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GRDC™ GROWNOTES™

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION

CANOLA

SECTION 1

PLANNING AND PADDOCK PREPARATION

PADDOCK SELECTION | ROTATIONS AND PADDOCK HISTORY | FALLOW WEED CONTROL | FALLOW CHEMICAL PLANT-BACK PERIODS | SEEDBED REQUIREMENTS | SOIL MOISTURE | YIELD AND TARGETS | POTENTIAL DISEASE PROBLEMS | NEMATODE STATUS OF PADDOCK

SECTION 1

Planning/Paddock preparation

1.1 Paddock selection

More information

Agriculture Victoria: Growing canola

IPNI: Juncea canola in the low rainfall zones of Victoria and South Australia

NSW DPI: Juncea canola in the low rainfall zone of south-western NSW

Bayer Crop Science: Canola talk

PIRSA: Mid North Region—land use potential for canola

Research paper: Canola industry in South Australia

In addition to early preparation and good crop management, success with canola cropping depends on careful paddock selection. The major considerations when selecting a paddock to grow canola in rotation with other crops are:

- soil type
- potential disease problems
- previous herbicide use
- broadleaf weeds

Choosing more reliable and weed-free paddocks is the best option (Figure 1). When coming out of the pasture phase it is desirable to soil-test during the previous summer and autumn and then to initiate pasture and fallow management by spring to control broadleaf and grass weeds, and establishment pests such as redlegged earth mites.

In a continuous cropping rotation, aim to keep weed numbers low through the use of fallow, hay or green/brown manure crops. Integrated weed management strategies including crop competition, crop-topping and harvest weed seed management should also be adopted. [1]

Figure 1: Choosing more reliable and weed-free paddocks is the best option for canola.

[1] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

1.1.1 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 (N) fertiliser is used, and after green manure crops if soil water is not limiting. 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 more even sowing depth and seedling emergence and more even crop ripening.

Avoid growing canola where the following problems occur: [2]

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. [3]

Many soils of southern New South Wales (NSW) appear to have sufficient cracks and biopores to enable root penetration through all but the hardest compaction layers. Deep ripping is not recommended as a standard tool for overcoming hardpans prior to sowing canola crops. Studies have rarely found significant yield responses to deep ripping. [4]

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 a sodic clay that disperses after wetting. The use of gypsum and/or stubble retention on hardsetting sodic clay soils can improve seedling emergence and early growth. [5]

Acid soils

Canola is more susceptible to low pH and aluminium (Al) toxicity than most other crops. If you expect the pHCa to be <5.0, have the prospective canola paddock soil-tested. If acidic subsoil is suspected, take split samples of soil depths 0–10 and 10–20 cm.

The depths of the deeper segments probably depend on individual soils, so limiting to a second 10-cm segment could be inconclusive.

Agronomist's view

Where a pHCa <4.7 is combined with exchangeable Al level of ≥3%, do not grow canola before obtaining specific advice. Other indicators of acidity problems are poor growth in barley and lucerne, or if oats and triticale grow better than wheat. Consider using lime when the topsoil pHCa drops to <5.0. [6]

Provided the surface soil is not acid, canola appears relatively tolerant of subsurface acidity, except where exchangeable Al exceeds 20%, where there is manganese

[2] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[3] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[4] G Poile et al. (2012) Canola and subsoil constraints Technical Bulletin April 2012. EH Graham Centre, https://www.csu.edu.au/__data/assets/pdf_file/0003/922764/Canola_-and-_subsoil_constraints.pdf

[5] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[6] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

toxicity, or where the acid 'throttle' is more than 20 cm deep. Typical subsurface acidity can be managed by liming the surface to pH Ca 5.5. [7]

Waterlogging

Soils become waterlogged when rainfall exceeds their infiltration capacity. It is most common in soils with a sodic clay subsoil of low permeability. However, hardpans can also induce waterlogging. 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. Use of raised beds has been a successful strategy for reducing the impact of waterlogging in high-rainfall areas of south-western Victoria and Western Australia. [8]

More information

GRDC: Canola best practice management guide for south-eastern Australia

1.2 Rotations and paddock history

Canola is an excellent choice to enhance or extend a crop rotation. It produces a high yield and can be a profitable crop in its own right as well as an excellent fit with cereals and pulses.

