to reduce the computation involved only varieties grown in at least seven trials have been included in the analysis. Results are reported for only those genotypes that have been released as varieties and are considered to be relevant to NSW wheat growers.

Trial results

Data for the individual varieties (Figures 2–8) is expressed as the estimated mean yield deviation from site mean, across all trials. There was a differential genotype response to time of sowing (shown by the difference in slopes of individual genotype responses) (Figures 2–8) which accounted for a reasonably large percentage (15%) of the total genetic variation. There was a large main effect of genotypes (6%). Terms such as genotype by irrigated and genotype by year interactions contributed effects of 7% and 12% respectively. If we could report individual genotype regression lines as a whole this would represent a total of 21% of the genetic variation in the data (see Table 2). All analyses were performed using the statistical software ASReml-R (Butler et al. 2009).

Table 2. Contributions to variance (actual and as percent of total genetic variance) for the time of sowing analysis.

Source	Variance	%Total
Genotype	0.0132	6%
Genotype:TOS	0.0315	15%
Genotype:spline(TOS)	0.0033	2%
Genotype:Irrigated	0.0155	7%
Genotype:Year	0.0247	12%
Genotype:Region	0.0004	0%
Genotype:Year:Region	0.0000	0%
Genotype:Year:Irrigated	0.0220	10%
Genotype:Region:Irrigated	0.0049	2%
Genotype:Year:Region:Irrigated	0.0134	6%
Genotype:Trial	0.0836	39%
Total Genetic	0.2127	

Note. Genotype.spline is a factor indicating nonlinearity of responses.

A simplified explanation of Table 2 for dryland environments is:

- Genotype (6%) - indicates that 6% of the yield variation was attributable to genotype
- Genotype:TOS (15%) - indicates that sowing time of a genotype was more important than the genotype
- Genotype:year (12%) - indicates that rankings of genotypes vary considerably from one year to the next and that this is as important as the genotype
- Genotype:trial (39%) - indicates that the variation between trials was very large and therefore yield results from as many trials as possible should be used when choosing a genotype
- Genotype:Region (0%) and Genotype:Year:Region (0%) - indicates genotypes had similar response to sowing time regardless of the region in NSW.

Genotype responses

There were differences in genotype response to sowing time. There seem to be three basic types of genotype response - genotypes that yield better when sown early (negative slope), those that yield better when sown late (positive slope) and those that perform similarly (flat slope) over all sowing times (see Figure1). The estimated yield responses of individual varieties are presented in Figures 2–8. Varieties graphed are divided into three groups, those suited to main season sowing, those suited to early sowing and the specialist quality types suited to a range of sowing times. The specialist quality types are soft and durum wheat varieties. The regression lines in Figures 2–8 extend only for the sowing dates for which the individual genotype has been included in trials. The dotted lines in these graphs are the confidence limits for these estimates.

The different response curves indicate that there is the potential to use response to sowing date as an aid in identifying the best genotype for a particular sowing date. Examples of the three response types are shown in Figure 1. Bolac is a facultative spring genotype with a response curve that has a negative slope and Sunco is a low yielding spring variety with a positive slope. Janz is a mid season spring genotype with a flat response curve. Spitfire is an early maturing spring type which increases and then declines in yield as sowing time is delayed.

