Pecan industry expansion

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Introduction

Global awareness of the health benefits of nuts, including pecans, is driving an increased demand for nuts and nut products. Pecans are native to the central south and south eastern regions of the US and Mexico. The first commercial planting of pecans commenced in the 1880s in the US, today pecans are also commercially grown in other regions including Mexico, South Africa, Israel, Argentina and Australia.

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 pecan industry.

Pecans

Pecans (*Carya illinoinensis*) are an alternate-bearing, wind pollinated and self-incompatible tree. A variety of cultivars are required within a pecan farm to ensure cross pollination. Wind pollination occurs during September and nuts mature until May when they are harvested. Pecan trees can grow 20 to 40 m tall with trunks up to 2 m in diameter. The large alternate leaves of the pecan tree consist of up to 15 small pinnate leaflets and are deciduous. As pecan trees age, pruning is critical to maximising light interception (amount of sunlight which penetrates tree canopy) and yields.

Australian Pecan Industry

The majority of the Australian pecan industry is located in northern New South Wales (NSW) and south-eastern Queensland (QLD). Stahmann Farms Trawalla property near Moree in northern NSW is the largest pecan operation in the southern hemisphere. There are over 100 pecan growers in Australia with more than 180,000 trees planted. Growers belonging to the Australian Pecan Growers Association (APGA) produce approximately 95% of nuts in Australia (APGA, 2011). Australian pecan production has plateaued at around 3,000 tonnes (in shell) since 2006 (ANIC, 2015). There is strong interest in industry expansion, and production is expected to increase to approximately 9,500 tonnes in shell by 2025. Identifying regions suitable for pecan production is a key factor for expanding the industry.

Pecan Growth Requirements

Chill and heat

Pecan trees are best grown in regions with hot, humid summers. Pecans, 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 units required varies between cultivars, ranging from 38.8 to 44 (Table 1). During spring time the accumulation of heat units is necessary for flowering and nut maturation. The quantity of heat units required also varies between cultivars, however, on average pecan trees require 750 heat hours to accumulate throughout the growing season (approximately 31 August to 31 October).

Table 1 Chill portions (low from Schley variety, high from Wichita variety), heat units (degree days) and water (1 October to 30 April mm) requirements of pecan trees

	Requirement
Chill	38.8-44
Heat	750
Water	1058

Water

Pecans are native to regions with humid summers and interrogation of literature revealed that pecans require at least 7 ML water during the growing season (1 October to 30 April). Research from the University of Georgia reports pecans can use as much as 13 to 20 ML water annually. Disparities in values between literature sources indicate the need for local research into pecan tree growth. The average water requirement reported in literature has been applied as a rainfall contour to the bioclimatology model.

Soil

Pecans prefer deep well drained, fertile soils. Australian soils are often poorly structured and have low fertility and high salinity. Establishment of highly productive, sustainable and long term pecan plantings requires individual site analysis followed by careful planning and preparation. The depth, clay content, structure and previous use of the soils at each site has the potential to vary greatly within a small area. 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 pecan bioclimatology model map.

Risk factors

Pecans and other nut crops are susceptible to certain risk factors including late spring frosts, high heat events, and rainfall during harvest, but there are many other risks that affect different locations. The severity of the impact of risks varies each year, from region to region and even within small areas on an orchard. Furthermore, these risks are potentially negated or reduced by orchard management strategies, and are influenced by orchard size and local infrastructure. These factors are not incorporated into the model as we are not able to accurately account for the high variability between locations, farm management, infrastructure and the severity of each risk factor from year to year. We strongly recommend local research to assess the potential for negative climatic conditions.

Bioclimatology model for pecan industry expansion

Potentially suitable regions for pecan industry expansion throughout Australia have been modelled 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 pecan industry.