The average yield of canola across Victoria between 2002 and 2007 was 1.3 t/ha, which includes three drought years. Yields of >4 t/ha are achieved by some farmers in better years, especially in higher rainfall regions such as south-western Victoria and sometimes under irrigation. Cereal yields after canola are often enhanced because of the 'disease cleaning' that occurs when an unrelated crop type, such as canola, is alternated with cereals and is kept free of grassy weeds.

Canola in the rotation allows farmers to improve management of weeds because canola is a broadleaf crop and there are different herbicide-tolerant varieties of canola. [9]

Canola can reduce but not eliminate the incidence of some cereal root and crown diseases, such as crown rot, take-all and cereal cyst nematodes. Research has shown canola to be the most effective winter crop for reducing levels of crown rot in subsequent wheat crops.

Canola can have both positive and negative effects on subsequent crops. Canola is non-mycorrhizal, and so levels of arbuscular mycorrhizal fungi (AMF) can fall under canola. This may disadvantage subsequent crops that are highly dependent on AMF. Crops affected include all commonly grown summer crops (sorghum, cotton, maize, sunflowers and the summer pulses) as well as faba beans and chickpeas.

Wheat, barley and oats have a low dependence on AMF, and so they can be readily grown in rotation with canola.

Research has shown that wheat yield increases of ~0.6–1.0 t/ha can be expected when following canola compared with following wheat.

No-tillage, which retains more stubble, is increasing the carryover of many of the main cereal diseases, such as crown rot, in NSW. Canola fits well into this system by allowing an additional season for cereal stubble breakdown to occur, therefore reducing the carryover of disease.

Maintaining a rotation of one canola crop every 4 years also minimises the potential for disease build-up in the canola.

The use of triazine-tolerant (TT) varieties of canola has helped to control difficult weeds such as mustards, wild radish and sow thistle.

7 M Conyers et al. (2010) Canola yield decline in south-eastern Australia. Grassroots Agronomy, http://www.grassrootsag.com.au/CiD%20low%20res.pdf

8 P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

9 S Holden (2010) Growing canola. AG0750. (Revised 2012 by F Prichard, C Bluett). Agriculture Victoria, http://www.depi.vic.gov.au/agriculture-and-food/grains-and-other-crops/crop-production/growing-canola

More information

[GRDC: Over the bar with better canola agronomy]

[GRDC: Canola best practice management guide for south-eastern Australia]

Rutherglen bugs may be present in large numbers on canola stubble around harvest time. These can readily move into neighbouring summer crops or crops planted directly into the canola stubble, causing serious damage. [10]

1.3 Fallow weed control

Weeds can affect crop yield either through direct competition or possibly as hosts for pathogens such as *Sclerotinia*. In particular, for canola, a number of *Brassica* weeds can cause significant problems.

Growers should be aware of the following important *Brassica* weeds when selecting a paddock for canola:

- charlock (*Sinapis arvensis*)
- wild radish (*Raphanus raphanistrum*)
- wild or Mediterranean turnip (*Brassica tournefortii*)
- wild cabbage or hare's ear (*Conringia orientalis*)

Each of these weeds has a seed size similar to canola and they cannot be easily removed from canola grain samples. Because they contain ~50 times more erucic acid in the oil and ~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 *Brassica* weeds have smaller seed than canola and they are usually removed during harvesting. These include shepherd's purse (*Capsella bursa-pastoris*), turnip weed (*Rapistrum rugosum*), musk weed (*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.

More information

[AOF: Canola volunteer control guide]

If sowing canola into paddocks where any of these *Brassica* weeds are present, select an appropriate, herbicide-resistant variety. Growing 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. [11]

Paddocks usually have multiple weed species present at one time, making weed-control decisions more difficult and often involving a compromise after assessment of the prevalence of key weed species. Knowledge of your paddock and controlling weeds as early as possible are important for good control of fallow weeds. Information is included for the most common problem weeds; however, for advice on individual paddocks, contact your agronomist.

