Department of Primary Industries
primefact

Chestnut industry expansion

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Jacquelyn Simpson, Research Horticulturist, Horticulture Unit, Yanco Agricultural Institute

Introduction

Global awareness of the important health benefits from nuts in the human diet is driving an increased demand for nut and nut products. The Australian chestnuts industry is largely (~70%) located in north-eastern Victoria. There are also chestnut production areas in New South Wales (NSW), including Blue Mountains and Orange, South Australia (SA) around Adelaide Hills, Western Australia (WA) in the south-western region and Tasmania. The production quantity is sufficient for local consumption, and only approximately 2% of the annual crop is exported to the Asian market. There is an opportunity to increase Australian chestnut production in response to a growing demand from the American, European and Asian markets. The 2015 of in shell chestnut production was approximately 1,200 tonnes. By 2025, this is expected to increase to 1,650 tonnes (ANIC, 2015).

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 chestnut industry.

Chestnuts

The chestnut (*Castanea sativa* mill.) is a medium-sized tree, growing 20–35 m tall and 6 m wide. The tree has thick, oblong-lanceolate leaves and prefers mild summers and cool winters. Chestnut trees originated from Europe and Asia Minor and have a long-standing role in the human diet in Asian and European countries. In Europe, during medieval times, one chestnut tree was said to provide one person with a lifetime of sustenance and one tree was planted for every child born in towns under siege.

The monoecious flowers bloom in November and December and nuts are harvested between March and May. Catkins are bi-sexual with pistillate (female) flowers located at the base of the catkin. The remainder of the catkin is staminate (male) flowers. Pollination (wind) often occurs before pistillate flower receptivity, hence multiple cultivars are recommended. It is possible for each pistillate flower to develop into 1–3 nuts, with the cultivar influencing the quantity, therefore the size of nuts, produced in each pistillate flower. The cotyledon, or edible portion of the chestnut, is encased in the pellicle, a hard shell, protected within an involucre, or spiny bur.

Chestnut growth requirements

Chill

Chestnut trees are best grown in regions with cool winters and warm summers. Chill requirements were identified as a critical determinant of agronomic success. Chestnuts, 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.

Water

Chestnuts require a minimum of five to seven megalitres (ML) water throughout the growing season (1 October to 30 April). A rainfall contour has been added to the bioclimatology model to show regions that receive 633 mm rainfall or more during the growing season. This 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.

Soil

Chestnuts prefer deep well-drained, fertile soils. Chestnuts do not respond well to liming or poor drainage. It is recommended that chestnut plantings are established on slopes to improve the drainage. Preferable sites selected for orchard establishment will have soils that are well drained, 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.

Table 1. Chill portions, and water (1 October to 30 April mm) requirements of chestnut trees

	Requirement
Chill	58–88
Water	633

Using the Dynamic Model to predict chill portions

The Dynamic Model was used to predict chill portions and heat units for 5 km × 5 km grid points covering the entirety of Australia (Figure 1). 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.

Bioclimatology model for chestnut industry expansion

Potentially suitable regions for chestnut 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 chestnut industry

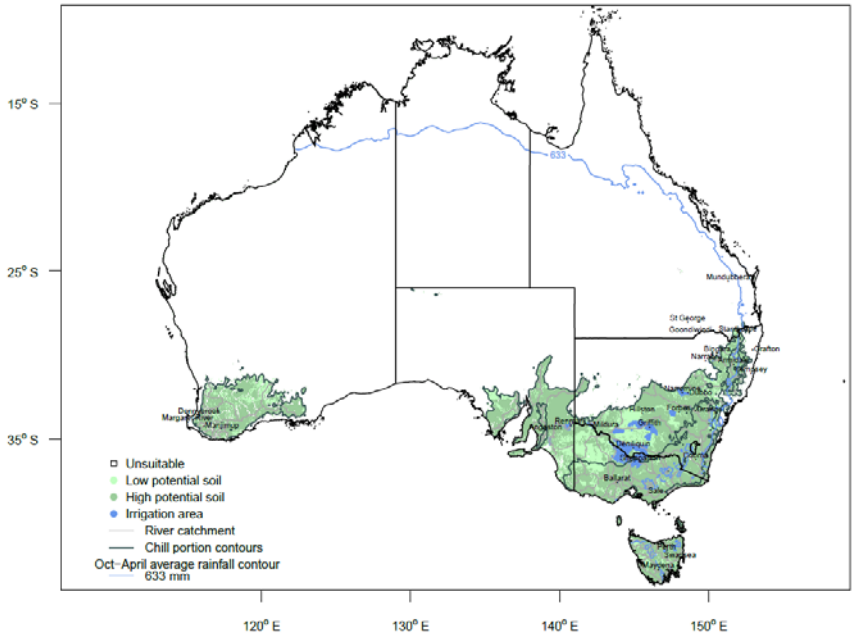

Figure 1. Bioclimatology model for chestnut industry expansion; see Figure 2 for interpretation.

