



HAZELNUT MARKET ASSESSMENT STUDY

A report for the Hazelnut Growers of Australia Ltd. (HGA Ltd)
prepared with funding provided
through the Central West Area Consultative Committee (CWACC)

by

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Executive Summary

Australia imports about 1800 tonnes of hazelnut kernels annually for a wide range of uses. These have a value of about A\$10.2 million. The objective of this study was to identify the current utilization of hazelnuts in Australia, to assess the market potential for Australian grown hazelnuts and to indicate how this market opportunity might be realized.

The key buyers and users of raw hazelnuts were identified and contacted to seek their collaboration in this market study. Nineteen businesses participated with data being sought on usage of hazelnuts, the type of hazelnuts bought and the approximate quantities purchased. Feedback was also sought on the suitability of some Australian grown varieties.

Australian grown varieties were independently evaluated for taste. The oil and sugar content was measured. The literature on aspects of blanching, roasting, keeping quality, nutritive value and nut marketing was reviewed.

The key findings were that imported raw kernels are used in a diverse range of products, including confectionery items, bakery products, pastes, spreads, health and snack foods. Most users of kernels have their own product specifications, which commonly include size, shape, appearance, blanching characteristics as well as quality standards. Most users purchase on a price basis, provided their specifications and quality standards can be met. Buyers do not seem to have a specific variety preference. When purchased overseas, hazelnuts are generally named according to the locality or production area in which they are grown, rather than by varietal name.

Most of the buyers who collaborated in this study indicated considerable interest in purchasing Australian produced kernels. In general, all of the Australian grown varieties evaluated were considered to have a suitable taste. Preference was based on size, appearance and blanching properties rather than taste. The potential use of the varieties evaluated was identified.

If Australian hazelnuts are to be purchased, they need to be available in sufficient quantities to meet the buyer's specifications and at a competitive price. A potential competitive advantage for Australian grown product is freshness, availability out of season from the Northern Hemisphere and freedom from pesticides. It is considered that to capitalise on these opportunities, the current Australian production sector of the industry needs to expand considerably, to work in a collaborative manner and to market hazelnuts in a manner that meets the needs of buyers and consumers.

Currently, imported raw hazelnut kernels are worth about A\$6/kg and imported nuts in-shell about A\$4/kg. A total area of 1500-2000 hectares of well-managed, productive plantings would meet all of Australia's current needs. It is concluded that the current industry could expand considerably to meet market opportunities. However, this would require careful selection of productive varieties to meet market needs. A system of crop handling, quality assurance and marketing would also be required. The following is recommended for development of the hazelnut industry in the Central West of NSW:

Recommendations:

1. The establishment of a Central West Hazelnut Industry Steering Committee, which could include representation from the HGA Ltd, hazelnut buyers, the University of Sydney, CWACC, NSW Agriculture, and the Department of Land and Water Conservation (DLWC). The objective of that group would be to develop and facilitate a strategic direction for the establishment of a hazelnut industry in the Central West of NSW.
2. Funds be sought to develop a package of information, for growers and investors in hazelnuts, on production systems, crop mechanization and the economics of hazelnut growing in the Central West of NSW.
3. Funds be sought to prepare a business plan for industry commercialization, that includes the development of a co-operative for handling, drying, storing, processing and marketing hazelnuts.

1 Introduction

Hazelnuts (*Corylus avellana* L.) are native to Europe where they grow as small trees or bushy shrubs. The major hazelnut production areas in the world are in northern Turkey, Italy, north-east Spain and Oregon in the USA. These locations have Mediterranean climates with cool winters and warm summers and are within 100 km of the sea, with its moderating effect on temperatures (Lagerstedt, 1979).

It appears that hazelnuts were introduced into Australia about 150 years ago but, to date, they have remained a minor crop and been grown only on a relatively small scale. Currently, Australian hazelnut production is very low, probably less than 50 tonnes per annum. (Baldwin, 1995). Most of the Australian plantings are scattered throughout the cooler, higher rainfall areas of south-eastern Australia. This includes the valleys of north-eastern Victoria and the Tablelands of NSW. Many groves include trees of unknown origin, or of inferior types and productivity is low.

There is potentially a good market for hazelnuts, as Australia imports on average about 1800 tonnes of raw hazelnut kernels annually with a value of A\$10.2 million (ABS 2002). There is an expanding interest in growing hazelnuts in Australia, but growers and investors are seeking two key items of knowledge. These are:

- a) which hazelnut varieties are productive?
- b) which varieties are accepted by users and consumers of hazelnuts?

Currently research is being undertaken on a field evaluation of the productivity of hazelnut varieties by the University of Sydney in collaboration with NSW Agriculture, Agriculture Victoria and some growers. This research is supported by a grant from the Rural Industries Research and Development Corporation (RIRDC). It involves field experiments at five sites, two in NSW, two in Victoria and one in Tasmania. Some of the nuts from these experiments were used in this marketing study.

The objective of this study was to identify the current utilization of hazelnuts in Australia, to assess the market potential for Australian grown hazelnuts and indicate how this market opportunity might be realized.

2 Market characteristics

2.1 Market size and trends

In 2001, world production of hazelnuts was 870,500 tonnes, the fourth major tree nut produced (Table 1). Turkey is the largest producer, followed by Italy and the USA (FAO 2002). The world consumption of hazelnuts is expected to increase as more people consume nuts as part of a healthy lifestyle. The popularity of hazelnuts is expanding and they are no longer considered to be a nut that is only eaten at Christmas or other festivities (Lobb 1995).

Table 1: Annual Production of major tree nuts

Tree nuts	Production tonnes/ year
Cashews	1 604 569
Almonds	1 330 321
Walnuts	1 246 259
Hazelnuts	870 475
Chestnuts	615 000
Pistachios	249 439
Brazil Nuts	68 750
Macadamias	31 770

Source: FAO, 2002

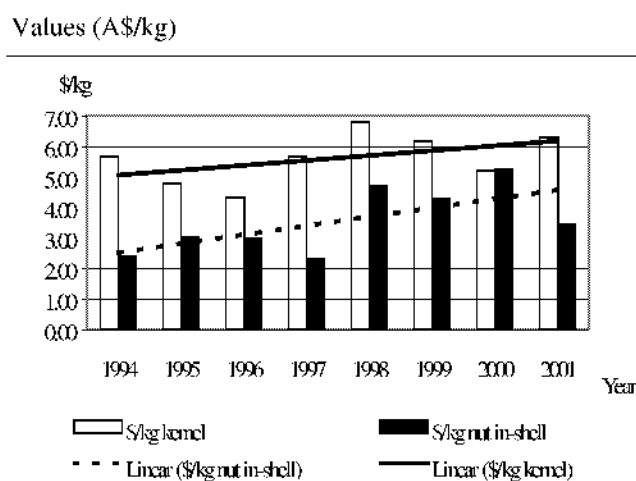
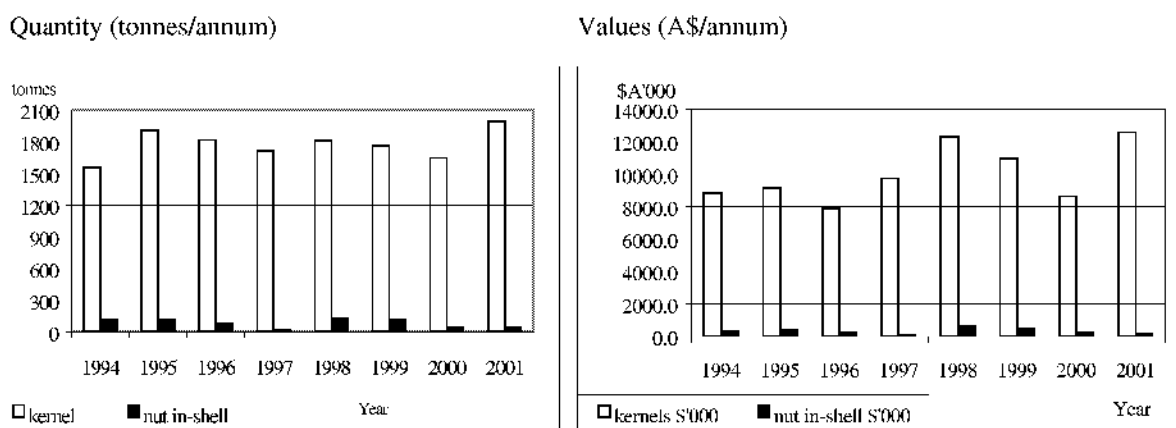
The commercial production of in-shell hazelnuts in Australia is very small, less than 50 tonnes per annum. Australian production of hazelnuts is estimated to increase during the next decade as interest in growing the crop increases. Many plantations are yet to reach full production and many current growers plan to plant more trees. Over the period 1994 to 2001, Australia imported an average of about 1800 tonnes of raw hazelnut kernels per annum with an average value of A\$ 10 million and an average price of A\$ 5.60/ kg. (Table 2 and Figure 1). The climate of mild temperate areas of Australia is comparable to that found in traditional hazelnut growing areas of the world. The potential for the establishment of an Australian hazelnut industry exists, with import replacement opportunities and possible expansion potential in the longer term.

Table 2: Annual imports of hazelnut kernels and nuts in- shell for the period from 1994–2001

	Quantities (tonnes/annum)		
	Mean	Highest	Lowest
Kernel	1775	1990	1551
Nut in-shell	82	125	16
	Values (A\$'000/annum)		
	Mean	Highest	Lowest
Kernel	9998	12583	7860
Nut in-shell	300	590	66
	Value (A\$/kg)		
	Mean	Highest	Lowest
Kernel	5.63	6.80	4.33
Nut in-shell	3.56	5.27	2.33

Source: ABS, 2002

Figure 1: Australian imports of raw hazelnut kernels and nuts in-shell

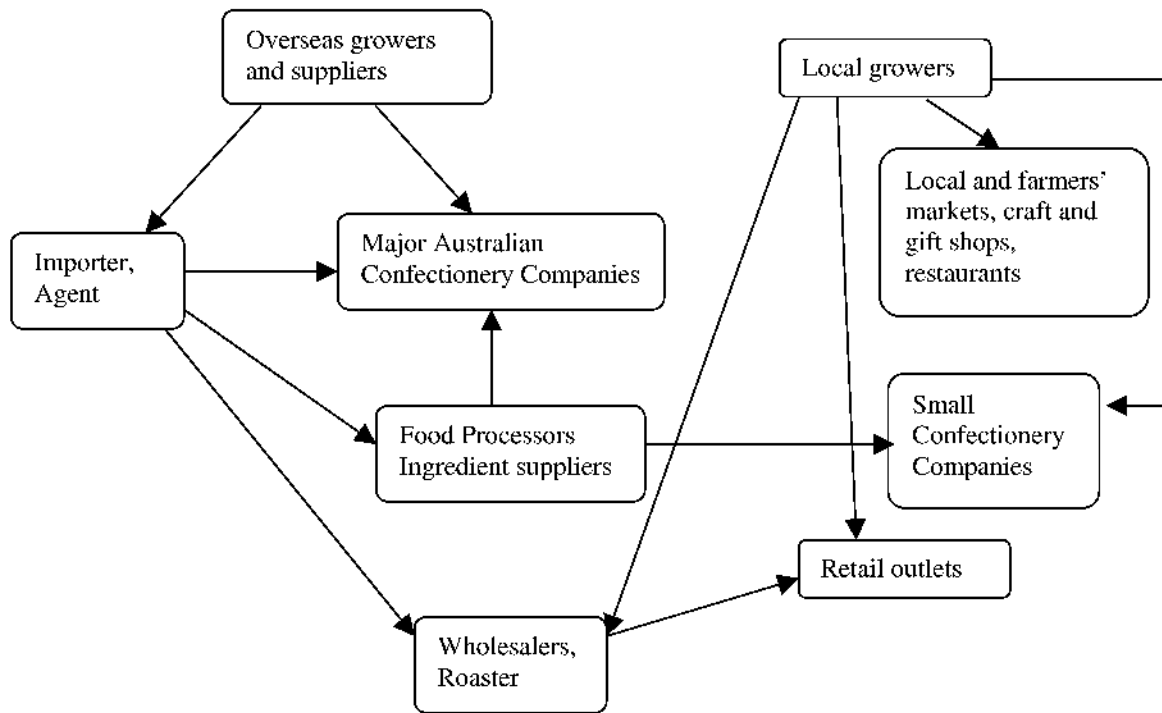


Source: ABS, 2002

The major users of hazelnuts in Australia rely on imported kernels and nuts. Australian production is mainly from individual growers with small orchards, who sell small quantities locally and are able to fetch premium prices through direct selling.