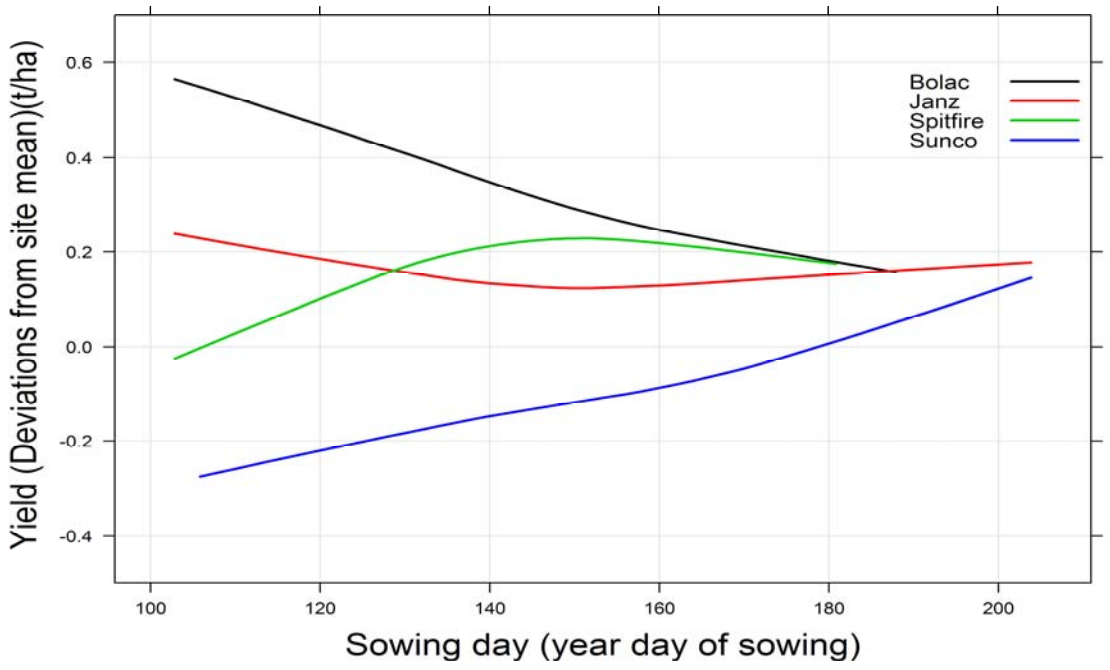
Janz, Bolac and Spitfire achieve roughly the same yield when sown at around year-day 180 (29 June) (Figure 1).

The data shown in Figures 2–8 should be used as an aid in choosing the highest yielding genotype for individual sowing dates. It should be used in conjunction with the across sites analysis from the NVT trials. Data from the across sites analysis is available from the NVT website (*www.nvtonline.com.au*). A subset is reproduced in the NSW DPI Winter crop variety sowing guide(Matthews, McCaffery and Jenkins) for the current year.

Whilst this analysis is the best available estimate of the relative response of varieties to sowing time there are still some unexplained issues with the responses. It is a widely held view that yield declines by 4–7% for each week that sowing is delayed after the optimum time. The response curves with positive slope and flat slope do not reflect this response to later sowing. The variety response curves with negative slope also seem to level off as sowing date is delayed past about year-day 170 (19 June).

The slope of the response curves of early flowering genotypes such as Axe and Ventura, did not decline with early sowing. A possible reason for this is that variety trials which have been badly frosted are usually excluded from analysis or not harvested. Growers should be aware that sowing these varieties before their sowing period substantially increases the risk of frost damage.

Figure 1. Examples of genotype response to sowing date response curves, with negative slope (Bolac), positive slope (Sunco) and flat slope (Janz) and increase to maximum and then decline (Spitfire).



Acknowledgements

Trials used for this data analysis were funded by NSW Department of Primary Industries and Grains Research and Development Corporation. These experiments were grown as part of the National Variety Testing (NVT) program and the Variety Specific Agronomy Packages project.

The significant contribution of staff who conducted these trials, District Agronomists and farmer co-operators is gratefully acknowledged.

References

Matthews P.W., McCaffery D.W. and Jenkins, L. (2013) Winter crop variety sowing guide 2013 NSW Department of Primary Industries.

Butler. D., Cullis. B. R., Gilmour. A. R. and Gogel. B. J. (2009) “Analysis of Mixed Models for S Language Environments”. ASReml-R Reference Manual. (Brisbane: QDAFF Publications).

Published by the NSW Department of Primary Industries.

ISSN 1832-6668

INT 14/3427

Yield response curves for common varieties

Yield deviation response from site mean (t/ha) for a range of wheat varieties to sowing time (year day of sowing). The solid line is the estimated grain yield deviation from site mean. The dashed lines are upper and lower 95% confidence limits.

