Department of Primary Industries
primefact

# Almond industry expansion

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## Introduction

Global awareness of the important health benefits for nuts in the human diet is driving an increased demand for nut and nut products. Almonds have been branded as a superfood in recent years as they are high in Vitamin E, with low sugar and a low glycaemic index (GI) (ABA, 2015). The Australian almond industry is rapidly expanding and projected to continue this expansion into the future.

The Californian almond industry is responsible for approximately 80% of global almond production. The Australian almond industry has recently surpassed the Spanish almond industry as the second largest producer of almonds globally. Since 2006, almond production in Australia has increased from 23,000 tonnes in shell to 115,000 tonnes in shell. By 2025, Australian almond production is projected to be more than 185,000 tonnes in shell. Expanding the Australian almond industry is essential to reaching production forecasts and capitalising on the demand for almonds.

This information package is supplementary to high-resolution maps available online. The information provided should be used as a guide to find potential regions for expansion. However, specific and comprehensive site analysis must precede the final decision regarding site suitability for any orchard establishment. A further use of this work would be to provide information on suitable regions for sentinel plantings to determine those most appropriate for expansion of the Australian almond industry.

## Almonds

Almonds (*Prunus duclis*) are native to the Middle East and southern Asia. Trees are small, 4 to10 m tall with trunks of up to 30 cm in diameter. Almonds flower in August with white and pale pink flowers that have five petals. Almonds rely on bees for pollination; they are self-incompatible (self-sterile). Budburst occurs after flowering and small single leaves develop. In February, after the nuts have filled, matured, and the hulls have cracked, the nuts are mechanically harvested.

There are many different almond varieties; some of the most important in the Australian almond industry are listed in Table 1. Each variety has a different set of growth requirements and produces a slightly different nut. The Almond Board of Australia (ABA) conducts research into almond production, enhancing the knowledge-base on growing almonds in Australia.

**Table 1. Current (as of 2014/2015) almond plantings by variety (hectares planted) (ABA, 2015).**

| Variety | Hectares planted |
|---|---|
| Nonpareil | 14,642 |
| Carmel | 9,160 |
| Price | 3,417 |
| Other | 1,748 |
| **Total** | **28,967** |

# Bioclimatology model for almond industry expansion

Potentially suitable regions for almond industry expansion throughout Australia have been modelled (Figure 1) using bioclimatology – the study of the effects of climate on living organisms. The aim of this work is to provide an objective basis for expansion of the Australian hazelnut industry.

