HAZELNUTS
In a nut shell

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About the hazelnut

The hazelnut or filbert as it is known in some parts of Europe was once the dominant species of vegetation over much of northern Europe. It is regarded as being the first shrubby type tree to emerge as the ice of the Ice Age receded. Pollen count made in the peat bogs of Europe which were laid down in the period 8000 – 5000 BC show that hazelnut pollen exceeded the pollen of all other plants.

Corylus, the botanical name for the genus which we know as the filbert or **hazelnut** is a native of Britain and all temperate parts of Europe and Asia. It is one of six genera belonging to the birch family – Butulacae. In addition to the birch, the alder, ironwood and hornbeam are members of the family.

The hazelnut tree/bush is by nature an understorey plant, being found on river edges amongst dense forests and hence got its moisture and protection from the plants around it. It has developed a shallow surface rooting system as a consequence without a significant tap root. This is why the plant does not like being grown in hot areas where the roots are exposed to hot soil temperatures and hot winds.

The cultivated hazelnut as we know it in Australia is *Corylus Avellana* L., (referred to as the European hazelnut) when left to its own devices will grow numerous suckers and grow in the form of a multi-stemmed shrub/tree to aprox. 4-6m at full maturity (15 yrs- depending on the variety). For better management and to maximise productivity in the commercial situation we train it to grow as a single stemmed tree.

Although it is stated that the life of a commercial hazelnut tree is around 50 years, there are some trees in Europe still producing at over 400 years of age. It seems that with the correct maintenance and care, these trees should last forever.

History in Australia

Hazelnut cultivars were introduced into Australia sometime in the early to mid 1800's into areas around Hobart, the Dandenong Ranges and Ovens Valley in Victoria and in Glen Innes and possibly Orange in New South Wales, although not in any commercial quantities.

It appears that in the early 1970's Imre Tokolyi initiated research that renewed interest in hazelnuts as new more suitable and higher yielding varieties were named and propagated (such as the variety TBC – Tokolyi Brownsfield Cosford). These varieties are used extensively in commercial production in Australia today.

The undertaking of research trials by Basil Baldwin and the Department of Agriculture of New South Wales has led to resurgence in interest in hazelnut production. These 10 year trials will unfortunately come to a close this year – 2006, but the valuable research gained will have enormous benefits to the future of this industry in Australia. These trials were conducted to basically evaluate

variety performance and market opportunity in Australia and the results have been most interesting. In summary it could be

evaluated that varieties that yield well and generally perform well in other parts of the world do not always do the same in Australia. By doing these trials it has saved the grower thousands of dollars as we would have otherwise followed world 'trends' growing varieties not suited to our conditions and had decreased yields, failed trees and an industry that would have gone backwards as a result.

The potential for hazelnut production in Australia has been largely underestimated. Historically Australia has been increasing hazelnut imports annually with imports presently of over 2000 tonnes annually. As Australia is estimated to currently produce between 15 and 20 tonnes annually and buyers requesting more local produce, there is a big opening for import substitution.

Nutritional Value

Hazelnuts are a nutrient and energy dense food and an excellent source of monounsaturated fats. They are cholesterol free and a good source of dietary fibre, manganese, potassium, copper and thiamine. They are high in vitamins E and B6 as well as folate and antioxidants.

Hazelnuts are low in sugar and are a good source of protein and many minerals not found in other nuts.

Hazelnuts are considered to have many beneficial effects on health and are a good source of energy due to their oil content. (aprox. 60% oil in many varieties comprising 75% monounsaturated fatty acids and 25% oleic acid). Monounsaturated fatty acids help to lower blood cholesterol which in term reduces the risk of heart disease.

The main sugar is sucrose. Sugar content is one component influencing the roasting process, leading to changes in colour and taste.

Climate

A suitable temperate climate (cool winter and mild summer) and reliable rainfall or irrigation is important for good tree growth and the production of high quality nuts.

The Meander Valley in Tasmania has been suggested to be the one of the most suitable climate in Australia if not the world to grow hazelnuts due to its cool winters and mild summers.

Long periods of chilling are required to ensure fruitfulness and reliable hazelnut yields. Chilling requirements vary for male catkins, female flowers and leaf buds but about 1200 hours between 5ºC and 7ºC is suitable. For female flowers severe

frost areas with temperatures below -5ºC should be avoided when the female flowers are opening.

Very cold temperatures, below -10ºC, and temperatures of about 21ºC can kill dormant catkins whilst very warm temperatures during flowering can cause the catkins to break the winter chill cycle and release their pollen before the female flowers are receptive.

The hazelnut flowers in winter, so spring frosts are not a hazard. However, if a frost occurs very late in spring, the young developing nutlets can be burnt off.

Strong winds, particularly in summer, can be a problem as the hazelnut has a relatively shallow root system. Hot winds which dry out the soils can result in moisture stress and leaf scorch. The trees can be blown over in strong winds, so it is advised that in windy situations trees be staked appropriately.