Figure 2. Main season varieties.

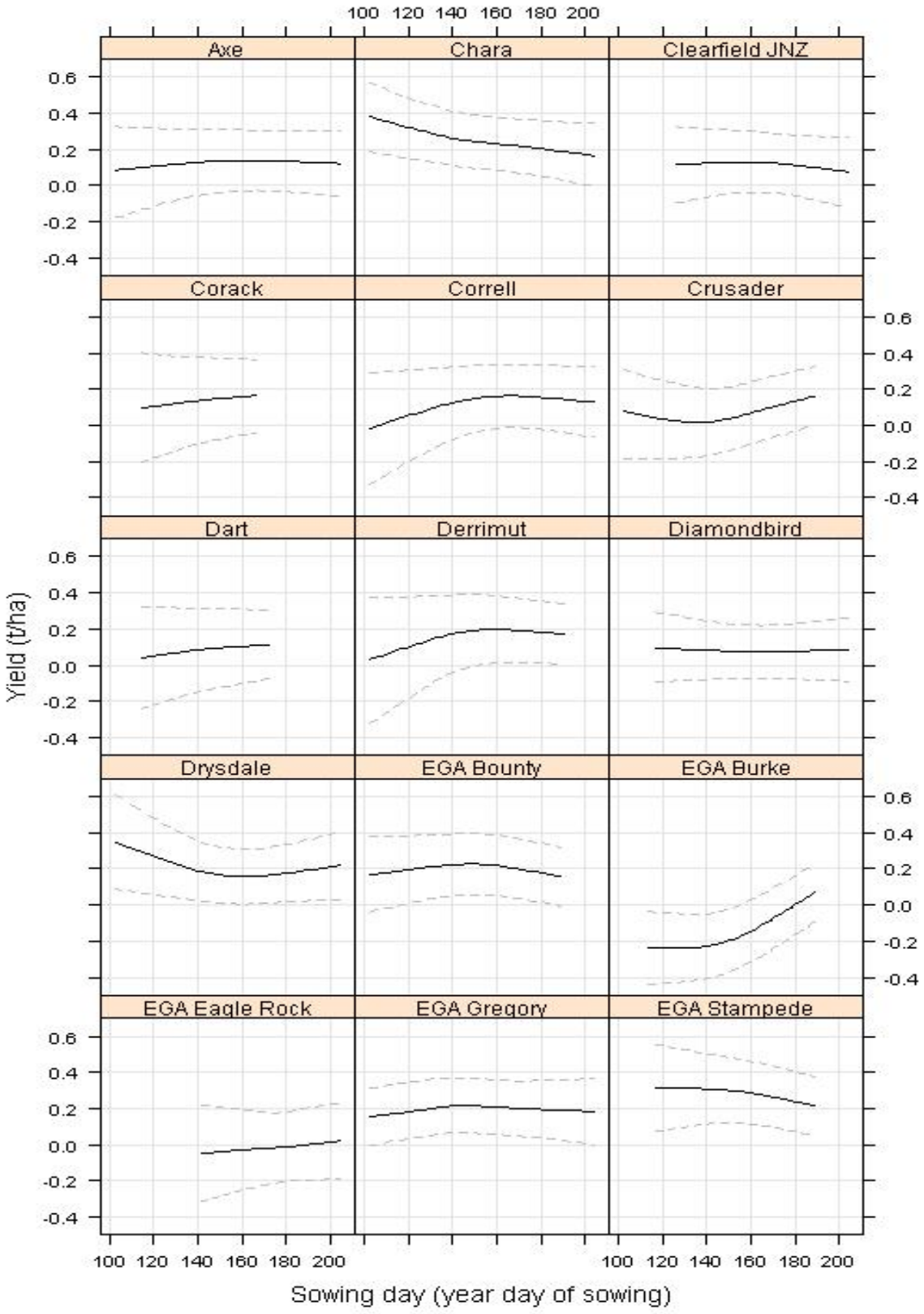


Figure 3. Main season varieties (continued).

