

SECTION 1

Planning and paddock preparation

For more information, see the *GRDC GrowNotes WHEAT (Northern region)*, Section 1: Planning and paddock preparation.

1.1 Paddock selection

Select paddocks that are fertile, and store good levels of stored water or receive reliable in-crop rainfall or have access to supplementary irrigation. Durum wheat must only be grown where a reliable harvest of high protein (13%+), plump hard vitreous grain can be produced. The highest grade of durum (ADR1) must have a minimum protein level of 13% and ADR2 >11.5%. Careful management of soil nitrogen (N) is essential to achieve this.¹

Durum wheats should not be sown into paddocks known to carry high levels of crown rot inoculum. A suitable rotation should be practised to reduce the crown rot inoculum levels. Paddocks that were planted to corn in the previous season should be avoided. Ground preparation is the same as that for bread wheat. Adequate weed control should eliminate all weeds and volunteer plants of bread wheat, barley or other crop species.²

1.2 Paddock rotation and history



Figure 1: Rotations with non-cereal species, including canola, are important for durum paddocks.

Crop rotations using pulses, canola, sorghum, sunflower and pasture legumes are essential to control disease, and also to provide opportunities for weed control. A robust crop rotation must be planned over a number of seasons if successful crops of durum wheat are to be produced.³

¹ R Hare (2006) Agronomy of the durum wheats Kamilaroi, Yallaroi, Wollaroi and EGA Bellaroi. Primefacts 140, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0007/63646/Agronomy-of-the-durum-wheats---Primefact-140-final.pdf

² DAFF (2012) Durum wheat in Queensland, Queensland Department of Agriculture, Fisheries and Forestry, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/durum-wheat>

³ J Kneipp (2008) Durum wheat production. NSW Department of Primary Industries, <http://www.nvtonline.com.au/wp-content/uploads/2013/03/Crop-Guide-NSW-Durum-Wheat-Production.pdf>

Rotations with non-cereals, including pulses, canola, pasture legumes (especially lucerne) and sunflowers, are essential in order to:

- control root disease, especially crown rot
- provide for the biological fixation of N₂ through legumes
- control weeds and contaminant crop species, and aid in herbicide group rotation.

Durum should be the first cereal crop after a non-cereal species. Avoid successive durum crops.⁴

1.3 Benefits of durum as a rotation crop

Generally, durums are relatively resistant to the root lesion nematode, *Pratylenchus thornei*, compared with other winter cereal crops. Durum crops in rotation reduce the nematode count in the soil.

1.4 Disadvantages of durum as a rotation crop

Durum will more rapidly build up crown rot inoculum that can negatively affect subsequent winter cereal crops.

1.5 Fallow weed control

Good weed control can be achieved effectively by controlling weeds in preceding crops and fallow, rotating crops, growing competitive durum crops, and the judicious use of herbicides. It is important to control weeds such as New Zealand spinach, climbing buckwheat (black bindweed) and Mexican poppy, as their small black seeds can be difficult to remove from the grain, affecting consumer acceptance.⁵ Controlling these winter weeds in both preceding crops and winter fallows is important for subsequent durum crop quality.

1.6 Seedbed requirements

Quality seed for planting is essential. Only use seed that has a high germination rate, is large and plump, is genetically pure, and is free of all contaminants such as weed seeds and impurities of other winter cereals, in particular bread wheat and barley. Seed must be treated with an appropriate fungicide to avoid head disease (smuts and bunts) and leaf diseases (stripe rust).

Plant seed into a cultivated or chemically prepared seedbed at around 4–6 cm depth and preferably use minimum disturbance equipment with a press wheel adjusted to soil and moisture conditions. Seeding rates and sowing times will vary from state to state, so consult local information.⁶

1.7 Soil moisture

While ~20% of rain is stored during fallows, small changes in soil management can improve this apparent low water efficiency and have large impacts on profit.

Water stored can be improved through longer fallow, weed control, soil cover and reduced compaction. This can be achieved through reduced tillage, controlled traffic and planting crops before the soil fills.

