

# Comparison of grain yield and grain protein concentration of commercial wheat varieties

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## Key words

Grain protein concentration, Grain yield, LongReach Spitfire<sup>1</sup>, EGA Gregory<sup>1</sup>, Sunvale

## GRDC code

Variety Specific Agronomy Packages (VSAP) – DAN00129

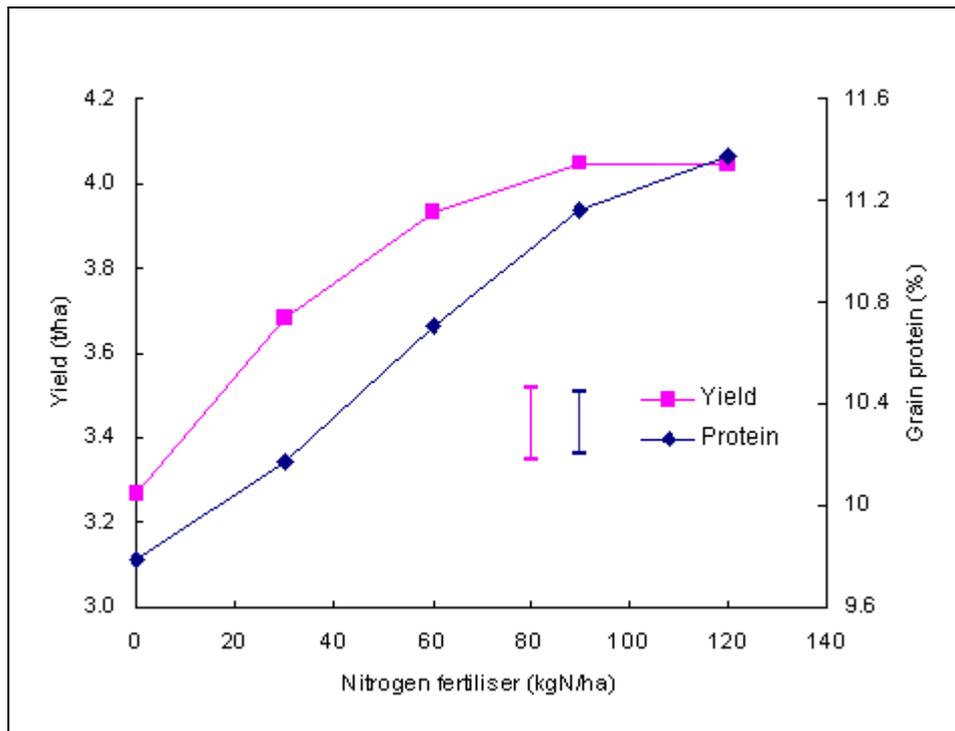
### Take home message:

- Grain yield and grain protein concentration of wheat in a specific situation are generally negatively correlated. However initial investigations in 2011 indicate that the wheat variety LongReach Spitfire<sup>1</sup> may have a greater grain protein concentration at a given yield level relative to other wheat varieties.
- EGA Gregory<sup>1</sup> has shown consistently lower grain protein concentration than other commercial varieties. This appears to primarily be as a result of high yield potential and subsequent dilution of protein.
- Variety choice and N management should take these factors into account in conjunction with the complete package of disease management, varietal maturity, varietal yield and potential protein premiums to make planting decisions in 2012.

## Background

Efficient use of nitrogen (N) is crucial to economic wheat production, with the risk and reward trade off of applied nitrogen being marginal for western regions. Excessive application of N may increase susceptibility of the crop to disease and increase water use early in the growing season whereas insufficient application may limit grain yield, grain protein and subsequent profitability. Within a given season in a cereal crop, fertiliser rate and timing are the major tactical tools used for N management. Applications of N at sowing or up to the start of stem elongation drive greater crop biomass and grain yield response in comparison to late applications (around anthesis or GS61) which have little influence on grain yield but can drive a significant protein response.