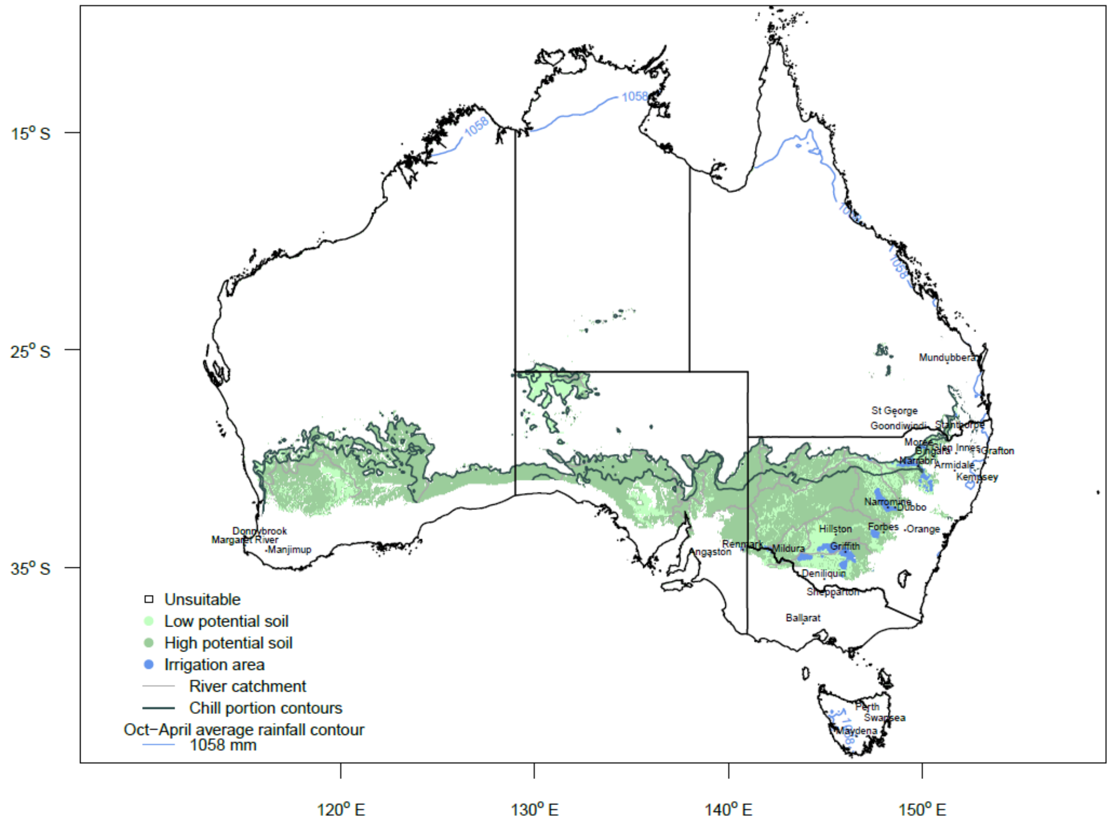

Figure 1 Bioclimatology model for pecan industry expansion.

The bioclimatology model was generated based on pecan tree phenology requirements. The Dynamic Model of Chill Portions (Dynamic Model) quantifies chill hours (hours between 0 °C and 7.2 °C) accounting for the cancelling effect of heat. This model has been extensively tested on many crops in Australia and California (Luedeling, 2011; Zhang, 2011). Chill portions were determined as the most limiting factor to regional suitability so were the primary factor to be modelled.

Additional layers were added to the chill portion map to incorporate water availability and soil suitability. Water availability has been added in the form of blue contour lines for rainfall, blue shaded vectors for irrigation schemes, and grey lines show the river catchment areas. The depth of green shading increases with increasing soil suitability.

Dynamic Model to predict chill portions and heat unit requirements

The Dynamic Model was used to predict chill portions and heat units 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–31 August and heat units for 1 October–30 April. We interpolated chill portion data, from the Bureau of Meteorology (BoM) historical temperature records, gathered since 1996 to overcome special and temporal discontinuities within BoM data records.

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 2). 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.

Interpreting the model

A sample section of the hazelnut industry map (Figure 3) 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).

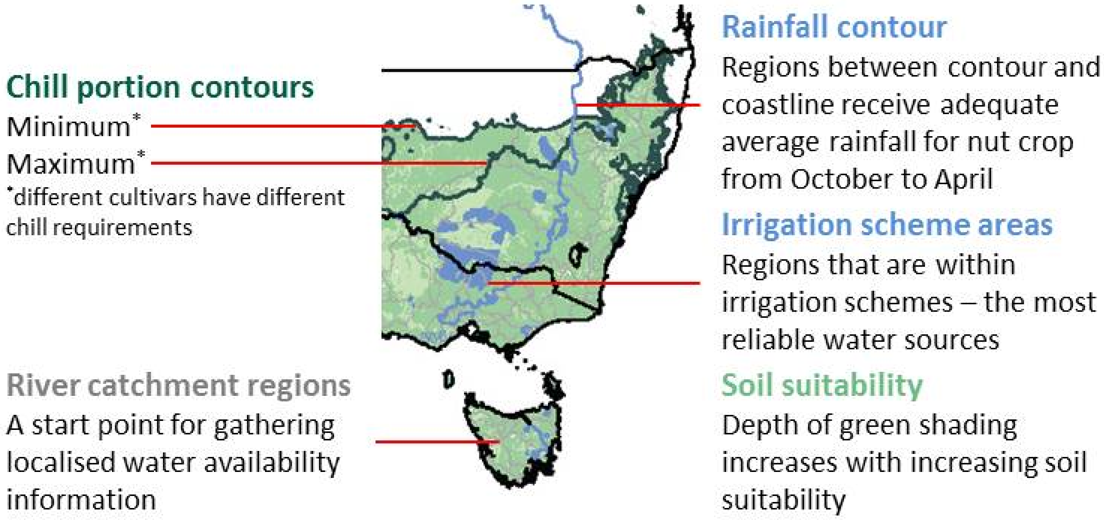

Figure 2 Key to interpretation of bioclimatology model. An example using hazelnut bioclimatology map

