SOUTHERN
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GRDC GROWNOTES™

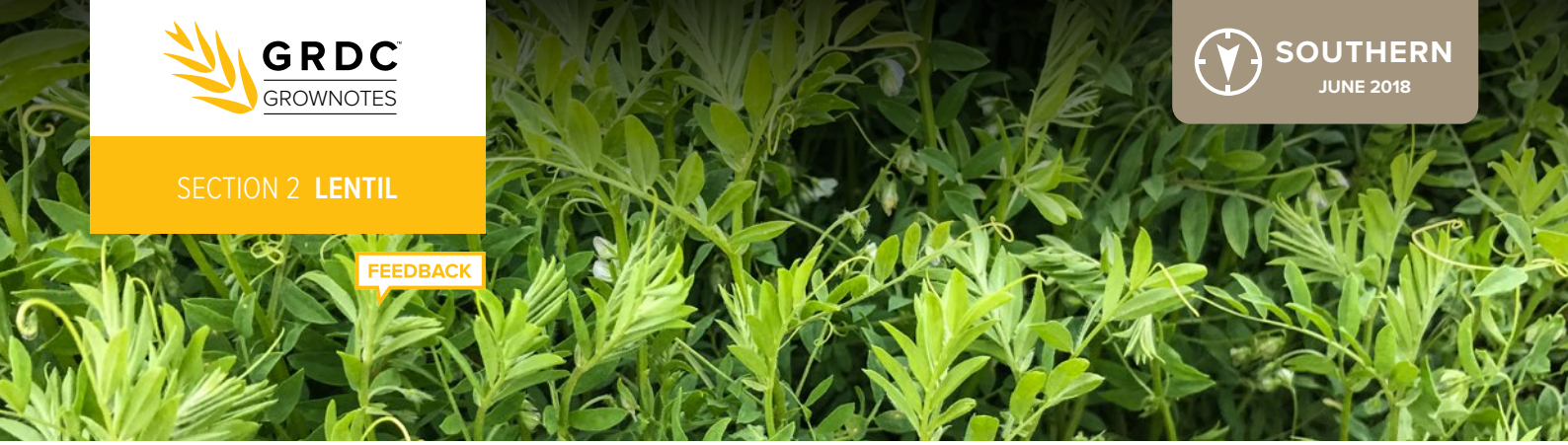
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

LENTIL

SECTION 2

PLANNING AND PADDOCK PREPARATION

KEY POINTS | LENTIL REQUIREMENTS | RAINFALL AND SOIL MOISTURE | SOIL TYPE | SEEDBED REQUIREMENTS | STUBBLE MANAGEMENT | ROTATION HISTORY | HERBICIDE RESIDUES IN SOIL | WEED STATUS OF PADDOCK | DISEASE STATUS OF PADDOCK | NUTRITION STATUS OF PADDOCK



Planning and paddock preparation

Key points

- Lentil requires annual rainfall greater than 300 mm
- When annual rainfall is greater than 550 mm, delayed or spring sowing may be necessary.
- Soil needs to be heavy and deep enough to hold sufficient water to finish the season.
- Soil needs to be friable without setting excessively hard on the surface.
- A soil pH between 6 and 8 (in calcium chloride) is required for lentil.
- Lentil requires free-draining soil as it does not tolerate waterlogging.
- Lentil paddocks need to be free of surface stones and sticks, and relatively flat.
- Plant-back periods and rainfall must accounted for to avoid herbicide residue damage when growing lentil.
- Low weed burdens for broadleaf weeds and herbicide-resistant annual ryegrass are required for growing lentil.
- Lentil should be sown into standing cereal stubble.

FEEDBACK

2.1 Lentil requirements

Checklist for lentil paddock selection:

- Is annual rainfall >300 mm?
- If the annual rainfall is >550 mm, is delayed or spring sowing possible?
- Is the soil heavy and deep enough to hold sufficient water to finish the season?
- Is the soil friable and will not set excessively hard on the surface?
- Is the soil pH between 6 and 8 (in calcium chloride)?
- Is the soil free draining (no waterlogging)?
- Is the paddock free of surface stones and sticks, and relatively flat?
- Are plant-back periods and rainfall accounted for to avoid herbicide residue impacts?
- Are the weed burdens low for broadleaf weeds and herbicide-resistant annual ryegrass?
- Is the control of weeds possible?[1]

2.2 Rainfall and soil moisture

Lentil is best suited to locations that receive an annual rainfall of 350–500 mm. In drier or colder areas, lentil plants may not grow tall enough to be harvested efficiently.[2]

Lentil prefers the better, deeper, wheat-growing soils with higher water-holding capacity and good drainage ("Table 1: Soil requirements for pulse crops." on page 4).[3]

Lentil is particularly sensitive to waterlogging. Spring sowing may be an option on some deeper, heavier soils in higher rainfall areas.