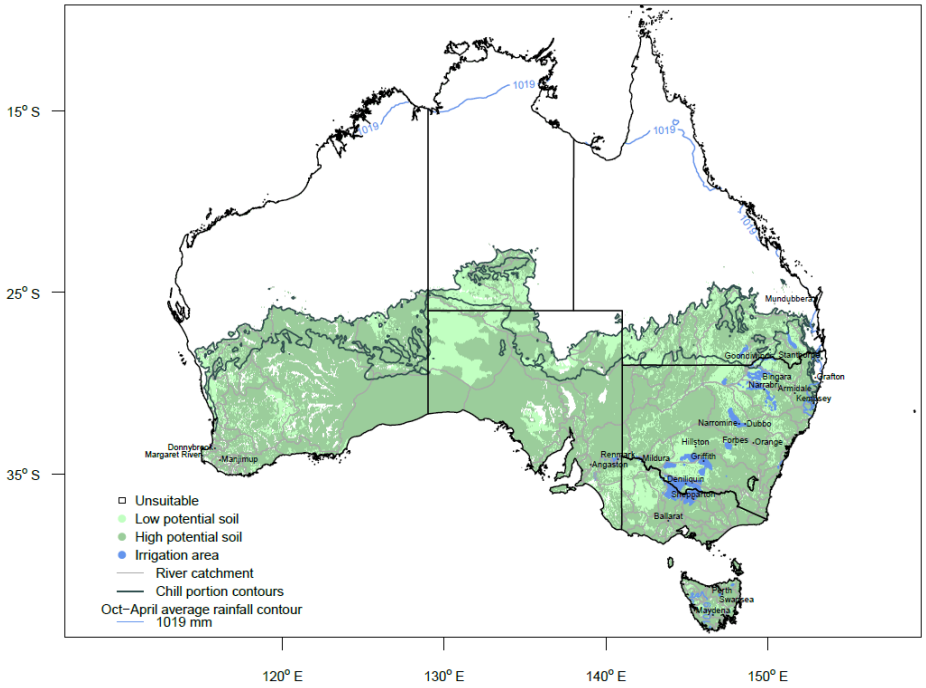


**Figure 1. Bioclimatology model for almond industry expansion. See Figure 2 for interpretation.**

## Using the Dynamic Model to predict chill portions

The Dynamic Model was used to predict chill portions for 5 km × 5 km grid points covering the entirety of Australia. The Dynamic Model uses daily temperature maxima and minima to generate hourly temperatures for the midpoint of each grid. Chill portions were calculated for 1 May to 31 August. The 'R' statistical package was used to plot dark green chill portion contour lines on a digital map of Australia for each of six temperate nut industries (Figure 1). The upper dark green contour represents the minimum chill requirement and the lower dark green contour represents the maximum chill requirements for a range of commercial cultivars for each nut type.

The Bureau of Meteorology (BoM) historical temperature records date back to 1911. However, this data is often subject to spatial and temporal discontinuities. For this reason, temperature data gathered since 1996 was used to interpolate the chill portion data used to map regions suitable for nut expansion The Moree site in NSW was selected to compare chill portion estimates derived from the interpolated data with those calculated using actual recorded daily temperatures. There was good agreement between the two methods.

## Interpreting the model

A sample section of the hazelnut industry map (Figure 2) outlines the key features of the bioclimatology models: chill portion contours, river catchment regions, rainfall contour, irrigation scheme areas and soil suitability. These are features common to each nut industry model. The two chill portion contours represent the range in chill portion requirements of the range of commercial cultivars for each nut crop (as describe further in the following sections for each specific nut crop).

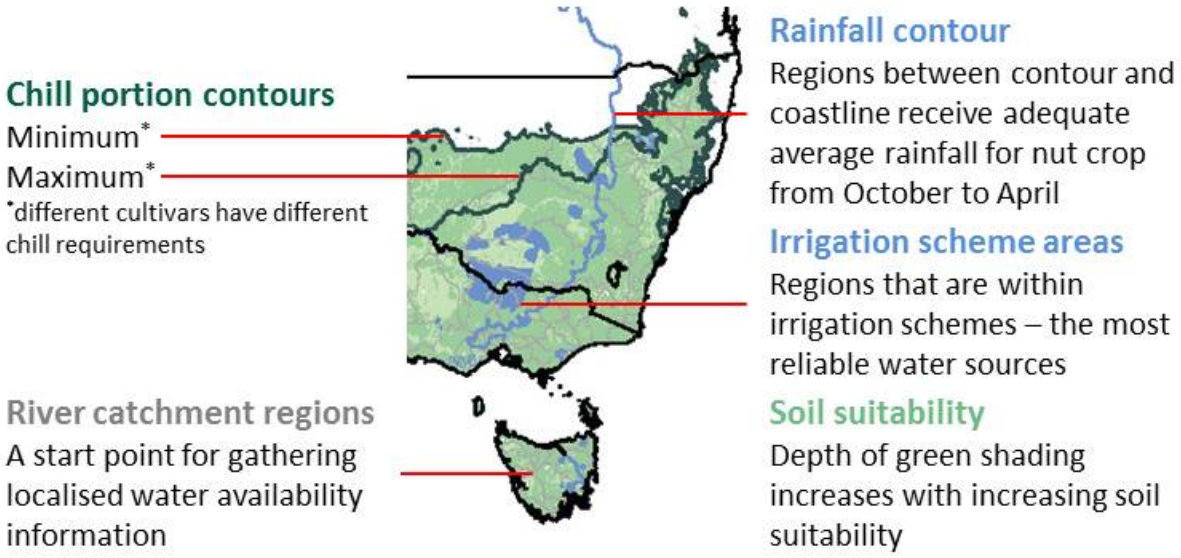


**Figure 2. Key to interpretation of bioclimatology model. An example using hazelnut bioclimatology map.**

## Almond growth requirements

### Chill

Almond trees are best grown in regions with a Mediterranean climate. Chill requirements were identified as a critical determinant for agronomic success. Almonds, like other nut trees, require a minimum chill accumulation throughout dormancy (1 May to 31 August) for phenological processes, including budbreak and flowering. The quantity of chill portions required varies between cultivars (Table 2).

