Grain Yield and Protein Content of Wheat (*Triticum aestivum*) as Influenced by Nitrogen Fertiliser Application and Cropping System Under No-Till in the Swartland Sub-Region of the Western Cape of South Africa

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**Background**

Wheat is a very important winter cereal grown under dry land conditions in the Swartland sub-region of the Western Cape Province of South Africa. Wheat can be included in crop rotation systems after various crops including wheat, canola, lupin and medic. Information on carry over nitrogen and the rate of N mineralisation in soils that were planted to abovementioned crops (wheat, canola, lupin and medic) is not readily available in the Western Cape and needs to be quantified.

Grain yield and quality is a function of, amongst others, N supply. Adopting conservation agriculture (CA) leads to, amongst others, changes in soil organic matter content and a resultant increase in soil nitrogen mineralisation potential (Doran 1980, Tivet et al. 2013). As a result of this increase, a decrease in nitrogen fertiliser requirement of the wheat crop is expected. The aim of this study was to evaluate the effect of mineral nitrogen as influenced by the previous crop on wheat yield and grain protein content in no-till systems.

**Applications and implications for conservation agriculture**

Adoption of conservation agricultural practices during the late 1990’s in the Western Cape resulted in changes of several important soil characteristics. Changing from monoculture wheat under conventional till to rotating non-related crops with minimum soil disturbance at seeding changed the characteristics of the uppermost layer of the soil. Amongst others, crop residue cover and soil organic C content increased. It is therefore necessary to revisit N fertilisation norms as it is expected that, as the positive influence of conservation agriculture develops, nitrogen fertiliser requirements will decrease.

**Experimental approach**

A trial was laid out at the Langgewens Research Farm near Moorreesburg (33°16’42.33” S; 18°42’11.62” E; 191m) to evaluate the effect of previous crop and nitrogen (N) application rate on wheat production and grain protein content grown under no-till conditions during the 2008-2010 seasons. The trial was laid out as a factorial arranged in a split plot design with previous crops (wheat in WWWW-, canola in WWCW- or medic in McWMcW system) allocated to main plots and N treatments to sub-plots. Nitrogen fertiliser rate treatments were either 0 or 30 kg N ha⁻¹ at planting followed by various combinations of 0, 30 or 60 kg N ha⁻¹, 30 and/or 60 days after emergence. Fertiliser application rate was calculated as the sum of nitrogen applied during the growing season. Data were pooled as 0, 30, 60, 90 and 120 kg N ha⁻¹.

**Results and discussion**

A gradual increase in mean grain production in the McWMcW system was recorded as N fertiliser application rate was increased from 0 kg N ha⁻¹ to 90 kg N ha⁻¹ followed by a decrease in grain yield as N rate was increased to 120 kg N ha⁻¹ (Fig 1). Grain protein content followed a linear increased response (R²=0.9824) as N application rate was increased from 0 – 120 kg N ha⁻¹.
Figure 1 Influence of fertiliser N application rate (0, 30, 60, 90 and 120 kg ha\(^{-1}\)) on wheat grain yield and grain protein content (%) in a wheat-medic-wheat-medic system at Langgewens.

An increase in N fertiliser application rate resulted in a gradual increase in grain yield in the WWCW system. Although increased N fertiliser application rate resulted in a linear increased response (R\(^2\)=0.8405) in grain protein content, a definite decline in grain protein content was observed at 30 kg N ha\(^{-1}\), a definite indication of N shortages during grain filling (Fig 2).

Figure 2: Influence of fertiliser N application rate (0, 30, 60, 90 and 120 kg ha\(^{-1}\)) on wheat grain yield and grain protein content (%) in a wheat-canola-wheat-lupin system at Langgewens.

The response to fertiliser N in the WWWW was similar to the WWCW, however at lower grain yield and grain protein levels.

Conclusions
Wheat that followed medic in a cropping system produced higher grain yields of higher grain protein content compared to the WWWCW and WWWW systems.

References


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