The market for hazelnuts is divided into two segments which are the kernel and the nut in-shell market. In Australia the main market for hazelnuts is the kernel market, which is steadily growing. The nut in-shell market is small and is expected to decline in the future. Most hazelnuts are cracked and sold as kernels for a wide range of uses (Figure 2). Kernels are consumed raw, roasted, sliced, chopped, diced, or ground into flour or paste (Oezdemir 2001b). The bulk of kernels is used in chocolate manufacture, confectionery or baked goods. They are used to provide flavour in a range of foods such as dairy, bakery and confectionery products, muesli and snack foods. Hazelnuts are also used in the oil and cosmetic industries. Hazelnut shells are used for fuel or mulching and also in making artificial wood and linoleum (Oezdemir 2001b). Research has shown that the drug Taxol, which is commonly used to treat breast cancer occurs in hazelnuts (Imaginis 2002). Taxol has been found in leaves, stems, raw nuts and shells. The findings could lead to a reduction in Taxol prices and another market for hazelnut shells.

Figure 2: Australian supply chain



2.2 Nutritional value of hazelnuts

Hazelnuts are considered to have many beneficial effects on health and are a good source of energy due to their oil content. They are high in oil, approximately 60% in many varieties, mainly consisting of monounsaturated fatty acids, with oleic acid comprising 75% of the total fatty acids. Monounsaturated fatty acids help to lower levels of blood cholesterol, a risk factor in heart disease (Stone 2000). Hazelnuts are low in sugar and are a good source of protein and many minerals. They are high in vitamins E and B6, which are considered to have beneficial effects in relation to several medical conditions (Stone 2000).

3 Identification of major buyers, current suppliers and type of usage of hazelnuts

3.1 Survey Methodology

In order to gain a better understanding of the market opportunities for hazelnuts in Australia, a survey was conducted on the ways that hazelnuts are used, quantities used, origin of material and which of the hazelnut varieties, currently showing promise in Australia, are likely to be accepted by the market. Significant buyers were identified by internet searches, telephone directories, product labels in supermarkets and from contacts in the industry. The buyers were contacted by phone to ascertain their interest in the project. A questionnaire form was sent out to those who were prepared to participate in the project. Buyers were asked if they would be interested in evaluating samples of Australian grown hazelnuts in order to provide information on which varieties would be likely to be in demand by the market. The questionnaire form listed the names of varieties available for sampling. Participants were asked to compare these samples with imported hazelnuts and to comment on their suitability and provide the criteria they use when buying hazelnut kernels.

3.2 Results of questionnaire and acceptability of hazelnut samples

3.2.1 Questionnaire results

The questionnaire results were recorded onto a Microsoft Excel spreadsheet and analyzed. A total of 19 buyers collaborated in this survey. The data on usage appeared to include most of the significant users of hazelnuts. Participants in the survey included importers, wholesalers, food processors and manufacturers.

In order to describe the size and structure of the hazelnut market, it was important to know the approximate quantity of hazelnuts (kernels or nuts in-shell) that the survey participants purchased annually. The total quantity of raw hazelnut kernels bought annually by all participants was estimated to be 1764 tonnes. During the same period, the ABS import statistics were 1990 tonnes of raw hazelnut kernels (Figure 1), indicating the high level of participation in the survey. During the last eight years, the average import of raw hazelnut kernels was about 1800 tonnes per annum, Table 2. The quantities of nut in-shell calculated in this survey was 33.1 tonnes annually. This figure is lower than the ABS statistics that show 43 tonnes were imported in 2001. The nut in-shell market is much smaller than the kernel market and appears to be declining.

The responses from the survey participants showed that hazelnuts are used for a wide range of purposes (Table 3). The scale of usage was also very extensive, ranging from small-scale specialty use to larger scale volume sales in a range of products.

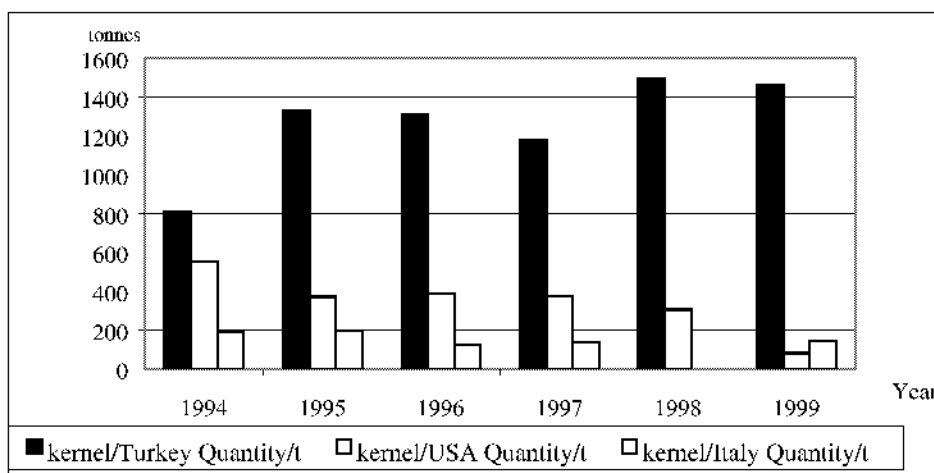
Table 3: Quantities of raw kernels and in shell hazelnuts used by industry participants

Main usage	Quantities bought (t/year)	Respondents
Baked goods, confectionery goods, raw and roasted kernels, dry and oil roasted, mixed with other nuts, hazelnut meal	0-20 kernels	10
Mixed with other nuts, roasted, confectionery goods, hazelnut spread, diced, paste, blanched	20-600 kernels	5
Mixed with other nuts, raw in packets, roasted, flavoured, chopped, chocolate coated nuts, food ingredient supplier, import of kernel and nut in-shell	N/A	4
Nut in-shell	0-40 nut in-shell	2

Note: Some respondents bought both kernels and nuts in-shell

Data was sought on the source of hazelnuts purchased. It was found that just over half of the buyers used hazelnuts from Turkey, followed by hazelnuts from the USA, with smaller quantities being bought from Italy and a few nuts in-shell from Australia. These findings seem to coincide with the ABS data, which shows that Australia imports the largest amounts from Turkey followed by the USA and lower quantities from Italy (Figure 3). The quantities imported from Turkey appear to be increasing relative to those from the USA and Italy. Discussions with buyers indicate that product is bought on price, the source of imports probably reflects the relative cost of the kernels in Australian dollars.

Figure 3: Origin and quantities of imported hazelnuts



Source: ABS, 2002

Note: No data was available on imports from Italy in 1998

The ABS data shows that largest quantities go into New South Wales and Victoria followed by Tasmania (Table 4). The reason for this is probably due to the location of confectioners and processors in those states.

Table 4: Annual quantities of raw hazelnut kernels imported into states of Australia

Year	Quantities(tonnes/annum)					
	NSW ⁽¹⁾	VIC ⁽²⁾	TAS ⁽³⁾	WA ⁽⁴⁾	Q ⁽⁵⁾	SA ⁽⁶⁾
1994	663	502	273	55	14	45
1995	751	618	431	62	34	8
1996	778	579	400	10	49	0
1997	656	610	395	29	24	0
1998	612	716	375	21	86	1
1999	775	854	32	29	64	9
Mean	706	647	318	34	45	16

Source: ABS, 2002

⁽¹⁾ NSW-New South Wales, ⁽²⁾ VIC-Victoria, ⁽³⁾ TAS-Tasmania,

⁽⁴⁾ WA-Western Australia, ⁽⁵⁾ Q-Queensland, ⁽⁶⁾ SA-South Australia

Participants were asked which varieties are used and if there is a preference for certain varieties. Different types were named by the participants, such as Oregon and Ennis from the USA, Levant, Ordu and Trabzon from Turkey, Round Romans, Round Naples and Round Giffoni from Italy. Cultivar names as found in the literature were rarely described, Ennis being an exception. There are other factors which are more important to buyers than origin and varietal names of the hazelnuts. One participant commented, “where they come from is not of interest”. Size and shape are important standards hazelnuts need to meet. Size ranges such as 10-12 mm, 11-13 mm, 13-15 mm, or greater than 15mm, were sought by the participants. The three smaller size grades were preferred by confectioners, with 15 mm and larger being preferred by manufacturers of mixed nuts and flavoured hazelnuts for snack food packets. Quality, reliable quantities and competitive prices are important factors. Low oil content, blanching and an even roasting ability, colour and thickness of pellicle are other factors influencing the choice of kernels, depending on use.

3.2.2 Acceptability of Australian grown samples

The participants were asked if they would like to evaluate samples of hazelnuts grown in the field trials conducted by the University of Sydney (Table 5), to compare these samples with their imported material. They were also asked to provide information on the criteria used to evaluate the suitability of raw kernels. Eight buyers agreed to evaluate the samples, with a further seven providing information on the criteria that hazelnuts need to meet for their specific usages. Samples of 200g raw kernels of 14 varieties were offered for evaluation.

Table 5: Varieties offered for evaluation

Variety	Country of origin
Atlas	Australian seedling type
Casina	Spain
Eclipse	Australian seedling type
Montebello	Italy
Negret	Spain
Oregon Barcelona	USA
TGDL	Italy
Tokolyi (Brownfield) Cosford	Australian seedling type
Tonda di Giffoni	Italy
Tonda Romana	Italy
Segorbe	France
Wanliss Pride	Australian seedling type
Willamette	USA

Participants stated the physical and chemical characteristics that hazelnuts need to meet in order to be used in their products. The physical characteristics were uniformity in size and shape, thin pellicle, colour, texture, flavour, blanching and roasting ability and absence of foreign matter. Chemical characteristics were moisture and oil content, free fatty acids and peroxide level, aflatoxin and other microbiological characteristics. Appendix D shows an example of the general requirements specified by one participant for hazelnuts, both roasted and diced.