Hazelnuts require aprox. 750mm (30 inches) of annual rainfall for good production. The amount of rainfall is not important so long as the trees do not become stressed and can be supplemented with irrigation. In most areas where summer rainfall is less than the evaporation (most parts of southern Australia), irrigation is necessary. Supplementary irrigation during the establishment stage has shown to have marked results in the long term health and growth of the trees.

Soils

The hazelnut has a shallow root system (aprox. 0.6m) with its feeding roots near the surface and no significant tap root. It therefore prefers good well drained **loamy soils** aprox. 1.8m deep which allow for greater exploitation of soil resources and heavier production in the mature orchard. On shallow soils the tree will usually thrive for a few years then decline.

Soils should be sufficiently deep to allow the tree to develop a good root system. Any impervious layer (rock, hardpan, watertable) in the top 0.6-1.0m of soil will inhibit adequate root growth and is therefore detrimental even though the hazelnut has most of its roots in the top 0.6m of soil.

Although hazels grow in their wild state in poor soils and produce nuts, it is now considered essential to grow them in fertile soils for profitable commercial production.

Heavy clays and very snady soils should be avoided with a deep loam preferred. Acid conditions and a high manganese level can be detrimental to growth.

A neutral to slightly acid soil (pH 6.0) is suitable. Lime should be applied below pH 5.6.

Soil management and Fertilisers are discussed further under ‘Management’ (p. 19)

The Plant & Plant Cycle

The hazelnut is truly an oddity in the plant kingdom as it is said to be never truly dormant as at all times of the year something is going on.

1. It blooms in the middle of winter when most other plants are truly shutting down to rest
2. months can elapse between pollination and fertilisation
3. at the time of pollination the flower has no ovary
4. It produces both pollen and a female flower but is self incompatible

As the hazelnut is a deciduous plant it undergoes a period of 'dormancy' during the winter months. During dormancy the plant must undergo a period of cold adjustment in order to make the required physiological and morphological changes to produce catkins and female flowers:

1. terminal shoot growth ceases
2. Shoot tips fall off
3. leaves drop off
4. buds develop protective waxy foliar structures (scales and stipules)
5. true winter rest ensues

To break the period of winter rest, a period of exposure to low temperatures is required. Commonly known as CHILL HOURS (Less than 7ºC). The number of chill hours required is generally less for the male flower cluster (catkins or male pollen) than the female flower clusters.

The lack of required chilling hours or a break of warm days amongst a period of chill has a negative effect on nut production as less or no pollen may be produced or the female bud may not set. It can also change the timing of catkin elongation (pollen release) in respect to female receptivity. It is important therefore to plant early, mid and late polliniser varieties (varieties that shed their pollen at different times).

There has been increased interest in the trigger factor for pollen set and female flower set with some thoughts that a period of warmer temperatures has a greater effect on the whole cycle than first believed.

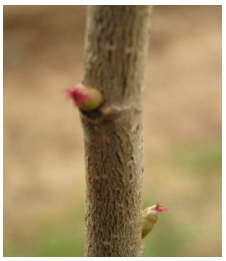
There are three important phases in the set, development and shedding of pollen; the development of female flowers and vegetative buds:

Phase I:	Dormancy	or	'rest'
Phase II	Chilling	or	'Post rest'
Phase III	Warming	or	'Post Chill'

Flowering and Pollination

The tree is monoecious – that is both male and female organs are carried on the same tree, but separately (see pictures below). They are self infertile and are pollinated by wind – not bees.

Female flowers



The female flowers emerge as little dark red hairs from the top of a bud. Prior to the emergence of these hairs, the bud can not be distinguished from a vegetative or growth bud.

When the bud is dissected, a short shoot which terminates in a flower cluster can be seen. In the spring these shoots grow with the nuts in a cluster at their tip.

Each female flower consists of several very small flowers. The ovary does not exist at this time.

Male flowers (Catkins)

The male flowers are carried on catkins similar to your garden variety silver birch tree but unlike other trees producing catkins, the hazelnut catkin is self-sterile. In some varieties the males flower first; in others it is the female, however in Australia the varieties we use generally see the male flowering first.

Cross pollination is essential for hazelnuts, because without pollination there will not be nuts. It is therefore essential to have at least two different varieties. Not only must the bloom time be the same, but the cultivars must be genetically cross-compatible (see Genetic Compatibility). In some cases one cultivar may pollinate another, but the reverse is not successful. The relationship between cultivars is vital if one is to grow hazelnuts commercially, hence the usual method of planting is to plant a range of cultivars which will produce a broad spread of cross-compatible pollen at varying times the female of the main variety is receptive.

Pollination

The catkin transform from being a tightly packed bundle of scales hanging from a twig to stretching out (elongation) whereby the scale (pollen) is released into the air. This usually takes place over a period of approximately 3 weeks depending on the variety and is more effective on nights that are cool and misty without a strong wind.