Benefits of fallow weed control are significant:

- Conservation of summer rain and fallow moisture is integral to winter cropping in the southern region, particularly so as the climate moves towards summer-dominant rainfall. Long fallow is undertaken in more marginal areas of the south.
- Modelling studies show that the highest return on investment in summer weed control is for lighter soils or in situations where soil water that would support continued weed growth is present. [12]

[10] L Serafin, J Holland, R Bambach, D McCaffery (2005) Canola: northern NSW planting guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/148300/canola-northern-NSW-planting-guide.pdf

[11] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[12] GRDC (2012) Make summer weed control a priority. Southern Region. Summer Fallow Management Fact Sheet, GRDC January 2012, http://www.grdc.com.au/GRDC-Manual-SummerFallowWeedManagement

1.4 Fallow chemical plant-back periods

Canola is particularly susceptible to a range of residual herbicides. Under dry seasonal conditions or in alkaline soils, residues from herbicide applied to a previous pulse or cereal crop can persist into the next cropping season. For example, the sulfonylurea group (e.g. chlorsulfuron, sulfosulfuron) used in cereal crops have a canola plant-back period of 24–30 months. Similarly, some herbicides registered in pulse crops can have plant-back periods ranging from 9 months (simazine) to 24 months (flumetsulam) to 34 months (imazethapyr). The use of these herbicides can therefore restrict crop options and prevent the sowing of canola for up to 3 years. The use of various herbicide-tolerant (TT or Clearfield®) canola varieties coupled with their companion herbicides (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. [13]

Plant-back periods are the obligatory times between the herbicide spraying date and safe planting date of a subsequent crop. Many plant backs also have rainfall requirements in addition to the time period.

Some herbicides have a long residual. The residual is not the same as the half-life. Although the amount of chemical in the soil may break down rapidly to half the original amount, what remains can persist for long periods, as is the case for sulfonylureas (chlorsulfuron). Herbicides with long residuals can affect subsequent crops, especially if they are effective at low levels of active ingredient, such as the sulfonylureas. On labels, this will be shown by plant-back periods, which are usually listed under a separate heading or under 'Protection of crops etc.' in the 'General Instructions' section of the label. [14]

More information

Australian Pesticides and Veterinary Medicines Authority

NSW DPI: Using pre-emergent herbicides in conservation farming systems

NSW DPI: Weed control in winter crops

Research paper: Sulfonylurea spray contamination damage to canola crops

1.5 Seedbed requirements

Seed–soil contact, especially under dry conditions, is crucial for helping moisture to diffuse into the canola seed. Emergence of canola seedlings can be reduced by the formation of soil crusts in hardsetting, sodic or dispersing soils. Sodic or dispersing soils that surface-seal will reduce the emergence of canola seedlings.

A firm, moist seedbed provides uniform seed germination and rapid seedling growth. Adequate soil moisture at the seedling and elongation stages promotes the development of a strong, healthy plant less prone to lodging and with maximum leaf growth by the end of July. [15]

Sowing canola into raised beds has proven very successful in southern Victoria. Many soil types in this region (heavy duplex soils and impervious clay subsoils) are prone to severe waterlogging in winter. Raised-bed cropping provides a relatively inexpensive and practical drainage solution, enabling growers to successfully produce canola and other crops and obtain much higher yields. Research in southern Victoria has demonstrated yield improvements of 60% where canola was sown on narrow raised beds (1.5–2.0 m wide and 25 cm high) compared with canola sown on much wider beds (20–30 m wide and 20 cm high). Root development and trafficability after rainfall events were also improved, and in subsequent years, indications are that the soil structure of raised beds starts to improve. Raised beds have also been adopted in some of the

13 P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

14 B Haskins (2012) Using pre-emergent herbicides in conservation farming systems. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/431247/Using-pre-emergent-herbicides-in-conservation-farming-systems.pdf

15 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

More information

[GRDC: Canola best practice management guide for south-eastern Australia]

wetter areas of the south-west of Western Australia. They have been trialled in southern NSW, but a string of dry years has reduced grower interest. [16]

1.6 Soil moisture

Soil moisture is vital for both germination and emergence. Canola must absorb a high percentage of its weight in water before germination begins. It will germinate when the seed moisture content has risen to ~24%.