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 from which to seek further information. For example, Figure 3 shows the Paroo River, Lake Bancannia and Darling River catchments of northern NSW/southern QLD, however, the water availability in these catchments is variable and depends on many factors including rainfall and temperature.

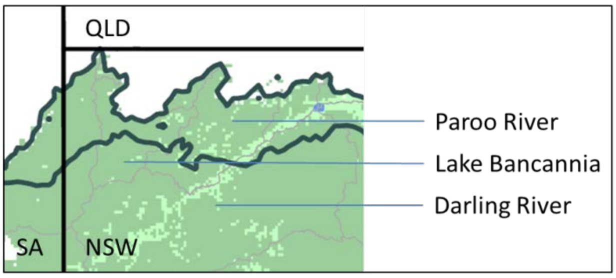

Figure 3 Example of river catchments shown on pecan bioclimatology map

There are some river catchment areas that are highly suitable for establishing nut tree plantings. The most suitable river catchment areas contain perennial rivers that constantly flow and are relatively reliable sources of stable water, compared with non-perennial or seasonally flowing rivers.

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

Recommendations

Suitable regions for expansion of Australian Pecan industry could be within the irrigation scheme of the Murrimbidgee Irrigation Area (MIA) and areas of central NSW (Figure 4).

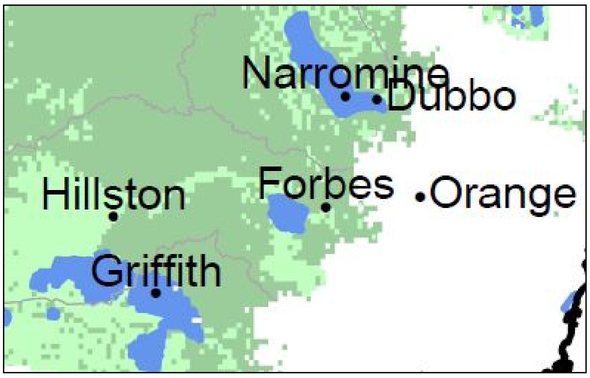

Figure 4 - Example of potentially productive regions (MIA and central NSW)

There are potentially suitable regions on the QLD/NSW border near Moree and Stanthorpe (Figure 5a) and the NSW/Victorian border near Mildura (Figure 5b).

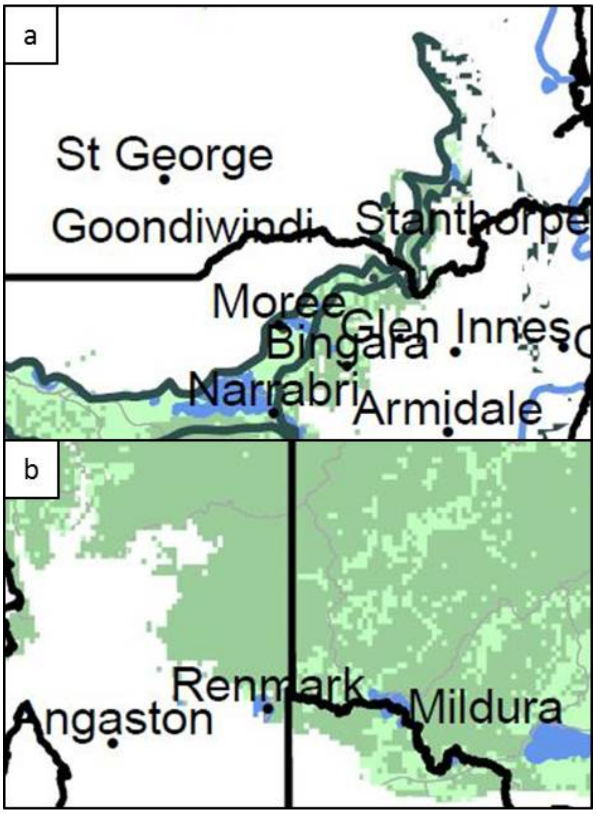

Figure 5 Example of potentially productive regions (a – NSW/QLD border, b – NSW/Vic/SA border)

Online resources

Model available for download as PDF

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

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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