The potential for hazelnut production in Australia

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Abstract. Very few hazelnuts are produced in Australia, yet we import more than 1800 tonnes of kernels valued at more than $10 million per annum. Hazelnuts are a deciduous tree crop, that requires mild temperatures, well-drained soils and good soil moisture. Although Australia generally has a semi arid climate, climate comparisons for some areas in South-eastern Australia, compared with key production areas in the northern hemisphere, indicate there are areas in Australia with a suitable climate.
Field evaluation of a range of cultivars and grower selections indicates some genotypes with potential for Australian conditions. Yields recorded for young trees grown at Myrtleford in northeastern Victoria compare very favourably with commercial yields in some of the highest producing regions in the world. Technology and equipment is available overseas for crop mechanisation.
It is concluded that hazelnuts are a crop with potential for select parts of Australia, but key elements for success will be growers working collaboratively to develop a productive, highly efficient industry with good marketing strategies.

Keywords: Climatic requirements, soils, markets, cultivars, nut yields, hazelnuts.

Introduction

Although hazelnuts (Corylus avellana L.) were introduced into Australia over 100 years ago, to date they have only been grown on a relatively small scale. Current annual production is estimated to be approximately 25 tonnes of in-shell nuts. However, there appears to be an opportunity for considerable expansion of the local industry, as about 1800 tonnes of kernels, valued over $10 million, are imported into Australia annually (ABS 2002), as observed in Figure 1 and Figure 2.

It is considered that the establishment of a local industry could complement

Figure 1 Volume of hazelnut imports into Australia, 1994-2001

Figure 2 Value of hazelnut imports into Australia, 1994-2001

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overseas production through the provision of fresh, locally grown nuts which could be stored in shell, at a relatively low cost and cracked as required to supply fresh kernels for local processors and consumers. Major users of hazelnuts in Europe are also interested in obtaining product from Australia, provided the nuts or kernels are of appropriate quality and are available in sufficient quantities. There is particular interest in organically grown nuts. As few of the major pests and diseases of hazelnuts have been introduced into Australia, organic or pesticide free production should be feasible.

In order to capitalise on these market opportunities, there is a need to evaluate appropriate varieties and develop efficient production systems. To be competitive and gain labour efficiencies, growers need to mechanise harvesting and post-harvest handling. Although opportunities exist for growers to market their own produce, as production expands and smaller market niches are satisfied there will be a need for growers to develop strategic alliances with major buyers.

Markets and marketing issues

Hazelnuts are marketed as two products, nuts in-shell and kernels. Nuts in-shell, marketed mainly for home or table consumption, account for less than 10% of the total market (Figure 1). Most hazelnuts are cracked and sold as kernels, which can be eaten fresh, but the vast majority are either blanched or roasted and then used in confectionery products, cakes and biscuits. Hazelnuts are highly nutritious and can be used for a wide range of purposes, such as in muesli, salads and as a compliment to many food dishes.

The major centre of hazelnut production in the world is in northern Turkey, on the Black Sea coast. There are other important production areas in Italy, Spain and Oregon, USA. The nuts produced by the Turkish and European growers are commonly stored on farm and then sold during the year to operators of cracking plants. The cracked kernels are size-graded and placed in plastic vacuum packs for use by processors and for export.

Major constraints to the development of the local industry are the lack of knowledge on the performance of introduced varieties and local seedling types as well as on the best localities and soils for hazelnut production.

Climatic requirements

Hazelnut production is favoured by a mild climate with a cool winter and mild summer, such as is found in the coastal and some upland areas of south-eastern Australia. Hazelnut trees have a poor tolerance to heat, wind and moisture stress, but have moderate frost tolerance (Tous Marti 2001).

The tree is deciduous and is wind pollinated. The male catkins, formed during late summer and autumn, elongate in winter and shed pollen, which is carried on the wind to the small female flowers. When receptive, these female flowers appear as small buds with reddish tufts of filaments (stigmas) at their tips. Pollen and female flowers can tolerate temperatures down to -10°C (Tous Marti 2001). Both catkins and female flowers are borne on the same plant, but hazelnuts are not self-fertile. Although pollination occurs in the winter, fertilisation does not take place until early summer when the embryo (kernel) develops within the shell (Germain 1994). At this stage, late November and early December in Australia, if maximum temperatures are less than 21°C for three or more days, development of fertilized embryo can cease, resulting in blank or empty nuts (Tous Marti 2001). The mature nuts ripen in late summer and, in most varieties, fall from their husks to the ground during March. As a deciduous tree hazelnuts require sufficient chilling in the winter to
overcome dormancy in catkins, female flowers and vegetative buds. Chill hours (0-7°C) are greatest for leaf buds and vary with cultivars ranging from about 600 hours for Tonda di Giffoni to 1500 hours for Casina (Mehlenbacher, 1991).