Water absorption is a passive process. The ability of seeds to absorb water depends on the difference in water potential between the seed and the surrounding soil. Seeds can absorb water even at very low soil-water potentials, but low water potentials may induce secondary dormancy.

Seed size influences the rate of water absorption. Small seeds have a high surface-to-volume ratio, which means that less time is required to absorb adequate moisture for germination.

In soils with a low moisture content, the germination rate will be lower and emergence slower (Table 1).

Table 1: Effect of soil moisture content on final emergence percentage and days to 50% emergence

Source: Modified from Canola Council of Canada (2003)

Total soil water content (% weight)	Final emergence percentage	Days to 50% emergence
18%	82%	9
15%	59%	12
13%	45%	13
11%	4%	–

The trial was established in a growth chamber at constant day–night temperatures of 8.5°C–10°C. In summary:

- The higher the total soil water content, the higher the final germination percentage.
- The higher the soil water content, the quicker the time to 50% seedling emergence. [17]

Water is essential for plant growth. Adequate soil moisture:

- promotes root growth
- promotes a large, abundant leaf area
- helps plants to retain their leaves longer
- lengthens the flowering period
- increases the numbers of branches per plant, flowers forming pods and seeds per pod
- increases seed weight and seed yield

Moisture stress is more important during podfill than at the vegetative stage. However, too much or too little water at any growth stage reduces yield potential. Factors that may limit yield include:

- the amount of moisture stored in the soil over summer
- the rate and duration of rainfall during the growing season
- the ability of the soil to absorb water, store it, and make it available for plants

[16] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[17] J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

More information

IREC: Is there a place for canola on irrigation?

Research paper: Yield of wheat and canola in the high rainfall zone of south-western Australia in years with and without a transient perched water table

Modifying some of these factors can improve moisture availability and efficiency of water use.

When soil water and nutrients are abundant, the balance of root to stem and leaf growth typically shifts in favour of stem growth at the expense of roots. When water is limited, the opposite usually occurs. Roots account for ~25% of plant dry matter at stem elongation in moisture-stressed canola, compared with ~20% in unstressed plants.

1.6.1 Moisture stress during rosette formation and elongation

Canola has limited ability to withstand severe drought. To avoid dehydration, the plant closes its stomata and rapidly sheds leaves.

Moisture stress during the early vegetative stages reduces the ability of stomata to conduct carbon dioxide and therefore slows photosynthesis. This in turn reduces leaf area expansion and dry matter production. It also limits root growth, which reduces nutrient uptake. More severe water deficits inhibit photosynthesis because of cell and chloroplast shrinkage.

This is important in seasons with dry winters. It is also important in low-rainfall areas where the period of crop growth is restricted at the start of the season by lack of rainfall and at the end of the season by water deficits and high temperatures.

Plants under early-season moisture stress will usually recover normal growth with subsequent rainfall or irrigation. Stressed plants are able to recover leaf area, form flowers, set pods and fill seeds when water becomes available, but with hastened development rates, crops have early maturity and lower yields. The worst time for drought stress in canola is during stem elongation or flowering.

Long periods of drought will reduce yields more than frequent, short periods of drought. The impact will be greatest on coarse-textured soils and shallow soils with low water-storage capacity.

Adequate soil moisture tends to lengthen the number of days to maturity by up to 10 days. Additional soil moisture will result in no further increase in yield and may cause yield reductions through poor soil aeration and/or increased lodging and diseases. [18]

More information

DAWR: A change in climate

DOE: Climate change

BOM: Climate change and variability

Agriculture Victoria: Weather and climate

NSW DPI: NSW climate summary

QAAFI: Seasonal crop outlook (wheat)

GRDC: Grain marketing—wheat, canola and barley outlook

Rabobank: Agribusiness Outlook 2015

1.7 Yield and targets

1.7.1 Seasonal outlook

The NSW Department of Primary Industries provides a seasonal outlook to assist grain growers. The Seasonal Conditions and Climate Change Summary e-newsletter will let you know as soon as the monthly report is published. Subscribe now.

