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Yield response of wheat varieties to sowing time in NSW, 2009

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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 sown, early sown 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.

Trials and years

The analysis includes data from trials conducted in NSW by the Enterprise Grains Australia breeding program, NSW Department of Primary Industries variety evaluation program, Variety Specific Agronomy Packages (VSAP) project and National Variety Trials (NVT) program from 1998 to 2009.

Trials were grown across 4 NSW wheat regions: NE, NW, SE and SW.

There were 794 dryland and 97 irrigated trials grown across 105 locations included in the analysis.

Sowing times

Sowing dates, or times of sowing (TOS), are expressed as year-day which is the number of days after 1st January. Year-day/date equivalents are presented in Table 1. Sowing dates across all years ranged from 13th of April (year day 103) to the 14th of 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	10th April
120	30th April
140	20th May
160	9th June
180	29th June
200	19th July

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Genotypes (variety)

In order to reduce the computation involved, only the 803 genotypes that were grown in at least 7 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 deviations from site mean yield. 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 (10%) of the total genetic variation. There was a large main effect of genotypes (10%). Terms such as genotype by irrigated and genotype by year interactions contributed reasonable effects of 12% and 10% 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).

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

Source	Variance	%Total
Genotype	0.01840	10%
Genotype.TOS	0.01952	10%
Genotype.spline (TOS)	0.00195	1%
Genotype.Irrigated	0.02256	12%
Genotype.Year	0.01838	10%
Genotype.Region	0.00218	1%
Genotype.Year.Region	0.00000	0%
Genotype.Year.Irrigated	0.01260	7%
Genotype.Region.Irrigated	0.00487	3%
Genotype.Year.Region.Irrigated	0.01172	6%
Genotype.Trial	0.07569	40%
Total Genetic	0.18788	100%

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

A simplified explanation of Table 2 for dryland environments is:

- Genotype (10%) : indicates that 10% of the yield variation was attributable to genotype
- Genotype.TOS (10%): indicates that sowing time of a genotype was equally important as the genotype
- Genotype.year (10%) indicates that rankings of genotypes vary considerably from one year to the next and that this is as important as as the genotype
- Genotype.trial (40%): 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 (1%) and Genotype.Year.Region (0%): indicate genotypes had similar response to sowing time regardless of region in NSW

Genotype responses

There were differences in genotype response to sowing time. There seem to be 3 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 3 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 prime soft and durum 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. Whistler is a winter genotype with a response curve with negative slope and Waagan a high yielding early maturing spring genotype with a response curve with negative slope. H46 is an early maturing genotype with a response curve with positive slope. Janz is a mid season maturity spring genotype with a flat response curve.

Janz, H46 and Whistler achieve roughly the same yield at around year day 130 (12 May) (Figure 1). Whistler is likely to be higher yielding than Janz and H46 if sown before year day 130 and lower yielding if sown after year day 130.

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 web site (www.nvtonline.com.au). A subset is reproduced in