Seven participants evaluated samples of raw kernels on appearance, texture and taste, but noted that chemical characteristics as described above also influence the choice. One confectionery company evaluated samples of roasted kernels, in order to compare them with the factory standard. This company used a taste panel to evaluate samples on roasted hazelnut flavour, crunchiness, mouth feel after eating and overall liking. In general, all varieties were considered to be acceptable, with little difference in preference between them. This was very similar to the outcomes from taste evaluation tests conducted by the researchers, (section 3.3.4).

Overall results show that all 14 varieties would be acceptable, depending on the type of usage. The variety Tokolyi (Brownfield) Cosford was preferred by most participants due to the thin pellicle, clean taste, good colour, shape, size and blanching ability. Segorbe was also favoured because of its appearance and was described as a “good tasting and firm nut”. Casina was favoured because of its size and round shape. Oregon Barcelona was rated positively because of its good flavour, texture, colour and large kernel with a consistent shape. Willamette received a good rating on size, taste and round shape but was downgraded on the pellicle, which was described as “dark looking”. Wanliss Pride was rated as a “good looking nut” but more suitable for the nut in-shell market due to the flattened and irregular shape of its kernel, as well as variability in size. Medium ratings were received for the varieties Montebello, Negret, Tonda di Giffoni, TGDL, Tonda Romana and Tonollo. The varieties Atlas and Eclipse were rated lower than others due to their thick pellicle, variability in size and poor taste.

3.3 Kernel characteristics

3.3.1 Kernel sizes

The size of hazelnut kernels is an important factor for buyers. Hazelnut kernels need to be graded, as a uniform size is important to achieve even roasting results or for use in confectionery goods.

The kernel sizes of 13 out of the 14 Australian grown varieties were measured to determine the size range of these varieties and if they match buyers' preferences. The variety Eclipse was not included in this measurement as it had received a lower rating on shape and taste.

For this measurement, a random sample of 150 raw hazelnut kernels of each variety was selected. These samples included kernels from the Myrtleford (Victoria) field site as well as samples from a range of other field sites. A plastic template with various diameter hole sizes was used to measure the kernels (Table 6). The mean for kernel sizes ranged from 13 to 17mm. Negret was recorded as having the smallest kernel, closely followed by Casina. The measurements show minimal differences between kernel sizes from different sites, except for the variety Wanliss Pride. However, kernel sizes of all varieties from the Myrtleford site were slightly bigger, probably reflecting the favourable growing conditions at this site.

Within the sample of each variety, variation in size occurred and therefore statistical measures of variation were computed to define the scatter of size around the mean, the "coefficient of variation". The samples from the Myrtleford site were found to be the most uniform, as shown by their lower coefficient of variation (Table 6). The composite samples from multiple field sites were more variable. The results in Table 6 show that the varieties Tonda di Giffoni and Willamette showed a high degree of uniformity. Wanliss Pride was the most variable (Table 6 and Figure 4). Appendix A provides further details of statistical values and definitions.

Table 6: Mean kernel size measured for 13 different varieties

Variety	Mean kernel size (mm)		Coefficient of variation (%)	
	Myrtleford site, Victoria	Multiple sample	Myrtleford site, Victoria	Multiple sample
13-15mm size range				
Negret	13.4	*** ⁽¹⁾	5.78	*** ⁽¹⁾
Casina	13.5	13.1	5.70	13.09
Segorbe	13.7	13.1	5.47	8.41
Tonda Romana	14.4	13.5	5.75	7.00
TGDL	14.4	13.7	6.79	7.83
Tonda di Giffoni	14.6	14.2	4.34	5.07
Montebello	14.2	14.2	4.99	8.21
15mm,+ size range				
Willamette	15.1	14.9	4.37	5.78
Atlas	15.3	14.8	5.58	6.23
Tokolyi Cosford	15.8	14.4	6.61	8.74
Barcelona	15.7	14.7	5.96	8.54
Tonollo	16.3	15.8	5.20	6.08
Wanliss Pride	17.0	14.6	6.99	16.07

⁽¹⁾ No data available

The size and weight of hazelnut kernels is genetically determined but can fluctuate with crop load (McCluskey et al. 2001), seasonal conditions and harvest time (Oezdemir 2001b). Differences between kernel size for the two sources of samples is probably caused by differences in the environmental conditions under which the varieties were grown.

When considering kernel size, suitable varieties for the confectionery trade would be Negret, Tonda Romana, TGDL, Tonda di Giffoni and Montebello. These varieties had a mean kernel size ranging from 13 to 15mm. Tokolyi (Brownfield) Cosford and Willamette were generally slightly larger and probably better suited to specialty confectionery, such as individually coated kernels. Although Casina and Segorbe have small kernels, they are less suited for confectionery as they do not blanch well.

Varieties more suitable for snack food manufacturing, due to their larger kernel size, are Wanliss Pride, Oregon Barcelona, Tonollo, Tokolyi (Brownfield) Cosford, Atlas and Willamette. However, the reputed poor keeping qualities of Wanliss Pride make it generally unsuitable for processed foods as it has a short shelf life. Atlas was generally not considered to have a good flavour and did not blanch well, so is not considered to be a good kernel variety. Willamette has rather a thick pellicle, making it unattractive for snack foods, but was found to be very even in size and blanched well.

Measurements of kernel size showed that variation in size occurs within varieties. Size grading is important after cracking, in order to ensure evenness of kernel size for marketing. This is particularly important when there is considerable variation in kernel size such as in Wanliss Pride (Figure 4) but is still important with more evenly sized varieties (Figure 5).

Figure 4: Wanliss Pride, random sample of 150 hazelnut kernels graded into sizes

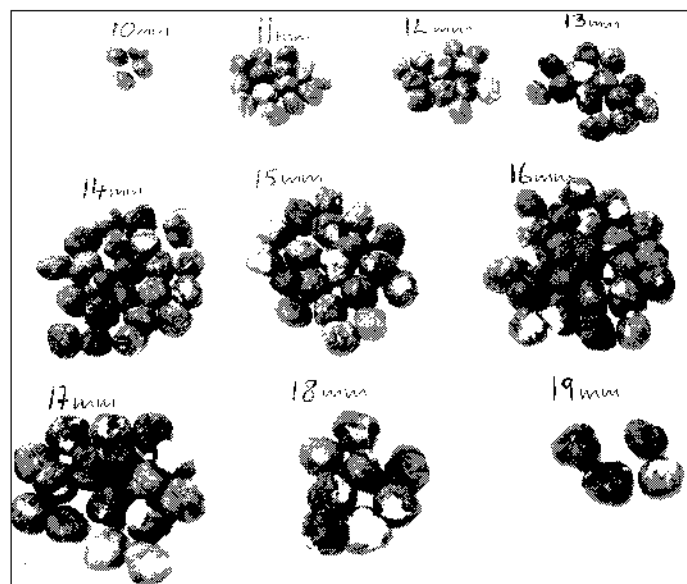


Photo taken by M. Simpson, 2002

Figure 5: Tokolyi (Brownfield) Cosford, random sample of 150 kernels graded into sizes

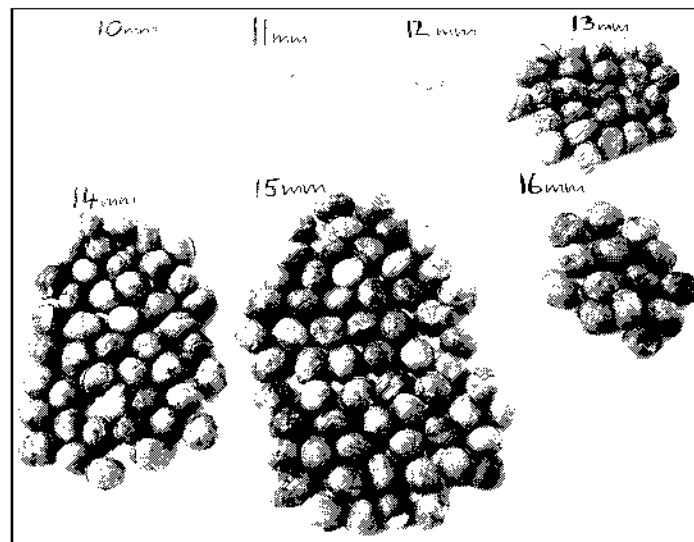


Photo taken by M. Simpson, 2002

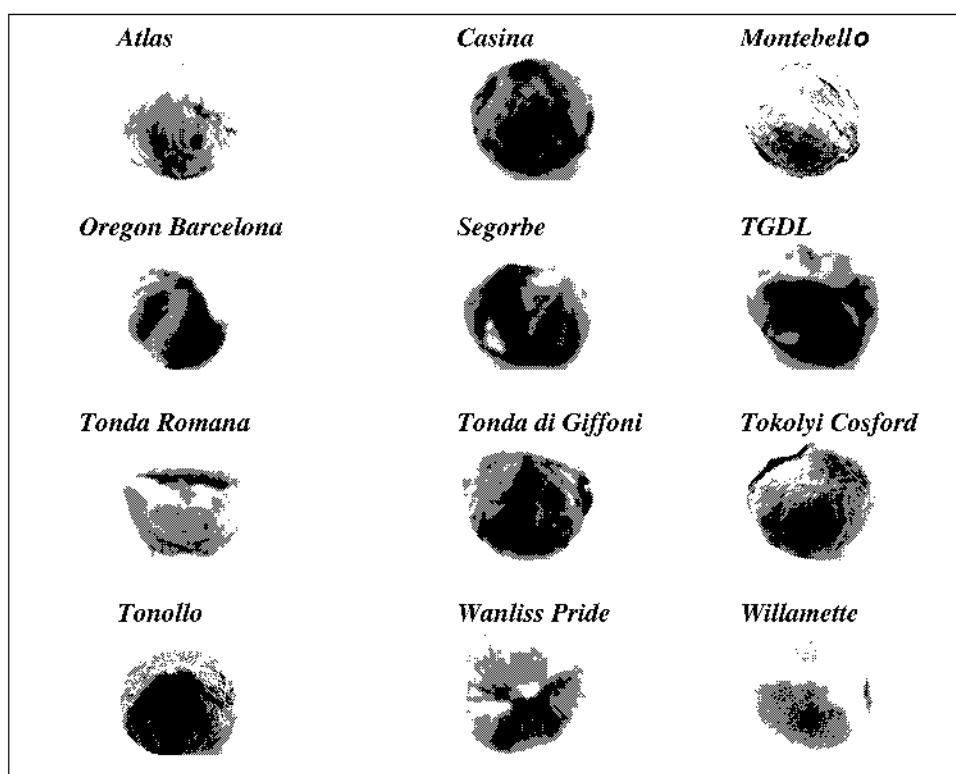
3.3.2 Kernel shape and appearance

Survey participants stated that shape and appearance of kernels is important. Buyers tended to prefer a uniform spherical shape, as spherical kernels are more appealing and easier to handle. In general, the kernels of the Australian grown varieties tend to be either round or round and pointed. Varieties with a round kernel shape are Willamette, Tonollo, Tokolyi (Brownfield) Cosford, Montebello and Oregon Barcelona (Figure 6). However, some varieties such as Tonda di Giffoni, Tonda Romana and TGDL, have a strong indent on the side of their kernels. Except for Wanliss Pride, most varieties are uniform in their kernel shape. None of the kernels evaluated were from long nuts.