With the application of N, yield will generally increase to a maximum level, whereas protein may continue to increase beyond this level with further N application. This was shown in a trial at Parkes in 2011, where yield of wheat increased at a reducing rate where nitrogen was applied at 30 kg/ha increments. Yield was maximised with N application of 90 kg/ha. Protein increased linearly for each 30 kg/ha increment up to 120 kg/ha N. In this trial, yield appeared to be maximised at a grain protein concentration of 11.2 % (Figure 1).



**Figure 1:** Grain yield (t/ha) and protein concentration (%) from 10 wheat varieties with 0, 30, 60, 90 and 120 kg/ha applied nitrogen in a trial at Parkes in 2011.

Nitrogen management for protein has become a prevalent issue, particularly in the past two seasons with large premiums being paid for wheat with greater than 13% protein (APH2, APH1 and H1).

One wheat variety, EGA Gregory<sup>®</sup>, has had regular claims by growers and agronomists alike that relative to other varieties, EGA Gregory<sup>®</sup> generally has low grain protein concentration at a given yield level. It must be noted though that EGA Gregory<sup>®</sup> has demonstrated wide adaptation across grain growing regions in New South Wales with high relative yields, good resistance to stripe rust, high level of tolerance to root lesion nematode - *Pratylenchus thornei*, flexibility with sowing dates and it is classified as an APH variety in northern NSW.

Results from the NVT trial network provide some level of support to observations made by growers and agronomists. Of 103 main season NVT trials (since 2008) that contained the varieties EGA Gregory<sup>®</sup>, LongReach Spitfire<sup>®</sup> and Sunvale, EGA Gregory<sup>®</sup> was the highest yielding variety, with Sunvale being the lowest. However, EGA Gregory<sup>®</sup> had the lowest overall grain protein concentration, while LongReach Spitfire<sup>®</sup> had the highest overall grain protein concentration. A regression analysis of grain yield and grain protein concentration showed that grain protein concentration at a given yield level significantly ( $P < 0.001$ ) varied between varieties. For a given yield LongReach Spitfire<sup>®</sup> had 1.5 % and 0.6 % greater protein concentration than EGA Gregory<sup>®</sup> and Sunvale respectively.

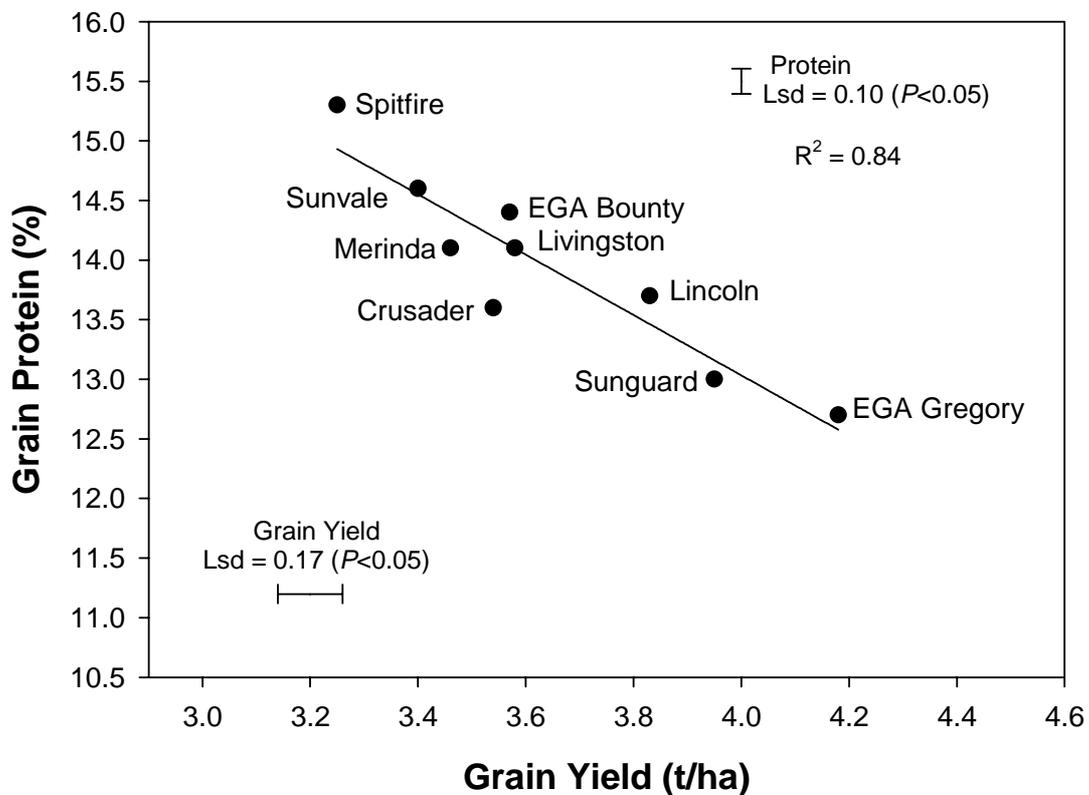
As part of the GRDC funded VSAP project, five nitrogen use efficiency trials were conducted in 2011 at Trangie, Condobolin, Parkes, Coonamble and Spring Ridge, as well as a sowing time trial at Trangie, with these trials used in this paper to assess the grain yield and grain protein concentration of several commercial wheat varieties. The aim is to determine if at a given yield level, any of the current commercial varieties have a comparative advantage with regard to grain protein concentration.