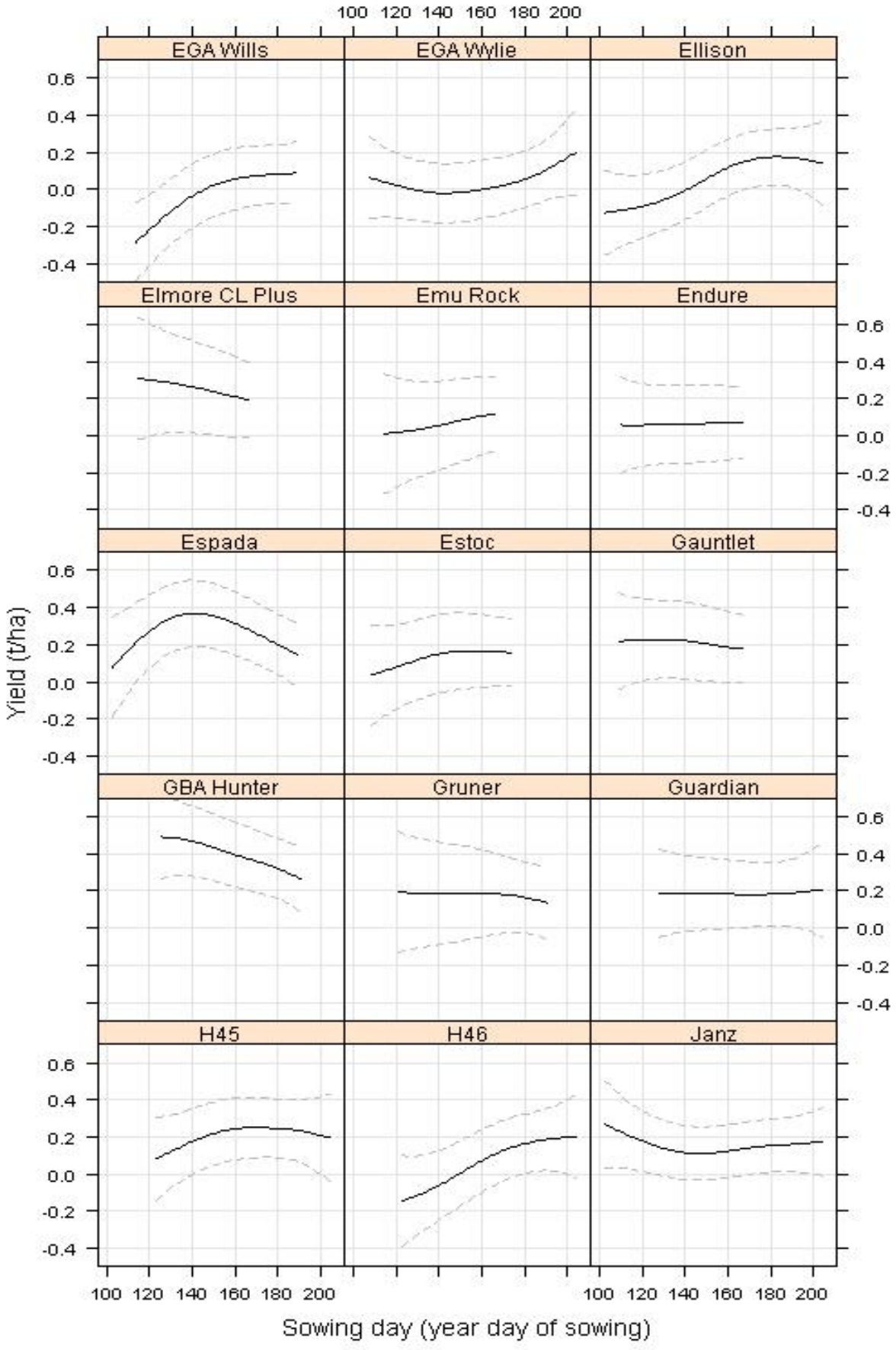


Figure 4. Main season varieties (continued).

