# Fertiliser inputs for maximum yield and quality of Gairdner barley

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## Abstract

This study found that inputs of nitrogen fertiliser increased Gairdner barley crop yields in the 2001 season for the cool season, high rainfall cropping zone of south Western Australia (400-700mm). Grain yields were increased to 5.6 t/ha, a 33% increase over Nil inputs and a 10% increase over the district practice. The addition of extra nitrogen fertiliser increased crop yields above the French and Schulz potential yield of 3.6 t/ha for the season (Growing Season Rainfall 291mm). Extra nitrogen applied at mid tillering, increased protein from 10.1% to 11.3% and screenings from 6.2% to 16.3%, although the addition of potassium significantly reduced screenings, to 14.3%.

## Key Words

Nutrition, nitrogen, potential yield, barley, quality.

## Introduction

Average yields for barley of 2.5 t/ha in the cool season, high rainfall cropping zone of south Western Australia (400-700mm) are well below the potential yields of 6-10 t/ha. Potential yields are obtained from the French and Schultz equation, where Yield potential = (~ April-October rainfall -110)*20 (French and Schultz 1984), and although this equation is a useful approximation, the sowing time, amount of stored moisture and soil type are not taken into account. Crop nutrition has been identified as a major limiting factor to increasing the average crop yields in the southern high rainfall zone (Anon, 1996). Responses to nutrition in past research under more conventional practices have been inconsistent, varying across sites, between seasons and with management (For example, Anderson and Smith 1990, Smith and Anderson 1989). This trial assesses whether the French and Schultz approximate Yield potential equation will work under high input fertiliser regimes, while maintaining grain quality.

## Methods

The trial was sown on a sandy loam soil 5 km west of Arthur River (496780E, 6303680N), and had Canola in 2000 and wheat in 2001. Random site soil tests were taken for the top 10 cm, and sent to CSBP for analysis. Analysis results showed 1.25% Organic Carbon (OC), 67 ppm Phosphorus (P), 132 ppm Potassium (K), 12 ppm Sulphur (S), 0.1 ppm Copper (Cu), 0.7 ppm Zinc (Zn), and pH ($CaCl_2$) 4.7. Phosphorus retention at the site was average.

Gairdner barley was sown on 19$^{th}$ May 2001 at 70 kg/ha with knifepoints and press wheels at 18 cm spacings. Nutrients were deepbanded at the rates (kg/ha) shown in Table 1. No fertiliser inputs (Nil) were compared to district practice (DP) and various additional inputs as detailed in the table. Extra nitrogen (N) and trace elements (TE) were applied at mid tillering (~ Z26). Optimum management was practised before and throughout the growing season to ensure only water and nutrition would limit crop yield and quality.

## Results

### *Dry Matter and Grain Yield*

Adding extra nutrients, including N, P, K and S at sowing significantly increased early dry matter production by 27% over Nil. The addition of extra N and TE at Z26 increased dry matter production by 47% over Nil (Results not shown). At this developmental stage, the addition of the extra P, S and K at sowing to the extra N and TE at Z26 did not further increase dry matter. Plant analysis showed that these nutrients were already high. On the other hand, the addition of the extra N, P and S at sowing and extra N and TE at Z26 did significantly increase grain yield by 33% over the Nil treatment and by 10% over the district practice (DP) (Table 1.).

The harvest index (%) was the largest for the district practice treatment (DP) and the Nil treatment (Table 1), and the lowest for the DP + TE + N treatment. This showed that the extra N and TE stimulated vegetative growth more than reproductive growth of the crop, especially during early growth.

**Table 1: Nutrient inputs (kg/ha), harvest index (HI%), grain yield (GY t/ha), protein (%) and screenings (Scrns%) for Gairdner barley at Arthur River for different nutrient treatments applied in 2001.**

| Treatment | Nutrient inputs (kg/ha) | HI (%) | GY(t/ha) | Protein (%) | Scrns (%) |
|---|---|---|---|---|---|
| Nil | 0 | 45 | 3.8 | 10.7 | 5.8 |
| DP | 34N, 13P, 25K, 5S, 0.2Cu, 0.2Zn, 0.01Mn | 47 | 5.1 | 10.4 | 5.9 |
| DP + TE | 34N, 13P, 25K, 5S, 0.4Cu, 2.6Zn, 0.5Mn | 37 | 4.7 | 10.1 | 6.2 |
| DP + TE + N | 98N, 13P, 25K, 5S, 0.4Cu, 2.6Zn, 0.5Mn | 33 | 5.3 | 11.3 | 16.3 |
| DP + TE + N + P + S | 104N, 24P, 25K, 9S, 0.6Cu, 2.7Zn, 0.5Mn | 43 | 5.6 | 11.6 | 18.4 |
| DP + TE + N + K | 99N, 13P, 37K, 5S, 0.4Cu, 2.6Zn, 0.5Mn | 39 | 5.5 | 11.6 | 14.3 |
| DP + TE + N + P + K + S | 104N, 24P, 37K, 9S, 0.6Cu, 2.7Zn, 0.5Mn | 39 | 5.6 | 11.4 | 14.0 |
| *Lsd* ($p<0.05\%$) | | 11.1 | 0.41 | 0.56 | 3.67 |

*Grain quality*

There was a protein and screenings response to nitrogen. Table 1 shows that grain protein was increased from 10.1% for DP + TE to 11.3% for DP + TE + N, and screenings for the same two treatments increased from 6.2% to 16.3%. The addition of extra P, S and K did not further increase protein, although the addition of K significantly reduced screenings of the added nitrogen treatments to 14.3% (Table 1)

*Actual yields vs potential yields*

Growing season rainfall (April-October) was 291 mm, which equates to a potential yield of 3.6 t/ha according to the French and Schultz formula. Our highest yields exceeded this estimated potential for wheat crops. However, assuming water losses were as low as 80mm, and crop transpiration efficiencies as high as 25 kg/ha/mm, the potential is increased to 5.3 t/ha. This is a realistic assumption as there was no effective stored moisture prior to sowing, the pattern of rainfall for each month was very even, and the season was mild and warmer than usual.

**Conclusion**

Although the 2001 growing season was milder and warmer than usual, the addition of extra nitrogen increased Gairdner barley seed yield above the apparent potential yield for the site. Unfortunately, nitrogen reduced grain quality (increased protein and screenings), and current research is aiming to identify the actual balance of nutrients required for maximum crop growth, yield and quality. The key to achieving potential yields in this type of season would appear to have been to keep a balance of nutrition by using a combination of soil and plant analysis before and throughout the growing season.

**References**


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