## Results

### Trangie NUE trial

The trial at Trangie Agricultural Research Centre (TARC) contained nine varieties and four nitrogen rates (0, 30, 60 and 90 kg N/ha) applied as urea at sowing. In addition the 60 kg/ha rate had a sub-treatment of 30 kg/ha at sowing followed by 30 kg/ha at GS30. There was no significant effect of timing on yield or protein.

The trial site had a high residual soil nitrogen level, with all rates of applied nitrogen showing no yield response compared to the untreated control. There was a significant varietal yield response with EGA Gregory being the highest yielding variety and LongReach Spitfire the lowest. LongReach Spitfire had the highest grain protein concentration and EGA Gregory the lowest grain protein concentration (Figure 2).



**Figure 1:** Grain yield and Grain protein concentration of nine wheat varieties across four nitrogen rates in a trial at Trangie in 2011. The trendline shows that grain yield and grain protein concentration were negatively correlated across all varieties.

The application of nitrogen had a significant effect on grain protein concentration, with an average increase of 0.3 and 0.6 % over the untreated control for the 30 and 60 kg N/ha rate respectively. There was no further increase beyond the 60 kg N/ha rate.

The correlation between yield and protein was negative in this trial, with all varieties following this trend.

### Trangie sow date trial

A sowing date trial with three sowing dates and a similar set of varieties was also conducted at Trangie. While most varieties followed the trend of reduced protein with increased yield, LongReach Spitfire displayed greater protein concentration than other varieties with

similar yield. Similar to the NUE trial at Trangie, EGA Gregory yielded the highest, and although having the lowest grain protein concentration, this seemed to be primarily due to it having the highest grain yield (Table 1).