The female stigmas remain receptive for a long time, especially if the weather is cool, so pollination can occur over an extended period.

Fertilisation

After pollination takes place, the pollen tube grows to the base of the styles and 'hibernates' for several months as the ovary develops. When the ovary is mature, 4 to 5 months later, the pollen tube recommences growing towards the egg so that it can be fertilised.

Once fertilisation has taken place, the shell grows to its final size. The embryo then grows to form the kernel.

If pollination does not take place then there will not be any nuts produced.

The presence of blank nuts is not a pollination problem, but a fertilisation or physiological problem.

Plant Cycle in Summary

Month	Process
March/April	Catkin development
March/April	Bud development
June	Dormancy (leaves drop leaving catkins and buds)
June-September	Catkin elongation/pollen release
June-September	Female flower set/receptivity (shown as a small hair-like protrusion from the end of the bud)
June-September	Pollination (pollen attaches to female flower)
September-December	Pollen remains dormant inside 'bud' waiting for ovary to develop (many months)
December	Ovary develops and fertilisation takes place
Late December	Shell develops into final size
January-February	Embryo develops and kernel forms inside shell
Late March	Nuts fall from husks and are harvested

Compatibility

There are two criteria that are critical to ensure nut production:

1. Genetic compatibility *(Table 1)*
2. Timing of pollen release in relation to female receptivity *(Table 2)*. There is no point having a variety that fits all your requirements but the polliniser variety does not release pollen at the same time the female of your main variety is receptive.

Genetic Compatibility

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Hazelnuts have been found to be self-incompatible. In their genetic make-up, alleles, known as S-alleles, prevent hazelnut trees from pollinating themselves and other trees of the same variety. More than 20 different S-alleles have now been identified.

Identification of the S-alleles for each variety enables compatibility relationships between varieties to be determined. Each variety has two S-alleles (shown as eg. S_1S_2) and both of these are expressed in the female flowers. In the pollen both alleles MAY be expressed when they are of equal dominance, that is, they are co-dominant. However, if one allele in the pollen is dominant over the other, only the dominant allele is expressed in the pollen.

For varieties to be compatible, the S-alleles of the female must differ from the dominant or co-dominant alleles of the pollinisers eg. In Barcelona ($S_{\mathbf{1}}S_2$), only the dominant allele $S_{\mathbf{1}}$ is expressed, whereas in Hall's Giant ($S_{\mathbf{5}}S_{\mathbf{15}}$) the S-alleles are co-dominant, therefore both are expressed. See below for example (underline and/or bold indicates dominance).

When the Allele expressed by the Pollen is met by the same allele in the female flower, the cross is **NOT COMPATIBLE.**		POLLEN					
		Barcelona	Jemtegaard #5 (J5)	Lewis	Tokolyi Brownfield Cosford (TBC)	Tonda di Giffoni	Tonda Romana
FEMALE Parent	S-Alleles	**1**	**3**	**3 8**	**5**	**2**	**10 20**
Barcelona	**1** 2	-	+	+	+	-	+
Jemtegaard #5 (J5)	2 **3**	+	-	-	+	-	+
Lewis	**3** **8**	+	-	-	+	+	+
Tokolyi Brownfield Cosford (TBC)	**5** 23	+	+	+	-	+	+
Tonda di Giffoni	**2** 23	+	+	+	+	-	+
Tonda Romana	**10** **20**	+	+	+	+	+	-

Table 1

		S-alleles		Compatible
Nut producing variety (female):	Barcelona	**1**	2	
Polliniser varieties (male):	TBC	**5**	**23**	Yes
	Lewis	**3**	**8**	Yes
	Butler	2	**3**	Yes
	Montebello	**1**	2	No
	Tonda Di Giffoni	**2**	23	No
	XYZ	**1**	6	No

Both variety XYZ or Montebello are NOT compatible because the dominant S-allele carried in the pollen is the same as the dominant S-allele carried by the female.

The dominant allele in Butler is the S_3 allele. So although Butler has an S_2 allele, it is recessive in the pollen therefore, cross-pollination can occur.

Timing of Pollen release to female receptivity

Time of bloom is important because receptivity of female flowers to pollen must overlap with the time of pollen shed. Some cultivars shed their pollen for a relatively short period of time while others shed over a much loner period. Also, pollen shed of some cultivars may also be too early or too late.

Polliniser varieties should be chosen which will provide pollen for early, mid and late developing female flowers.

The following is an illustration of the timing of pollen release to female receptivity. The relative catkin numbers illustrates how many catkins are produced on each tree. It is preferred that the required pollinator sheds large amounts of pollen into the orchard.