Lentil varieties have an indeterminate growth habit in the environment with crop maturity in some being significantly affected by moisture supply.

Changes in soil type and moisture-holding capacity across a paddock can lead to uneven crop maturation, delayed harvesting, and increased risk of weather damage or high harvest losses. Desiccation can mitigate these risks.

Attention should be paid to the amount of stored soil moisture and received rainfall as this can have an impact on herbicide residues.

Photo 1: *Lentil dying under waterlogged conditions.*

Source M Raynes, formerly Pulse Australia

1 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

2 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

3 W Hawthorne (2007) Residual Herbicides and Weed Control. Pulse Australia Southern Pulse Bulletin, PA 2007 #03, http://www.pulseaus.com.au/growing-pulses/publications/residual-herbicides

FEEDBACK

2.3 Soil type

Paddocks that have an even soil type are relatively easier to manage and are preferred for lentil.[4] Changes in soil type across a paddock can lead to uneven crop maturation, which has implications for harvest. Implications include delayed harvesting, grain losses and increased risk of weather damage (all of which can be alleviated with desiccation).

Soil tests and paddock records should be examined, with particular attention paid to the following soil characteristics:

- pH 6 to 8 ($CaCl_2$);
- soil type – loams to self-mulching clays;
- low sodicity;
- low salinity/chloride; and
- no soild compaction and low bulk density.[5]

pH

Lentil is well suited to neutral to alkaline soils with a pH range of 6 to 8 ($CaCl_2$). A soil pH near 7 is best for lentil production.

Lentil performs poorly in acidic soils. Acid soils delay and limit nodulation and hence reduce yields. They can also cause growth and yield variation within a paddock. Reasonable yields can be achieved in paddocks with pH as low as 5 where aluminium and manganese levels are low (aluminium below 20 micrograms per gram and/or manganese below 50 µg/g.[6]

Soils with extreme low or high pH should be avoided.

Soil type

Lentil is best adapted to soil types of high fertility, from heavy clays to loamy sands. Lentil grows well in the self-mulching, grey clays of the Wimmera and will also grow successfully on loamy sands of the Mallee.

When grown on sandy loams, lentil requires a deep soil that is high in phosphorus and potassium.

Lentil will cope in loam and clay loam soils of low fertility. However, paddocks with low fertility will exacerbate the effects of waterlogging, salinity and high boron levels. Effects include variation in plant growth and reduced yield.

Sodicity and boron toxicity

Lentil is very intolerant to sodicity and boron toxicity. Excessive boron or sodic subsoil within the crop root zone can cause plant death and severely limit lentil yields.

Sodic soils are those with a sodium adsorption ratio (SAR) greater than 15. Tolerance to sodicity in the root zone (to 90 cm) is likely to be similar or less than chickpea. Less than 1% exchangeable sodium percentage (ESP) on the surface and less than 5% ESP in subsoil[7] (see Table 1).

4 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

5 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

6 Agriculture Victoria (2005) Acid Soils. Agriculture Victoria AgNote Number: AG1182, http://agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/soils/acid-soils

7 C Mullen (2004) The right pulse in the right paddock at the right time. NSW DPI AgNote 446, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/151112/the-right-pulse-in-the-right-paddock-at-the-right-time.pdf

FEEDBACK

Table 1: Soil requirements for pulse crops.

Crop	Soil type	Soil pH ($CaCl_2$)	Exchangable aluminium (%)	Drainage tolerance ** Rating (1–5)	Sodicity in root zone (90 cm) ESP ***
Lentil (estimate)	Loams – self-mulching clay loams	5.2–8.0	Nil	Very sensitive (1)	<1 surface <5 subsoil
Lupin - albus	Sandy loams, clay loams	4.6–7.0	Up to 8%	Very sensitive (1)	<1 surface <3 subsoil
Lupin – narrow leaf	Sandy loams	4.2–6.0	20% tolerant	Sensitive (2)	<1 surface <3 subsoil
Chickpea	Loams – self-mulching clay loams	5.2–8.0	nil	Very sensitive (1)	<1 surface <5 subsoil
Field pea	Sandy loams, clay	4.6–8.0	Up to 5–10%	Tolerant (3)	<5 surface <8 subsoil
Faba bean	Loams – clay loams	5.4–8.0	nil	Very tolerant (4)	<5surface <10 subsoil
Lucerne	Loams – clay loams	5.0–8.0	nil	Sensitive to tolerant (1-3)	<3 surface <5 subsoil
Canola	Loams – clay loams	4.8–8.0	0–5%	Tolerant (3)	<3 surface <6 subsoil