### Water

Almonds require a minimum of 8.5 to10 mega litres (ML) per hectare of water throughout the growing season (1 October to 30 April). More than 14 ML water per hectare could be required in some regions. Water requirements vary depending on other climatic variables such as humidity and air temperature, and agronomic factors such as soil water-holding capacity.

A rainfall contour has been added to the bioclimatology model to show regions that receive 1,019 mm rainfall or more during the growing season. This rainfall value is based on an average of values from an extensive literature review of internationally-based research and could vary significantly under Australian growth conditions

**Table 2. Chill portions (low from cultivar Nonpareil, high from cultivar Ferragnes) and water (1 October to 30 April mm) requirements of almond trees.**

| | Requirement |
|---|---|
| Chill | 23–32 |
| Water | 1,019 |

### Soil

Almond trees grow best in deep, well-drained loamy soils. Preferable sites selected for orchard establishment will have soils that are highly fertile, have low salinity levels and low clay content. Unfortunately, such descriptions cannot commonly be applied to Australian soils. With chemical and physical amendments and additions, the scope of potentially suitable and productive soils is broadened. Using the Australian Soils Classification and data obtained from the Australian Soil Resource Information System (ASRIS, 2011) the soil layer was added as a 5th layer to the almond bioclimatology model map.

## Water availability

Catchment areas are outlined on the bioclimatology map (grey). Due to the dynamic nature of water availability in some catchment areas, these are provided as a guide and starting point; further information will be needed to form your final decision. For example, Figure 3 shows the Warburton, Nullabor and Gairdner catchments in south western Victoria. The water availability in these catchments is variable and depends on many factors including rainfall, drainage and temperature.

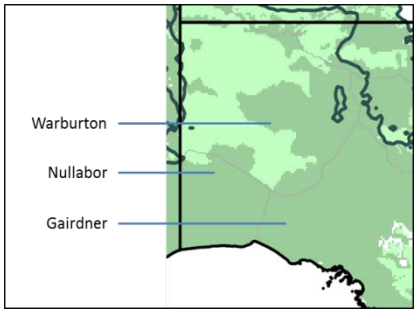


**Figure 3. Example of river catchments shown on the almond bioclimatology map.**

There are some river catchment areas that are highly suitable for establishing almond plantings. Rivers that constantly flow are termed perennial rivers and are relatively reliable sources of stable water, compared with non-perennial or seasonally flowing rivers (Figure 4).

The main perennial river systems with the capability to supply water for irrigation are the Murrumbidgee and Murray Rivers, which run through NSW, Victoria (Vic.) and South Australia (SA). There are also coastal perennial river systems on the eastern coast of Australia and small perennial rivers in south-western Western Australia (WA).

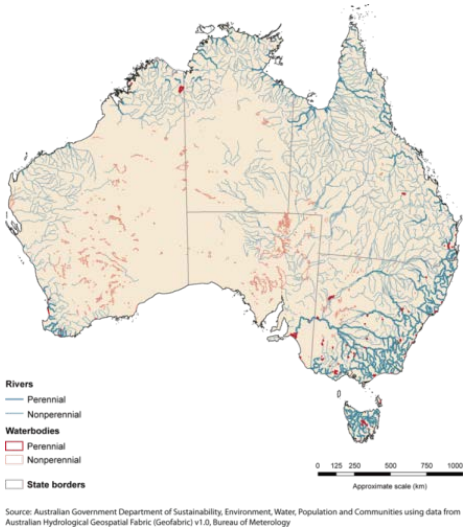


**Figure 4. Australian perennial (permanently flowing) and non-perennial (seasonally flowing) river systems and water bodies (SoE, 2011).**

It should also be noted that there are other options for obtaining water such as dams, which increase the scope of suitable regions beyond this model.

## Recommendations

Suitable regions for expanding the Australian almond industry are identified throughout Central NSW (Figure 5a) and Victoria (Figure 5b). These regions have perennial river systems and irrigation schemes.

