4. Crop rotation and paddock selection

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CROP ROTATION

Any crop rotation should be based on sound principles but remain flexible to allow for variations in the seasonal break, commodity prices and changing circumstances. What happens in one paddock is linked to activities across the farm, such as balancing grazing demands or spreading commodity and financial risk.

It is also important that economic returns from a canola crop are considered for the full term of the cropping rotation and not just on an individual crop basis. Research has shown that the benefits from growing canola can flow on to subsequent crops for two or three years after the initial canola crop. While preparing a simple gross margin on the canola crop will give a guide to the input costs and potential returns, it does not take longer-term benefits into consideration nor does it spread some long-term costs – such as the application of lime – over several crops.

The benefits of having canola in the rotation include:

- reduced incidence of diseases such as take-all, crown rot and common root rot in winter cereal crops grown after canola through the removal of their grass weed hosts.
- numerous studies have demonstrated an average yield increase of 20 per cent in wheat crops grown after canola compared to wheat grown after wheat. If disease levels are high, the yield increase may be significantly more than 20 per cent;
- canola leaves a more friable topsoil which is well suited to the direct drilling of the following cereal crop;
- rotation of herbicide groups reduces the potential for herbicide resistance to develop and for herbicide residues to accumulate in the soil. It also results in better longer-term control of weeds;
- spreads the time available to use machinery and labour because of canola’s earlier sowing and harvest timing relative to cereals; and
- provides a range of grain delivery and marketing options. Selling grain off the header at harvest can give growers an early cashflow and reduce on-farm storage demand, while storing or warehousing canola can spread price risk and provide marketing flexibility.

These benefits can result in a more profitable and sustainable farming operation by:

- consistently producing higher yielding, more profitable cereal crops;
- more diversified income from growing a range of crop types;
- an alternative to cereals with an established and stable marketing system;
- improved weed control and herbicide resistance management;

Canola leaves the soil friable for direct drilling a cereal crop, saving fuel and valuable soil carbon.
PHOTO: D. MCCAFFERY, NSW DPI
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- enabling more efficient use of machinery and labour because of a broader spread of crop preparation, sowing and harvesting operations;
- reduced competition with wheat and other grains for on-farm grain storage as canola is not usually stored on farm; and
- providing a range of marketing options to manage price risk.

While there is no single ‘best’ cropping rotation, the most efficient rotation is one where disease, weeds and the risk of production failure can be minimised while fertility and profitability are maximised. The most benefit from rotating crops will be achieved by avoiding growing, where practical, a cereal following a cereal crop, or a broadleaf crop following another broadleaf crop.

Although many growers in southern New South Wales have successfully grown canola in a canola-wheat-canola-wheat rotation, the unpredictability of returns from canola due to seasonal conditions and disease has made this a more risky rotation and much less common than a rotation that contains about 25–30 per cent break crops, consisting primarily of canola.

A good rotation could incorporate the following sequence of crops:
- legume pasture (for example medic, clover or lucerne) – to restore nitrogen and build up soil organic matter;
- canola – to use some of the nitrogen fixed and to break cereal root disease cycles;
- cereal crop (for example wheat) – to provide an alternative crop type, utilise more nitrogen and provide alternative options for weed control;
- pulse crop (for example lupins, field peas) – to restore nitrogen and provide a disease break;
- cereal crop (for example wheat) – exploit residual fertility and provide options for weed control prior to pasture; and
- undersown cereal crop (for example barley) – to assist with the rapid establishment of the next pasture phase.

Although the yield potential of canola is usually higher after a legume dominant pasture phase, it can be successfully grown later in the rotation with adequate nitrogen inputs.

In high rainfall, longer season districts, yields in excess of 3.5 t/ha have been achieved where canola has been sown after a long-term legume pasture.