(1-5, 5=many)

	Rel. Catkin Nos.	No. Days	Polliniser Timing	JUNE 4	11	18	25	JULY 2	9	16	23	30	AUG 6	13	20	27
BARCELONA		42														
LEWIS		35														
TBC		40														
BARCELONA	2	42	Early													
J5	5	18	Late													
LEWIS	2	35	Mid													
TBC	5	39	Mid													
TONDA DI GIFFONI	3	38	Early													

NOTES:

Full Bloom - female (Nut producers)

Pollen Shed

Rel. Catkin Nos. score: 1-5 (1=few, 5=many)

Table 2

TBC: The Barcelona will cover the early TBC flowers and run through to the mid stage of the TBC flowering. The Lewis will cover through the mid to later stages and the J5 is used to cover any very late flowers to maximise pollination and hence yield.

BARCELONA: The TBC will cover the early-mid stage of the Barcelona and although the TBC is placed as a Mid cycle polliniser, it covers the Barcelona through from early to the end stages. The Lewis will cover the mid to later stages of flowering and the J5 are good late pollinisers to catch any late Barcelona flowers.

Propagation

Traditional Method – Stool Bedding:

The traditional method of propagating hazelnuts is by layering or by suckers. It requires that a 'mother tree' is encouraged to sucker in raised beds or Stool beds where the young suckers are tied off and encouraged to grow roots from above the strangulation point. When the sucker is strong enough and has produced an adequate independent root system, the suckers are cut from the mother plant and can be planted out in the orchard. It can take 2-3 years to get a sucker from the mother tree to the orchard. There is a considerable cost in getting plants using this method.

Micropropagation (tissue culture)

This is certainly the way of the future. The development of the hazelnut industry on a commercial basis rests on the success of this technology.

Micropropagation is the process of taking cuttings from the desired variety (preferably in spring time when there is plenty of tip growth), growing them in a lab environment and then making additional cuttings so as to multiply the plant in a matter of months which traditionally would have taken several years. These plantlets are rooted and acclimatised in a greenhouse. At this point (15-20cm tall) they are transferred to larger pots or placed in 'grow on' beds. Once they grow to aprox. 1 metre tall, mature and develop a strong root system, they will be ready to be planted in the orchard. The whole process from a cell to an orchard tree takes aprox. 12 months.

The advantages of micropropagation are as follows:

- The plants are genetically identical.
- The plants are disease free.
- Much greater numbers can be produced in a much shorter period of time. (a mother tree will produce aprox. 10 suckers/year so to get 10,000 trees it could take many years conventionally. Using this method it could be possible in as little as 12 months).
- Experience in the USA has shown that micropropaged trees can go from a plantlet to a nut producing tree in two years.
- Orders can be placed in advance with certainty.
- The development of new improved varieties is possible given the shorter time it takes to develop and release new varieties.
- Trees can be planted all year round if they are grown on in pots.

Under no circumstances should seedling trees be planted for nut production – that is trees grown from the nut itself. As the nuts are open pollinated and therefore do not come true to type, they should not be used for nut production. Not only this but as the plant has twin genetic alleles, the possibilities of seedling alleles are many. For example, if the alleles of the mother tree are S_1S_2 and the pollinator S_5S_8, the possibilities of the seedling could be: S_1S_5, S_1S_8, S_2S_5, S_2S_8. In simple terms for example, if the S_2 allele carries small nut gene and the S_5 allele carries

the blank nut gene, we really don't want a S_2S_5 mix so we have to get the suckers from the known selected parentage to ensure the genetics carry through.

Although it may appear appealing to produce your own suckers from your orchard trees, it is however not advisable. If the trees are planted for nut production, suckers should be removed to maximise growth and energy for producing nuts and producing good strong vegetation. If the suckers are required for propagation of new trees, the trees should be managed as such in a controlled environment and any nut production prevented.

Trees that have been encouraged to sucker at any stage will develop substantial root systems and continuously produce more suckers. This will therefore make them hard to manage as single stemmed nut producing trees at any later stage.

Choosing Varieties

It is preferable to choose varieties that cross pollinate with each other as a main variety and polliniser and are compatible both genetically and in timing of pollen release and female receptivity, and have desired physical characteristics that encompass a wide range of marketing opportunities.

To get the maximum benefit from your orchard it would seem practical to use pollinisers that match the characteristics of the main variety as much as possible so all the nuts can be utilised. This has not been the traditional approach overseas however – a polliniser is used solely as just a polliniser and often hand eliminated from the crop prior to harvest.

As the industry in Australia is just starting to gather momentum, there is a severe shortage of available stock for most of the pollinisers at present, although Micropropagation will hopefully eliminate this problem in the future. If a supply of the main variety can be sourced it is probably wise to get whatever pollinisers are available at the time with the aim of filling in the gaps as time progresses.

Physical characteristics

The following criteria are also important and require a lot of consideration when choosing your main variety and to some extent your polliniser.

- Yield
- Vigour
- Cold hardiness
- Suckering habit
- Nature of husk
- Cracking quality
- Nut shape
- Nut Size
- Pellicle removal (the brown skin on the kernel). This is important in the confectionary market.
- Taste

The varieties of cultivars are extremely variable in their appearance and traits, so it is important to grow the variety to best suit the market you wish to engage.