* Estimated to be the same as chickpea cited by Mullen (2004). ** No hard-pans and good drainage (no puddles after 24 hours from a 50 mm rain event). Hardpans – can aggravate waterlogging and cause artificial waterlogging. *** ESP = exchangeable sodium percentage.

Source: C Mullen (2004), The right pulse in the right paddock at the right time, (2004), NSW DPI AgNote 446, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/151112/the-right-pulse-in-the-right-paddock-at-the-right-time.pdf

Salinity

Lentil is very susceptible to salinity.

Saline soils are defined as those with an electrical conductivity (EC) of the saturated soil extract greater than 4 dS/m. Lentil is particularly salt-sensitive compared to cereal crops and other pulses. Yield reduction has been reported in lentil at about 20% at an EC of 2 dS/m and 90–100 % at an EC of 3 dS/m.[8]

There are small differences between varieties (moderately intolerant versus intolerant) that can be of practical significance, particularly in combination with boron sensitivity. (See variety “Table 3: Red lentil agronomic traits.” on page 17 and “Table 7: Green lentil agronomic traits.” on page 23)

Waterlogging

Effective drainage is essential as **lentil does not tolerate flooding or waterlogged soils**. Lentil plants will die if exposed to even short periods of waterlogging or flooding. Free-draining soils are a must when growing lentil.

8 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia.

FEEDBACK

2.4 Seedbed requirements

Surface condition, along with uniformity of soil type and topography, are all important criteria in assessing whether a paddock is suitable for growing lentil.

Lentil plants are short (15–80 cm) and can lodge at maturity, resulting in harvesting near-ground level. This means **paddocks must be flat** to allow harvesters to operate at a low cutting height. This is particularly an issue in dry seasons when crop height is low.

Heavily contoured and 'crab hole' country should be avoided when selecting paddocks for growing lentil.

Furthermore, with the increasing width of harvester fronts, small variations in paddock topography can lead to big variations in cutting height. This results in increases in harvest losses.

The soil surface of paddocks selected for lentil should be levelled as much as possible, either prior to, or at, sowing.

Cloddy or badly ridged paddocks are likely to cause soil contamination in the lentil sample during harvest.

Stones and sticks in paddocks are also an issue for growing lentil. Harvest losses increase dramatically if the harvester front needs to be raised, to avoid serious mechanical damage to the harvester, due to sticks and stones. Small stones and wood fragments can also contaminate the grain sample and downgrade quality.

Foreign material must not exceed 3% by weight, of which no more than 0.3% must be un-millable material (soil, stones and non-vegetable matter). Lentil that does not meet this export standard needs to be graded at a cost to the grower of around $25 per tonne.[9]

The use of a roller after sowing is a common practice when growing lentil as it is a valuable aid for efficient harvesting. The purpose of rolling is to level out ridges in the soil caused by sowing, and push clods of soil and small stones and sticks down, level with the soil surface.

MORE INFORMATION

For more information on rolling go to Section 5: Post-planting.