The bioclimatology model was generated based on the nut 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, hence were the primary factor to be modelled.

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).

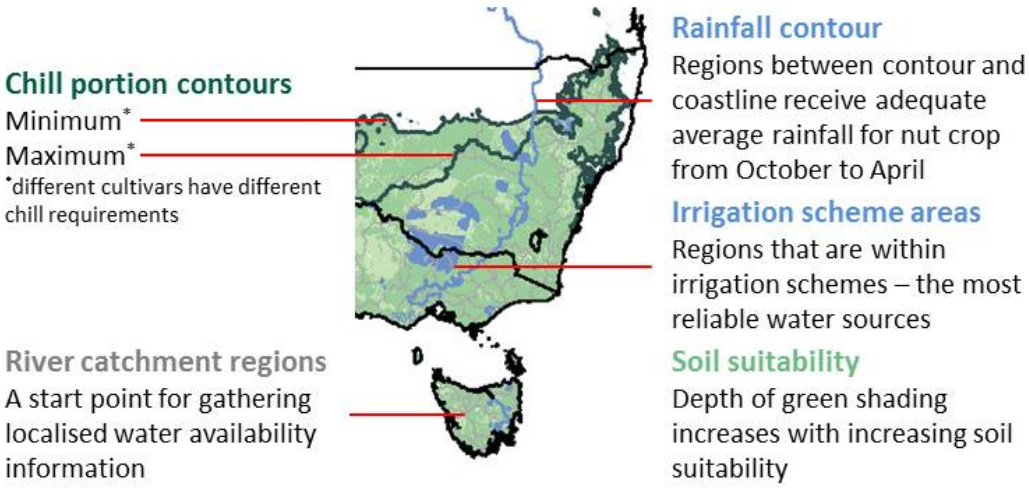

Figure 2. Key to interpretation of bioclimatology model – an example using the hazelnut bioclimatology map.

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 and starting point; further information will be needed to form your final decision. For example, Figure 3 shows the Glenelg, Hopkins and Portland catchments near the south-western coast of Victoria. The water availability in these catchments is variable and depends on many factors including rainfall, drainage and temperature.

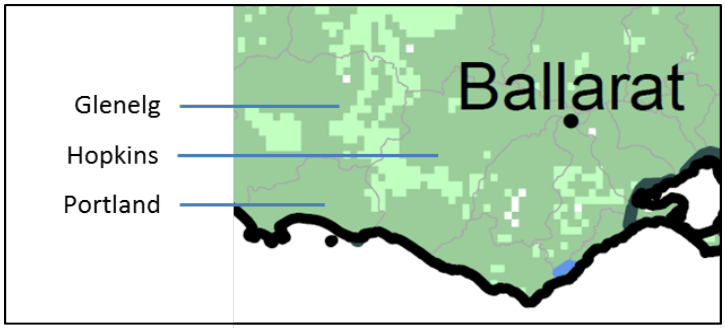

Figure 3. Example of river catchments shown on the chestnut bioclimatology map. Including river catchments should be used as a starting point from which to obtain further information for specific catchment areas.

There are some river catchment areas that are highly suitable for establishing chestnut 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).