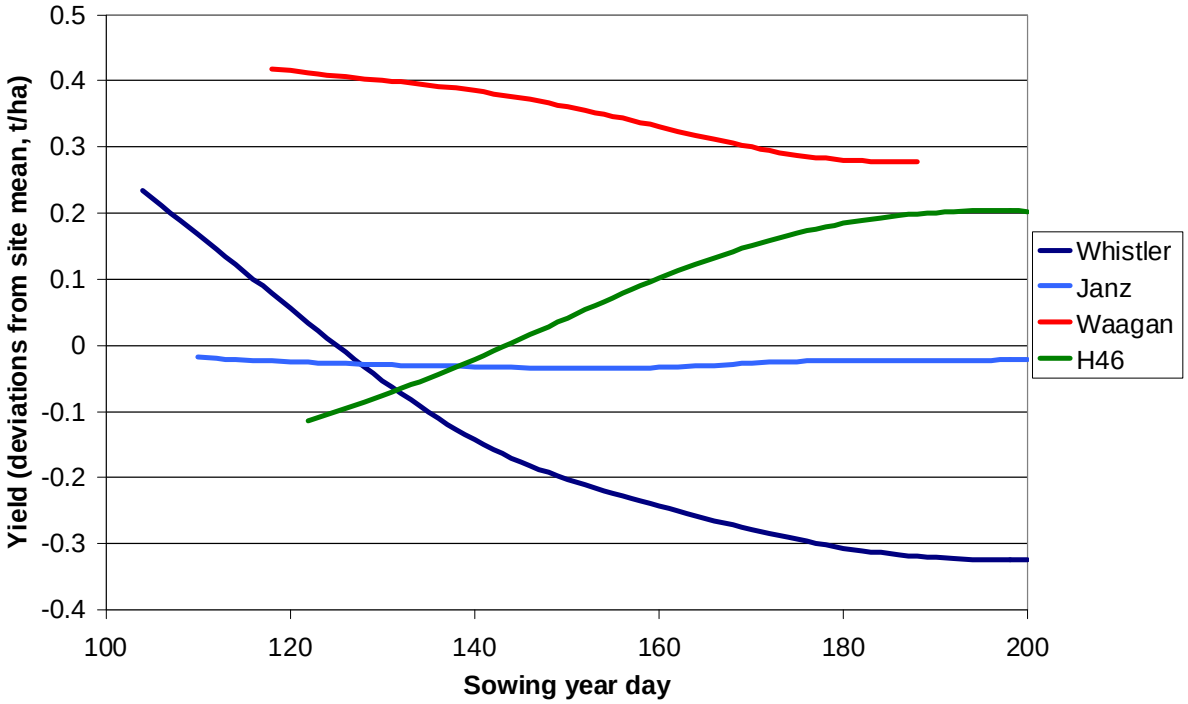

Figure 1 Examples of genotype response to sowing date response curves, with negative slope Waaggan and Whistler), positive slope (H46) and flat slope (Janz).

the *Winter crop variety sowing guide* for the current year (McRae et al. 2010).

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 sowing 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 response curves of very early flowering genotypes, such as Axe, H46, Ventura and Waagan, 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.

Acknowledgements

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References

McRae FJ, McCaffery DW, Matthews PW (2010) *Winter crop variety sowing guide*. (New South Wales Department of Primary Industries).

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Yield response curves for common varieties

Yield response (t/ha) of a range of wheat varieties to sowing time (year day of sowing). Solid line is the estimated grain yield; the dashed lines are upper and lower 95% confidence limits.