⁴ R Hare (2006) Agronomy of the durum wheats Kamilaroi, Yallaroi, Wollaroi and EGA Bellaroi. Primefacts 140, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0007/63646/Agronomy-of-the-durum-wheats---Primefact-140-final.pdf

⁵ DAFF (2102) Durum wheat in Queensland, Queensland Department of Agriculture, Fisheries and Forestry, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/durum-wheat>

⁶ J Kneipp (2008) Durum wheat production. NSW Department of Primary Industries, <http://www.nvtonline.com.au/wp-content/uploads/2013/03/Crop-Guide-NSW-Durum-Wheat-Production.pdf>

More information

[C McMaster, N Graham, J Kirkegaard, J Hunt, I Menz, \(2015\) "Buying a spring" – the water and nitrogen cost of poor fallow weed control.](#)

More information

[K Verburg, B Cocks, T Webster, J Whish, \(2015\) Methods and tools to characterise soils for plant available water capacity \(Coonabarabran\).](#)

[G Wockner, D Freebairn, \(2016\) Commonly asked questions about soil water and soil management.](#)

[D Freebairn \(2016\) Improving fallow efficiency.](#)

[D Freebairn \(2016\) SoilWaterApp – a new tool to measure and monitor soil water.](#)

[K Verburg, J Whish, \(2016\) Drivers of fallow efficiency: Effect of soil properties and rainfall patterns on evaporation and the effectiveness of stubble cover.](#)

Stubble retention combined with reduced or zero tillage almost universally results in better water storage.

Better water storage results in better yields, especially in dry years.⁷

1.7.1 Dryland

In NSW, the major production area is in the north, and in Queensland it is the Darling Downs and central Queensland. Northern NSW and southern Queensland share similar, summer-dominant rainfall conditions. The Vertosol soils of both the Darling Downs and the Liverpool Plains are typically deep, friable black clays capable of storing plant-available water to the depth of 1 m+. Most fallows are no-tilled to maximise storage of moisture from summer rainfall.⁸

1.7.2 Irrigation

Durum wheat is grown successfully under irrigated conditions in most of the production areas, using both surface and overhead irrigation systems. Both water and N management are crucial if high-yielding crops of high-quality grain are to be achieved. In northern NSW, irrigated crops have yielded 8–10 t/ha with ~3.5 megalitres (ML) water/ha.⁹

1.8 Yield and targets

Eight commercial durum crops were monitored in 1999 in the Liverpool Plains (northern NSW) to identify the factors limiting durum wheat yields and the levels for target yields. WHEATMAN-generated values for critical plant and soil parameters for durum production were used as benchmarks. Low plant population (42–91 plants/m²) resulting from poor seed quality (60–95% germination), combined with insufficient nitrate supply (3–27 kg N/ha at harvest at four of five sites) appeared to be major factors limiting durum yields in the monitored crops (range 4.3–5.3 t/ha). Disease management was also likely to be a contributing factor, as crown rot levels in the wheat paddocks were <5% following sorghum and 15–30% following wheat.¹⁰

1.8.1 Water-use efficiency

Plant breeders in the Durum Breeding Australia project (NSW DPI and The University of Adelaide) and researchers at CSIRO Plant Industry (Canberra) are breeding water-use-efficient and salt-tolerant durum wheats to increase durum yields in current production areas as well as new environments.

Researchers are improving water-use efficiency by trying to combine several traits: high transpiration efficiency, long coleoptiles and early vigour. They have found, using 50 years of climate data and computer simulation, that combining high transpiration efficiency and early vigour is likely to make durum wheat much more suitable for growing in both southern and northern cropping areas.

Elite durum varieties have low transpiration efficiency, but the research team has found a highly transpiration-efficient durum to cross with them. This will give the plants a water-use efficiency trait similar to that of the HRZ wheats Drysdale⁽¹⁾ and Rees⁽¹⁾.