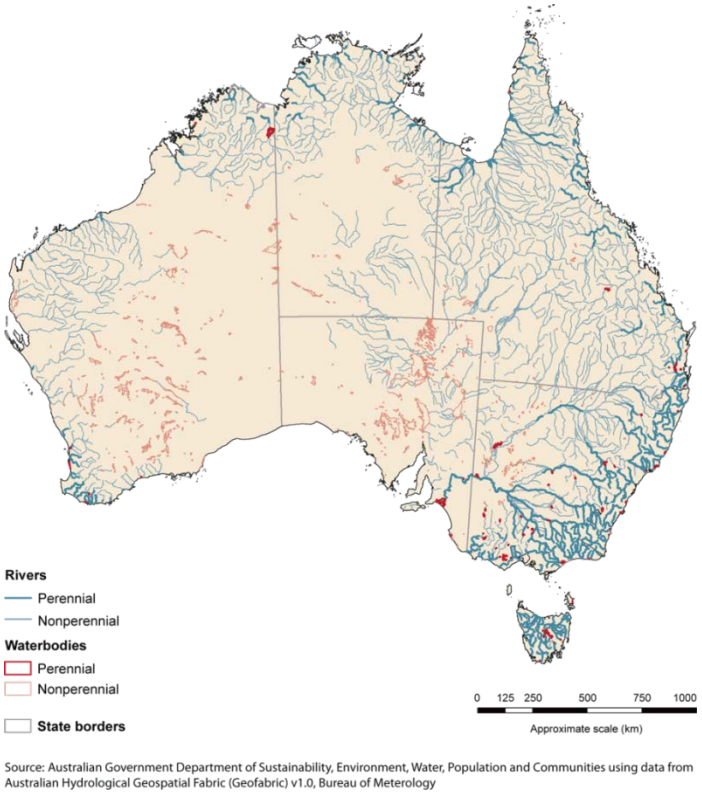

Figure 4. Australian perennial (permanently flowing) and non-perennial (seasonally flowing) river systems and water bodies (SoE, 2011).

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 chestnut industry are identified throughout southern NSW and Victoria (Figure 5). The area between the eastern coastline and Orange in NSW down to Shepparton in Victoria is most suitable.

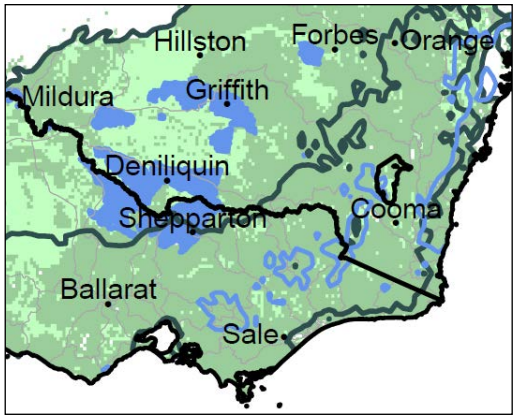

Figure 5 Example of potentially productive regions throughout NSW and Victoria.

Other potentially productive regions include most of Tasmania (Figure 6a), the Adelaide Hills (Angaston) and Renmark regions of SA (Figure 6b), small areas in the northern NSW Tablelands near Armidale (Figure 6c), and the south-eastern coast near the NSW/Victorian border, including some parts of the Snowy Mountains near Cooma (Figure 6d).

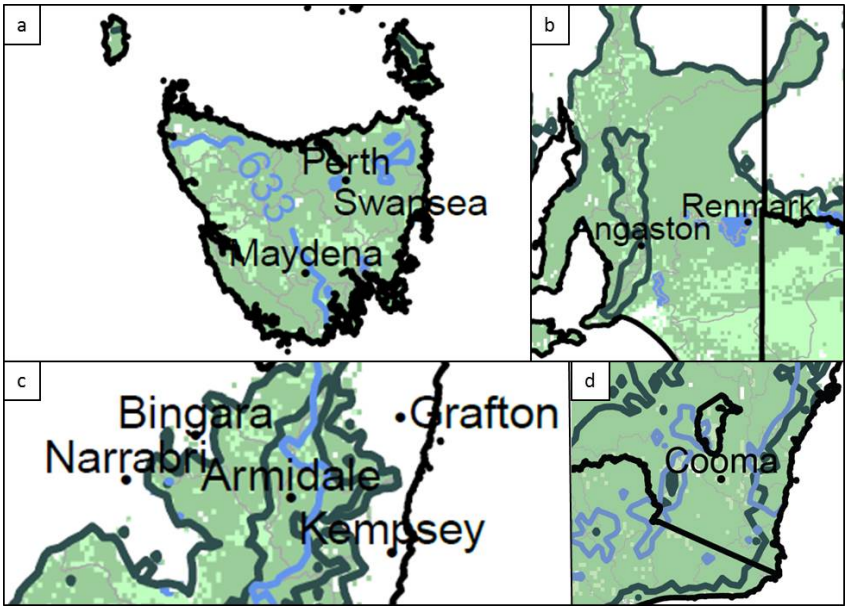

Figure 6. Example of potentially productive regions (a: TAS, b: SA, c: northern NSW, d: NSW/Vic border)

Future work and possible applications

We encountered issues when attempting to determine values for chill, heat, water and soil requirements based on scientific literature and industry publications as there is limited Australian based research into the growth of Chestnuts. The Australian chestnut industry could benefit greatly from further research into the requirements and of chestnut trees under Australian conditions.

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 chestnut production.

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 (Chestnut 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 chestnuts. Models for other temperate nut industries (almonds, hazelnuts, pecans, 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

Jacquelyn Simpson 02 6951 2611 email: jacquelyn.simpson@dpi.nsw.gov.au

Acknowledgments

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

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