The Victorian Government produces 'The Break' newsletter, which allows grain growers to access seasonal climate risk information. The newsletter describes credible seasonal outlooks, generates potential crop yields from decision-support computer tools, provides links and highlights topical climate-risk information. The Break is produced as part of the Future Farming Strategy.

Click here to view previous issues of The Break and The Fast Break, as well as subscribe to future newsletters.

1.7.2 Fallow moisture

Like wheat, canola will benefit from stored subsoil moisture. Strict summer fallow management is critical to achieving yield potential in all areas. The stored soil moisture

18 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

allows earlier sowing and moisture reserves through the season in no-till systems. Fallows should be managed efficiently to maximise the amount of moisture at sowing. [19]

1.7.3 Nitrogen- and water-use efficiency

Nitrogen fertiliser can increase the water-use efficiency (WUE) of early-sown canola (Table 2). The additional N enables the crop to cover the ground quicker and develop a dense leaf canopy, resulting in reduced soil evaporation and better WUE.

However, because the N promotes vegetative growth, there is a risk that the crop could become water-stressed during pod-filling if reserves of soil moisture have been depleted and there is little rainfall (Table 3). [20]

A University of Adelaide study in 2013 of canola under different water regimes with N showed that grain yield was mainly driven by biomass production. It also revealed that the timing of N had little impact on yield; however, split application improved oil content. Canola crops extracted water to 60–80 cm, and addition of N increased the drying of the profile by maturity but had little effect on total water use relative to nil N. Both N-use efficiency and WUE were improved by additional water availability. [21]

Grains Research and Development Corporation-funded research in Victoria estimated the WUE of plot-grown canola to be 18 kg/mm.ha and evaporation 112 mm. In seasons when growing season rainfall exceeds 375 mm, canola WUE is likely to decrease because of waterlogging. [22]

Kirrily Condon from Grassroots Agronomy says: We use a target WUE of 8 kg/ha.mm for canola. From our benchmarking in 2014 of 102 canola paddocks, 36% achieved this target, 49% achieved between 6 and 8 kg/ha.mm.

A practical WUE equation for farmers to use, fine-tuned by James Hunt (CSIRO), is:

WUE = (yield x 1000)/available rainfall

where available rain = (25% November–March rain) + (growing season rainfall) – 60 mm evaporation

Agronomist's view

Table 2: Effects of nitrogen fertiliser on yield and water-use efficiency of canola in the Victorian Wimmera

Note that increasing fertiliser rate improves yield per unit water use at the expense of yield per unit N

Nitrogen rate (kg N/ha)	Grain yield (t/ha)	Shoot dry matter (t/ha)	Water use (mm)	Soil evaporation (mm)	Dry matter per unit water use (kg/ha.mm)	Yield per unit water use (kg/ha/mm)	Yield per unit nitrogen fertiliser (kg grain per kg N)
0	1.6	5.2	307	128	17.1	5.3	
70	2.5	8.8	349	112	25.3	7.1	35.3
140	2.5	8.7	344	91	25.2	7.3	17.9
210	2.8	9.5	335	87	28.4	8.4	13.4

[19] L Jenkins (2009) Crop establishment. Ch. 5. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[20] P Hocking, R Norton, A Good (1999) Crop nutrition. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0013/2704/Chapter_4_-_Canola_Nutrition.pdf

[21] A Riar, G McDonald, G Gill (2013) Nitrogen and water use efficiency of canola and mustard in Mediterranean environment of South Australia. GRDC Update Papers, 13 February 2013, https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Nitrogen-and-water-use-efficiency-of-canola-and-mustard-in-South-Australia

[22] D Grey (1998) Water-use efficiency of canola in Victoria. 9th Australian Agronomy Conference, http://www.regional.org.au/au/asa/1998/5/181grey.htm

Table 3: Difference in yield and water-use efficiency of cereal and oilseed crops (source: Norton and Wachsmann 2006)

Cereals have a much greater water-use efficiency than oilseed crops. This reflects the low energy cost of starch relative to fat as main products stored in grain

