5 Nutrition

5.1 Profit and nutrition

Profitable canola production depends a great deal on optimum and balanced plant nutrition. This section is general in nature as varying soil types, rainfall zones, seasons, varieties, rotations, fertiliser history and other factors will determine optimum fertiliser strategies. Detailed advice from your adviser(s) is recommended.

As is the case with all crops, the key to making the most from your fertiliser dollar lies in identifying (through observation, sampling, testing and recording) the most limiting nutrients in each paddock, in each season and then applying the optimum fertiliser rates. Rates are also influenced by achievable yield potential.

Comparing canola fertiliser needs to those of wheat
Research on wheat nutrition by the Department of Agriculture provides guidance for canola fertiliser decisions. From wheat research the following rules of thumb can be used to compare canola fertiliser needs to those of wheat:

- Where nitrogen is not limited canola will yield approximately half that of wheat (t/ha).
- Wheat response (kg/ha) to applied N is approximately double that of canola.
- Canola appears better at extracting phosphorous and trace elements from the soil than wheat. However it is recommended that phosphorus applications for canola equal that applied to wheat in the same situation. If in the year of production less P is applied than for wheat the following crop will require more P to replace the extra P extracted by canola.
- It is more critical when growing canola to ensure K levels are adequate.
- Canola has a higher sulfur requirement, especially in high nitrogen situations.
- Canola is more sensitive to low pH.
- Canola is less responsive to trace elements.

5.2 Soil nutrient content

Variations in soil nutrient levels occur from year to year and may also vary within paddocks. Paddocks should be regularly soil tested for nutrient status. Take soil test or plant tissue test samples from the poor and good areas of a paddock to determine the limiting nutrients.

The most commonly deficient nutrients in Western Australian soils are nitrogen and phosphorus. Potassium deficiencies are likely to occur on sandy soils and possibly on some duplex soils of the Great Southern. Increased yield response on header trails or swath rows, especially those that are burnt, are often an indicator of potash deficiencies or low soil pH levels.

Soils with low to moderate levels of organic matter are likely to be deficient in sulfur for canola.

Calcium and magnesium are generally not in short supply for crop growth in Western Australia although “induced” calcium deficiency in canola is becoming more common in dry soils and on deep sandy soils of high rainfall districts. Generally the application of lime and/or gypsum supplies adequate calcium requirements.

5.3 Fertiliser priorities and strategies

In practice nitrogen and sulfur deficiencies represent the vast majority of nutritional problems encountered in canola.

While there will be some exceptions the nutrients to be applied to canola in most situations can be prioritised in value for money order as listed below:

1. nitrogen, sulfur
2. phosphate
3. potassium
4. calcium, magnesium and trace elements.

However, this will change according to the most limiting nutrient at a particular site. For example, where there is a deficiency of potassium as shown by soil test; potash must be applied as the first priority or the investment in N, S & P will be wasted.

Points to consider

1. Excess nitrogen occurring later on during crop growth can reduce oil content and increase grain protein. This is most likely to occur when nitrogen supply is excess to requirements for the actual yield achieved. This can occur if simply too much nitrogen is available to the crop (eg. high rate of urea application on a long term clover pasture) or some other factor has limited the yield (eg. late sowing, sulfur deficiency, insect damage, dry spring).
2. In most situations, time of sowing and environmental factors such as high temperatures during pod fill, have a greater impact on oil concentration than nitrogen.
3. Excess rates of other nutrients do not appear to reduce oil content.

Fertiliser strategy

1. **Apply nitrogen within 8 weeks of seeding.**
   For maximum effect nitrogen needs to be available to the canola plant at the beginning of stem elongation. There is no consistent benefit in delaying nitrogen application beyond this stage. It may be a realistic option to apply all nitrogen at seeding in low rainfall districts with little risk of leaching loss especially for short season varieties, however delaying applications allows yield potential to be better assessed prior to applying additional nitrogen. In areas of high leaching risk 30–60% of N should be applied at seeding with the balance at 4–6 weeks, or possibly, split 4 & 8 weeks after seeding.
2. **Ensure that sulfur is in a form that is readily available to the plant.**
   Plant roots take up S as sulfate. Common sources are compound fertilisers high in sulfur (eg. Agstar and Allstar), sulfate of ammonia products and gypsum. Elemental sulfur is only effective when it is in a fine powdered form, and then mostly not until spring when warm conditions allow soil bacteria to oxidise S and release sulfate.
3. **Fertiliser toxicity is a very real risk when high rates of nitrogen are drilled close to the seed.**
   The risks increase when seeding with knife points, sowing into dry soil and using wider row spacing. In practice, 20–25 kg N/ha with the seed is safe when sowing into moist soil with full cut points. For knife points on 180 mm spacings 15 kg N/ha is a maximum which should be further reduced if soil moisture is marginal or using wider row spacings. Try to minimise the amount of N in close proximity to the seed.
4. **Regular soil testing is strongly recommended to further refine the decision for individual situations.**
5. **K compounded products give a good starter level of K.**

5.4 Nitrogen

Nitrogen is a very important nutrient for canola growth and high yields. It is important in the production of many compounds in the plant, including protein and chlorophyll. A shortage of nitrogen results in very pale plants. Nitrogen is an important component of protein in canola meal but excess N can reduce the oil content of the grain.