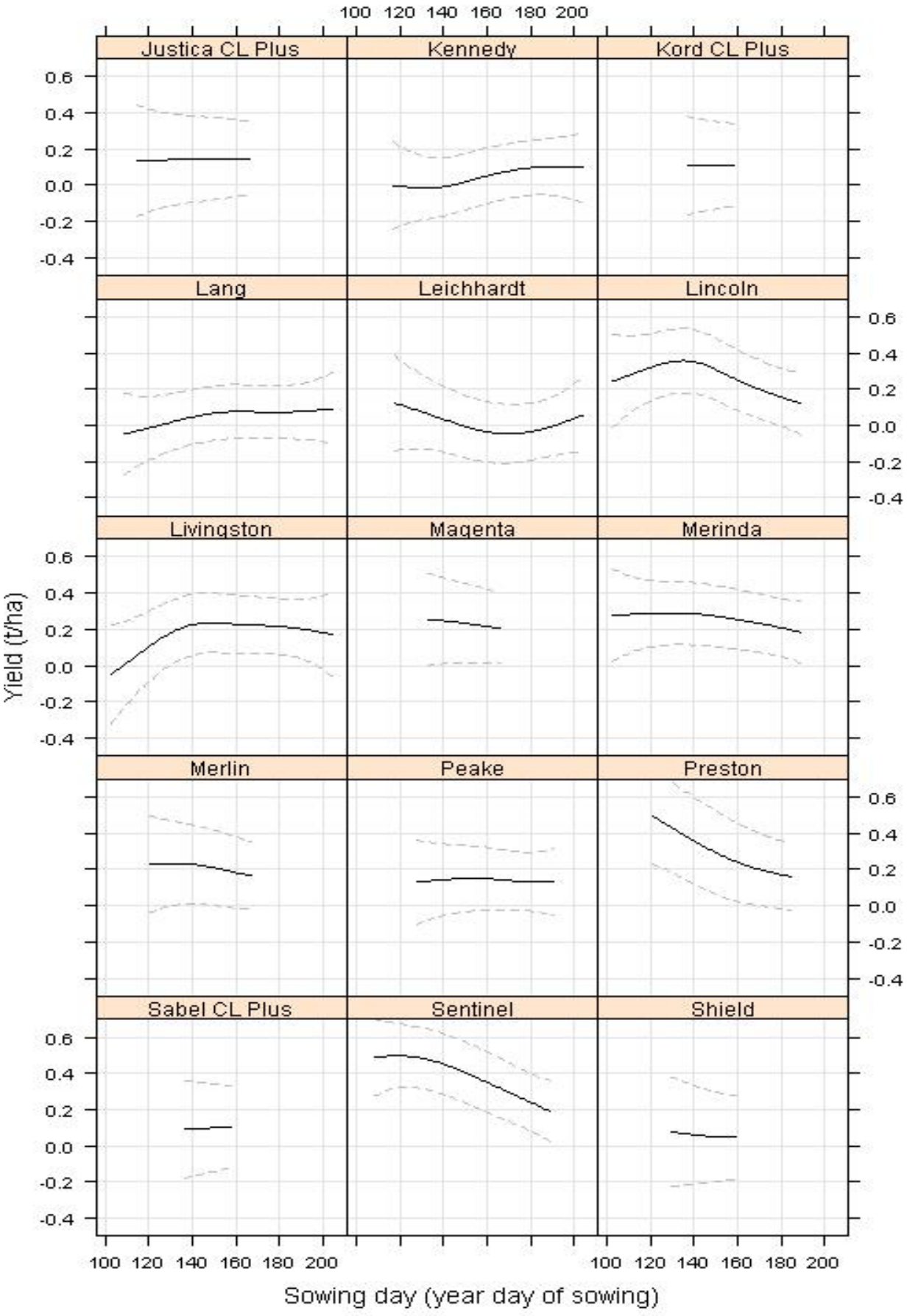


Figure 5. Main season varieties (continued).