Given their individual qualities, varieties have traditionally been grown for specific markets - confectionary , fresh or the in-shell market. Australian growers are aiming more at finding varieties that are more universal and not specific to any particular market. This makes a lot a sense as it will enable greater profitability if any one market is going through a downturn in demand. No matter what is grown however, they all find their place.

There are more than 200 different named varieties of hazelnuts in the world but we in Australia only have approximately 40 at our disposal.

Imre Tokolyi developed a cultivar we now know in Australia as **TBC** or Tokolyi Brownfield Cosford (although it does not resemble the true Cosford from Europe) which has been planted extensively and is now bearing good yields commercially.

The following varieties are being assessed to be suitable to be grown extensively in the Meander Valley in Tasmania. The reasons for choosing these varieties are as follows:

- The nuts are uniform in shape and size so can be mixed.
- They can be used as main varieties as well as pollinators for each other. They intermix with time of pollen release, female receptivity and are genetically compatible.
- Their growth habits and vigour are similar
- Their cracking ability and pellicle removal are similar
- Taste is similar

Barcelona is a heavy bearing cultivar with medium-large nuts. It has a higher percentage of blanks than many other commercial varieties but its large yield accounts for this. Nuts are round and dark brown with a thick shell. Kernels are of high quality, sweet and easily removed from the shell. They blanch well/have a good pellicle removal rating– 5/7. They are a good roasting kernel with a good taste and mix well with TBC. This variety is grown throughout the world and performs well in many different soils and environments. It is considered the universal nut.

Jemtegard #5 (J5): Used as a late polliniser and is compatible with many cultivars. It produces a large amount of catkins and very few nuts as there is generally nothing around late enough to pollinate it. It has a blanching rating of around 4/7.

Lewis: This is a newer variety (1970's- USA) but has only recently been recognised to have enormous potential as a replacement for Barcelona. It is a high yielder, is smaller in size than Barcelona and appears to have a higher crackout than Barcelona with fewer blanks. It can be used as a main crop and/or as a pollinator. It produces large amounts of catkins mid season which makes it

an excellent pollinator for both Barcelona and TBC. The nuts are a versatile size and taste good with a medium pellicle removal rating (4/7).

TBC (Tokolyi Brownsfield Cosford) was bred in Australia in the late 1970's. It is an oval nut carried in cluster of one to four with many singles but with few blanks. Shells are thin, light brown and easily cracked. Kernels are large and well flavoured, but as with most large kernels, shrinkage does occur with storage. It has excellent pollen shed with a high percentage of viable pollen and crosses well with Barcelona and Lewis. It has a blanching rating of 6/7. This is truly a great Australian variety.

ENNIS has been overlooked for a number of reasons. It is a large nut bred in the USA specifically for the **in-shell** market in the USA and Germany. It has the lowest pellicle removal rating (outer skin removal) of all the nuts worldwide (**0/7**) and is therefore totally unsatisfactory for the confectionary, fresh or kernel markets. Australians – unlike Germans and other European countries, prefer to eat nuts as a kernel, either raw or roasted rather than cracking the shell. The market research showed that only 4% of total hazelnut imports were in-shell and declining. Ennis could not be satisfactorily used as meal due to its difficulty in removing the pellicle. There could be considerable risk in growing a variety with such limited market opportunities.

It appears the varieties TBC (Tokolyi Brownfield Cosford) and Barcelona are the most widely used varieties in Australia at present. Research shows that Lewis has potential as a high yielding tree with a small nut suited to the confectionary market, however given that it has only recently been introduced into Australia, it is only presently available in small numbers.

Common belief in the past has been that we could mix together whatever variety of nut we were growing and the end user would not know the difference. It was suggested that we were getting too concerned about the varieties we were growing and that a hazelnut is a hazelnut. This has been shown to be **inaccurate** as a recent survey of confectioners in Australia found that both physical and chemical parameters had to be met in order for them to buy the product. These parameters were:

- Size
- Uniformity in size, shape and appearance
- Thin pellicle
- Colour
- Texture
- Flavour
- Blanching and roasting ability
- Moisture and oil content

The size of hazelnut kernels is an important parameter for buyers. Hazelnut kernels need to be graded into the preferred size ranges. An even size is important to achieve even roasting results or for use in confectionery goods.

The shape and appearance is also important to many confectioners. Buyers tend to prefer a uniform spherical shape, as spherical kernels are more appealing and easier to handle – (TBC, Barcelona)

The pellicle (skin) around kernels influences the appearance. The pellicle thickness varies with each variety with most confectioners prefering a thin pellicle. Indented kernel shape may be a disadvantage from the cracker's point of view, as during the cracking process as the kernel can stay in half of the shell – (varieties such as Tonda di Giffoni and Tonda Romana).

It is important that we acknowledge these parameters when deciding on the varieties to be grown and their intended market.