The main northern hemisphere production areas have a Mediterranean-type climate and are in the latitude range 40° to 45°N. The climate of locations in Australia where hazelnut groves have been successfully established generally compares favourably with major northern hemisphere production areas (Figure 3). The temperature for Corvalis in the Willamette Valley, which is the major centre for production in the USA, is similar to that for Orange on the Central Tablelands of NSW and Myrtleford in north-eastern Victoria. However, rainfall at Corvalis is strongly winter dominant, compared with Orange and Myrtleford, where it is lower, but more evenly spread throughout the year.

A contrasting pattern is at Reus, in Spain, near Camp de Tarragona, another significant centre for hazelnut production. Winter temperatures at Reus are similar to those in southern Italy, where hazelnuts are also grown. Similar mild winter climates are found in maritime locations, such as Kingston in southern Tasmania, the south coast of NSW and even the southern highlands as represented by Moss Vale. The summer temperatures experienced in Tasmania are quite cool in comparison with most overseas localities and mainland Australia. The implications for low maximum temperatures in November and December on kernel development are yet to be assessed. It appears that some cultivars are less sensitive to cool temperatures at this stage of development than others (Germain 1994).

In Oregon, hazelnuts are grown on deep alluvial loam soils, where they are grown as a dryland crop on a mean annual rainfall of about 1000mm. At Reus (Camp de Tarragona), where the mean annual rainfall is less than 600mm, hazelnuts are grown as an irrigated crop. An average of 2.5 ML/ha of water is applied.

Rainfall data for other centres of production (Tous Marti 2001) suggests that about 850 mm of annual rainfall is about the minimum necessary for dryland commercial production. However, if soils are not deep and rainfall is erratic, as is frequently experienced in Australia, supplementary irrigation is beneficial as hazelnuts are very sensitive to moisture stress. Irrigation experiments in the Arge

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Figure 3. Comparisons of climate for two key centres of production in the Northern Hemisphere compared with potential production areas in Australia

Reus, Spain (588mm)

Corvallis, Oregon (1092mm)

Orange, NSW

Myrtleford, Vic

Moss Vale (976 mm)

Kingston, Tas

Sources: Bureau of Meterology, 2004 Oregon: Taylor, GH. 1991
provision of irrigation water to the orchard site. There are two main aspects that have to be considered in cultivar selection: the productivity of the trees and the marketability of the nuts. The cultivars planted should be both productive and of a type for which there is a market demand. The greatest demand is for kernels.

In order to assist potential growers and investors select appropriate cultivars, a research project has been initiated within the Faculty of Rural Management in conjunction with growers and state government departments across a range of sites in southeastern Australia. Funding for the research has been provided by the Rural Industries Research and Development Corporation.

The key objectives of the research are to:

- Determine the most suitable hazelnut varieties that could be used for the establishment of a hazelnut industry in southeastern Australia.
- Assess the effects of geographical region and climate on hazelnut production and varietal performance.
- Assess the productive potential of hazelnuts (Corylus avellana L.) in Australia.

Five variety trials have been established in southeastern Australia in locations where it is considered that hazelnuts could be grown. The five sites represent different rainfall and temperature patterns as well as different soil types. Two sites are in NSW, Orange and Moss Vale, two in Victoria, Myrtleford and Toolangi and one in southern Tasmania at Kettering, near Kingston (Figure 4).

![Figure 4. Locations of the five hazelnut cultivar sites in south-eastern Australia. In the Northern Hemisphere, main production areas lie in the latitude range 40–45°N](http://www.afbmnetwork.orange.usyd.edu.au/afbmjournal/)
The principal objective of selecting the range of locations was to ascertain whether there were any interactions between cultivar and climate. It is recognised that, in addition to climatic variation, the sites differ with respect to soil, which may compound climatic effects. The soil differences have been assessed and monitored. Standard procedures for site management have been implemented, as much as it is possible, to minimise variation due to management practices.

The soil profile at each site has been described from soil samples taken down to 600mm depth. The soils at both Orange and Toolangi have been developed from basalt, which has weathered to form deep, red krasnozem soils. The soil at Myrtleford is alluvial and is situated on a relatively recent floodplain or terrace. It is deep and well-drained; it has a coarser texture than the krasnozem. The Moss Vale site is on a red podsol and the Kettering site is on a grey podsol. The podsolic soils typically have a duplex profile with a heavier textured subsoil or B horizon which has poorer drainage characteristics than the A horizon, particularly at Kettering.

Soil samples were taken across each of the sites from the top 10cm of soil and analyzed to determine pH and the availability of soil nutrients. All sites were found to be slightly acid. As the growth and production of hazelnuts is favoured by pH 6-6.5 (Olsen, 1995) all sites had five tonnes/ha of ground limestone applied before planting, except Myrtleford, where 7 tonnes/ha was applied.