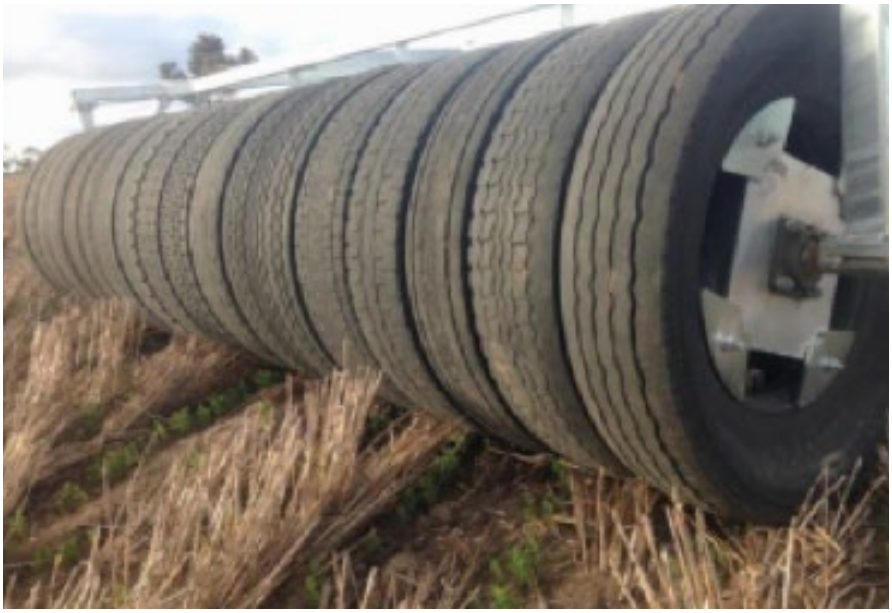


Photo 2: *A roller in a lentil crop.*

Photo: M. Raynes, formerly Pulse Australia

9 M Peoples (2015) Break crops should be a profitable choice. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Ground-Cover-Supplements/Ground-Cover-Issue-115-Profitable-pulses-and-pastures/Break-crops-should-be-a-profitable-choice

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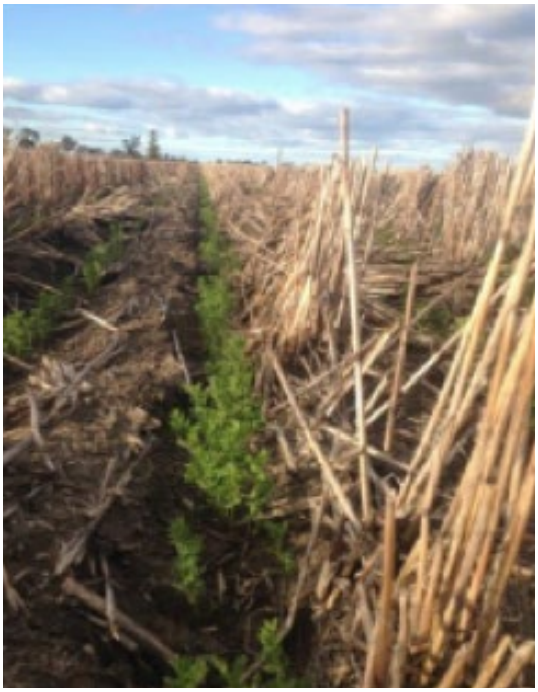

Photo 3: *Ridges in a lentil crop prior to rolling.*

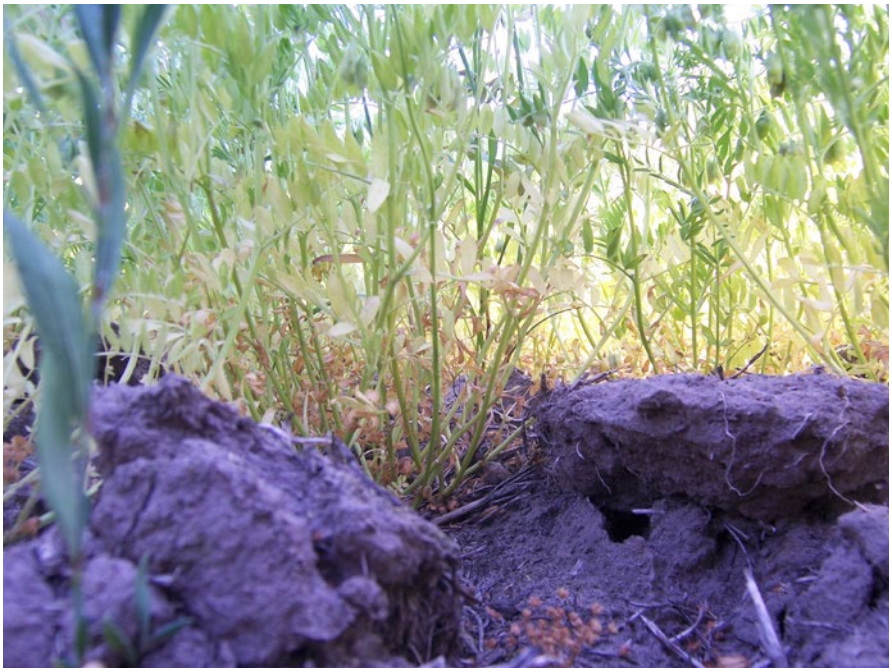

Photo 4: *Clods can be a lentil harvest hazard: soil can contaminate the sample if the paddock is not rolled after sowing.*

Photo: W. Hawthorne, formerly Pulse Australia

FEEDBACK

Photo 5: *Stones can be a harvest hazard in lentil paddocks, highlighting the importance of rolling after sowing.*

Photo: W.Hawthorne, formerly Pulse Australia

IN FOCUS

Stubble bunching or clumping can occur when sowing lentil into retained stubble if inter-row sowing techniques are not utilised. The process of sowing can result in blockages of stubble that are left in clumps in the paddock which, in turn, becomes problematic at harvest. These mounds of stubble are often picked up in the harvester front, causing mechanical blockages and contamination of the sample if they contain excessive amounts of soil.