Season	Water regime	Crop	Water use (mm)	Yield (t/ha)	Yield per unit water use (kg/ha.mm)
2000–01	Rainfed	Wheat	237	2.05	8.6
	Rainfed	Canola	252	1.19	4.7
2001–02	Rainfed	Wheat	337	4.18	12.4
	Rainfed	Canola	256	1.75	6.8
2001–02	Irrigated	Wheat	401	6.04	15.1
	Irrigated	Canola	387	3.44	8.9

1.7.4 Estimating maximum yield per unit water use by location and nitrogen

Researchers propose a three-step procedure to derive the 'slope' parameter representing maximum yield per unit water use accounting for N and location.

Step 1

Use the data in Figure 2*a* to account for the effect of N on maximum yield per unit water use. For severely limited crops (N supply <50 kg N/ha), maximum yield per unit water use would be ~5–6 kg grain/ha.mm. For crops with abundant N supply (>200 kg N/ha), the parameter approaches 24 kg grain/ha.mm. For intermediate N supply, maximum yield per unit water use can be estimated graphically using this curve.

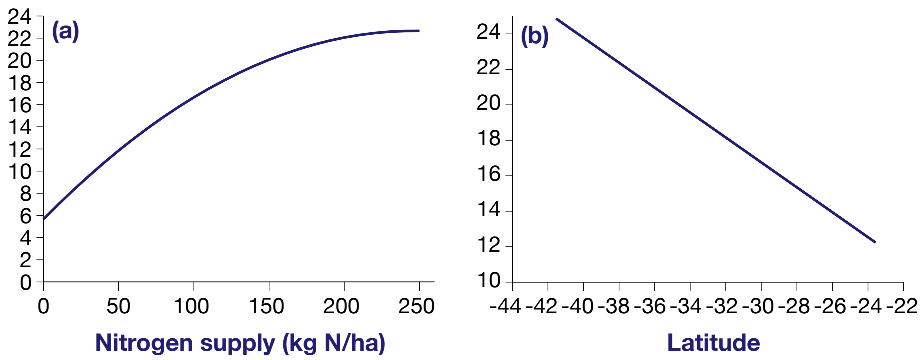

Figure 2: Maximum yield per unit water use (kg/ha.mm) as a function of (a) nitrogen and (b) location.

Step 2

Use the line in Figure 2*b* to correct for location. For a latitude of –41.5° (Launceston, the southernmost location in this study), maximum yield per unit water use would be ~24–25 kg grain/ha.mm. For a latitude of –23.5° (Emerald, the northernmost location), maximum yield per unit water use would be ~12 kg grain/ha.mm. For intermediate locations, maximum yield per unit water supply can be estimated from the graph (Figure 2*b*).

Step 3

Select the lowest value from steps 1 and 2. For example, if we want to estimate the maximum yield per unit water use for Dalby (latitude –27.1°) with intermediate N supply (100 kg N/ha), the location correction would return 14.7 kg/ha.mm and the N correction would return 16.6 kg/ha.mm. We therefore select the lowest value, 14.7 kg/ha.mm, as a benchmark for this combination of location and N supply. [23]

[23] V Sadras, G McDonald (2012) Water use efficiency of grain crops in Australia: principles, benchmarks and management. GRDC Integrated Weed Management Hub, http://www.grdc.com.au/GRDC-Booklet-WUE

Table 4: Water-use efficiency based on total biomass (WUEdm) or grain yield (WUEgy) of different crops

Water-use efficiency is based on the biomass or yield per mm of crop water use. Values are mean and range.