Canola has also been used as a cover crop for the establishment of a pasture at the end of a cropping rotation. Although this can be very successful, it means that one of the major benefits of using canola in the rotation – to maximise the yield potential of a following cereal crop – is lost. However, this could be justified in some situations, for example if adverse seasonal conditions such as drought have affected the planned crop sequence.

Be careful when growing canola on alkaline soils that have been heavily cropped without much fertiliser. Fertilisers containing phosphorus, zinc, nitrogen and sulfur will probably be needed much earlier in the rotation than if only cereals and pulses were grown.

Canola in summer crop rotations

Growers of grain sorghum and cotton on alkaline soils in northern NSW have reported low yields and poor growth following canola, particularly on the Liverpool Plains. This is due to the depletion of soil micro-organisms called arbuscular mycorrhizal fungi (previously known as VAM fungi). They are beneficial soil fungi that assist the uptake of phosphorus and zinc, which would otherwise be unavailable to the crop. Canola does not need these fungi to help it take up phosphorus and zinc so under canola the fungal population declines to a low level. To avoid this problem, follow canola with a short fallow crop such as wheat or another cereal crop rather than pulses or long fallow crops like sorghum and cotton that depend on arbuscular mycorrhizal fungi.

Biofumigation

Biofumigation is the chemical effect that some Brassica species have on soil micro-organisms in a rotation cropping system. It is thought the breakdown compounds from glucosinolates in decaying roots, called isothiocyanates, suppress soil-borne pathogens which cause cereal root diseases such as take-all and crown rot. However, research has found no biofumigation effect on cereal root diseases from a previous crop of canola, with most of the increased cereal yield due to the removal of the grass weed hosts of the disease.

Paddock selection

As well as early preparation and good crop management, success with canola depends on careful paddock selection. The four major considerations when selecting a paddock...
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to grow canola in rotation with other crops are:
- soil type;
- potential disease problems;
- previous herbicide use; and
- broadleaf weeds.

Choosing more reliable and weed-free paddocks is the best option.

When coming out of a pasture phase, start paddock selection and preparation at least 12 months before sowing to ensure that potential problems are addressed. It is better to soil test during the previous winter and initiate pasture and fallow management early enough to effectively control broadleaf and grass weeds and establishment pests such as redlegged earth mites.

In a continuous cropping rotation, a fallow, hay or green manure crop can reduce the weed burden. Alternatively, use competitive crops such as wheat or barley before canola to assist in the reduction of weed seed numbers. If a pulse is the prior crop, strategic weed control can have significant benefits, especially where problem weeds are difficult to control in canola.

Soil types
Canola generally grows best in fertile soils. In mixed livestock and cropping areas, it is ideally grown immediately after pasture.

High yields can also be obtained after a fallow or a cereal, provided adequate nitrogen fertiliser is used. Canola will not perform well in low fertility paddocks. Generally the best wheat growing soils will produce the best canola crops. Paddocks with a uniform soil type will permit a more even sowing depth, seedling emergence and more even crop ripening.

Avoid growing canola where there are the following problems:

Hardpans
Although canola is a tap-rooted plant, it is not strong enough to penetrate some tight hardpans and can still suffer from ‘J’ rooting problems. Paddocks should be checked 12 months in advance by using a soil probe or by digging a small pit to visually assess a suspected problem and determine the depth of working or ripping that may be required to break up any hardpan.

Crusting soils
The surface of a soil can crust after rainfall and reduce plant establishment if it is poorly structured with low organic matter levels or if it is a sodic clay that disperses after wetting. The use of gypsum and/or stubble retention on hard setting sodic clay soils can improve seedling emergence and early growth.