Figure 2. Main season varieties

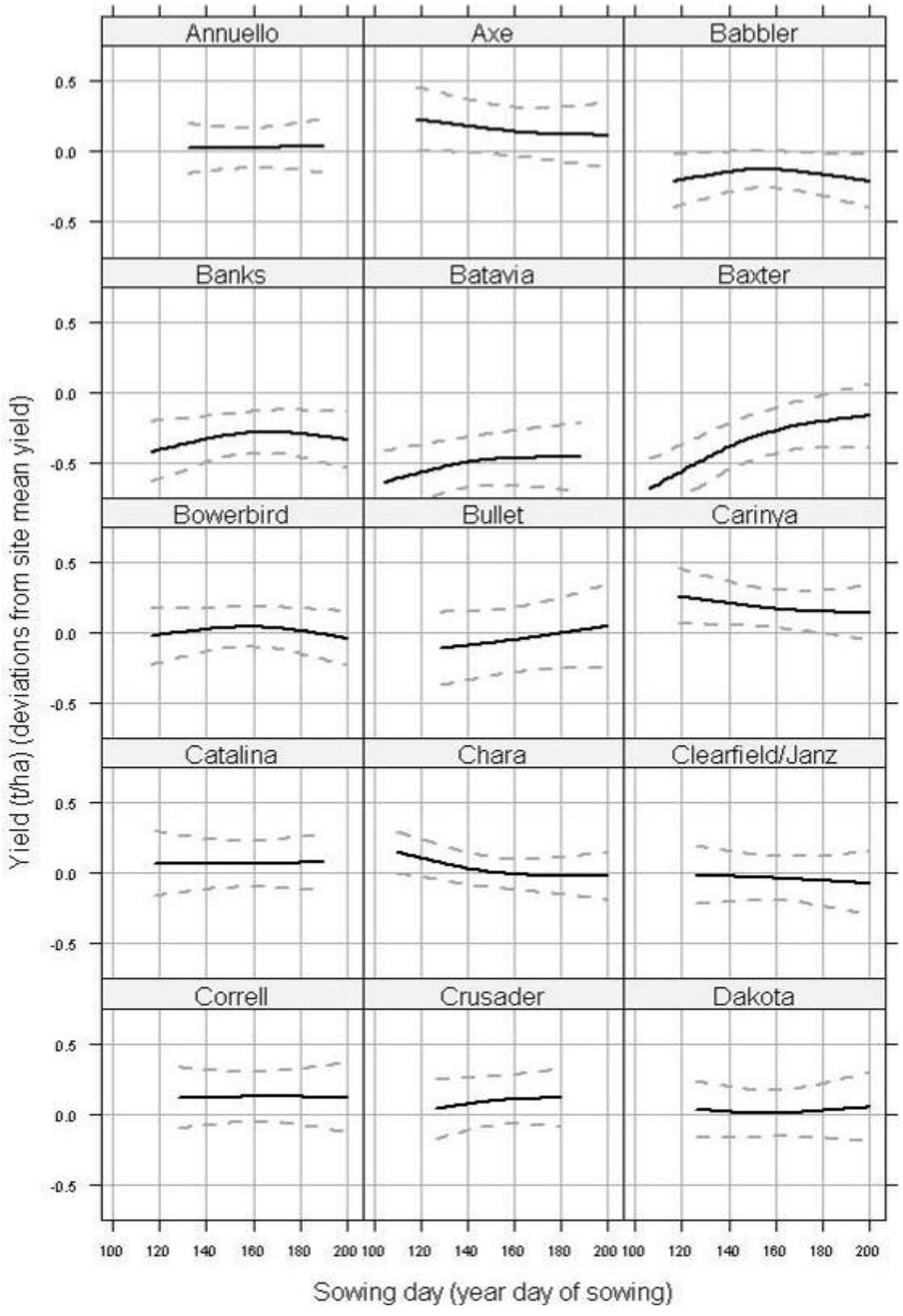

Figure 3. Main season varieties (continued)