Indented nut shape may be a disadvantage from the cracker's point of view, as during the cracking process the kernel can stay in half of the shell. Figure 6 shows the kernel shape and pellicle of 12 different varieties.

The pellicle of kernels influences their appearance with some varieties having a thicker pellicle than others. Most participants preferred kernels with a thin pellicle.

Figure 6: Kernel shape of raw hazelnut kernels ⁽¹⁾



⁽¹⁾ Individual kernels are not at the same scale, see Table 5 for average kernel sizes (Photo taken by M. Simpson, 2002)

3.3.3 Blanching

Kernels have a fibrous skin or pellicle surrounding them, ranging from a relatively thin skin, in a variety such as Segorbe, to a thick and coarse skin in the variety Atlas. Blanching ability or pellicle removal after thermal treatment, is an important criterion for buyers. The degree of pellicle removal improves the appearance of kernels and their suitability for various uses. The pellicle can influence the taste of hazelnuts and usage in products. Buyers tended to require hazelnut kernels with a blanching characteristic of 65-75% pellicle removal or better.

For the evaluation of pellicle removal, samples of the varieties used for size grading were blanched at 140°C for 10 minutes and then compared with each other as to the degree of pellicle removal, using a standard 1 (high) - 7 (nil) grade scale. This blanching method was adapted from previous studies undertaken by McCluskey, et al. (2001). Two samples for each variety were collected, one contained kernels from the Myrtleford site and the second contained samples from different field sites. The blanching results of this experiment were compared with results from previous studies undertaken by Baldwin (2001) at the University of Sydney, Orange and McCluskey, et al. (2001) at Oregon State University to ascertain the degree of uniformity or variability (Table 7). Varieties were ranked on the degree of pellicle removal, as ascertained from the tests carried out on the samples sent to survey participants.

Table 7: Degree of pellicle removal
(1-7 scale with 1-all pellicle removed, 7-no pellicle removed)

Variety	University of Sydney, Orange ⁽¹⁾		Oregon State University ⁽²⁾	
	Mean	Range	Range	PC Grin database ⁽³⁾
Good blanching ability				
Negret	1.4	1-2	1.2-3.7	1
Montebello	1.5	1.5		
Willamette	1.8	1.5-2.5	2.2-4.2	
Wanliss Pride	2.0	1.5-3		
Tonda Romana	2.5	1-4.5	4.8-6.2	5
Medium blanching				
Tonollo	3.2	1.5-5		
Tokolyi Cosford	3.3	4-5		
Oregon Barcelona	3.5	3-5	3.2-5.2	4
TGDL	3.6	2-5	1.8-2.8	2
Tonda di Giffoni	3.6	3.5-5	1.6-3.2	1
Atlas	3.9	2-6.5		
Poor blanching ability				
Segorbe	4.0	2-6		4
Casina	5.8	4.5-6.5	3.4-6.0	5

¹ Results collected from several field sites and years. Range column shows the best and worst rating. Mean column is the results of all ratings from different field sites and years

² Results from several years and field trials

³ PC Grin database (2002) Germplasm Resources Information Network, National Genetic Resource Programme within the US Department of Agriculture

The degree of blanching for a given variety can vary due to the situation in which the tree was grown and the time lapse from harvest. Oezdemir (2001b) reported that pellicle removal of hazelnut kernels was influenced by nut maturity.

Comparing the overall results, there were varieties that generally blanched better than others. The better blanching varieties were found to be Negret, which is often considered to be the industry standard, Willamette, Montebello and Wanliss Pride. In the test undertaken at the University of Sydney, Tonda Romana was found to blanch with 70-85% pellicle removed. At the Oregon State University, the blanch ratings were only 25 to 40%. The varieties Tonollo, Atlas, Oregon Barcelona and Tonda di Giffoni blanched fairly well with 55-70% pellicle removal. The results for TGDL varied significantly between locations. The tests at the University of Sydney, Orange in 2002 for TGDL produced blanch ratings of 40-55%. At Oregon State University, TGDL blanched well with 85%. Segorbe and Casina were not found to blanch well with only 25-40% pellicle removal.

3.3.4 Roasting

Roasting of nuts improves their flavour and texture (Ozedemir 2001a). The roasting process can lead to changes in carbohydrates, protein, fat and other substances. Chemical reactions during the roasting process can change colour, taste and flavour but also affect shelf life. Sugar caramelization is responsible for colour and flavour changes. The key flavour component of the hazelnut is filbertone which is formed during the roasting process. Although unroasted hazelnuts do not contain high amounts of filbertone, they contain significant amounts of a precursor which generates odour by thermal treatment. The amount of filbertone, which is responsible for the typical nutty roasted odour formed during the roasting process, increases with roasting time (Pfnuer et al. 1999). Roasting removes the pellicle of hazelnut kernels, inactivates enzymes and destroys undesirable microorganisms and food contaminants.

Roasting characteristics of hazelnuts was important to some buyers participating in the survey. In order to evaluate the roasting characteristics of selected hazelnut varieties, several taste panels were conducted. These taste panels helped to assess the roasting process, optimum roasting conditions and the differences in roasting characteristics between varieties.

The first taste panel was conducted to test roasting and sensory evaluation techniques. Eleven people took part as assessors in this taste panel. Individual kernel samples of the varieties Negret, Tokolyi (Brownfield) Cosford and Tonda di Giffoni were roasted at 200°C for 10 minutes, 160°C for 10 minutes, and 160°C for 20 minutes to try to identify the ideal temperature and roasting time. Some kernels in all of the varieties were found to be overcooked in the 160°C for 20 minutes treatment. This test revealed that the process of roasting was critical to achieve a nice nutty flavour and light roasted colour, along with a crisp and crunchy texture. The optimum roasting conditions seem to depend on the size and chemical constituents of the hazelnut. Uniform size appeared to be important to achieve even roasting results. Chemical characteristics such as oil and sugar content appeared to have an influence on flavour, colour, roasting time and temperature. Adjustments to the scoring sheet and sample presentation were made for further tasting panels. As the ratings by assessors seemed highly variable, it was decided to increase the number of assessors for future tasting tests.

Another two taste panels were conducted with two different groups. The first group contained 28 adults and the second group 19 teenagers as panelists. Seven different hazelnut varieties were tested, including those that had generally received higher ratings by participants in the industry survey. These varieties were Tokolyi (Brownfield) Cosford, Segorbe, Oregon Barcelona, Tonollo, Tonda Romana, Tonda di Giffoni and TGDL.

In these tests, the kernels of all varieties were roasted at a temperature of 160°C for 15 minutes in a conventional fan forced oven. After 15 minutes, the varieties TGDL and Tokolyi (Brownfield) Cosford were removed, as, in previous tests, these varieties had tended to be overcooked. The remaining varieties were cooked for another minute. Panelists were asked to rate texture and taste on a 1-5 scale from 1 (like very much) to 5 (dislike very much), the scoring sheet is shown in Appendix C. They were also asked to try and describe the flavour of the roasted kernels.

The results of the taste panel showed that whilst the panelists generally preferred the texture and taste of some varieties over others, these preferences were minor and no single variety scored much higher than others. The adult group generally gave lower scores for texture and taste with slightly higher preference values than the teenage group. Of the seven varieties tested, both groups placed the same varieties within the top three but did not score these in the same order (Table 8). In general, all seven varieties were considered to be highly acceptable, with the possible exception of Segorbe. Results of a taste panel conducted by one of the survey participants, using Australian grown hazelnuts, showed a clear preference for the Australian grown product but taste preferences between varieties were minor.

Table 8: Taste panel results, mean scores for each variety

Mean scores					
Variety	Adults	Teenagers	Variety	Adults	Teenagers
TEXTURE			TASTE		
Tonollo	1.7	2.3	T.Cosford	1.8	2.6
T.Cosford	1.8	2.4	Tonollo	1.9	2.6
T.Romana	1.9	2.0	T.Romana	2.3	2.4
T.d.Giffoni	2.1	2.5	TGDL	2.4	2.7
O.Barcelona	2.1	2.6	T.d.Giffoni	2.5	2.5
TGDL	2.3	2.4	O.Barcelona	2.5	2.8
Segorbe	2.4	3.1	Segorbe	2.7	4.2

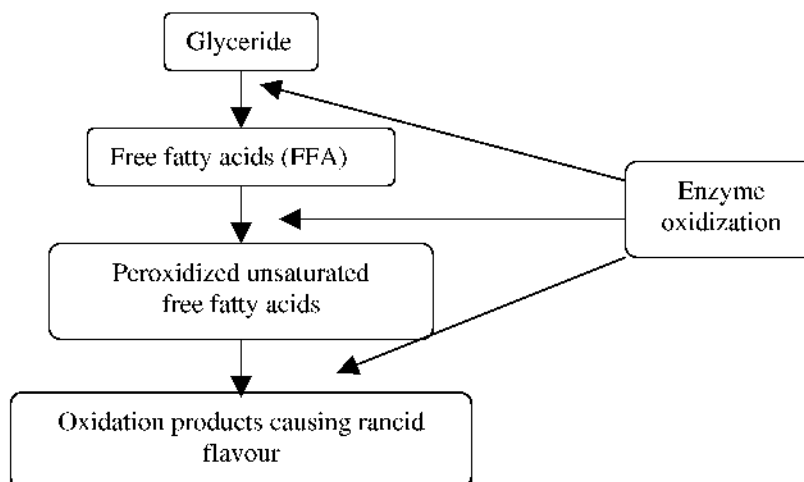
Comments used to describe taste included “toasted”, “bread”, “sweetish” and “strong flavour”. In the first taste test, some varieties had been slightly overcooked and the flavour of these was described as “burnt or overcooked” by some assessors and were consequently scored lower. However, some people seemed to have a preference for slightly overcooked kernels. Frequent comments used to describe texture were “crunchy”, “crisp”, “nice” and “good texture”.

These roasting experiments showed that varieties can react differently when roasted under the same conditions. Some changed in colour quicker than others. It appeared that size was not a key factor in determining roasting time, as varieties with larger kernels required little more roasting than smaller kernels. It seemed likely that sugar content had a greater effect than kernel size.

3.3.5 Oil content

The oil content of hazelnuts was an important characteristic mentioned by survey participants, particularly confectioners who used chocolate coating. The oil content is important because oil can migrate from the nut into the chocolate and cause fat bloom. The lower the oil content and the less damage to the nut cell walls in the process of cracking, the less oil will migrate into the chocolate. Confectioners stated they require hazelnuts with 63 to 66% oil content (Appendix E). The oil content and its composition have a tendency to vary depending on harvest time, variety, geographical region and growing practices (Oezdemir and Devers 1999). Hazelnut oil is composed of 80-90% mono- and polyunsaturated fatty acids. Foods containing these are prone to rancidity (Oezdemir and Devers 1999). Shelf life, final flavour and aroma qualities are influenced by oil stability and lipid oxidation. Free fatty acids (FFA) develop during storage and are the substrates of lipid oxidation, resulting in undesirable flavour characteristics (Figure 7). Hadorn et al. (1977) measured low FFA levels in fresh hazelnuts (0.1-0.3%) but levels generally rise during storage. Values of more than 1% indicate that deterioration has taken place. Oezdemir and Devers (1999) and Keme et al. (1983) reported that FFA levels above 0.7% indicate the onset of rancidity. Survey participants stated that 0.5% is the maximum for FFA levels for their requirements. Peroxides are products of lipid oxidation, having the tendency to react with other compounds and form aldehydes and ketones which are associated with unpleasant flavour and odour (rancidity). Peroxide and FFA values of hazelnuts are used as quality indicators for rancidity.