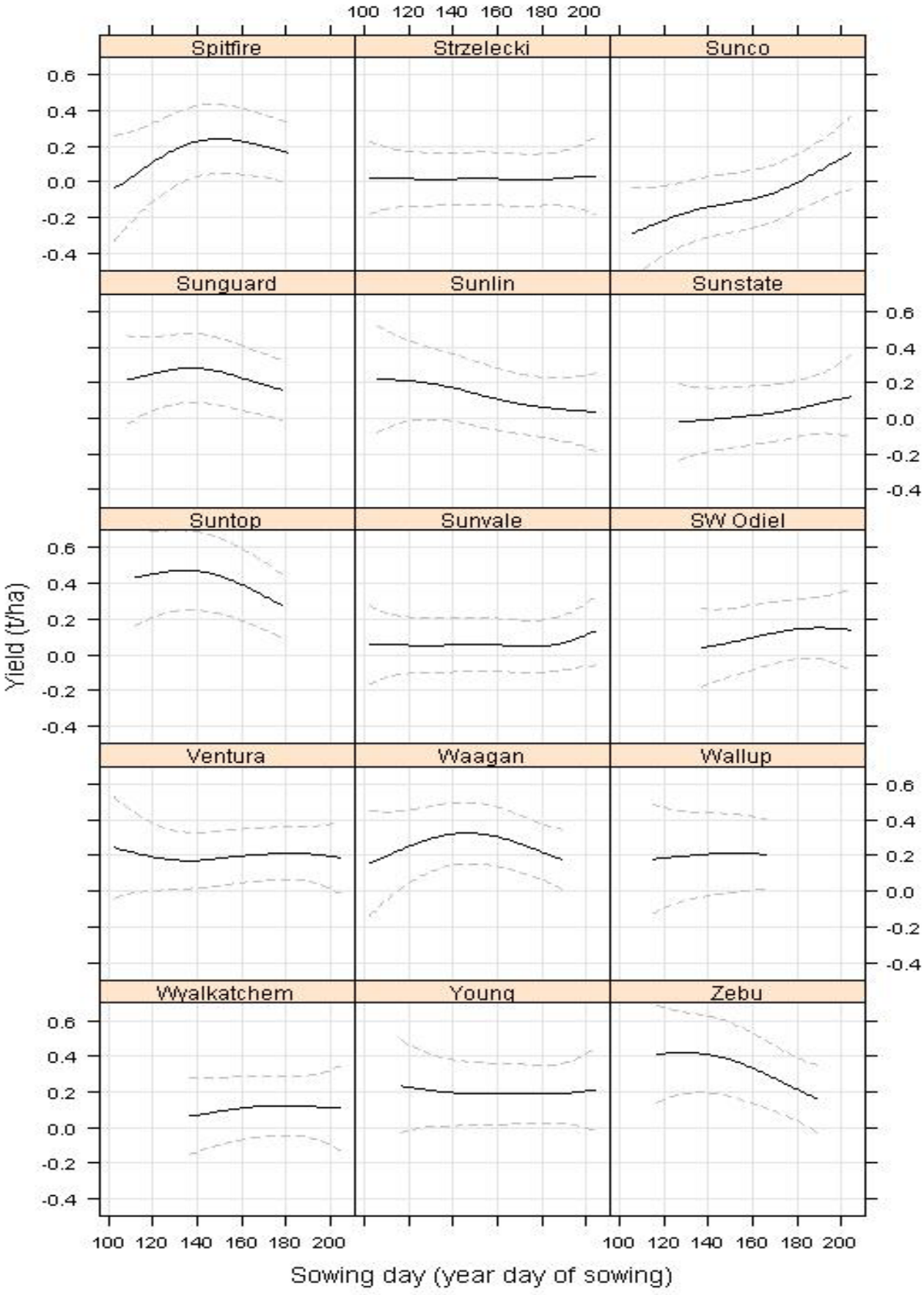


Figure 6. Early sown varieties.