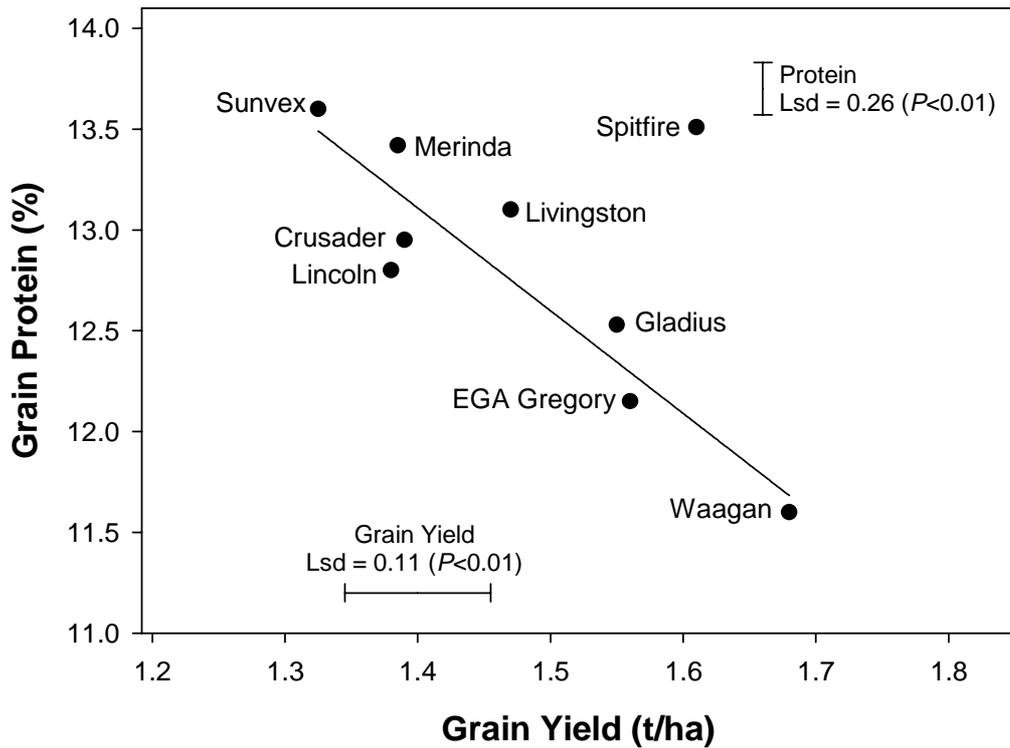
**Table 1:** Grain yield and grain protein concentration of 8 wheat varieties averaged across three sowing dates at Trangie in 2011.

	<b>Grain Yield (t/ha)</b>	<b>Protein (%)</b>
<b>EGA Bounty</b>	5.44	11.5
<b>Crusader</b>	5.53	12.1
<b>EGA Gregory</b>	5.87	11.1
<b>Livingston</b>	5.37	12.3
<b>Merinda</b>	5.56	11.4
<b>Longreach Spitfire</b>	5.49	12.8
<b>Sunguard</b>	5.38	11.3
<b>Sunvale</b>	5.20	12.2
<b>Lsd (P=0.05)</b>	0.17	0.28

#### **Condobolin NUE trial**

The Condobolin NUE trial contained nine bread wheat varieties, with the make up of varieties being slightly different to Trangie. There was no significant effect of N rate on grain yield, however the effect on protein was significant with protein increasing for increasing rates of applied N.

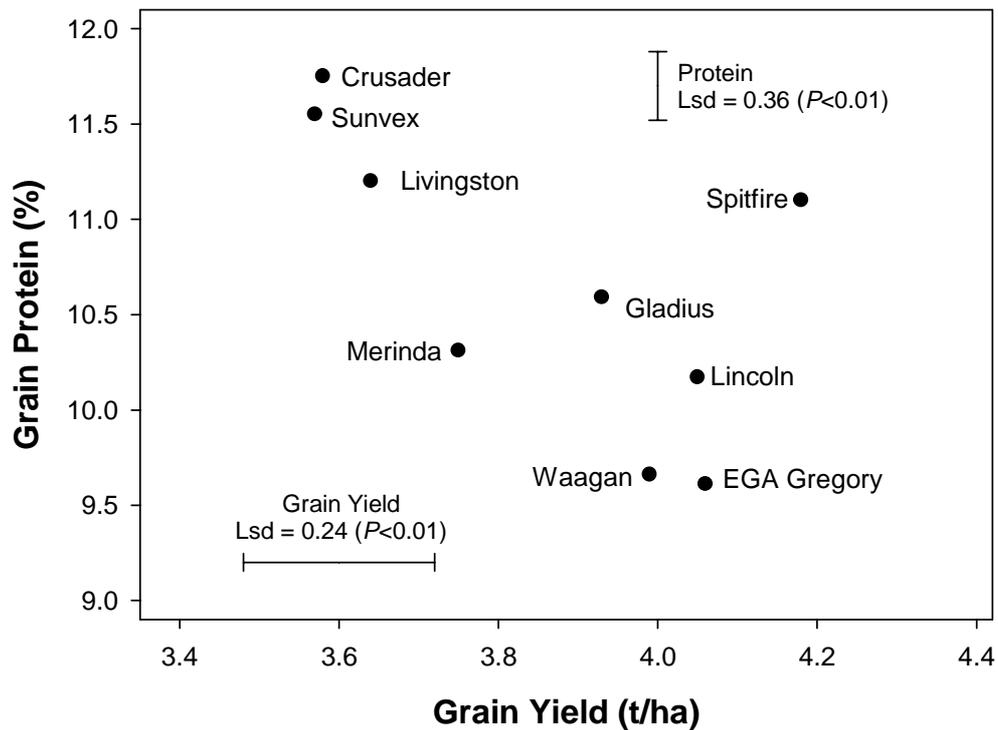
Similar to the Trangie sow time trial, there was a negative correlation between the varieties for grain yield and grain protein concentration, with the exception being LongReach Spitfire, which maintained a relatively high grain protein concentration at a relatively high grain yield level.



