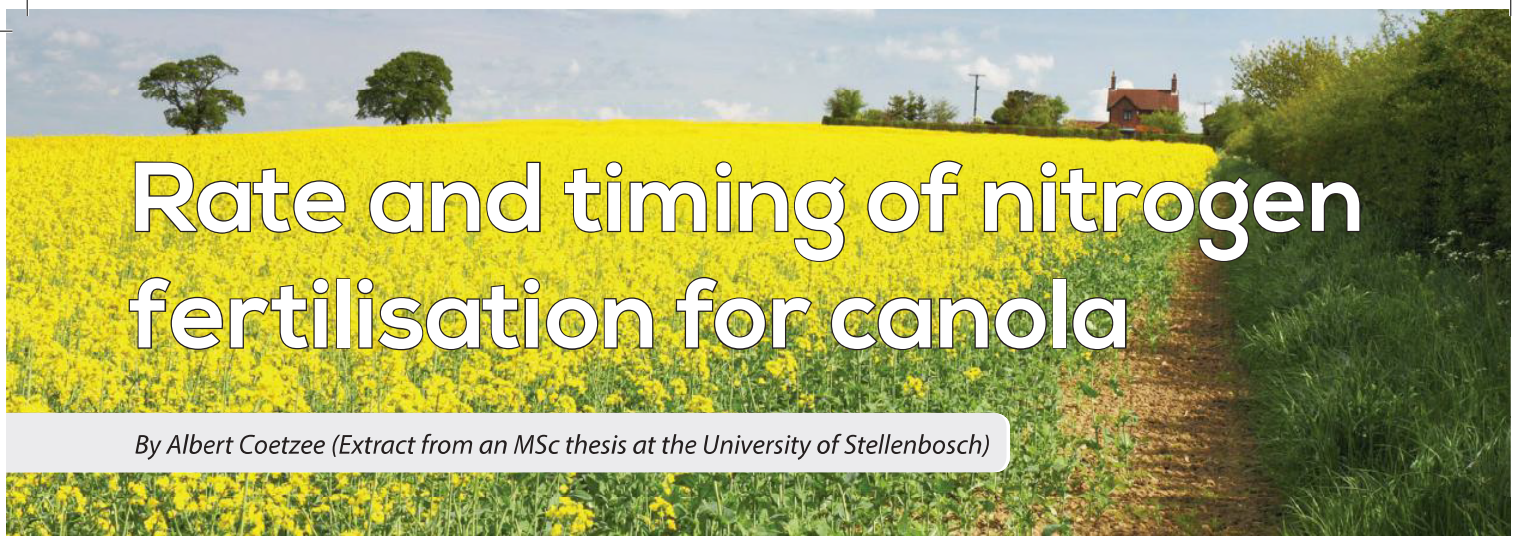


Rate and timing of nitrogen fertilisation for canola

By Albert Coetzee (Extract from an MSc thesis at the University of Stellenbosch)

Canola is increasingly becoming more popular as a crop in the Southern Cape and Swartland regions of South Africa due to its health benefits for consumers and various other benefits in crop rotation systems for producers.

Canola has a relatively low nitrogen use efficiency (NUE), and due to the rising input production cost of N fertilisation, refined N fertiliser guidelines are needed. This will not only enhance the yield of canola to satisfy the rising demand of consumers, but also to maximise profitability for producers.

Currently, the appropriateness of N fertiliser guidelines for canola in South Africa is questioned. These guidelines are adopted from international literature or from guidelines for wheat, and should be refined for the local environmental conditions.

The objective of this research project was to determine to optimal rate (kg N/ha) and time of N application for the Swartland (Altona and Langgewens) and the Southern Cape (Roodebloem). The effects of rate and distribution of N fertilisation on total soil mineral N, leaf area index (LAI), biomass production, agronomic N use efficiency (ANUE), water use efficiency (WUE), thousand kernel mass (TKM), grain yield and profitability were determined.