Orchard Layout / Planting distances

Until there are orchards that have been producing good yields consistently for many years, we will not know whether there is truly a single approach to an orchard layout or several, however the traditional planting of 6m x 6m remains the most sensible for mechanisation.

Polliniser placement

There are so many varied opinions with what pollinisers to use with what cultivars at what ratios and in what pattern. Polliniser placement should however, be a function of distance from pollen source, not the percentage of pollinisers per planting.

Polliniser distances have not been confirmed and further research is required to establish an industry standard or recommendation, however at present observations have concluded that planting a maximum of 20 metres from pollinisers be used. Research has shown that the greater the distance from the polliniser, the smaller the yields.

Placement of pollinisers is a key factor in the economic viability of a grove and should be carefully planned to take into account:

1. Ratio of pollinisers to main crop variety (recommended 10-15%)
2. Intended method of harvest
3. Direction of prevailing winds - not a great deal of convincing evidence to show this to be relevant given that pollen moves about the orchard more effectively on still evenings
4. Direction of maximum sunlight - only applicable if not planting equal distances in-row and between rows

It is acceptable to have a ratio of aproximately 10% of pollinisers in the orchard for effective pollination. Although traditionally, a polliniser tree is less productive than the main variety. If a polliniser variety is used that produces a good yield itself, the nuts can be incorporated with the main variety and the effective yield/ha is increased (eg. Lewis, TBC, Barcelona). This is why we have selected varieties that can cross pollinate and bear similar quality nuts.

The favoured system in the USA is planting a polliniser every sixth place in every third or fouth row. In Australia there are a number of different systems used.

If a large orchard is to be planted with a view to mechanised harvesting, the following system should be considered:

Plant several rows (3 – 5) of the main crop variety then one row containing an assortment of prospective pollinisers (Early/Mid/Late).

(A polliniser row should be considered on the prevailing wind side)

The following are examples of the above layout Barcelona(B)-Early Pollinator, Lewis (L)-Mid Pollinator, TBC (T)-Mid/Late Pollinator, J5-late pollinator. The main varieties are also used in the pollinator rows to increase yield.ha. The planting layout could look like this:

L	T	T	T	T	**J5**	L	L	L	L	**L**	B	B	B	B	**J5**
L	T	T	T	T	**B**	L	L	L	L	**L**	B	B	B	B	**B**
T	T	T	T	T	**L**	L	L	L	L	**T**	B	B	B	B	**L**
J5	T	T	T	T	**L**	L	L	L	L	**J5**	B	B	B	B	**L**
B	T	T	T	T	**T**	L	L	L	L	**B**	B	B	B	B	**T**
L	T	T	T	T	**J5**	L	L	L	L	**L**	B	B	B	B	**J5**
L	T	T	T	T	**B**	L	L	L	L	**L**	B	B	B	B	**B**
T	T	T	T	T	**L**	L	L	L	L	**T**	B	B	B	B	**L**
J5	T	T	T	T	**L**	L	L	L	L	**J5**	B	B	B	B	**L**
B	T	T	T	T	**T**	L	L	L	L	**B**	B	B	B	B	**T**

This illustration places the main varieties in the polliniser rows and therefore increases yield per ha. It is believed that this planting plan will still give adequate coverage of pollinisers to main variety as there is a polliniser of any one type a max. of aprox. 15 metres from any main variety.

The timing of the pollinators (mid, early, late) determines when they will produce pollen in relation to the time the female of the main or nut producing variety is receptive. For example, an early pollinator (EP) means it produces the majority of its pollen in the early stages of the female of the main variety being receptive.

There is no simple spacing of hazelnut trees which is ideal for both young and old trees. Obviously it is more economical to have close planting in early years in order to maximise yields for the area planted and also to improve pollination. However, if the planting is too close, alternate trees will have to be removed at some stage to avoid crowding – an operation which involves time and money. Although this method was trialled in the USA, it is certainly not an advisable option.

Long term studies overseas have proven closer plantings produce more nuts during the first 10 years. However, this must be balanced against the increased management inputs, the loss in yields for the 3-4 years following tree removal and the ‘waste’ of capital expenditure at planting. Although higher density plantings are being considered in some growing areas overseas, the benefits of this and the resultant pulling out of alternate trees at years 10-12 does not appear practical. If you are trying to increase the yield per hectare however, a closer planting would be necessary.

High density planting may be an option if you have plenty of capital, water and management costs are not an issue.

A planting plan needs to be adopted for the long term and planting trees at a suitable spacing allowing for growth is a far more economical way to plant, especially if area is no constraint.

Smaller Spacing (3m x 6m): (NOT PREFERRED)

The recommended planting between trees (in row) and between the rows has been traditionally smaller to increase yields/ha, however there is now significant evidence to suggest that hazelnut trees have a reduction in yield from the effects of reduced sunlight (shading) and crowding as they develop. The increase in management (pruning) is also a consideration in orchards with smaller tree spacings and the cost factor of perhaps having to remove every second tree around year 10.