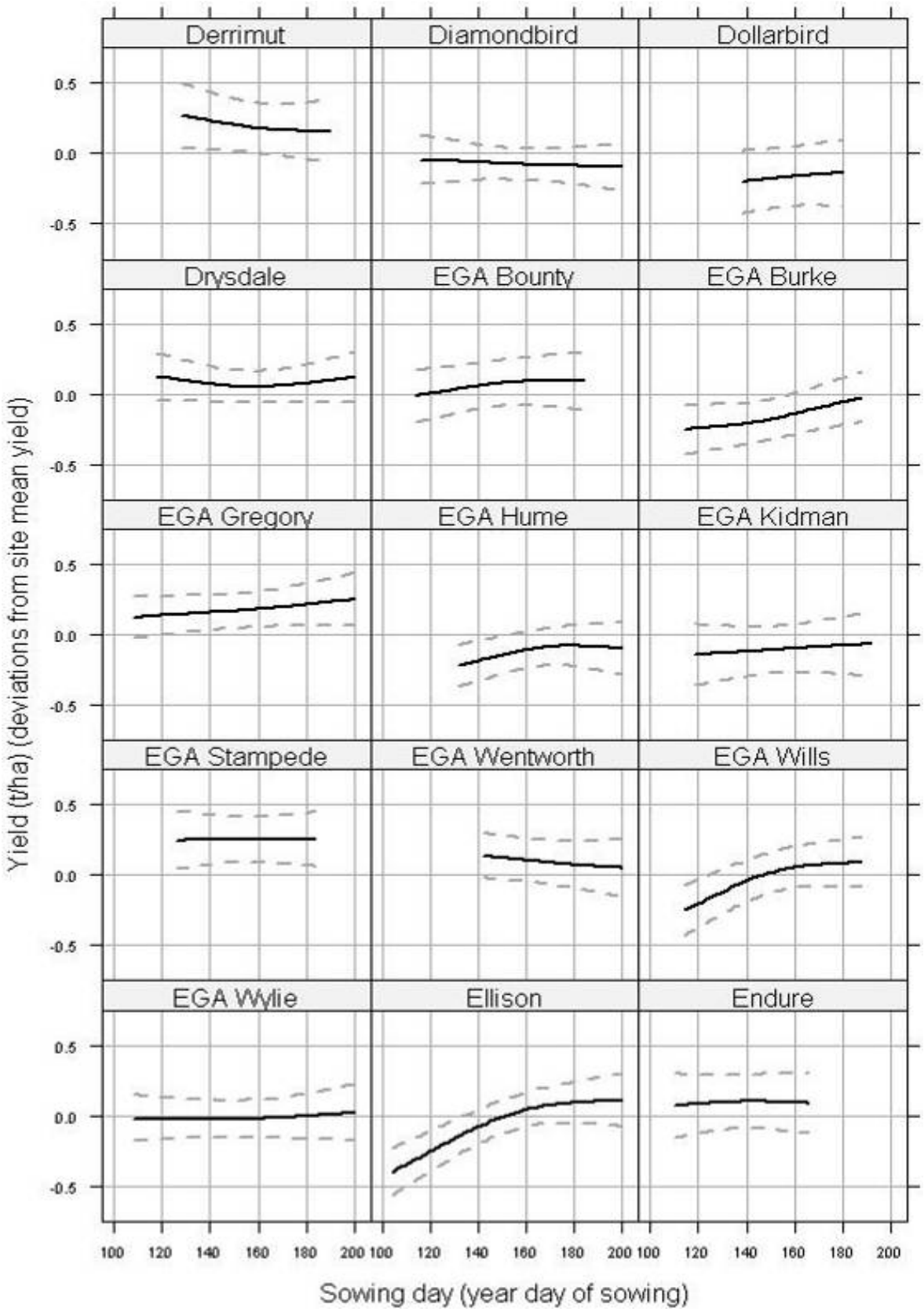

Figure 4. Main season varieties (continued)