Acid soils
Canola is more susceptible to low pH and aluminium toxicity than most other crops. If you expect the pH\text{Ca} to be less than 5.0, have the canola paddock soil tested in the previous winter. If acidic subsoil is suspected, take split samples of 0–10 and 10–20 cm depths. Where a pH\text{Ca} level of less than 4.7 is combined with an exchangeable aluminium level of three per cent or more, do not grow canola before obtaining specific advice. Other good indicators of possible acidity problems are poor growth in barley and lucerne or where oats and triticale grow better than wheat. Consider using lime when the topsoil pH\text{Ca} drops below 5.0. For more information see Chapter 7 on nutrition (page 31).
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Waterlogging
Soils become waterlogged when rainfall exceeds the infiltration capacity of the soil. It is most common in soils with a sodic clay subsoil of low permeability. However, hardpans can also induce waterlogging. The presence of a sodic subsoil problem can be identified by a simple soil testing procedure (dispersion test) backed up by laboratory chemical analysis. Avoid these soils unless they have a good depth of well drained topsoil which allows for adequate root growth even after heavy rainfall. Using raised beds has been a successful strategy for reducing the impact of waterlogging in high-rainfall areas of south-western Victoria and Western Australia.

Potential disease problems
Blackleg is the major disease of canola in Australia and can significantly reduce yields, especially in higher rainfall districts (see p. 59).

Research has shown that 95–99 per cent of blackleg spores originate from the previous year’s canola stubble. Spores can travel more than one kilometre on the wind but most travel shorter distances, so selecting a paddock as far away as possible from the previous season’s canola stubble will help to reduce the disease pressure. Where possible, a buffer distance of 500 metres is recommended. On larger farms it may be possible to implement a system of block farming whereby blocks of several paddocks of a particular crop type are rotated around the farm to maintain an adequate buffer distance. Reducing canola stubble by raking and burning only provides limited benefits in reducing the disease level as not all the infected stubble or old roots are destroyed. Growing blackleg resistant varieties in combination with an appropriate fungicide treatment, if necessary, is the best way of minimising yield losses.

Careful paddock selection can also assist in reducing the impact of another potentially serious canola disease, sclerotinia stem rot (S. sclerotiorum). Sclerotinia is an intermittent problem in many canola growing districts, particularly central and southern NSW. It has a wide host range of broadleaf plants and weeds, including lupins, chickpeas, field peas, faba beans, sunflowers, capeweed and Paterson’s curse. Growing canola after any of these crops or in paddocks that have had heavy populations of these weeds can increase the risk of sclerotinia stem rot, especially when canola is grown under irrigation or in higher rainfall areas.

Previous herbicide use
Canola is particularly susceptible to a range of residual herbicides. Under certain seasonal conditions (dry) or in particular soils (alkaline) residues from a herbicide applied to a previous pulse or cereal crop can persist into the next cropping season. For example, the sulfonylurea group (for example chlorosulfuron, sulfosulfuron) used in cereal crops have a canola plant-back period of between 24 and 30 months. Similarly, some herbicides registered in pulse crops can have plant-back periods ranging from nine months (simazine), 24 months (flumetsulam) to 34 months (imazethapyr). The use of these herbicides can therefore restrict crop options and prevent canola being sown for up to three years.

The use of various herbicide tolerant (TT or Clearfield®) canola varieties coupled with their companion herbicides...
Canola best practice management guide

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(triazines or Group B herbicides) can restrict crop selection options in the following year. Plant-back periods are provided on herbicide labels for sensitive crops under these conditions.

Weeds
Weeds can affect crop yield either through direct competition or possibly as hosts for diseases such as sclerotinia. In particular for canola, a number of Brussica weeds can cause significant problems.

Growers should be aware of the following four important Brussica weeds when selecting a paddock for canola:
- charlock (Sinapis arvensis);
- wild radish (Raphanus raphanistrum);
- wild or Mediterranean turnip (Brassica tournefortii); and
- wild cabbage or Hare’s ear (Conringa orientalis).

Each of these weeds has a similar seed size to canola and cannot be easily removed from canola grain samples. As they contain approximately 50 times more erucic acid in the oil and about 10 times more glucosinolates in the seed than found in canola, any contamination could result in the crop being rejected at delivery because of the impact on oil and meal quality.