Options for dealing with stubble clumping include:

- using a zero-till (disc) seeder, or other seeder capable of handling heavy stubble;
- modifying existing air seeders (tyne shape and lifting some tynes);
- sowing before soil and stubble become too wet;
- using rotary harrows to spread and level stubble; or
- burning or slashing standing stubble if sowing equipment with good trash flow is not available.

FEEDBACK

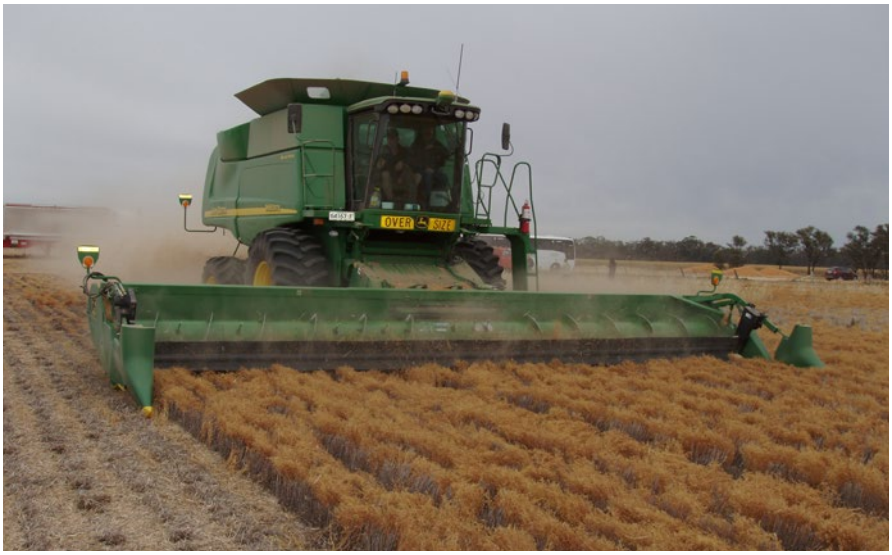

Photo 6: *Flat paddocks assist with harvesting efficiency.*

Photo: T.Bray, formerly Pulse Australia

FEEDBACK

2.5 Stubble management

Stubble retention is when the stubble of the previous crop is left standing on the soil surface of the paddock or incorporated (buried) into the soil.

Lentil should be sown into standing cereal stubble.[10]

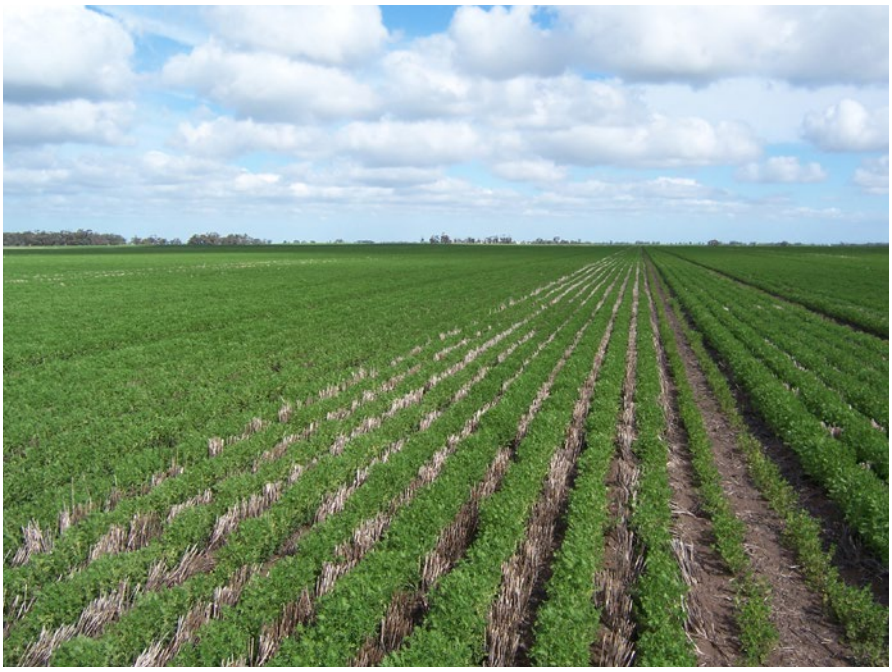

Photo 7: *Lentil sown into cereal stubble establishes well and loses less soil moisture than if sown into bare soil.*