The team is also introducing alternative dwarfing genes from European durum wheats into commercial varieties. These genes restrict plant height, but allow the expression of long coleoptiles (about 15 cm compared with 9cm for Tamaroi⁽¹⁾).

⁷ D Freebairn (2016) Improving fallow efficiency. <https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/Improving-fallow-efficiency>

⁸ J Kneipp (2008) Durum wheat production. NSW Department of Primary Industries, <http://www.nvtonline.com.au/wp-content/uploads/2013/03/Crop-Guide-NSW-Durum-Wheat-Production.pdf>

⁹ J Kneipp (2008) Durum wheat production. NSW Department of Primary Industries, <http://www.nvtonline.com.au/wp-content/uploads/2013/03/Crop-Guide-NSW-Durum-Wheat-Production.pdf>

¹⁰ GJ Butler, PT Hayman, DF Herridge, T Christian. (2001) Working with farmers to benchmark high-yielding durum wheat on the Liverpool Plains. 10th Australian Agronomy Conference. Australian Society of Agronomy/The Regional Institute Ltd, <http://www.regional.org.au/au/asa/2001/4/b/butler.htm>

Longer coleoptiles provide insurance that the shoot will reach the soil surface, even when deep sowing is required because of receding topsoil moisture, or when there is uneven sowing depth due to stubble or direct drilling. Durum lines combining the high transpiration efficiency and long coleoptiles may be available within 4–5 years.

CSIRO and NSW DPI are developing salt-tolerant durum wheats, to allow durum to be grown in areas affected by subsoil salinity. This follows a search of the Australian Winter Cereal Collection in Tamworth that revealed ancient Persian durum wheats have the ability to exclude salt from their roots. Elite lines derived from crosses between Tamaroi (D) and the sodium-excluding ancestors were grown in saline and non-saline soils for the first time in the 2004 season.

The team has identified two major genes that confer the salt tolerance, and a molecular marker has been found for one. There is ongoing research to find a marker for the other. The research is being conducted through the AUSGRAINZ joint venture between CSIRO and NZ Crop and Food Research (GRDC Research Codes: CSP344, CSP298, CSP00058).¹¹

1.8.2 Nitrogen-use efficiency

Nitrogen-use efficiency is a term that is rarely understood. It aims to quantify the amount of N fertiliser applied that is available to the crop. In GRDC-funded benchmarking trials carried out by NSW Department of Primary Industries (DPI) in 2009, this value ranged from 25 to 95% in the benchmarked crops, which varies dramatically from the figure of 50% commonly used for N-budgeting purposes.

The major reason for the variation is the level of N that is tied up by trash, and the amount released by mineralisation. In the crops benchmarked, crops following cotton tended to have lower N-use efficiency, as the cotton trash that is incorporated into the soil requires large amounts of N to feed the bugs that break the trash down. In addition, there is minimal short-term, in-crop mineralisation. Crops following maize or fallow, however, had very little N tied up, and released much more N through mineralisation, and hence had higher N-use efficiency.

The amount of N removed was calculated by $N \text{ in grain (kg/ha)} = \text{yield (t/ha)} \times 1.75 \times \text{protein (\%)}$, and $\text{crop N requirement} = N \text{ in grain (kg/ha)} \times N \text{ uptake efficiency factor}$. So, if we know the starting soil N, the yield and the protein percentage, we can then estimate the N uptake efficiency factor.¹²

For more information, download 'Growing wheat after cotton—Durum benchmarking 2009': <http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2011/08/Growing-wheat-after-cotton-Durum-benchmarking-2009>

1.9 Disease status of paddock

The crown rot fungus enters the plant through the roots, disrupting plant water supply and hence grain yield. Moisture stress will exacerbate these conditions, resulting in the appearance of 'whiteheads' in the crop, which produce small shrivelled grain. It is therefore recommended that durum crops not be grown following a previous wheat crop or maize, which is also a carrier of the Fusarium head blight (FHB) fungus (*F. graminearum*).¹³

1.9.1 Crown rot

The ground should contain very little crown rot inoculum. The most conspicuous broadacre symptom of crown rot is the appearance of 'whiteheads' in the crop.