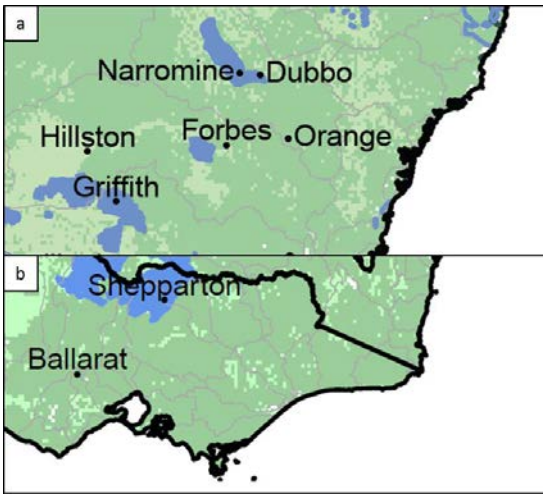


**Figure 5. Potentially productive regions near towns such as Griffith, Narromine and Forbes in NSW (a) and Shepparton in Vic (b).**

Potentially productive regions for almond industry expansion include:

- the south-eastern corner of SA near Angaston and Renmark (Figure 6a)
- south-eastern Queensland (QLD) and north-eastern NSW, however, summer humidity in coastal parts of these regions may increase disease risk (Figure 6b). Locations near Stanthorpe and Narrabri are suitable
- the Murrimbidgee and Murray river and irrigation systems in NSW and Vic (Figure 6c), which have not only water availability but well-established infatrusture
- the regions of south-western WA, near the river systems of the Margaret River into Manjimup (Figure 6d).

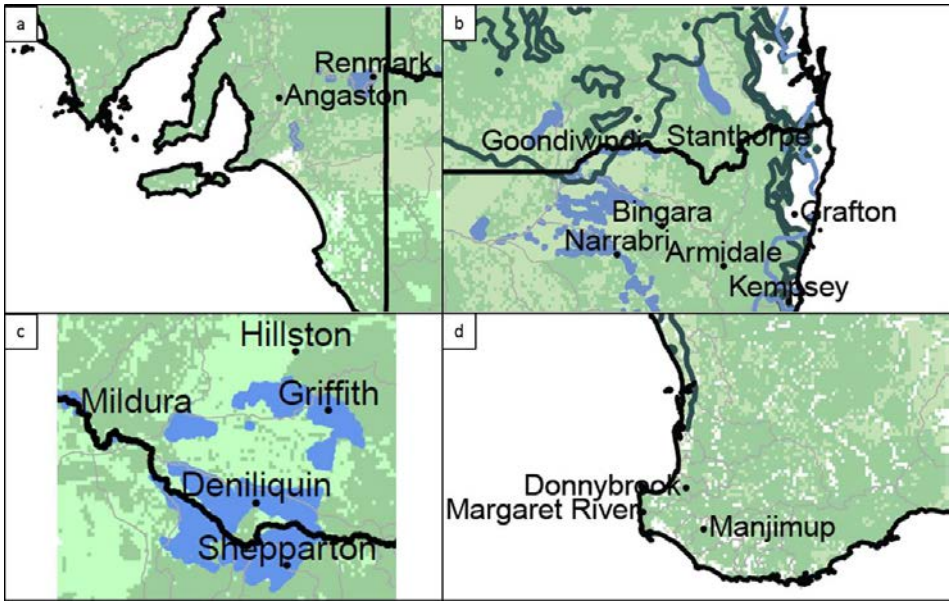


**Figure 6. Example of potentially productive regions for almond industry expansion. SA (a), NSW/QLD border (b), irrigation schemes of the Murray and Murrumbidgee rivers (c) and WA (d).**

## Online resources

## Model available for download as PDF

The model generated is available online as an extremely high-resolution map on the NSW DPI website with this Primefact (Almond industry expansion). This map is able to be interrogated, by zooming, to a resolution of 5 km × 5 km. The model is based on bioclimatology and the phenological requirements of almonds. Models for other temperate nut industries (chestnuts, hazelnuts, pecans, pistachios and walnuts) have also been developed and are also available online from the NSW DPI nuts page.

Initially, this information package could be used as a guide for establishing sentinel plantings in some locations that have been listed/highlighted as potentially suitable regions for almond production.

## Multi-industry information package and map

This Primefact is one of six industry specific Primefacts available online (NSW DPI nuts page). In addition, we have a multi-industry information package, which includes more information than these industry specific documents and a more user friendly map. This user friendly map does not include all the information (rainfall, soil or irrigation schemes) that the PDF maps do and we suggest using the two map types to get the maximum possible use out of the resources available.

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### More information

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For updates go to www.dpi.nsw.gov.au/factsheets



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