Figure 7: Enzymatic mechanism of lipid oxidation and formation of breakdown products causing rancid flavour in hazelnuts



The oil content of selected varieties was measured by Diagnostic and Analytical Services, NSW Agriculture (DAS) for 12 varieties to determine whether there were significant differences between varieties (Table 9) in their oil content and how these matched processor requirements.

Table 9: Oil content of selected varieties

Variety	Oil content (%)			
	Australia		Oregon	
	DAS ⁽¹⁾	Dawson and Halleday ⁽²⁾	Ebrahim ⁽³⁾	Richardson ⁽⁴⁾
Wanliss Pride	57.5	57.1		
Casina	59.3		65.3	64.6
TGDL	59.6		63.0	63.5
Willamette	60.0		63.4	63.4
Tokolyi (Brownfield) Cosford	60.1	65.0		
Tonollo	60.2	57.3		
Atlas	60.6	62.1		
Segorbe	61.0			
Tonda Romana	61.1		62.9	63.6
Oregon Barcelona	62.0		62.8	61.8
Montebello	62.2		61.3	61.4
Tonda di Giffoni	63.6		62.9	63.1

¹ DAS, Diagnostic and Analytical Services, NSW Agriculture, Hazelnut samples for oil tests from field trials conducted by Baldwin at the University of Sydney (USYD), Orange, NSW

² Dawson and Halleday (1993)

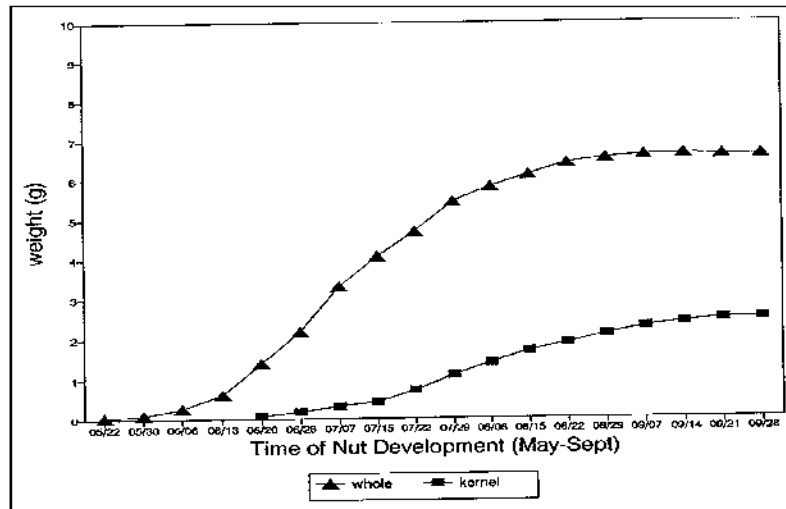
³ Ebrahim, et al (1994)

⁴ Richardson (1996)

In the tests conducted, the total oil content of the selected varieties ranged from 57.5 to 63.6%. The higher end of this range matches that required by confectioners. The results were lower than reports on some of the major Turkish varieties, which contain from 55 to 66% oil (Oezdemir and Devers 1999). The oil content was comparable with measurements from hazelnut varieties grown in New Zealand, where oil content ranged from 54.6 to 63.2% (Savage and McNeil 1998). Dawson and Halleday (1993) undertook some research on hazelnut properties with Australian seedling types. The oil content obtained for both the varieties Wanliss Pride and Atlas was similar to the DAS results. Oil content analysis undertaken by Ebrahim et al. (1994), in Oregon showed slightly less variation between varieties but overall similar levels to the Australian data. Ebrahim (1994) and Oezdemir and Devers

(1999) reported that the oil content of kernels increases during the process of kernel development, whereas moisture content falls during this period (Figures 8 and 9). The oil content of kernels differs with varieties and the conditions under which they are grown.

Figure 8: Growth of the whole nut and kernels, based on studies of Barcelona, Ennis, Daviana, Tonda Romana, TGD and Tombul Ghiaghli



3.3.6 Sugar content

Hazelnuts are generally rich in oils and low in sugar. Sugar content values of 4-5% are common, but varietal differences have been recorded (Botta et al. 1994). The main sugar is sucrose. Sugar content is one component influencing the roasting process of hazelnuts, leading to changes in colour and taste. Caramelization of sugars can occur with a darkening in colour (Oezdemir and Devers 1999).

Storage at high relative humidity can result in a breakdown of sucrose to glucose with further break down leading to undesirable flavours (Oezdemir and Devers 1999). Levels of glucose and fructose greater than 0.1g/100g in mature kernels indicate nuts are old or have been badly stored (Oezdemir and Devers 1999). Savage and McNeil (1998) also reported that levels of monosaccharides found in the kernel may give a good indication of the storage conditions required.

The total sugar content of 12 kernel samples from the field trials was measured to determine levels and variability between varieties. Wanliss Pride, a sweet tasting nut, was found to have the highest sugar content (Table 10).

Table 10: Total sugar content of selected varieties

Variety	Total sugar (%)	
	UYSD	Dawson & Halleday
Tonda Romana	4.0	
Montebello	4.0	
Tonda di Giffoni	4.1	
Oregon Barcelona	4.2	
Atlas	4.4	5.0
Tonollo	4.7	12.1
Segorbe	4.8	
TGDL	4.9	
Willamette	5.3	
Casina	5.5	
Tokolyi (Brownfield) Cosford	5.6	7.10
Wanliss Pride	6.9	12.9

Generally, sugar levels for the varieties Wanliss Pride, Tokolyi Cosford, Tonollo and Atlas were found to be lower than those reported by Dawson and Halleday (1993), who found that Wanliss Pride kernels had very poor keeping qualities when stored at 5 °C for periods of up to six months. Comments from some survey participants confirmed the short storage life of Wanliss Pride which may be related to its high sugar content.

Although Wanliss Pride was not a variety evaluated by the taste panel, it was included in roasting tests and was found to roast to desired levels quicker than other varieties, even though it had the largest kernel. It is suspected that the tendency towards over cooking is due to the high sugar content. Tonda Romana, Tonda di Giffoni, Oregon Barcelona and Tonollo were found to need slightly longer roasting time than Tokolyi (Brownfield) Cosford and Wanliss Pride, possibly reflecting the lower sugar content of the former varieties.

3.4 Discussion of results

The aim of the survey conducted with significant buyers of hazelnuts was to collect information on type of usage, source of hazelnuts, annual quantities used and the potential acceptability of Australian grown nuts.

The outcome of the survey and interaction with potential buyers has led to the conclusion that all 14 varieties offered to participants for evaluation were acceptable, depending on the type of usage. Although there was a widespread acceptance of the Australian grown nuts, there was a buyers' preference for certain varieties.

All buyers stated the need for quality product that met their specifications for size grades, cleanliness, moisture content, shape and appearance (pellicle thickness), in addition to blanching ability, roasting characteristics and oil content. An example of such quality requirements is given in Appendix E.

Several varieties could be recommended, particularly for supplying the confectionery trade (Table 11). Tokolyi (Brownfield) Cosford could be suitable for this market because of its medium size, allowing multiple usages. This variety appealed to buyers because of its good shape and appearance and was also one of the more preferred varieties by the taste panel. Willamette and Negret are recommended for the confectionery market because of their good blanching ability, shape and size. Montebello and Tonda Romana are recommended because of their blanching ability, good kernel size and shape. Tonda Romana was preferred by the taste panel. The shape and size of Casina and Segorbe were rated highly by survey participants. However, these varieties generally blanch poorly and are therefore not recommended if good blanching ability is required.

For the snack food trade or nut in-shell market, varieties that are bigger in size, such as Oregon Barcelona, Tonollo, Tokolyi (Brownfield) Cosford and Willamette are recommended. These varieties were rated positively by survey participants because of shape, taste and size. The varieties are also characterized by a good blanching ability.

The results showed that it is important to identify which market is targeted in order to supply varieties with the required characteristics.

Although the nut in-shell market was not appraised in this survey, being a small market in Australia, it is potentially a large market in China. Separate studies conducted by students at the University of Sydney, Orange, have shown a preference for large, shiny nuts, such as those from the varieties Ennis and Wanliss Pride and to a lesser extent Oregon Barcelona.

Table 11: Summary of characteristics and potential uses of evaluated hazelnut varieties

Variety	Shape	Pellicle characteristics	Blanching ability	Mean kernel size (mm)	Total oil (%)	Total sugar (%)	Comments on main possible usage
Negret	round	thin	excellent	13.4	N/A ⁽¹⁾	N/A	Highly desirable for confectionery
TGDL	indent	medium coarse	medium	14.4	N/A	4.9	Suitable for confectionery
T. Romana	indent	medium coarse	good	14.4	61.1	4.0	Suitable for confectionery
Montebello	round	thin	good	14.2	62.2	4.0	Suitable for confectionery
T.d.Giffoni	indent	medium coarse	medium	14.6	63.6	4.1	Suitable for confectionery
T.Cosford	round	medium coarse	medium	15.8	60.1	5.6	Specialty confectionery, snack foods, nut in-shell
Willamette	round	coarse	good	15.1	60.0	5.3	Suited for specialty confectionery, e.g. coated hazelnuts.
Casina	round	thin	poor	13.5	59.3	5.5	Snack foods
Segorbe	indent	thin	poor	13.7	61.0	4.8	Snack foods
O.Barcelona	round	coarse	medium	15.7	62.0	4.2	Snack foods, nut in-shell
Tonollo	round	coarse	medium	16.3	60.2	4.7	Snack foods, nut in-shell
Wanliss Pride	erratic shapes	medium coarse	good	17.0	57.5	6.9	Nut in-shell, poor keeping quality
Atlas	round	coarse	medium	15.3	60.6	4.4	Poor taste/ coarse pellicle, limited appeal

⁽¹⁾ N/A Information not available

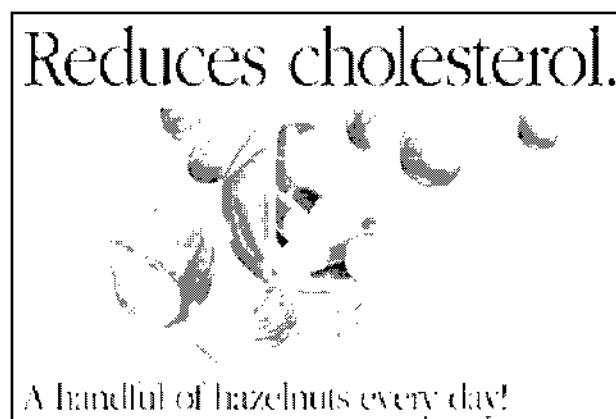
4 Outline of other nut industries

4.1 The Turkish Hazelnut Industry

Turkey is the largest producer of hazelnuts world wide with an estimated area under cultivation of 550,000-600,000 hectares and an average annual production of 450,000 tonnes of nut in shell (Hazelnut Promotion Group 2002a). Turkey produces 70% of the world crop and exports hazelnuts as in-shell nuts, kernels and various processed forms to 90 countries throughout the world, with the majority shipped to Europe. Kernels are sold according to size grades with a range of one or two millimeters or according to buyers' requirements. The hazelnut industry is controlled by the government, who influence price and quantities allowed onto the market. There is an inspection scheme to ensure quality standards. Turkish hazelnut groves are generally small, 1-2 hectares, with the crop being hand picked.