Photo: W. Hawthorne, formerly Pulse Australia

Lentil fits well into stubble-retention systems such as minimum-tillage, direct drilling, no-tillage or zero-tillage. This is provided the physical sowing process is not affected by blockages of stubble in the seeder at sowing.

Yield increases of 10% and higher can be expected when lentil is sown into standing stubble utilising inter-row sowing.

Using GPS-guidance and auto-steer systems means lentil can be sown inter-row, between standing stubble rows. This aids in stubble clearance during sowing, often reduces herbicide throw and damage, and the lentil plant grows taller and more erect, achieving greater harvest efficiency.

Reducing the stubble load with livestock

Stubble can be grazed over the summer to benefit livestock and, importantly, reduce the stubble load in preparation for growing lentil.

It is important to note that stubble, which grazing animals have trampled, is lodged or brittle from summer rainfall can present difficulties at sowing, even when sowing inter-row.[11]

Rolling lentil

Rolling lentil after sowing, for harvest efficiency or herbicide safety reasons, partially flattens standing stubble. Partially flattened standing stubble still provides trellising support for the growing plant.

10 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia.

11 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia

FEEDBACK

Erosion

On sandy and light soils, stubble retention lessens the risk of wind erosion. Stubble loads are often low on these soils and do not usually present a barrier to minimum-tillage sowing or direct drilling. Stubble retention and reduced tillage also provide protection from water erosion on hills and steep slopes, especially during summer rainfall or storms.

Slugs and snails

Stubble retention is often not possible in areas where slugs and snails are a major problem at establishment, or where snails are a concern at harvest, particularly in higher rainfall zones.

In southern Australia, late burning of high stubble loads just before sowing can assist with sowing (by reducing likelihood of blockages due to excess stubble), and the control of pests such as slugs and snails.

After a late stubble burn the soil surface is exposed, which increases the risk of erosion. It also allows weeds to establish more readily, compared to retained stubble.[12]

Stubble from drought-affected cereal or hay

Lentil crops that follow a drought-affected cereal or a hay cut may not benefit from the limited amount of stubble retained. This is particularly so when sowing is aggressive, causing a high level of soil disturbance and incorporation of the remaining stubble.[13]

Photo 8: *Stubble management trials on lentil.*

Photo: M. Lines, formerly Southern Pulse Agronomy

12 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

13 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia

FEEDBACK

MORE INFORMATION

Go to the GRDC website for the following information:

The value of break crops in low rainfall farming systems and which ones perform best. https://grdc.com.au/news-and-media/news-and-media-releases/south/2015/04/lentils-benefit-from-stubble-support

Key outcomes arising from the crop sequence project. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/02/key-outcomes-arising-from-the-crop-sequence-project

2.6 Rotation history

Pulses have an important, complementary role in crop rotations, by enabling better management of weeds, diseases, herbicide residues and soil nitrogen.[14]

While the most suitable rotation requires careful planning, there are no set rules and a separate rotation should be devised for each cropping paddock. The main aims should be sustainability and the highest possible long-term profit.

To achieve this, the rotation must be flexible enough to cope with key strategies such as maintaining soil fertility and structure, controlling crop diseases, and controlling weeds and their seedset.

Recent research in Victoria and southern New South Wales showed that canola and pulse crops were frequently as profitable, and, in some cases, considerably more profitable, than wheat. Furthermore, wheat following break crops (including pulses) was consistently more profitable than a wheat-on-wheat rotation.[15]

Some growers have adopted a pulse–wheat–barley sequence as a basic rotation.

However, where a pulse can be grown with other crops, growers are increasingly adopting a continuous pulse–cereal–oilseed–cereal rotation.[16]

Successive cropping with the same pulse is likely to result in rapid build-up of root and foliar diseases and weeds. **Extreme care must be taken if growing the same crop in the same paddock without a break of at least three years.**

Where possible, different pulse crops should be alternated when in a continuous rotation with cereals.