A total of 25 hazelnut genotypes are under evaluation for growth and productivity. They are mainly those suited to the kernel market, but also include cultivars suited to the in-shell trade and others whose main role is as pollinisers. The genotypes are mainly named cultivars of European and North American origin, but also include some Australian grower selections that have been given local names. The planting material was obtained chiefly from specialist hazelnut propagators.

Planting at the Orange and Toolangi sites was commenced in July 1995. Planting commenced at Myrtleford and Moss Vale in July 1996 and at Kettering in 1999. The genotypes are replicated at each site in a randomized block layout. Tree spacing is 5m between rows and 3m within rows.

Periods of pollen shed and female bloom and the relative numbers of catkins per variety have been recorded annually. The dates when the vegetative buds started to open, indicating the start of leafing out, have also been recorded. General observations of tree growth have been made throughout the period of the experiment. Leaf samples have been collected from each site in February to monitor the nutritional status of the crop. In April of each year, the butt circumferences of all treatment trees have been measured 15 cm above the ground. These measurements have been used to make comparisons of tree growth between years and varieties.

Nut yields have generally been obtained by collecting all the fallen nuts from under the trees in late summer to early autumn. The nuts have been dried at 30°C for two to three days, then cleaned and any husks removed before weighing. Post harvest assessments of kernel quality have been conducted.

**Observations**

- Trees have grown best at Myrtleford and least well at Orange. Plants of some genotypes died at Orange. These were replaced, but the replacements also died or struggled to grow. Very high levels of manganese were detected in the leaf samples from Orange (Figure 5), whereas the levels of manganese were far lower at Myrtleford and were also low at Toolangi and Kettering. Tree growth has been
good at both of those sites. It is hypothesized that manganese toxicity may account for poor tree growth at Orange, with differential tolerance occurring in genotypes. Such variation in tolerance has been recorded for other crops, such as lucerne (Sale et al, 1993.).

**Cultivar productivity**

The cultivar Barcelona has given consistently high yields at all sites, being one of the four highest yielding cultivars (Baldwin et al. 2003.). The Australian selection Tokolyi/Brownfield Cosford (TBC) has also generally produced high yields and was consistently the highest producing cultivar at Moss Vale (Figure 6) and in the top two at Toolangi. Tonda di Giffoni has performed very well at Moss Vale, and at Myrtleford. A cultivar supplied as Tonda Romana has also performed well, but tree, fruit and kernel characteristics suggest this is not true to cultivar name. At Orange, the disease bacterial blight ("Xanthomonas corylina") has been prevalent, causing severe damage to newly emerging leaves in early spring. It appears to affect early leafing cultivars, such as Tonda di Giffoni, more than late leafing types, such as Ennis. This may account for the relatively lower yield of Tonda di Giffoni, compared with Ennis. The new cultivar Lewis, which was bred at the Oregon State University, was planted at later date as material was not available at the commencement of the experiment. This cultivar also looks promising.

All the cultivars discussed above yielded higher than Wanliss Pride, which had been the most widely grown cultivar in Australia until the early 1990’s. At that time, this cultivar was viewed as the industry standard or benchmark cultivar in Australia.

**Conclusions**

Hazelnuts are a crop that is sensitive to heat and moisture stress and are therefore not considered to be well adapted to the Australian environment generally. They require well-drained soils that are moderately fertile. Considering these constraints, there are locations within Australia that are proving to be suitable for hazelnut growth and the establishment of an industry. Key areas with potential are the upper river valleys in north-eastern Victoria and Gippsland, the south coast and Central Tablelands of NSW and parts of Tasmania.

![Figure 5. Levels of manganese in leaf samples collected annually from all sites](http://www.afbmnetwork.orange.usyd.edu.au/afbmjournal/)
Figure 6. Development of nut yield with time for five key varieties. Tonda di Giffoni is an Italian cultivar that produces high quality kernels. TBC is an Australian selection, which also produces high quality kernels. Barcelona is the main cultivar grown in Oregon. Ennis is an in-shell cultivar capable of high yields in Oregon. Wanliss Pride is an old Australian selection.
Yields equivalent to 3t/ha have been achieved from young trees for some cultivars (Baldwin et al, 2003). These compare very favourably with yields reported for some of the highest yielding hazelnut producing regions of the world, Campania, Italy 2-2.8t/ha, Agen, France 2-2.5 t/ha and Camp de Tarragona, Spain 1.5 - 3t/ha. (Tous Marti 2001).

Factors favouring the development of the Australian industry are that technology is available overseas for the complete mechanization of the crop, and a grower's organisation exists to foster industry development (i.e. The Hazelnut Growers of Australia Ltd.).

Research is well advanced on cultivar assessment. It is considered that sufficient knowledge is available within Australia and overseas to enable growers and investors to establish a viable industry, but growers will need to take care in site selection and work collaboratively to develop a highly productive, efficient industry with good marketing strategies.

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