**Figure 2:** Grain yield and grain protein concentration of nine wheat varieties averaged across five nitrogen rates in a trial at Condobolin in 2011. The trendline shows that excluding LongReach Spitfire, grain yield and grain protein concentration were negatively correlated across varieties ( $R^2 = 0.69$ ).

**Parkes NUE trial**

At Parkes nine wheat varieties were sown across nitrogen rates from 0 to 120 kg/ha. Eight of the nine varieties (including EGA Gregory) followed the general negative correlation between grain yield and grain protein concentration. The exception was LongReach Spitfire which maintained a relatively high grain protein concentration at a high yield level (Figure 3).



**Figure 3:** Grain yield and grain protein concentration of ten wheat varieties averaged across five nitrogen rates in a trial at Parkes in 2011. LongReach Spitfire® maintained a relatively high grain protein concentration at a high grain yield level.

#### Coonamble NUE trial

The Coonamble trial contained six wheat varieties, with nitrogen rates of 0, 30, 60 and 120 kg/ha applied as urea at sowing. Within the 60 kg/ha treatment there was a sub-treatment where the 60 kg/ha was split into 30 kg/ha urea applied at sowing followed by 30 kg/ha applied as liquid UAN at anthesis.

Averaged across all N treatments, LongReach Spitfire® had the highest yield as well as the highest grain protein concentration (figure 4).

The split application of 30 kg/ha at sowing followed by 30 kg/ha at anthesis resulted in grain protein concentration similar to the application of 120 kg/ha at sowing.

**Table 2:** Grain yield and grain protein concentration of 6 wheat varieties sown across four nitrogen rates at Coonamble in 2011.