14 J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

15 M Peoples (2015) Break crops should be a profitable choice. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Ground-Cover-Supplements/Ground-Cover-Issue-115-Profitable-pulses-and-pastures/Break-crops-should-be-a-profitable-choice

16 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia.

FEEDBACK

2.7 Herbicide residues in soil

Lentil is extremely sensitive to some residual herbicides.[17]

Residues from herbicides used in the previous crop (sometimes previous two crops) can cause damage to the lentil plant. This is particularly so when summer rainfall has been minimal, as adequate rainfall and time are required to break down herbicide residues in the soil profile.

It is very important to know the chemical history of the paddock for at least two seasons. This includes:

- the chemical used;
- the group to which the chemical belongs;
- the plant-back periods;
- the soil pH;
- rainfall; and
- other requirements for herbicide breakdown.[18]

Herbicides applied two season ago can still have an impact, as can the presence of cereal stubble containing herbicides like Lontrel®. In some situations, some herbicides from more than two seasons ago can still have an impact.

Reading the herbicide label is critical to ensure adherence to plant-back periods. The plant-back period is the period of time required from spraying a herbicide to when it is safe to grow a new crop. It is deemed safe because the herbicide residues have broken down in the soil and can no longer damage the new crop.

Pulses and other crop types differ in their sensitivity to residual herbicides, meaning plant-back periods vary for crop types and also among varieties.

Most lentil varieties are particularly sensitive to soil carryover residues of Group B herbicides and Group I herbicides. Group B herbicides include sulfonylurea (SU) and imidazolinone (IMI). Examples of sulfonylurea herbicides include Ally®. Imidazolinone herbicides include On Duty® and Spinnaker®. Clopyralid and picloram are examples of Group I herbicides.

The recently released varieties PBA Hurricane XT$^{\phi}$ and PBA Herald XT$^{\phi}$ varieties show less sensitivity to sulfonylurea and imidazolinone (Group B) herbicide carryover residues.

These varieties (released in 2014 and 2012) have tolerance to imazethapyr. These XT$^{\phi}$ varieties allow a lentil crop to be grown without the risk of yield loss from herbicide damage.

Not all chemical labels include lentil in the plant-back information. Extra caution and advice, from the manufacturer and an experienced agronomist, are recommended when planning rotations for lentil.

MORE INFORMATION

For detailed information on herbicide residues go to Section 4.6 and Section 8.7.

17 W Hawthorne (2007) Residual Herbicides and Weed Control. Pulse Australia Southern Pulse Bulletin, PA 2007 #03, http://www.pulseaus.com.au/growing-pulses/publications/residual-herbicides

18 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

FEEDBACK

2.8 Weed status of paddock

Lentil competes poorly against weeds and paddocks with high weed burdens should be avoided for growing lentil. This particularly refers to broadleaf weeds that cannot be controlled by herbicides and high levels of herbicide-resistant ryegrass.[19]

Photo 9: *Weed infestations are difficult to control in paddocks planted to lentil.*

Photo: M. Ryanes, formerly Pulse Australia

Problem weeds

Some weeds are often more difficult to control in lentil than in other pulse crops. It is important to control these problem weeds in the years prior to growing lentil. These weeds include:

- vetches;
- tares;
- bifora;
- medics;
- self-sown peas;
- bedstraw;
- herbicide-resistant ryegrass;
- wild radish;
- beans;
- ball mustard;
- cleavers;
- soursob; and
- marshmallow.[20]

Attention must be given to preventing seedset of weeds in paddocks in the years prior to growing lentil.

19 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

20 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

FEEDBACK

Contamination

To avoid seed contamination at harvest, **lentil should not be grown in paddocks with a history of vetch.**

Cereal grains are not easily cleaned from lentil grain so self-sown cereals must be removed from lentil crops using grass herbicides.

Control

It is rarely possible to select a paddock with a weed-free status. Consequently, there are a range of herbicides available to provide effective weed control in lentil.

It is important to note that herbicides can affect lentil yield. Furthermore, there are differing degrees of sensitivity to specific herbicides in lentil varieties.

Close attention must be paid to weed control during the cropping season as weed numbers are likely to increase, resulting in reduced yields and potentially affecting future crops.

MORE INFORMATION

For detailed information on weed control go to Section 8: Weed control.

FEEDBACK

MORE INFORMATION

See Section 10: Diseases and Nematodes for further information.