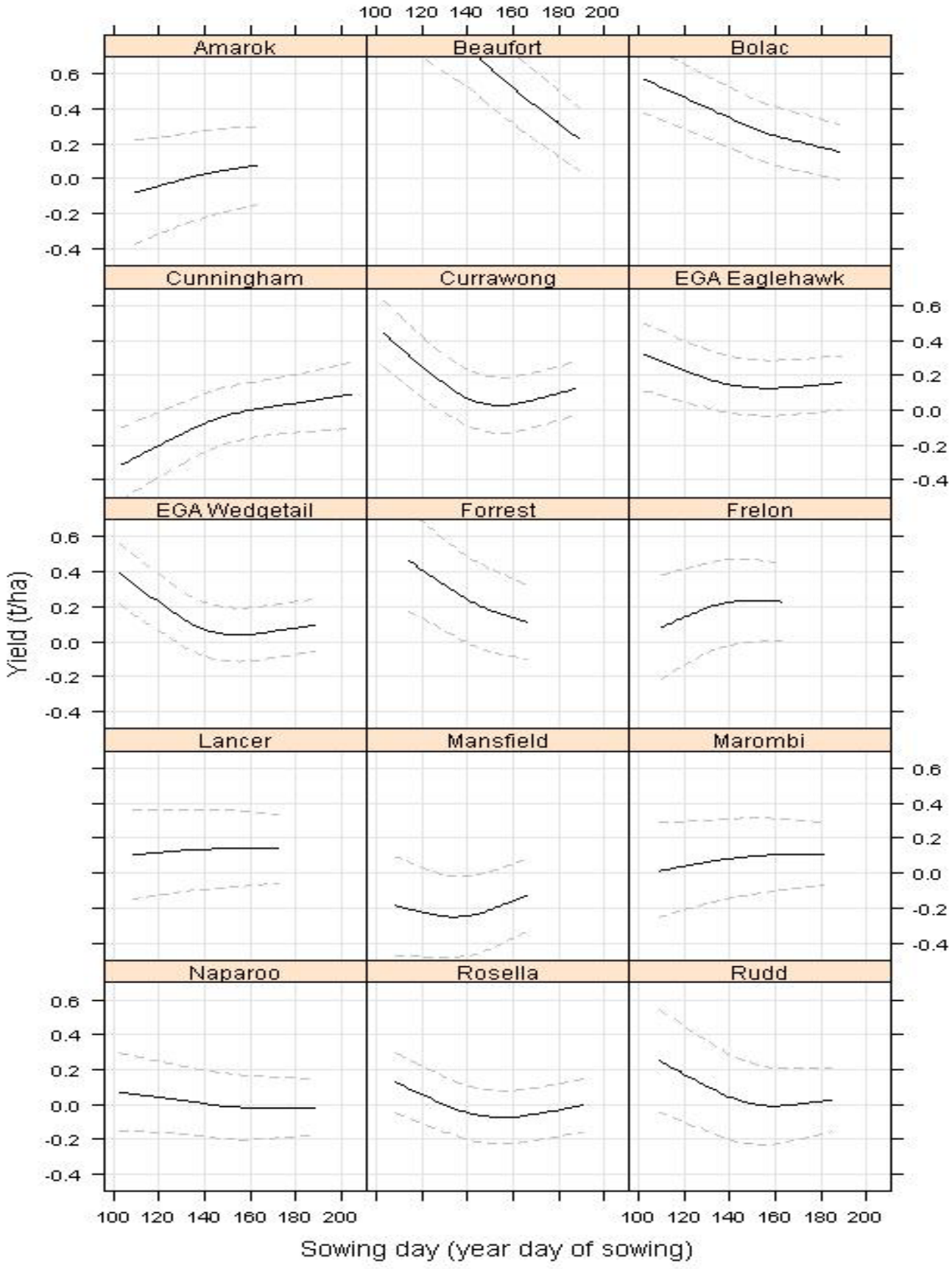


Figure 7. Early sown varieties (continued).