¹¹ GRDC (2005) Tracking water-use efficiency. GRDC Groundcover Issue 54, Feb. 2005, <http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-54/Tracking-water-use-efficiency>

¹² B Haskins, M Sissons (2011) Growing wheat after cotton—Durum benchmarking 2009, GRDC Update Papers 10 August 2011, <http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2011/08/Growing-wheat-after-cotton-Durum-benchmarking-2009>

¹³ J Kneipp (2008) Durum wheat production, NSW Department of Primary Industries, <http://www.nvtonline.com.au/wp-content/uploads/2013/03/Crop-Guide-NSW-Durum-Wheat-Production.pdf>

However, not all whiteheads are due to crown rot infection. Insect attack on stem tissues, frost and moisture stress damage can lead to whiteheads.

Stems that exhibit a brown (honey) discoloration on the lower internodes are a good indicator of crown rot infection, and a more reliable indicator of inoculum than whiteheads, which may not always be expressed in the crop. On severely affected plants, pink fungal growth is often present on the lower part of the stem and crown. Paddocks that have previously grown natural pasture should not be used, as the native grass species harbour the crown rot fungus.

These precautions are the same as those observed in bread wheat cultivation. Ground known to carry high levels of crown rot inoculum should be sown to an alternative crop such as sorghum or the broadleaf crops (e.g. chickpea, faba bean, mungbean, canola, sunflower) over a period of 2 years before replanting durum. The sowing of a durum crop following bread wheat is not recommended, as inoculum will be increased by both susceptible species.¹⁴

1.9.2 Fusarium head blight

Fusarium head blight (FHB) is not a major disease in Australian durum due to dry cropping conditions. This is a major advantage for Australian durum growers because FHB in North America and EU countries could lead to formation of a toxin known as deoxynivalenol (DON) in the grain rendering it unsuitable for human consumption if higher than certain levels. However, it is not advisable to plant maize in the rotation prior to durum, as maize is a susceptible host of the FHB fungus, *Fusarium graminearum*. Inoculum carried by the maize trash may pass the disease to the following durum crop if suitable weather conditions for infection, such as an extended wet period, prevail during and following flowering.¹⁵

1.9.3 Testing for disease

Soil sampling for future risk

PreDicta B™ is a DNA-based soil test that detects levels of a range of cereal pathogens, including the main Fusarium species that causes crown rot:

- It is commercially available to growers from accredited agronomists through the South Australian Research and Development Institute (SARDI).
- The test identifies the level of risk for crown rot (and other soil-borne pathogens) prior to sowing. However, this requires a dedicated sampling strategy and is not a simple add on to a soil nutrition test.
- Soil cores should be targeted from the previous winter cereal rows, if possible, and any stubble fragments should be retained.
- Short pieces of stubble (1–2 from each PreDicta B™ soil sampling location) from previous winter cereal crops and/or grass weed residues should be added to the soil sample to enhance detection of the inoculum that causes crown rot.
- Accredited agronomists can consult SARDI for the latest recommended sampling strategy for your region.

Stubble assessment

- A commercial stubble assessment service is available through Crown Analytical Services for crown rot and common root rot pathogens.¹⁶

¹⁴ R Hare (2006) Agronomy of the durum wheats Kamilaroi, Yallaroi, Wollaroi and EGA Bellaroi. Primefacts 140, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/data/assets/pdf_file/0007/63646/Agronomy-of-the-durum-wheats---Primefact-140-final.pdf

¹⁵ R Hare (2006) Agronomy of the durum wheats Kamilaroi, Yallaroi, Wollaroi and EGA Bellaroi. Primefacts 140, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/data/assets/pdf_file/0007/63646/Agronomy-of-the-durum-wheats---Primefact-140-final.pdf

¹⁶ GRDC (2016) Crown rot in winter cereals. <https://grdc.com.au/Resources/Factsheets/2016/02/Crown-rot-in-winter-cereals>

More information

[PreDicta B™](#)