A Hazelnut Promotion Group has been established with the aim of increasing hazelnut consumption both in Turkey and export markets. Promotional campaigns have been held to penetrate new markets predominantly in the US, China and Japan. China and Japan are relatively new markets for hazelnuts. The main themes of these promotional campaigns have been based on the positive health effects of hazelnuts (Figure 10) and include cooking contests, a recipe book and advertisements via newspapers, magazines, mega boards, television and cinema. There is a promotional film showing hazelnut production from harvest to delivery to the end consumer. The Promotion Group has allocated finance for promotional activities and scientific research.

Figure 10: Advertisement developed by Hazelnut Promotion Group



Source: Hazelnut Promotion Group, 2002 b

4.2 Hazelnut Industry Organizations in the USA

The State of Oregon accounts for virtually all the hazelnut production in the USA, with 800 growers (Stone 2000). The 2001/02 crop was 43,817 tonnes and the area planted with trees was estimated at approximately 12,500 hectares (Stone 2000).

The hazelnut industry in the USA is highly organized, comprising growers and handlers (Overview of the hazelnut industry organization, 2002). These people have developed four organizations, namely the Hazelnut Marketing Board (HMB), Oregon Hazelnut Commission (OHC), Nut Growers Society (NGS) and Associated Oregon Hazelnut Industries. Each of these organizations has an integral role in the industry, with the united aim of producing quality hazelnuts. The HMB, created in 1949, administers the Hazelnut Marketing Order (HMO), which is a federal law that was requested by the hazelnut growers (Lobb 1995). The HMO establishes quality regulations and standards for the sale of hazelnuts. The HMO is designed to protect the domestic nut in-shell market. The HMB puts effort into marketing research and promotion of hazelnuts by increasing the awareness and use of hazelnuts in bakeries and confectionery products both domestically and overseas. The HMB develops research projects. The OHC, established in 1951, undertakes production research, education, extension and promotion. The NGS is responsible for transferring information between organizations, holding meetings and tours. Associated Oregon Hazelnut Industries represents the industry and is responsible for federal and state matters and other industry matters as required. Hazelnut Growers of Oregon is the only co-operative, with more than 150 members representing a collective area of 3,036 hectares, an average of 20 hectares per grower. It is the largest producer and handler of Oregon hazelnuts. Being a co-operative, all profits are distributed to its members. Sales include raw kernels and value added products. The company provides different services to growers, for instance orchard inspections, soil samples, advice on pruning, spraying and harvesting.

The Oregon hazelnut industry provides an internet website with detailed information on hazelnuts for growers, handlers or other interested parties e.g. grower handbook, handler information, recipes and links on other various matters.

4.3 The Society of Ontario Nut Growers

The Society of Ontario Nut Growers is comprised of 300 people and was established in 1972. The society encourages promotion and research in nut growing and has established nurseries and experimental plantings to obtain yield and production data for varietal selections.

The Society of Ontario Nut Growers (2002) suggests the following marketing strategies for new or small growers, some of which are already used by growers in Australia. The first level of sales to encourage new growers is on-farm sales, which could be stimulated by having a large sign with opening hours and offerings at the farm entrance to tell potential customers that business is open and nuts are for sale. Advertising in local newspapers, in magazines and providing colour flyers etc. could stimulate sales. Opening hours could be held during the growing season and tours around the grove could be offered as well as the possibility of "pick your own". An article in the local newspaper about the grove could be useful, making the groves' presence known in the community. At every step, emphasizing the high quality and fresh taste of products is important. "Pick your own" could be an entertaining event for families, young and old. At harvest time, a picnic area could be provided and drinks and hazelnut snacks could be sold. Customers who want to pick their own nuts may need the nuts dehusked. As production increases, sales could be expanded to farmers markets, city markets and possibly flea markets, also grocery stores and fruit stands that emphasize local produce.

4.4 Australian Macadamia Industry

The Australian macadamia industry had its commercial beginnings in the 1960s but it was not until the early 1980s that serious plantings began (Beavis 2002). Today there are approximately 800 growers and 4 million trees planted on 15,000 hectares. The crop has increased from 4,400 tonnes in 1987 to 29,100 tonnes in 2000 (AMS 2002). Australia exports more than 70% of the total macadamia production and continues to look at this export market as the main destination for the product, where demands and volumes are stronger than the domestic market (Hinton 2002).

The industry is commercially focused and professionally organized. The Australian Macadamia Society (AMS) represents the industry and was founded in 1974 with the majority of members being growers. Members also include processors, administrators, business people, investors, marketers and researchers. The AMS provides a variety of services to growers and other parties in the industry such as a website, monthly newsletters with information on industry affairs, progress and final reports of macadamia industry research. Furthermore the AMS funds and promotes marketing surveys and promotional campaigns. Macadamias are a relatively new product and a new taste experience in many countries, therefore marketing and promotion are significant for encouraging consumer demand (Kermond and Baumgardt 1996, Hinton 2002). Marketing undertaken by the AMS includes programmes for the domestic and export market. Consumer awareness is enhanced by advertising programmes, promotion of samples during the festive season, exhibition stands at Fine Foods, encouragement of chefs and restaurateurs to use macadamias and visits to retail outlets around the country to ensure quality of products. AMS ensures grade standards in the industry. Promotion campaigns in Germany, one of Australia's biggest macadamia markets, have been very active. In 1992 during a major campaign developed by a Japanese business person, 15 gram packages of macadamias were distributed to Lufthansa in airport lounges and on board in all classes to passengers from many countries. Approximately 10 million of these packages were distributed. It is estimated that 5% of the German population were reached by this promotional campaign (Kermond and Baumgart 1996).

As Europeans are traditional consumers of hazelnuts, peanuts and almonds, consumers need to be persuaded to try to another nut. Kermond and Baumgardt (1996) consider only strong promotional campaigns will give results in persuading consumers. Furthermore it is recommended by AMS and Kermond and Baumgart (1996) that brokers, dealers and macadamia processors work together in a constructive way to improve the image of macadamia nuts and products made with them. All steps from selection of nuts during and after harvest, handling, packaging and transportation should be carefully planned. Ensuring quality standards remains an important issue for the industry. It is important that quality of the product is maintained across all purchasing channels (Hinton 2002).

Hinton (2002) comments that the outlook for the industry is seen as positive, demand is expected to grow while production is anticipated to increase. Australian production benefits from quality assurance and strong marketing. The low Australian dollar has enhanced competitiveness on the world market. It is expected that the promotion of health benefits of the product ensure wider acceptance within the community.

Australian macadamia crops are generally grown in the coastal areas of northern NSW and southern Queensland, in warm areas with summer rainfall.

4.5 Australian Pistachio Industry

The pistachio industry in Australia is relatively young. Early plantings began in the 1980s but Australian pistachios were not readily available until later in the 1990s. There are currently about 35 growers with 550 hectares of trees planted. Australian trees planted have a capacity to produce 1,500 tonnes per annum of pistachios, about 75 % of current domestic consumption.

Most of the pistachio crop is marketed through the Australian Pioneer Pistachio Company with 100 % being sold into the snack food market. The advantage of this is not only for the company but also for the pistachio industry, ensuring the quality of the product is consistent, which is what customers and end consumers expect. Pioneer pistachios are displayed with the Australian kookaburra spike logo. The company's main marketing strategy is promoting the nuts as Australian grown.

Pistachio crops are generally grown in areas with cool winters and hot dry summers, such as in the lower Murray valley.

5 Marketing strategies for the Australian hazelnut industry

5.1 Principles of marketing

Numerous definitions for marketing can be found in the literature. Kermond and Baumgart (1996) defined that the essence of marketing any product is a match of location, price, quality and quantity of goods with consumer needs. Achieving these goals involves logistics, contacts, contracts, finances, legal matters and the daily work of dealing with the unexpected. Keegan (1998) described marketing as a set of concepts, tools, theories, practices, procedures and experience. The concepts of marketing are universal but marketing practices vary between countries and customers, competitors, distribution channels and available media. Therefore it is necessary to adjust marketing plans to the specific context of the market. Keegan (1998) summarized three main principles of marketing which could be used to establish a marketing plan. The first principle is to define the purpose and task of marketing, the second is to build a competitive advantage and the third means focusing on the success of the first two.

Purpose and task of marketing

The purpose of marketing is to create a customer value or market proposition that is greater than the value provided by competitors. There are various possibilities to increase the value for customers such as improving or expanding the quality of the product or product line, providing a particular service, reducing the price or a combination of these. These possibilities need to be strong in order to gain and keep new customers.

Competitive advantage

A competitive advantage is a total offer that is more attractive to customers. The origin of the product, price, advertisement, promotion and distribution, continuity and timing of supply, payment options and delivery could achieve such advantages.

Focus on achieving the first two

Focus on customer relations is important to achieve and maintain customer value and competitive advantage.

5.2 The use of marketing principles in the Australian hazelnut industry

There is an existing market for hazelnuts but growers in Australia have to compete with overseas suppliers and therefore it is necessary for growers to create a market proposition or customer value for Australian grown hazelnuts. Promoting the origin, quality and freshness of Australian hazelnuts has considerable potential in creating customer value. There is a consumer trend for using Australian grown or made products which may help in promoting the product. Furthermore a market proposition for hazelnuts could be achieved by keeping quality at the highest level and expanding the product line. Clientele service is a door opener and could improve the value of the product. Price value of hazelnuts is the main market barrier as overseas suppliers produce larger quantities of hazelnuts and determine the price. Achieving economies of scale will be needed to enhance economic competitiveness.

Creating a competitive advantage of Australian grown hazelnuts over overseas imports could be developed by promotion, distribution, local supply, freshness, superior product, organic produce and packaging. The ease of readily supplying product throughout the year from local processing plants is another advantage in spreading purchasing costs for the buyer. Apart from big bud mite in Tasmania, Australia does not have the common pests and diseases of hazelnuts found in other parts of the world. Pesticide usage is minimal and a pesticide-free product is therefore potentially a big marketing advantage.

Focusing on customer and end consumer needs and how to deliver products is important to market products profitably. A high percentage of Australian consumers are unaware of hazelnuts, their origin and the diverse range of usage. The current usage is small in snackfoods, desserts or in bakery goods apart from hazelnut chocolates or spreads. This indicates the need for consumer education on hazelnuts and their versatility, health benefits and nutritive value. Promotional campaigns and advertisements could improve consumer education on hazelnuts.