Other problem Brussica weeds have smaller seed than canola and are usually removed during harvesting. These include shepherd’s purse (Capsella bursa pastoris), turnip weed (Rapistrum rugosum), muskweed (Myagrum perfoliatum) and the mustards (Sisymbrium spp.). These weeds reduce yield through competition, for example, shepherd’s purse may be a problem weed of canola grown after a pasture phase.

If sowing canola into paddocks where any of these Brussica weeds are present, select an appropriate herbicide resistant variety. Growing triazine tolerant (TT), Clearfield® or Roundup Ready® canola allows problem broadleaf weeds to be managed. However, eradicating problem weeds or reducing their seed populations prior to sowing is preferable.

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DUAL-PURPOSE CANOLA (GRAZING AND GRAIN)

The concept of using canola for grazing and grain (dual-purpose) has been tested in experiments and on commercial farms in southern Australia since 2004 with excellent results.

Dual-purpose canola can increase total crop profitability on mixed farms by providing a source of high-value fodder during the winter feed-gap as well as a high value grain. It provides an alternative to dual-purpose winter wheat where Wheat streak mosaic virus has reduced the viability of this option and eases grazing pressure on pastures in winter.

Spring canola types can be sown two or three weeks earlier than normal (early-mid April). Early sowing can result in significant biomass (2–3 t/ha) by mid-winter to fill the winter feed gap. Although any canola variety can be used as a dual-purpose crop, mid to mid-late maturing types for the area will be best suited to an earlier sowing. Other considerations in varietal choice include:
1. the higher biomass production of hybrids compared with conventional or triazine tolerant varieties of similar maturity;
2. weed control options for the variety in relation to chemical withholding periods for grazing; and
3. grazing tends to increase blackleg severity so choose a variety with a high blackleg resistance rating (MR+), especially in high-risk situations.

Canola is palatable to livestock and has high feed value. In 20 separate grazed paddock-scale experiments sheep liveweight gains of 210–300 g/day were achieved with no animal health problems. At least 600 to 800 dry sheep equivalent (DSE) x grazing days/ha were achieved in most cases.

Grazing can commence from the six to eight-leaf stage when plants are well anchored (biomass > 1.5 t/ha) and continue until buds have elongated no more than 10 cm. Grazing later than this growth stage will delay flowering and potentially reduce yield and oil content. Crops with good grazing management can yield the same as un-grazed grain-only crops sown at the standard time (early May) depending on seasonal conditions for regrowth. Topdressing nitrogen after stock removal will maximise regrowth and yield potential.

The following guidelines for growing dual-purpose canola have proven successful:
- select a variety with medium-late maturity for the area, with good blackleg resistance (MR–R) and high vigour – consider herbicide withholding periods in this decision;
- sow in a paddock planned for canola up to four weeks earlier than normal if the opportunity arises (early to mid April) into adequate moisture to ensure even germination;
- commence grazing when plants are well anchored and there is sufficient biomass for grazing, usually at or after the six to eight-leaf stage;

Canola sown as a dual-purpose crop can be grazed by a range of stock classes. PHOTO: N. COUTANCHE, LACHLAN FERTILISERS
ensure sufficient stock are available to capitalise on the high-value forage. Plan on around 600–800 DSE x grazing days/ha (for example, four weeks @ 25 DSE/ha) and graze evenly for uniform maturity. Few animal health issues have been reported but use the section on “Minimising stock health risks” (Chapter 11) as a guideline;

- remove stock before stem elongation (bolting) to avoid a yield or oil penalty, or graze elongated crops lightly to avoid stock removing the main stem. Heavy or late grazing delays flowering and increases the risk of yield and oil penalties;

- assess the potential yield penalty of grazing against the grazing value and overall system benefits including pasture spelling and break crop benefits in evaluating the concept; and

- consult local agronomists for the latest recommendations and try small areas first.