2.9 Disease status of paddock

Foliar diseases

To minimise foliar disease, it is recommended lentil crops should be separated from the previous year's lentil stubbles (and other pulse stubbles) by at least 500 m, and up to 1 km in areas where old stubble is prone to movement (for example, down slope and on flood plains).[21] The practicalities of achieving this are difficult. Current practice tends not to be sowing into a previous pulse stubble. However, sowing next to a paddock with a previous pulse stubble is considered acceptable.

This helps to reduce the spread of Botrytis grey mould and Ascochyta blight, both foliar and stubble-borne diseases.

Root diseases

Cereal cyst nematode

Cereal cyst nematode (CCN), or eelworm, was considered the most serious root disease in the majority of cereal-growing districts in the 1980s and 1990s. CCN requires a cereal or grass host to develop. Therefore, a pulse crop (a grass-free crop) following a cereal crop results in a significant reduction in the severity of the disease.

Pulses are one of the key factors in an overall long-term management strategy to control or avoid CCN.

Take-all (haydie)

Take-all, like CCN, must have a cereal or grass host to develop. As non-hosts, pulses, such as lentil can be used very effectively as a one-year disease break crop in a cereal rotation.

Rhizoctonia

Rhizoctonia has a very wide host range and so, unlike CCN or take-all, attempting to reduce the problem through crop rotation is not as effective. However, sowing and tillage practices can be very effective.

Another key factor in controlling Rhizoctonia is the availability of nitrogen in the soil. Including a pulse in a cereal rotation increases the amount of available nitrogen to the following crop. It is this increase in nitrogen that both masks some of the effects of the disease and helps the crop in recovering after an attack of Rhizoctonia.

*Root-lesion nematode (*Pratylenchus *spp)*

Either of the two species of root-lesion nematode (*Pratylenchus neglectus* or *P. thornei*) can reduce cereal crop yields. Growing a pulse crop that is resistant to root-lesion nematode (for example, lentil) can increase cereal yields by reducing the nematode population.

Disease combinations

In a normal cropping rotation, it is unusual for cereal root diseases to occur independently. Consequently, the ability of a pulse crop to reduce the severity of most major cereal root diseases is considerable.

The effectiveness in controlling cereal root diseases is dependent on grass weed control in non-cereal phases. In other words, **the success of the pulse in the rotation hinges on the control of all grassy weeds and volunteer cereals during the pulse phase**. Grassy weeds and volunteer cereals that survive in the pulse phase can carry over cereal root diseases.

For take-all, one year of a grass-free break crop is enough to gain maximum benefit. With CCN, several years of a break are required. Hence, maximum benefit is achieved through a crop rotation that includes pulses in combination with resistant cereal varieties, grass-free pastures and canola.

21 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

FEEDBACK

MORE INFORMATION

For information on nitrogen fixation go to the following GRDC Factsheets:

Nitrogen fixation of crop legumes: basic principles and practical management
https://grdc.com.au/resources-and-publications/all-publications/factsheets/2014/07/grdc-fs-nfixation-legumes

Nitrogen fixation benefits of pulse crops
https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2009/09/nitrogen-fixation-benefits-of-pulse-crops

MORE INFORMATION

For detailed information on nutrition requirements for lentil go to Section 7: Nutrition and fertiliser.

2.10 Nutrition status of paddock

Soil fertility

The move by many growers to adopt more intensive cropping rotations, including lentil, can have a negative impact on soil fertility if it is not actively managed.

Using pulses in the rotation assists in maintaining soil fertility. A trial in South Australia aimed to determine the effects of rotation on soil nitrogen (Table 2). After 10 years of continuous cereal and pulse cropping soil fertility was maintained in terms of both total soil nitrogen and organic matter.

Table 2: Effect of rotation on total soil nitrogen (%) and organic carbon (%) in the surface soil (0–10 cm).

	Total soil nitrogen (%)	Total soil nitrogen (%)	Organic carbon (%)	Organic carbon (%)
Rotation	**At start**	**5 years later**	**At start**	**5 years later**
Continuous wheat	0.087	0.079	0.93	0.88
Wheat/field pea	0.090	0.088	0.99	0.95
Wheat/lupin	0.089	0.102	0.95	0.92
Wheat/faba bean	0.094	0.095	0.98	0.95
Wheat/volunteer pasture	0.087	0.088	0.95	1.01
Wheat/sown pasture	0.092	0.099	0.98	1.12
Wheat/fallow	0.090	0.086	0.98	0.88

Source: J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

When choosing paddocks for growing lentil, it is important to take into account the ability of plants to fix their own nitrogen.

Additional nutritional requirements can be met with the application of fertiliser.