Although the trees get a 'protective' effect from a closer planting, pulling out alternate trees at around year 10 has proven to drop yields for around 3 – 4 years whilst the remaining trees re-establish root systems and adjust to the lack of protection to which they have been accustomed.

Advantages:

1. Increase in yields ($) for 4-5 years

Disadvantages:

1. Increase in capital (trees and irrigation)
2. Loss in production for 3-4 years following removal.

6m x 6m Spacing: (RECOMMENDED)

Advantages:

1. Eliminates the need to remove trees in later years when the canopy overlaps.
2. No tree shock and resultant decrease in yields on removal of crowding trees
3. Allows adequate sunlight to all parts of the tree and
4. Allows for easier management.
5. Allows air flow during pollination
6. The increase in air flow reduces the risk of disease between trees
7. Reduced need for pruning
8. Easier access for machinery

Disadvantages:

1. Lack of protection for trees in early years
2. Longer time period to achieve higher yields
3. Smaller capital input/haWhen all points are considered, it would appear the 6 x 6 metre planting system to be the most practical. If yield/ha is the main consideration, then the 3 x 6 planting may be preferred however with that comes a higher management cost, higher capital cost/ha, decreased yields at around year 10 when the canopies overlap and shading creates a drop in yield, disease issues, harvesting and mechanical issues.

Management

Mulching:

As the hazelnut tree is by nature an understorey plant, it gets its moisture and protection from the plants around it. It has developed a shallow root system as a consequence which benefits greatly from a mulch to maintain soil temperature and moisture. We have found that mulching with a 50/50 Poppy trash/sawdust mix laid thickly around the trees provides a benefit of weed control and moisture control.

Weed Control:

Herbicides need to be applied to maintain weed growth around the trees if you are not mulching.

We have found that spraying out along the rows makes it easier to mow between the rows, without having to cross mow. The tree line is kept weed free using a knock-down herbicide. The use of knockdown herbicides will also assist with sucker control.
Weed control approximately halves the water needs.

Sucker Control:

A slow translocation herbicide such as Basta can be used to spray the suckers. This will not affect the mother plant. If you do not wish to use chemicals, the only other method to control suckers is by manually removing them with secateurs.

Training:

It is important to establish the required shape of the tree so that the long term management of the grove can be achieved as efficiently and productively as possible. A single trunk having an open V-shape is more viable for several reasons:

1. The shape benefits mechanical harvesting by allowing easier access of equipment under the tree canopy
2. Fewer nuts are lost by being trapped in a network of stems.
3. The single trunk permits better sunlight penetration with obvious benefits. (Research has shown that a higher yield is achieved with less shading).
3. General orchard management such as sucker removal, irrigation, mulching and spraying are rendered easier with the basic vase-shaped tree pruned to shoulder height.

The only real disadvantage to single trunk trees is that if the main stem dies the tree will not bear fruit again until a sucker takes its place.

HAZELNUTS
In a nut shell

Pruning:

Compared to other deciduous fruit trees, hazelnuts require a minimal amount of pruning although sucker control can be time-consuming.

Maintenance pruning on a routine basis maximises fruit production. They will produce nuts on wood at any vigour, however, unless a pruning and fertiliser programme is used they will fall well short of their yield potential. Care must be taken as fruit is borne on **last years growth** and if it is cut out, yield will be affected.

All pruning should be done in late winter after pollen has been shed. It involves a light but detailed pruning to open up the canopy and allow the entrance of light and air. Some of the pruning is also aimed at maintaining the basic vase shape which was established during the initiail training.

The economics of pruning should however be considered. In large orchards it is not uncommon to heavily prune 1/5th of the orchard on a five year rotation. It must be remembered that if a wider planting system is adopted (6mx6m), then the need for management pruning is reduced as the trees will not be growing into and shading each other.

Pruning and adequate fertiliser should see growth of aprox. 30cm annually.

Fertiliser:

A balanced nutritional programme is always recommended. This can be supplied by annual application of a complete NPK fertiliser or organic manures. If tissue analysis discloses a deficiency in trace elements, these are usually best applied as foliar sprays.

Young hazelnuts are very sensitive to fertiliser and can be damaged easily in the first year of planting with over fertilisation. It is advisable to apply fertilisers before planting with the addition of a slow release fertiliser such as Osmocote annually or as required.

The only accurate method of determining the nutritional need of hazelnut trees is to use **soil** and/or **leaf tissue** analysis. This will give an indication of the fertility of the soil, and by using standard values for comparison, the nutritional status of the trees.

Annual applications of a complete NPK fertiliser or organic manures are a necessity. If tissue analysis discloses a deficiency in trace elements, these are usually best applied as foliar sprays.