Nitrogen is also very mobile in the plant. During a period of deficiency, nitrogen is remobilised in older leaves and moved to the younger growing tissue of the canola plant. As a result, deficiency symptoms first show in the oldest leaves.

Table 3. Best Bet Guide to N fertiliser for canola following different phases in the rotation and rainfalls

	Rainfall zone		
	Low < 330 mm	Medium 330–460 mm	High 460–600 mm
Yield potential (t/ha)	0.8 – 1.2	1.2 – 1.8	1.8 – 2.5
Previous phase	Rate of nitrogen (kg N/ha)		
Cereal	30 – 60	50 – 80	80 – 110
Legume or pasture	20 – 40	30 – 50	50 – 80

Canola is not as likely to 'hay off' as are cereals when too much nitrogen has been applied therefore fertilise canola according to the crops potential and soil nitrogen status.

Nitrogen deficiency (Photo courtesy David Sermon, ConsultAg).

Placement and timing

Nitrogen's ability to increase canola yields can be significantly affected by the method of placement and time of application.

Rates of nitrogen that would normally cause little or no damage to wheat or barley can cause severe reduction in germination and emergence of canola when placed with the seed. Urea based fertilisers are particularly damaging at emergence due to ammonia toxicity and should not be placed with the seed.

However, compound fertilisers containing both phosphorus and nitrogen can be placed with the seed. Applying phosphorus fertiliser in the same operation will reduce the cost. Side-band placement is the best method of applying fertilisers containing nitrogen (30 kg N/ha) in paddocks with little risk of leaching. However, at high rates of nitrogen, a 2.5 centimetre separation of seed and fertiliser bands may not be sufficient to prevent harmful effects.

Be aware that leaching losses could be severe if nitrogen is applied in the nitrate form. The ammonium form of nitrogen is more stable as it binds to the soil colloids.

Canola plants take up a large proportion of their nitrogen in the growth stages before flowering. This helps establish the number of branches, flowers and eventually pods. Nitrogen must be available early when it is needed most.

Rainfall immediately after broadcasting additional nitrogen will incorporate the nitrogen into the soil and move the fertiliser safely into the root zone. Be aware that urea is more subject to volatile losses at high temperatures, high soil pH, wind, low organic matter and intermediate humidity than other nitrogen sources.

Broadcasting granular fertiliser or spraying liquid nitrogen after the crop has emerged may cause damage if the foliage is wet.

Yield potential for canola is established during stem elongation and the budding stage, so all nitrogen should be applied before this stage of growth (8 to 10 weeks) after seeding.

Inadequate nitrogen or poor timing of application is a major reason why many canola crops set a low, or fail to reach, yield potential. Insufficient nitrogen also reduces returns on other investments in a canola crop, including other nutrients.

Use of liquid N fertiliser may increase flexibility of timing and provide better seasonal management of N levels.

Application options

- In heavier soils in low rainfall districts, all nitrogen can be applied at seeding. In medium to high rainfall areas where there is a greater risk of waterlogging and hence losses of nitrogen through denitrification, growers would be advised to consider splitting their nitrogen applications pre- and post-emergent. Broadcast or band N before, or at seeding, so that the seeder will bury most of the nitrogen. Further N could be applied if the season becomes favourable and yield potential is higher.
- On deeper sandy soil it is better to split the application with 60% of N at seeding, then broadcasting the balance four to six weeks after emergence, before stem elongation.
- In the lower rainfall districts, additional nitrogen can be added if the crop has a high yield potential, but again, applied four to six weeks after emergence.
- Under waterlogged conditions liquid fertilisers, such as UAN (eg. Flexi N), appear to be more readily absorbed by the canola plant, providing more rapid recovery. Growers in 2005 were able to stimulate growth, which resulted in good yields, through the strategic use of liquid fertilisers. The quick response is most likely due to the form of N applied.
- It is vital not to delay all second applications until the stem elongation stage. Do not allow canola to run out of available nitrogen.

5.5 Phosphorus

Soil phosphorus occurs in both organic and inorganic forms. Canola roots absorb only inorganic phosphorus present in the soil solution.

Phosphorus plays an important role in energy storage and use. Lack of phosphorus restricts root growth. This results in poorly developed root systems; spindly, thin stems with few branches and small narrow leaves. Severe phosphorus deficiency may cause a dark bluish colouration of leaves, often accompanied with purple or reddish colourations.

Phosphorous deficiency

(Photo courtesy David Sermon, ConsultAg).