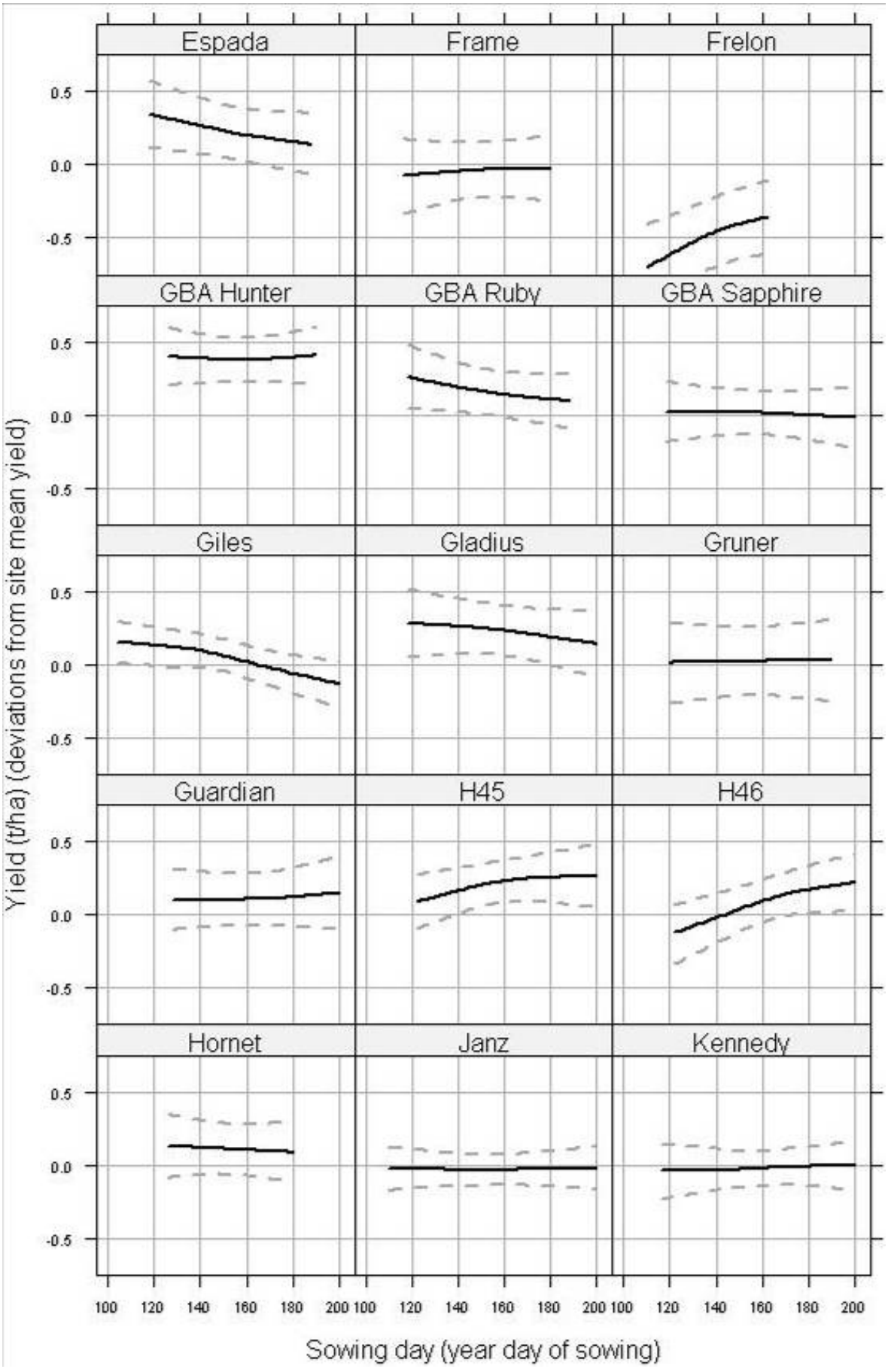

Figure 5. Main season varieties (continued)