The average rainfall

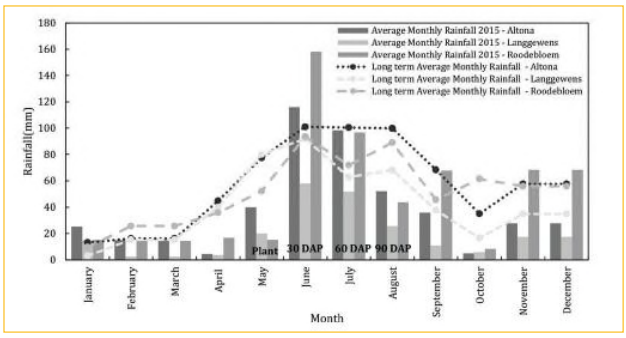
The 2015 season was characterised by dry conditions in the Swartland, with rainfall lower than the long-term average of most months. Roodebloem received higher than average rainfall during the leaf formation, stem elongation and flowering phases, while the rainfall during the remainder of the year was below the long-term average.

The average maximum daily temperatures in summer were generally similar or slightly lower than the long-term average daily maximum temperatures. The average minimum daily temperature was higher during August and September than the long-term average.

Soils of all sites were shallow (250 to 300mm) sandy loams with a high gravel content (>40%). The two Swartland sites were part of a crop rotation system where medics preceded canola the previous growing season, while wheat preceded canola at Roodebloem.

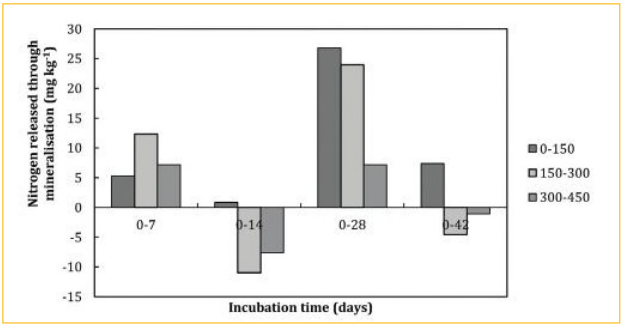
Total soil mineral N did not differ between treatments at Altona at 30, 60 or 90 days after planting (DAP), while at Langgewens the only difference in total soil mineral N was observed at 90 DAP. Nitrogen applied at a rate higher than 46kg N/ha, and at two intervals (30 and 60 DAP), resulted in a higher (P<0,05) total soil mineral N content. No differences (P>0,05) in LAI, biomass, ANUE, WUE, TKM or yield were observed between treatments at Altona and Langgewens.

Figure 1: Average long-term and monthly rainfall for 2015 for Altona, Roodebloem and Langgewens.



'Plant' indicates when the canola was planted, while 30, 60 and 90 DAP indicates the number of days after planting, when N fertiliser was applied.

Figure 2: Total soil mineral nitrogen released at soil depths of 0-150, 150-300 and 300-450 mm at Langgewens Research Farm after 7, 14, 28 and 42 days of incubation at 20°C and at 75% of field water capacity.



Higher biomass production

At Roodebloem, no differences in total soil mineral N were found between treatments. Although the LAI did not differ (P>0,05) between treatments, N fertilisation tended (P<0,1) to increase LAI at 30 DAP at Roodebloem. Treatments that received more than 70kg N/ha tended to have the highest LAI. There also was a trend (P<0,1) for higher biomass production at higher rates of N at 90 DAP at Roodebloem.

Figure 3: Summary of nitrogen fertiliser treatments applied at Altona, Langgewens and Roodebloem.

Experimental Unit	N-rate (kg ha^{-1})	At planting	30 DAP	60 DAP	90 DAP
0-0-0-0	0	0	0	0	0
20-0-0-0	20	20	0	0	0
20-40-0-0	60	20	40	0	0
20-20-20-0	60	20	20	20	0
20-13-13-13	60	20	13.3	13.3	13.3
20-70-0-0	90	20	70	0	0
20-35-35-0	90	20	35	35	0
20-23-23-23	90	20	23.3	23.3	23.3
20-100-0-0	120	20	100	0	0
20-50-50-0	120	20	50	50	0
20-33-33-33	120	20	33.3	33.3	33.3
20-130-0-0	150	20	130	0	0
20-65-65-0	150	20	65	65	0
20-43-43-43	150	20	43.3	43.3	43.3

The N fertiliser rate (kg/ha-1) is shown which was applied at different increments, viz, in order from left to right, fertiliser rate at planting (placed with seed) 30 days after planting (DAP), 60 DAP and 90 DAP.