Crop	Region	WUEdm (kg/ha.mm)	WUEgy (kg/ha.mm)	Source
Canola	Victoria	24.0 (17.1-28.4)	6.8 (4.7-8.9)	Norton and Wachsmann 2006
Canola*	NSW		13.4	Robertson and Kirkegaard 2005
Chickpeas	Western Australia	16.0 (11.1-18.3)	6.2 (2.6-7.7)	Siddique et al. 2001
Lentils		12.7 8.5-16.7)	6.7 (2.4-8.5)	
Lupins		17.3 (9.3-22.3)	5.1 (2.3-8.3)	
Faba beans		24.2 (18.7-29.6)	10.4 (7.7-12.5)	
Peas		26.2 (17.6-38.7)	10.5 (6.0-15.9)	
Vetch		18.2 (13.4-22.4)	7.5 (5.6-9.6)	
Chickpeas	Tel Hadya, Syria	13.7 (9.4-18.1)	3.2 (2.1-5.2)	Zhang et al. 2000
Lentils		8.7 (5.0-14.2)	3.8 (1.9-5.5)	
Wheat	South Australia	36.1 (21.2-53.1)	15.9 (9.2-23.2)	Sadras et al. (unpublished)
	South-east Australia		9.9 (max =22.5)	Sadras and Angus 2006

*Based on simulated estimate of crop water use

There are intrinsic differences in the WUE of crops (Table 4), with wheat more water-use efficient than grain legumes or canola, in terms of both total biomass production and grain yield. Differences in the composition of the grain—it is more energy efficient to produce starch than oil or protein—partially explain the higher grain yield per unit water use of wheat than of oilseed crops and pulses.

Further, canola and the grain legumes are grown at lower plant densities and/or have less vigorous seedlings than wheat, contributing to greater early losses of moisture through soil evaporation, and hence to lower WUE. The amount of winter growth made by the crop is therefore an important factor in determining crop WUE. [24]

More information

GRDC: Water use efficiency of grain crops in Australia: principles, benchmarks and management

GRDC: Nitrogen and water use efficiency of canola and mustard in Mediterranean environment of South Australia

Research paper: Nitrogen use efficiency in canola

CSIRO: A guide to consistent and meaningful benchmarking of yield and reporting of water-use efficiency

Research paper: Water-use efficiency of canola in Victoria

1.8 Potential disease problems

Blackleg is the major disease of canola in Australia and can significantly reduce yields, especially in higher rainfall districts. Research has shown that 95–99% of blackleg spores originate from the previous year's canola stubble.

Spores can travel >1 km 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 disease pressure. Where possible, a buffer distance of 500 m 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 provides only limited benefits in reducing the disease level because not all of the infected stubble and old roots are destroyed.

Use of blackleg-resistant varieties in combination with an appropriate fungicide treatment, if necessary, is the best way to minimise yield losses. Careful paddock selection can also assist in reducing the impact of another potentially serious canola disease, Sclerotinia stem rot (caused by *S. sclerotiorum*).

Sclerotinia stem rot is an intermittent problem in many canola-growing districts, particularly central and southern NSW. Agronomists report that it is also present in south-western and north-eastern Victoria. It has a wide host range of broadleaf plants

[24] V Sadras, G McDonald (2012) Water use efficiency of grain crops in Australia: principles, benchmarks and management. GRDC Integrated Weed Management Hub, http://www.grdc.com.au/GRDC-Booklet-WUE

and weeds, including lupins, chickpeas, field peas, faba beans, sunflowers, cape weed and Paterson's curse. Growing canola after any of these crops or in paddocks that have had large populations of these weeds can increase the risk of Sclerotinia stem rot, especially when canola is grown under irrigation or in higher rainfall areas. [25]

1.9 Nematode status of paddock

Canola has hosting ability of root-lesion nematodes of low–medium for *Pratylenchus thornei* and medium–high for *P. neglectus*.

Testing soil is the only reliable way to determine whether root-lesion nematodes are present in a paddock. Before planting, soil tests can be carried out by PreDicta B (SARDI Diagnostic Services) through accredited agronomists, to establish whether crops are at risk and whether alternative crop types or varieties should be grown. Growing-season tests can be carried out on affected plants and associated soil; contact local state departments of agriculture and PreDicta B. [26]

To organise testing and sending of soil samples, visit the PreDicta B website.

For more information, see *GrowNotes Southern Canola. Section 8. Nematodes*.

More information

GRDC: Variety choice and crop rotation key to managing root lesion nematodes

[25] P Parker (2009) Crop rotation and paddock selection. Ch. 4. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[26] GRDC (2015) Root-lesion nematodes. GRDC Tips and Tactics, February 2015, http://www.grdc.com.au/TT-RootLesionNematodes