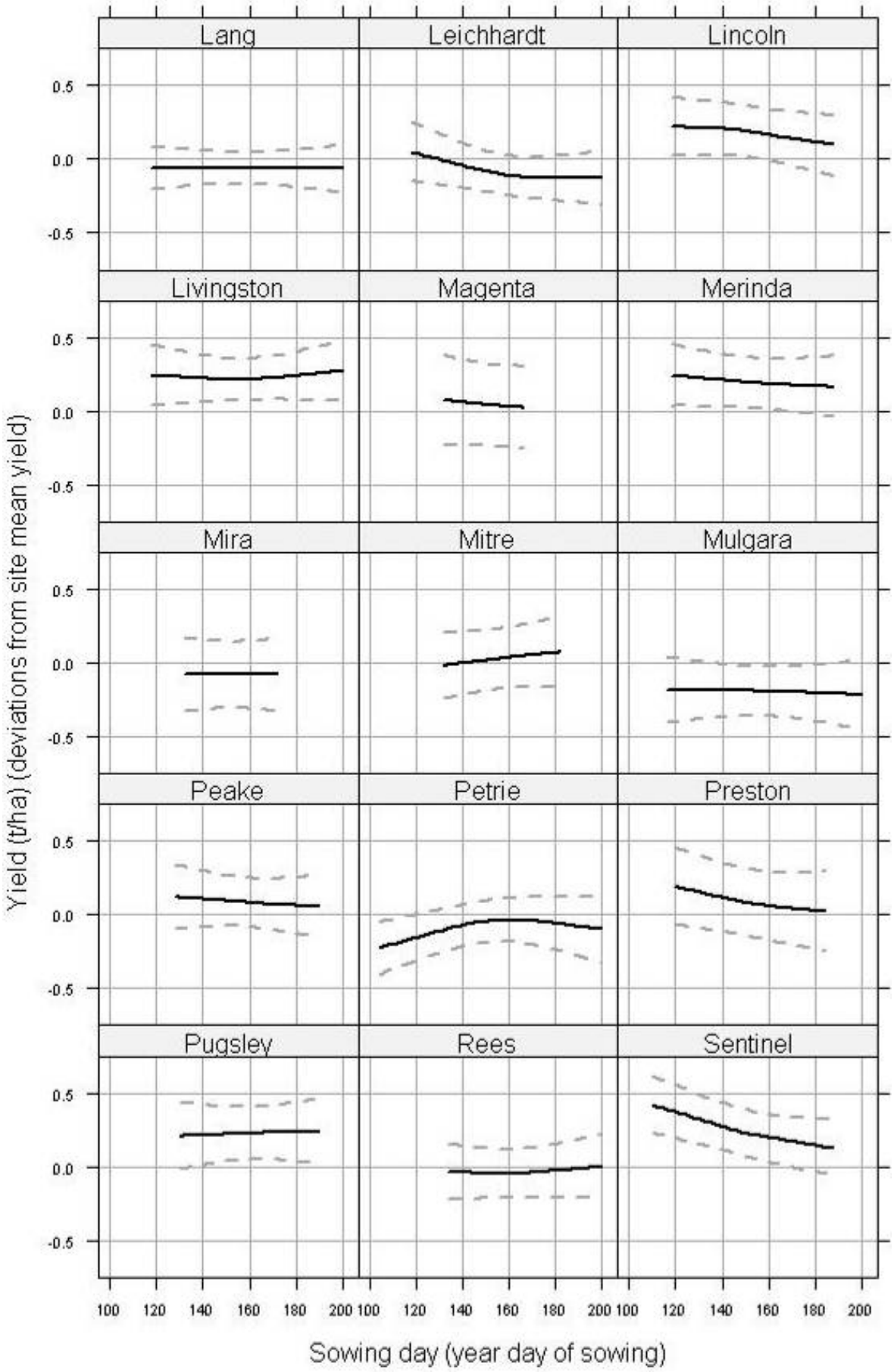

Figure 6. Main season varieties (continued)