Treatments that received more than 100kg N/ha at 30 DAP tended to have the highest (P<0,1) biomass production, with both treatments receiving the bulk of their total N rate at 30 DAP. Treatments that received more than 90kg N/ha, with applications of more than 23kg N/ha at 30 DAP, had the highest ANUE and WUE. At Roodebloem, treatments receiving 20kg/ha of N during planting, and a top dressing of more than 70kg N/ha at 30 DAP led to the highest yield.

No significant difference

These preliminary results indicated that in a low rainfall year, the application of additional N as a top dressing made no significant difference in yield in the Swartland. Due to the lower N mineralisation potential of Swartland soils, higher optimum levels of N are expected in normal and high rainfall years than in the Southern Cape.

The effect of treatments at Roodebloem might have been significant due to a combination of lower temperatures, sufficient soil moisture and high levels of N available during vegetative growth. Nevertheless, these results at Roodebloem indicate that treatments that received 20kg N/ha at planting and more than 50kg N/ha at 30 DAP led to the highest yield.

It can also be concluded from the results obtained in this study that the highest gross profit was realised by applying 0kg N/ha at the Swartland localities of Altona and Langgewens, in a year with poor rainfall distribution in a crop rotation system where canola was produced after medics. In the Southern Cape, applying N in excess of 70kg N/ha generated the highest gross income in a relatively normal rainfall distribution if compared to the long-term average of the area.

The hypotheses were as follows:

- H_1H_0: Increasing rates of N application will lead to increased yields to an optimum level.
- H_1H_1: Increasing rates of N application will not lead to increased yields.
- H_2H_0: Split application of N over more than one time of application will increase yield.
- H_2H_1: Split application of N over more than one time of application will not increase yield.

The H_1H_0 hypothesis was rejected at Altona and Langgewens as no differences in yield were found, while at Roodebloem, higher rates only increased yield up until 120kg N/ha, and, for this site, the H_1H_0 was accepted.

Recommendations from study

Split application of N over more than one time of application realised no difference in yield at Altona and Langgewens, and the H_2H_0 hypothesis was rejected at these localities. At Roodebloem, the H_2H_0 hypothesis is accepted as the highest yield was obtained at treatments where N was applied at planting and 30 days later.

With regard to the current study, it is recommended that it should be repeated in other years, before accurate general guidelines for N fertilisation of canola could be constructed. Lower than long-term average rainfall and higher temperatures may have influenced results, which is not typical of most other years. Future studies should also determine the total soil mineral N at harvest as well as the N content of the plants at harvest.

Canola is a good alternative to replace imported protein used in animal feed. Canola as cash crop in South Africa, and particularly the Southern Cape and Swartland regions, is a fairly young crop when compared to wheat or barley. Unpredictable establishment success and variable yields currently make farmers sceptical about canola cultivation.

Various agronomic factors and management practices that can lead to improved yield should therefore be researched. During the current study, only medics and wheat preceded canola.

Therefore, it is advised for further studies that the current trial be repeated with different preceding crops than only wheat and medics. The influence of the preceding crop on the availability of the residual N should then be incorporated in fertiliser guidelines.

Practices have changed

Current N fertiliser guidelines were developed in the 1960s. As can be expected, various management practices have since changed, including the adoption of minimum tillage and other conservation agriculture practices.

Minimum tillage supports organic matter accumulation in the topsoil, which in turn may lead to more plant available N in the topsoil. This implies that different N rates may be needed as additional application than what is currently prescribed. Regardless of these, guidelines are still based on outdated management strategies.

It is further recommended for crop modelling to be implemented to navigate the way forward and refine the recommendation rates by running the model for various scenarios and climatic conditions, to account for variation in temperatures, rainfall and mineralisation potential of soils.