Placement and timing

Phosphorus should be placed close (within 2–3 cm) to the seed to obtain an early boost to growth. Canola has the ability to start absorbing banded phosphorus in large amounts at an early growth stage. Canola generally absorbs more total phosphorus than cereals and it is also a very effective scavenger for soil phosphorus. The phosphorus requirement of canola is usually met by sowing the seed with an appropriate rate of an NPS-based fertiliser, determined by soil sample analysis.

Canadian research shows that the yield response of canola to both nitrogen and phosphorus fertiliser is nearly double the response of canola to nitrogen alone and around eleven times that of phosphorus alone.

5.6 Sulfur

Canola has a higher sulfur requirement than cereals as it is crucial to the synthesis of oil and proteins. Sulfur is also required for the formation of chlorophyll, vegetative growth and total dry matter production. The required nitrogen:sulfur ratios for canola are lower than for wheat so available sulfur needs to be considered when applying nitrogen.

Most sulfur in soil is contained in organic matter as proteins, amino acids and other compounds not immediately available to plants. Plants can only use sulfur in the sulfate form. Two common sources of sulfur are gypsum and ammonium sulfate. Gypsum is a good source of sulfur (16–18%) because unlike sulfate of ammonia it does not cause acidification of the soil. During the cool wet months of July and August, sulfur mineralisation is low (due to low soil micro-organism activity) and root exploration of the soil volume is low. This can result in the plants being unable to access sufficient sulfur, resulting in temporary deficiency symptoms showing in patches. Later when the soil warms up there is sufficient sulfur mineralisation to provide enough of the mineral to the growing plant.

Sulfur deficiency (Photo courtesy Graham Walton, DAWA).

Potassium deficiency (Photo courtesy DAWA).

Sulfur deficiency in canola crops is more common on deep sandplain soils and where leaching has moved residual sulfur from the root zone. Paddocks with a history of low sulfur fertiliser application are also a risk. Sulfur-deficient symptoms can be detected at all stages of growth. Unlike nitrogen and phosphorus, sulfur is not mobile in the plant, and therefore, new leaves, flowers and pods at the top of the branches are more likely to be deficient in sulfur than older leaves and pods.

Soil disturbance at sowing helps to increase available sulfur as organic matter breaks down, releasing useable sulfate. A strong trend towards direct drill and no-till may explain why there is increasing occurrence of sulfur deficiency in canola in some districts.

Maximum responses to sulfur fertiliser in trials occurred at rates of 10 to 20 kg/ha on soils which were very deficient in sulfur.

5.7 Potassium

Adequate supply of potassium (K) provides plants with increased disease and drought tolerance, and increased starch production. Canola crops take up large amounts of K during growth, but only a small proportion of this is accumulated in the seed. Few responses to potassium fertiliser in seed or oil yield have been recorded. Deficiencies are more likely to show up in following cereal crops, in the high rainfall districts, on sandy surfaced soils where the depth to gravel or clay is more than 40–50 cm and soil potassium test is below 50 ppm.

K should not be placed with seed due to toxicity from the salt load affecting emergence.

5.8 Calcium, magnesium and micronutrients

Calcium (Ca) and magnesium (Mg) are generally not required to be applied for canola crop growth in Western Australia. Ca is less mobile in dry soils, and therefore, under dry conditions Ca deficiency symptoms may be seen during the rapid growth stages of stem extension and flowering.

Canola requires a supply of all essential micronutrients to produce a healthy crop.

There is a limited amount of information on micronutrient responses in canola throughout Western Australia. Until further trial data can establish what effect they have on oil and yield, growers are advised to apply micronutrients as they would for wheat in a similar situation.

Trace element responses in canola are rare in WA. Confirm any suspected deficiencies with a tissue test before purchasing foliar trace element sprays.

5.9 Soil conditions

Soil acidity and aluminium toxicity

Canola has a similar tolerance to soil acidity as barley. Canola's preferred pH range is above 4.5. Canola will tolerate alkaline soils with a pH of up to 8.3 before serious yield reduction occurs.

On strongly acid soils plant root growth may be affected directly by the toxicity of hydrogen ions or by high levels of aluminium, which becomes increasingly soluble at pH below 4.5. Aluminium toxicity can cause foliar injury due to reduced uptake of nutrients and/or pathogen attack which are more pronounced in aluminium toxic, acid soils. Nutrients such as P and N are generally less available in acid soils due to lower microbial activity and chemical reactions of iron and aluminium with P to form insoluble compounds.

Soil tests for pH are recommended before growing canola and can be undertaken in late summer with the soil fertility test. Surface soil samples (0–10 cm) should be taken along with deeper samples (10–20 cm, and 20–30 cm) to check for sub-soil acidity.

Growers should have a good understanding of their soil pH values across the property and should be considering liming (apply 1–2 t lime/ha) if the pH is below 4.5, particularly where canola is part of the rotation.

Results from two trials in the Lakes district in 1997 showed consistent positive yield responses to lime application (DAWA). Canola responded to lime only one year after application at two sites, while responses in wheat yield can often take two or more years depending on the conditions.

Salinity

In the absence of waterlogging canola is considered moderately salt tolerant at a level similar to barley.