5.3 Current marketing of Australian grown hazelnuts

A survey was undertaken of hazelnut growers by the Hazelnut Growers of Australia Ltd (HGA, 2002) to obtain information on current crop yields, the number and age of trees, the varieties planted, planned future plantings and how crops are sold. The results showed that most growers sell their crop to local markets. This was followed by sales to specialty or gift shops and wholesalers. Restaurants and bakeries were other buyers. A few growers stated they sell their crop direct from the farm. The survey showed that tree numbers have increased, compared with an earlier survey. Thirty nine per cent of the growers stated that they plan future plantings, so an increase in production levels can be expected in the next decade. Twenty six per cent of the growers sell value added hazelnut products.

At current production levels, local markets and shops are profitable. However, as production increases, these markets will become saturated and other market options will need to be sourced. Other market opportunities could be supermarkets, food processors and ingredient manufacturers, wholesalers and confectioners. Some growers suggested, and have successfully experienced, that expanding the product line is a marketing opportunity. Suggestions for value added products (Table 12) could be roasted hazelnut kernels with or without flavouring, chocolate coated kernels, breads, cakes, nut butters, spreads and nut oil. Reject nuts could be sold as bird seed. Such products are already produced and successfully marketed by various producers.

Table 12: Hazelnut products and usage

Hazelnut products	Description	Usage
Raw kernels Whole Whole and broken Diced Sliced	Shell removed Whole nut with skin Whole nuts and pieces App. 1.60 to 9.40 mm Whole nut thinly sliced lengthwise	Snack food, food ingredient, eg. chocolate, baked goods, ice-cream, cereal Cost-effective form
Blanched/ Roasted kernel Whole Whole and broken Diced	Dry or lightly roasted in oil	Flavour and texture enhanced, food ingredient, (eg. as above)
Meal/ Flour	Finely ground raw or roasted hazelnut kernels	Flour substitute, binding agent, gluten free, food ingredient
Paste, Praline	Sweetened mixture of ground hazelnuts, spreadable but grainy	Adds body, flavour, sweetness and moisture in chocolate or ice-cream
Butter (smooth and chunky)	Finely ground nuts	Replaces animal fats, adds flavour, increases protein content, usage in chocolate, baked goods, end-consumer
Hazelnut kernel oil	Cold pressed	High nutritional value, cholesterol free, good source of Vitamin E, monounsaturated fatty acids, usage in salads or home cooking

Source: Lobb, (1995) modified by author of report

5.4 Suggestions for the hazelnut industry in Australia

The hazelnut industry in the USA is nearly 150 years old (Stone 2000). During this time, abundant research information has become available and the industry has developed organizational strategies from which Australia's hazelnut industry could learn.

Turkey is the world's largest producer and exporter of hazelnuts. Turkey is highly involved in increasing the consumption of hazelnuts, both domestically and internationally through promotional campaigns. The main strategy to penetrate new markets, particularly in China and Japan where hazelnuts are a new taste experience for consumers, are promotional campaigns which address the positive health effect.

The macadamia and pistachio industries are relatively young and were initially faced with the situation that their products were a relatively new taste experience to Australian consumers. These two industries have now achieved significant increases in production and consumer awareness. Organization and strong marketing within these industries were the main strategies for expansion.

As outlined in Chapter 2, there is an existing market for hazelnuts in Australia. Buyers and consumers of hazelnuts are not aware of Australian grown hazelnuts, due to the fact that current production levels are very low. Other nut industries as described in Chapter 4, were and still are faced with the challenge of penetrating new markets or increasing consumer awareness about their products. Promotional campaigns and research were used within all these industries to overcome the problems.

The Australian hazelnut industry is faced with the challenges of consumer ignorance of the product, its origin, nutritional value and diverse ability of usage. Strong promotion campaigns such as advertisements on food exhibitions, supermarkets, newspapers and television could help to increase both consumers and buyers interest in the product.

Survey participants commented that there is a market for Australian grown hazelnuts but they need sufficient quantities and reliable supplies are required. At current production levels, one participant suggested, "they are best used in regional tourist areas or local shops and markets until sufficient quantities are available". Another comment was "there is a market if distributed to the right business and for the right price". Furthermore it was stated that "if hazelnut growers can standardize the quality and grading, most wholesalers would prefer to use Australian grown products". Wilkinson (1999) and survey participants commented that processors expect growers to develop an overall quality management system which addresses foreign matter, hygiene and uniformity in size of hazelnuts. There is a need for breeding programmes to enhance shelf-life. Australian hazelnut buyers have cooperated with overseas suppliers for many years and know the quality of the product they are purchasing. They are generally reluctant to change to a new source of product that lacks continuity of supply and quality assurance standards. This emphasizes the importance for growers to meet industry standards and to promote the quality and freshness of their product.

It appears that an overall management service for quality regulations and promotion, such as that provided by the Hazelnut Marketing Board in the USA or the Promotion Group in Turkey, could be of significance to hazelnut growers in Australia. Such a structure should enable them to develop a more profitable and commercially orientated operation. An independent party in the Australian hazelnut industry that takes over the role of inspections on quality regulations and helps to promote the origin and versatile usage of hazelnuts could ensure that the product meets industry standards.

In the last three years, farmers' markets have been growing in popularity around Australia with approximately 40 markets currently trading (Farmers Market Conference: MARKET FORCES 2002). Farmers' markets are thriving in cities and country towns because consumers look to source fresher products away from big supermarkets. In November 2002, the first Farmers Market National Conference was held in Bathurst, NSW. In an interview on 22 January 2003, Kim Currie, Central Ranges Food and Wine Development Officer, stated that the main outcome of this conference was to develop strategies that ensured quality standards for produce at farmers' markets. There was also a proposal to ascertain the feasibility of establishing a National Farmers Market Network, with its own website.

At farmers' markets, stallholders sell fresh produce they have either grown, produced or raised themselves. Stallholders may also sell value added products of which the principle ingredient must have been grown, produced or raised by the stallholder. Kim Currie commented in the interview that there are some regulations that people have to follow in order to sell their produce at Farmers' Markets. Stallholders must register with the organizer of the market. There is a fee for stallholders which varies depending on the organising body. Central Ranges Food and Wine charges \$20 per stallholder. Stallholders have to obtain public liability insurance and are advised to be insured for \$10 million. However, there are insurance companies that specialise in such insurance policies and offer them at affordable prices e.g. \$75/annum. Often a farmer can include such public liability insurance cover in his business policy.

Farmers' markets could be a market opportunity for hazelnut growers to sell their crop or value added products, particularly at current production levels. Direct selling to the consumer may increase consumer awareness about hazelnuts, their versatile usage and nutritional benefits.

At this stage, individual growers can only supply small quantities of nuts, whereas most of the buyers contacted in the survey prefer to buy larger quantities of nuts. One way of providing a larger reliable supply would be to form a co-operative of growers with one central storage, drying, cracking and grading plant, with the possibility of roasting facilities to manufacture value added products. A central cracking and grading facility with its own quality assurance standards would ensure the production of a consistent quality product. Value added products could also be manufactured. Hazelnuts and products could be marketed under one label. This may achieve more effective promotion and the provision of information about hazelnuts may be more easily spread to consumers and buyers.

A survey undertaken by the HGA in 2002 showed that most growers have planted the larger size kernel varieties. The results of the market study show that some buyers prefer larger size kernels but there are many who prefer smaller sizes. In order to capture different market segments, varieties that are required by these segments need to be grown. Some varieties that are being grown are more suited to the nut in-shell market, but the size of this market in Australia is small and is not expected to increase. The main market for Australian grown hazelnuts will be the kernel market. Table 13 summarizes recommended marketing strategies.

Table 13: Recommended marketing strategies

- Promote hazelnuts, the variety of usage and health benefits to consumers
- Emphasize freshness and Australian grown
- Maintain quality at the highest level, meeting the physical and chemical standards of processors and consumers
- Provide appropriate packaging and quality descriptions
- Provide a consumer focussed service

6 Conclusion

6.1 General conclusion

The main findings of this study were that Australia imports about 1800 tonnes of hazelnut kernels and 80 tonnes of hazelnuts in-shell per annum, with a total value of about A\$10 million. The imported raw kernels are used in a diverse range of products, including confectionery items, bakery products, pastes and spreads, health and snack foods. Most users of kernels have their own product specifications, which commonly include size, shape, appearance and quality standards. Most users purchase on a price basis, provided their specifications and quality standards can be met. Buyers do not seem to have a specific variety preference. When buying from overseas, hazelnuts are generally associated with the locality of production rather than variety names. Thus buyers obtain "Giresuns" from Turkey, "Round Romans" from Italy and "Oregons" from the USA.

A range of Australian grown varieties was offered for evaluation to a wide range of users. Feed back on varietal preference was based on size, appearance and blanching properties rather than taste. In general, the varieties evaluated were considered to have a suitable taste. The potential use of the varieties evaluated was identified.

Most of the 19 buyers who collaborated in this study indicated considerable interest in purchasing Australian produced kernels. However, these need to be available in sufficient quantities, they need to meet the buyers specifications and be available at a competitive price. Potential competitive advantages for Australian grown product are freshness, ease of providing a supply throughout the year and freedom from pesticides. It is considered that to capitalise on these opportunities, the current Australian hazelnut industry needs to expand production considerably, to work in a collaborative manner and market hazelnuts to meet the needs of buyers and consumers.

Currently, imported raw hazelnut kernels are worth about \$6/kg and imported nuts about \$4/kg. A total area of 1500-2000 hectares of well-managed productive plantings would meet all of Australia's current needs. It is concluded that the current industry could expand considerably to meet market opportunities. However, this would require a careful selection of varieties that meet market needs and are productive in the field. There would need to be an increase in the scale of production in localities where the climate and soils are suitable. A co-operative system of crop handling and marketing is recommended.

6.2 The potential for hazelnuts in the Central West of NSW

The experiences of growers and results from the NSW Agriculture field site at Orange indicate that there is potential for hazelnut production on the Central Tablelands and adjacent cool climate areas of NSW. This market survey indicates a potential market for hazelnuts grown in Australia. There is an opportunity for local growers to form an action group that could spearhead the development of a local industry. If the vision was for a Central NSW industry producing 1000 tonnes of kernels it is estimated that this would require an area of about 1250 hectares. This is based on an average yield of 2t/ha of nuts in-shell and a crackout of about 40%. If growers received \$3.50/kg for nuts in-shell, the gross income for a grower would be \$7,000/ha. This compares very favourably with a gross return of \$250-350 for prime lambs or vealers. A 10 hectare orchard could provide a gross income of \$70,000, which would make hazelnut production a useful additional enterprise on many farms. There would be a multiplier effect in the rural community, as additional employment would be created through this new industry.

Preliminary results from the RIRDC funded field studies, growers' experience and this study indicate the following varieties to be potentially suited for the kernel market:

Kernels in the 13-15mm range suited to the confectionery trade

- Tonda Romana and
- Tonda di Giffoni

Kernels 15mm or greater, suited to special confectionery and snack foods

- Oregon Barcelona,
- Tokolyi (Brownfield) Cosford,

- Willamette and Lewis also look promising, but more data is required on these

Those wishing to grow for the smaller in-shell market could plant Ennis and possibly Butler

6.3 Stimulating industry development

At this stage, there is a need to answer the question, "*What is required to stimulate the development of a hazelnut industry in the Central West?*"

The development of new industries requires:

- People with enthusiasm, knowledge, skills and expertise. There is a need for knowledge of production systems and the technology required for those systems
- Finance to support the new industry, with a good knowledge of the potential profitability of the proposed venture and the attendant risks.
- Government support to encourage and facilitate the development of the new industry.
- Skilled and knowledgeable managers and employees in the production and service sectors.