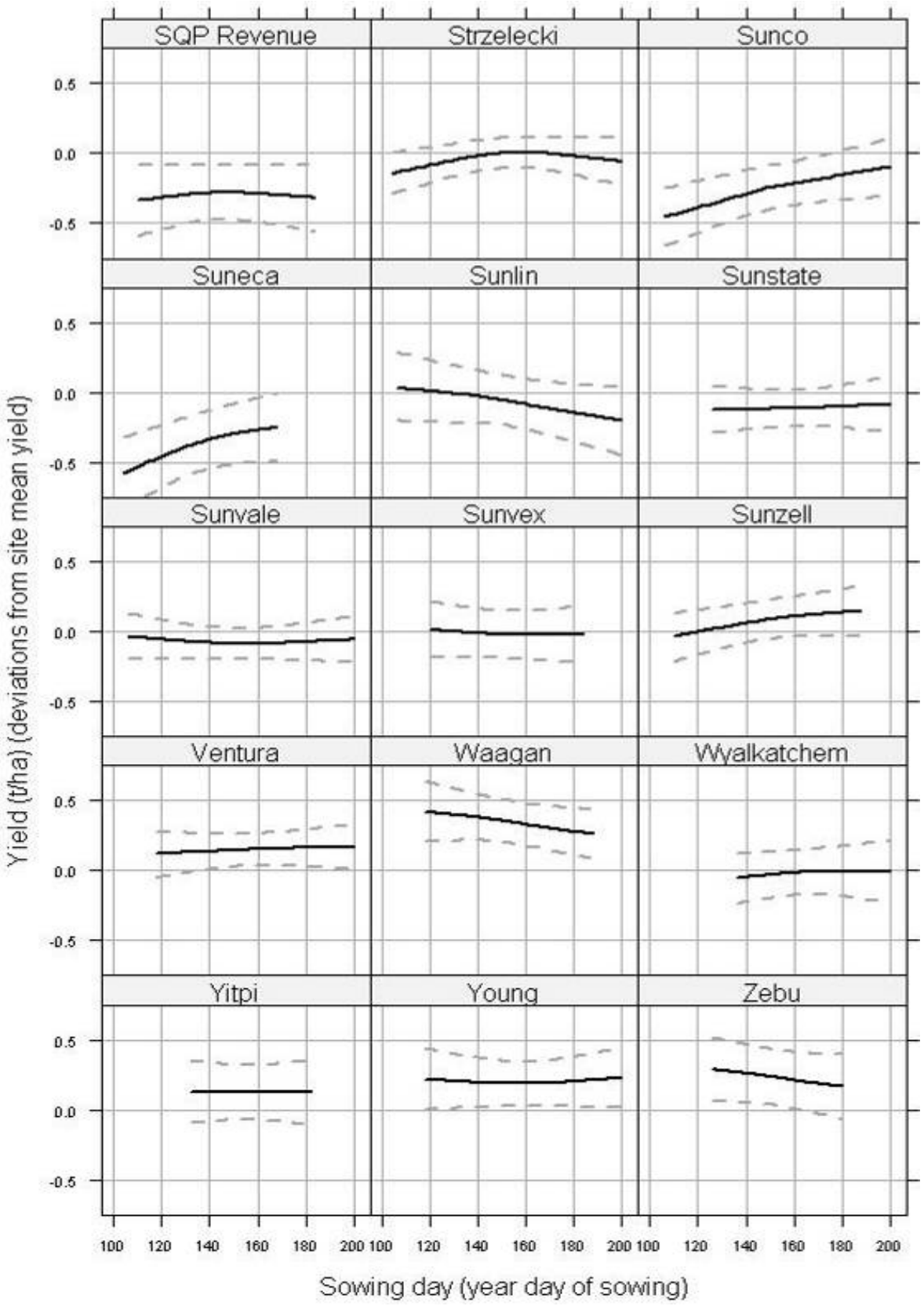

Figure 7. Early sown varieties

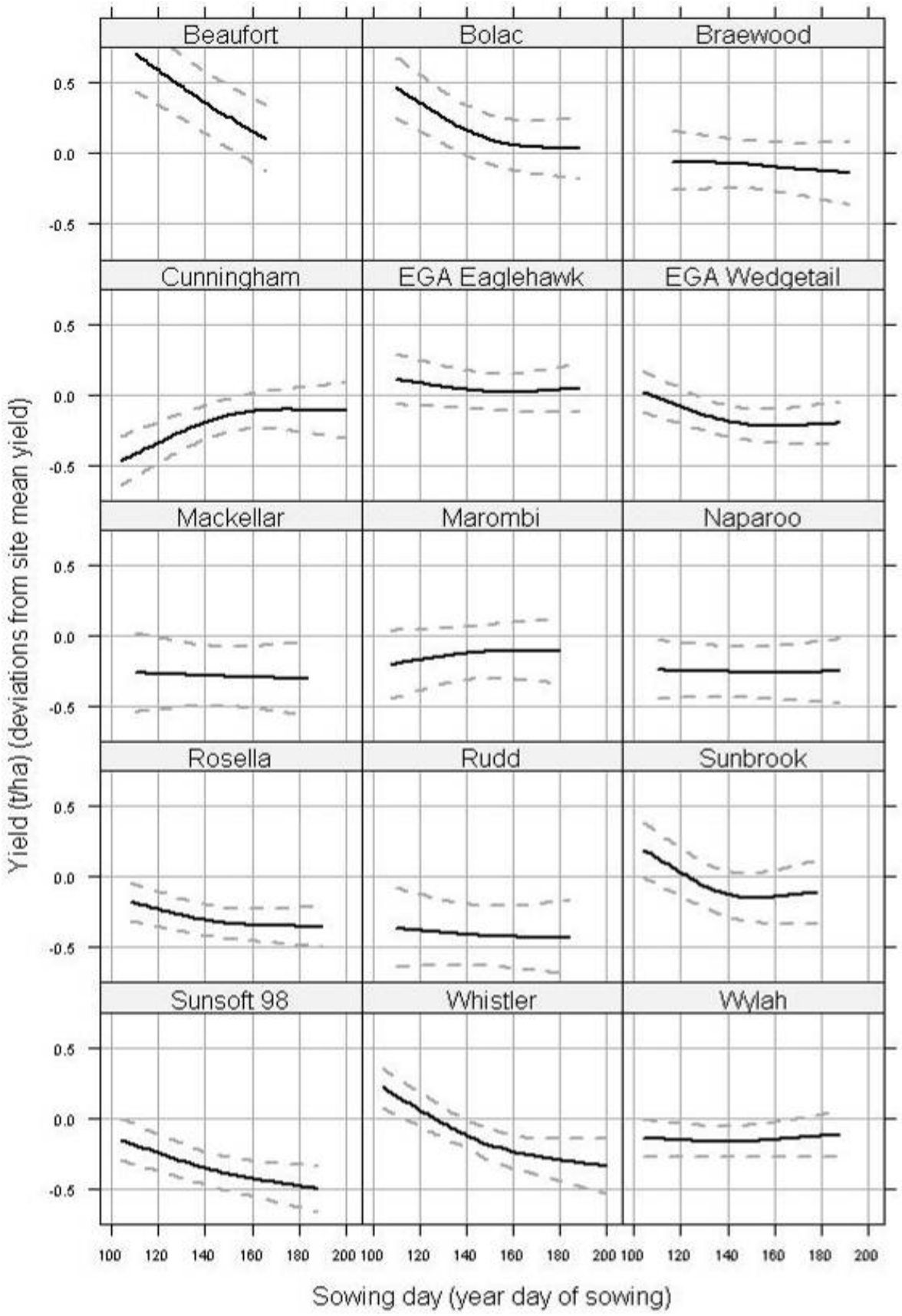

Figure 8. Soft and durum varieties