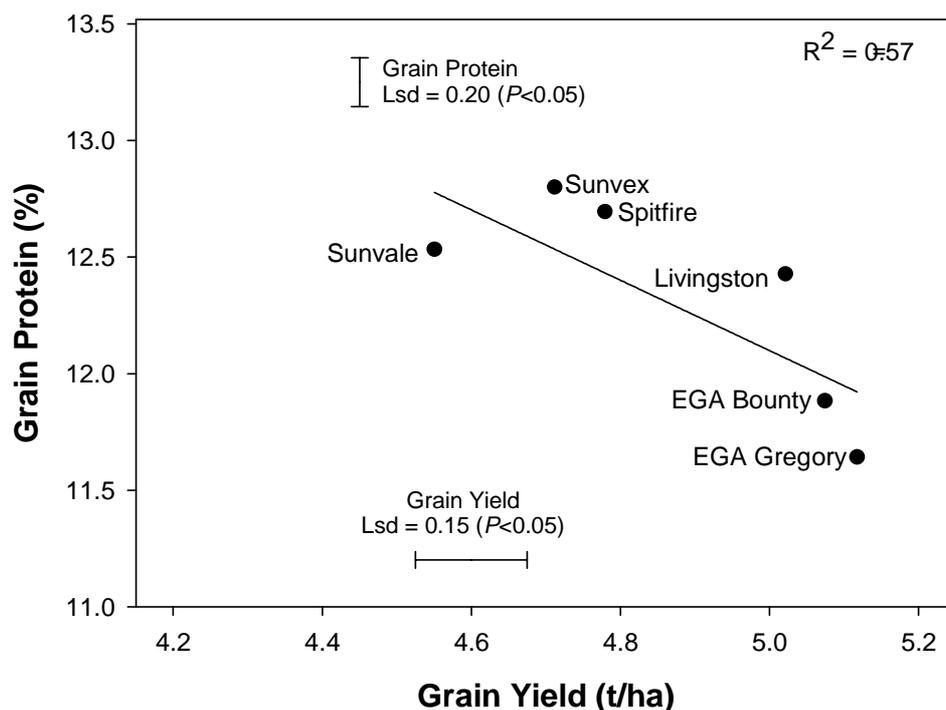
	Grain Yield (t/ha)	Protein (%)
EGA Bounty	1.80	12.4
EGA Gregory	2.01	11.4
Livingston	1.91	13.1
Spitfire	2.16	13.5
Sunvale	1.93	12.5
Sunvex	1.94	12.7
<b>Lsd (P=0.05)</b>	<b>0.22</b>	<b>0.5</b>

### Spring Ridge NUE trial

The Spring Ridge NUE trial contained the same varieties as Coonamble, with the N rates being 0, 40, 80 and 160 kg/ha all applied as urea at sowing.

N application increased the protein of all the varieties, with protein increases being recorded up to 160 kg/ha of applied N.

All varieties followed the general trend of grain yield being negatively correlated with grain protein concentration, with EGA Gregory being the highest yielding variety but with the lowest grain protein concentration.



**Figure 3:** Grain yield and grain protein concentration of 6 wheat varieties across four N rates in a trial at Spring Ridge in 2011. The trendline shows that grain yield and grain protein concentration were negatively correlated for all varieties ( $R^2 = 0.57$ ).

### Discussion

The trials in 2011 showed a general negative correlation between grain yield and grain protein concentration for most of the varieties averaged across all nitrogen rates. The main exception was LongReach Spitfire, with four of the six trials indicating that it could maintain a relatively high grain protein concentration, even at relatively high yield levels. This is also backed up by an initial regression analysis of 103 trials from the NVT trial system that showed for a given yield level LongReach Spitfire had a 1.5 % and 0.6 % greater grain protein concentration than EGA Gregory and Sunvale respectively.

The six trials presented above do not clearly indicate that EGA Gregory has a comparative disadvantage with regard to protein concentration at a given yield level compared to most other commercial varieties, with the primary exception being LongReach Spitfire. EGA Gregory did have the lowest grain protein concentration at five of the six trials, however it was also the highest yielding in three of these six trials and had grain yield above the site mean for each trial. The grain protein concentration of EGA Gregory, for a given yield level, appeared to track at a similar level to several other commercial varieties including Sunguard, Merinda, EGA Bounty and Lincoln.

In recent seasons producers in the north-west and central-west grains regions have delivered an increasingly greater proportion of ASW and APW grade wheat to receival points. This could partly be due to the fact that EGA Gregory<sup>®</sup> is one of the most widely grown varieties and is inherently high yielding resulting in low grain protein concentration; but is also likely to be due to the diminishing amount of nitrogen in the soil after several favourable seasons. The efficient use of nitrogen fertiliser combined with growing pulse crops or leguminous pastures will benefit wheat production regardless of the variety chosen.

While this paper does indicate a potential advantage of LongReach Spitfire<sup>®</sup> over other commercial varieties for grain protein concentration at a given yield level, producers and agronomists are advised to select varieties based on their overall agronomic package rather than on one trait in isolation.

While there is a general understanding of N management for wheat with regard to timing and rate, future work will determine if N nutrition tactics should vary for different varieties, especially with regard to inherently high yielding varieties such as EGA Gregory<sup>®</sup>.

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