This market research study along with the RIRDC funded field studies, coupled with the experiences of the existing hazelnut growers provide a very valuable foundation for industry development. There is a need for collaboration between a range of people in the local community to coordinate and plan further studies and industry development activities to achieve the potential for this new industry in the Central West of NSW.

6.4 Recommendations

1. The establishment of a Central West Hazelnut Industry Steering Committee, which could include representation from the HGA Ltd., hazelnut buyers, the University of Sydney, CWACC, NSW Agriculture, and the Department of Land and Water Conservation (DLWC). The objective of that group would be to develop and facilitate a strategic direction for the establishment of a hazelnut industry in Central NSW.
2. Funds be sought to develop a package of information for growers and investors in hazelnuts on production systems, crop mechanization and the economics of hazelnut growing in the Central West of NSW.
3. Funds be sought to prepare a business plan for industry commercialization, that includes the development of a co-operative for handling, drying, storing, processing and marketing hazelnuts.

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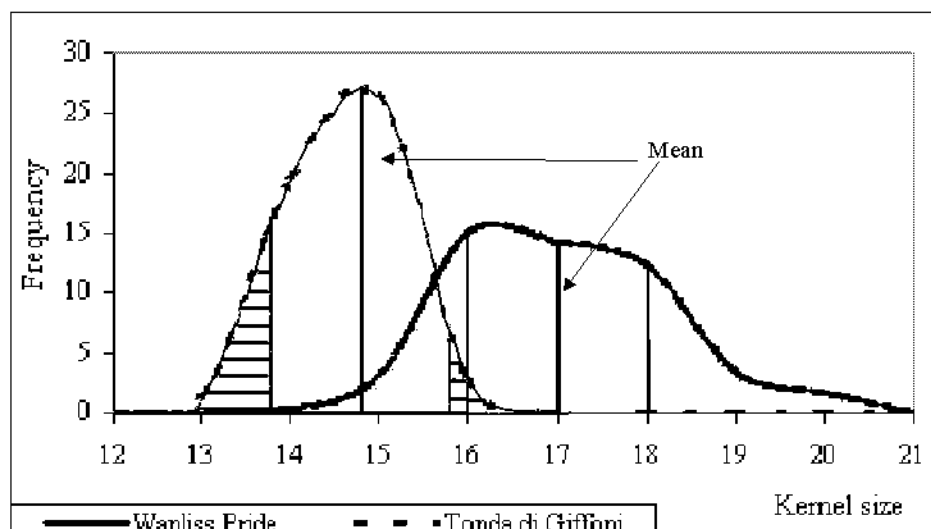
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Appendix A: Hazelnut kernel size

Table A 1: Mean kernel size, Variance, Standard Deviation (STDEV), and Coefficient of variation of hazelnut kernel samples from the Myrtleford field sites

Variety	Mean	Variance	STDEV	Coefficient of variation (%)
Negret	13.4	0.599	0.77	5.78
Casina	13.5	0.594	0.77	5.70
Segorbe	13.7	0.570	0.75	5.47
T.Romana	14.4	0.689	0.83	5.75
TGDL	14.4	0.964	0.98	6.79
Montebello	14.2	0.502	0.71	4.99
T.d.Giffoni	14.6	0.404	0.63	4.34
Willamette	15.1	0.437	0.66	4.37
Atlas	15.3	0.740	0.85	5.58
O.Barcelona	15.7	0.878	0.93	5.96
T.Cosford	15.8	1.107	1.04	6.61
Tonollo	16.3	0.727	0.85	5.20
Wanliss Pride	17.0	1.420	1.19	6.99

Figure A 1: Coefficient of variation and means for the varieties Tonda di Giffoni and Wanliss Pride



Definitions:

- **Mean** is the sum of the values divided by the number of values
- **Average** is most often used as a synonym for the mean
- **Variation** is the amount of dispersion or spread in the data
- **Variance** evaluates the average scatter around the mean, it is calculated by taking the sum of the squared differences around the mean divided by the sample size minus 1, calculated results are in squared units and therefore the Standard Deviation is the primary measure as the computed results are in the original units of data
- **Standard Deviation** evaluates how values fluctuate around the mean and it is calculated as the square root of the variance

- The Coefficient of Variation is a relative measure of variation and is always expressed in percentage rather than in terms of the units of the particular data. It measures the scatter in the data around the mean and is calculated by dividing standard deviation by the mean multiplied by 100 %.

For almost all sets of data, the majority of values lie within an interval of plus and minus 1 standard deviation above and below the mean. This means that the interval captures the majority of data.

The smaller the coefficient of variation, the less the data is spread around the mean.

In this experiment, the coefficient of variation was used to describe the homogeneity of the sample in size. The smaller coefficient of variation the smaller the amount of values outside the interval and therefore the samples of hazelnut kernels are more homogenous in size. The figure A 1 above shows the spread of sizes for two varieties, Wanliss Pride and Tonda di Giffoni. The figure indicates the mean and interval of plus and minus 1 standard deviation above and below the mean. The area outside this interval is smaller in the graph for the variety Tonda di Giffoni than for Wanliss Pride. Therefore the sample of Tonda di Giffoni was more homogenous in size than Wanliss Pride. The more homogenous the variety is in size, the less grading in sizes is required.

Appendix B: Blanching

Table B1: Blanch ratings for several varieties and years

Variety	University of Sydney, Orange Blanch Rating						Oregon State University Blanch Rating (1)			PCGrin database
	MV '01	T '01	O '01	MY '01	V'02	MY'02	1990 Trial	1991 Trial	1992 Trial	
Negret	***	1	1	2	***	1.5	1.2-3.7	***	***	1
Willamette	***	***	***	2.5	***	1.5	2.8-4.2	2.2-3.0	2.6-4.0	***
Montebello	***	***	***	***	***	1.5	***	***	***	***
Tonda Romana	2	2.5	2.5	4.5	1.0	2.25	4.8-6.2	***	***	5
Tonollo	***	***	***	5	1.7	3	***	***	***	***
Wanliss Pride	1.5	***	2.5	***	2.5	1.5	***	***	***	***
Atlas	3.5	***	3	***	2.5	6.5	***	***	***	***
O.Barcelona	3.5	3	3.5	3	3.5	4.5	3.2-4.9	3.6-4.4	3.2-5.2	4
T.d.Giffoni	2	3.5	3.5	4.5-5	3.5	3.5	1.6-3.2	***	***	1
T.Cosford	4	2	2	3	4.5	4.5	***	***	***	***
TGDL	***	***	2	***	4.8	4	1.8-2.8	***	***	2
Segorbe	3.5	2	4	4-4.5	4.8	5.5	***	***	***	4
Casina	4.5	***	6	6	5.8	6.5	4.1-5.9	3.4-5.6	5.1-6.0	5

(1) McCluskey et al, 2001

V Samples collected from different field sites

O- Orange field site

MY- Myrtleford field site

MV- Moss Vale field site

T- Toolangi field site

*** No data available

Appendix C: Questionnaire form

Hazelnut Market Assessment Study

1. **Would you like us to provide you with some locally grown samples of hazelnuts to compare with your imported product?**

Available 100g, samples contain roasted or unroasted kernels. Please indicate your preference.

Varieties/ Type available: Indicate any preferred variety by circling or state ALL

Atlas	Oregon Barcelona	Tonda Romana
Casina	Segorbe	Tonollo
Eclipse	TGDL	Wanliss Pride
Montebello	Tokolyi (Brownfeld) Cosford	Willamette
Negret	Tonda di Giffoni	
Nut in-shell varieties:	Butler	Ennis

2. **What products do you manufacture that contain hazelnuts?**
3. **What is the approximate quantity of hazelnut kernels/ nuts in shell you buy annually?**
4. **What is the origin of these hazelnuts?**
5. **Which varieties of hazelnuts do you use?**
6. **Do you have a preference for certain varieties, if so why?**

Appendix E: Example of industry specifications for roasted hazelnuts-chopped and diced

SPECIFICATION No:

DATE ISSUED:

MATERIAL NAME: **HAZELNUTS - ROASTED & DICED**

SUPERSEDES:

Please note that the attached General Requirements form part of this specification.

Section 1

<i>Description</i>	Hazelnut shall be product of good quality, medium roasted (11/13) diced to the correct size. Free from infestation, mould, rancidity, burnt nut and foreign matter.
<i>Physical Parameters</i>	
Appearance	Size: hazelnuts (11/13) - chunky diced comprising of halves > 75% and quarters < 25% Sieve analysis shall yield 0% passing through a 5mm mesh or being retained on a 9 mm mesh.
Flavour	Medium Roasted Hazelnuts notes, free from musty, rancid, stale, burnt, soapy or other foreign flavours. A crisp, firm to bite texture.
Colour	L value 63+/-1.5 Using lab colour system on a Minolta CR 310 over a petri dish using the ground procedure as per QA-LA-WI-040
Roast Level	Medium
Foreign Matter Extraneous Matter	Absent (ie glass, stones, insects) 0.005% maximum (ie shell fragments, stalks)
<i>Chemical Characteristics</i>	
Moisture	2% max
Fat Content	66% max
Pesticides residue	To comply with Aust Foods Standards code
F.F.A.	0.5% max
Arsenic	1 ppm max
Lead	2 ppm max
Copper	10 ppm max
S0₂	absent
Aflotoxins	15 ppb (maximum)

Section 1 (contd)

Microbiological Characteristics

Total Plate Count	<1000 /g (AS 1766.2.1)
Coliforms	<10 /g (AS 1766.2.3)
Yeast	<10 /g (AS 1766.2.2)
Mould	<10 /g (AS 1766.2.2)
Salmonella	N/D in 15 x 25g (AS 1766.2.5)

Storage Conditions

Cool & dry (20-22 Deg C & 50 - 60 % RH)

Shelf Life

6 months from manufacture date, unopened.

Certificate of analysis

Certificate to be approved with each batch on delivery.
Certificate to include results for:

- Organoleptic evaluation
- Moisture & Fat
- Microbiological analysis

Delivery & Transport
Section 2

As agreed with Purchasing Dept.

Approved Supplier/s

Halal Status

Kosher Status

Section 3

Quality Check on Reception:

As set out in QA Testing Schedule QA-VA-D001

Appendix F: List of survey participants

- Australian Coffee & Nut Company Pty. Ltd.
- Bristowe Farms
- Cadbury Schweppes Pty. Ltd.
- Dullo Chocolate
- Ferrero Australasia Manufacturing Pty. Ltd.
- GB-Commtrade Pty. Ltd.
- Genoa Food Wholesalers Pty. Ltd.
- Michael Wearing Trading Pty. Ltd.
- Nestle Confectionery
- Olympic Fine Foods Pty. Ltd.
- Santos Nuts & Fruit
- Scalzo Food Industries
- Select Harvests, Renshaw Foods
- Sweet Indulgence
- The House of Manuela
- The Nut Shop Pty. Ltd.
- The Sydney Nut & Sweet Co
- Trutaste Nuts
- Venice Food Wholesale Company