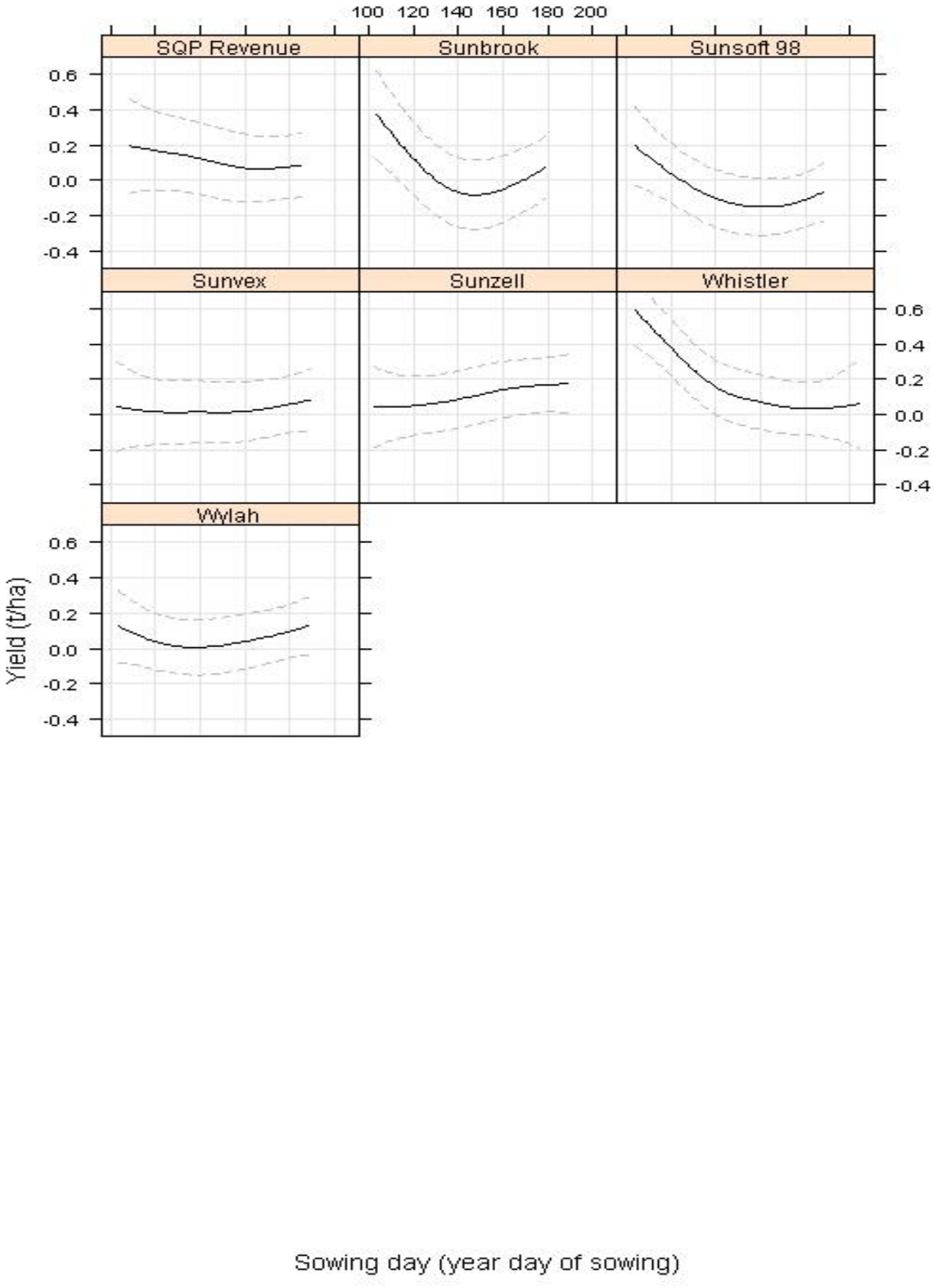


Figure 8. Soft and Durum wheat varieties.