The most common deficiencies found in hazelnuts are **nitrogen, potassium and boron.**

Low nitrogen:	Poor growth and pale leaves (easy to correct)
Low potassium:	Small leaves and short husks
Low Boron:	Shoot tip die-back

As a guide to nutrition, the following leaf standards are used in the USA. This is a typical Hazelnut leaf tissue analysis showing trace element amounts in deficient and normal trees.

	Deficient	Low	**Optimum**	High
Nitrogen (%)	< 1.8	1.8 - 2.2	**2.2 - 2.5**	> 2.5
Potassium (%)	<0.5	0.5 - 0.8	**> 0.8**	-
Phospherus (%)	-	0.13 - 0.60	**-**	-
Magnesium (%)	-	0.24 - 1.00	**-**	-
Boron (ppm)	< 30	30 - 100	**> 150**	-

These standards are based on leaves taken in late summer from current years growth.
They are expressed as dry weight values

Irrigation

More than 750 mm annual rainfall is required for good production with supplementary irrigation considered useful during the establishment stage. Evaporation rates must be considered when evaluating water requirements.

Irrigation is one of the most complex issues facing the prospective grower, with possibilities ranging from non-irrigation, drip irrigation, sprinkler irrigation, underground irrigation and overhead irrigation or a combination of options. The application of water during the establishment of an orchard it vital to ensure good growth.

Irrigation requirements can be evaluated by multiplying the evaporative losses by the area occupied by the plant. Eg: Given an established tree with a canopy diameter of 3m and an avg weekly evaporation rate of 40mm (Melbourne in January), the weekly water requirement is about 280 ltrs. ($\pi r^2 x40$, $3.14x1.5^2x40=283$ltrs/week).

As weed control aprox. halves the water needs and with additional mulching, the calculated requirement could be reduced greatly. With good orchard management (weed management and sucker control) it would be reasonable to suggest the following requirements for most regions of hazelnut production in Australia during the peak summer months. It is important trees are well watered during kernel growth to ensure a good yield (January – March).

The following would not be unreasonable in the critical months of January-March in most Australian growing areas given that good management practices are also implemented. They are only guidelines so professional advice should be sought for your area.

- **30 ltrs per young tree per week**
- **100 Ltrs per established tree per week**

There is an obvious trade-off between cost and benefit of irrigation and due to the diversity of budgets, climate and property topography, the decision can only be made by the individual grower.

The following outlines the advantages and disadvantages of each system.

	ADVANTAGES	**DISADVANTAGES**
Underground: Laying poly pipe underground (preferably at the time of planting) aprox. 30cm from the tree and aprox. 15cm deep. 4mm tubing is run to the surface with either drippers or sprinklers	- Main pipe is out of the way of equipment - Pipe does not move in the heat or become UV damaged - movement between rows is easy - Cross mowing is possible if desired	- 4mm tubing and drippers can get caught up in the equipment (high replacement cost) - Drippers/sprinklers need to be put out of the way during harvest (increased management) - Damaged/blocked lines are harder to detect and repair. - Inc. set up costs – requires digging in
Ground Level: Laying the pipe on the ground.	- Can move between rows (with care) - Damaged lines can be easily repaired - The **cheapest** and easiest method of applying water – no digging costs.	- Pipe moves - Pipe exposed to heat and UV (until canopy develops) - Drippers/sprinklers need to be put out of the way during harvest (increased management)
Above Ground - Trellis: Vineyard style irrigation system of having the pipe above ground on a wire.	- Main pipe is out of the way of equipment - Faulty drippers/sprinklers can be identified before the tree dies or shows stress - Lines are easily accessible for maintenance and repair - can mulch without the line/drippers/sprinklers being covered	- **Highest set up costs** – posts, wire, clips - Pipe exposed to heat and UV (until canopy develops) - Can't move around the orchard easily (have to go out the ends of the rows to get to the next eg. vineyard)

As well as considering the type of system, you also need to consider how you are going to apply the water - wether to use drippers, sprinklers or inbuilt compensated dripper line

	ADVANTAGES	DISADVANTAGES
Drippers Using either pressure compensated or regular drippers at a flow rate of 4-8 ltrs/hr	- Cheaper to install - Use less water than sprinklers - Not affected by wind - Encourages deep roots when used efficiently - Requires less pressure - Minimal evaporation/wastage	- Root system not completely watered - Requires longer watering time - Water can seep out before tree can utilise it
Sprinklers Using either pressure compensated or regular sprinklers at a flow rate of 30-50 ltrs/hr. It is advisable to use the 'break off' type to increase throw diameter so they can accommodate coverage as the tree grows.	- Get greater root coverage - Keeps roots cool - Faulty sprinklers can be seen before the tree shows stress or dies - Can get multi-throw sprinklers with a break off tab to increase throw diameter as the tree grows (don't have to add extra drippers/sprinklers during the growing stages)	- More expensive to install - Can be affected by wind
In built compensated dripper line Dripper line with the drippers already built in at either 4 or 8 ltrs/hr rate	- Easier to install (do not have to place drippers or sprinklers) - No drippers/sprinklers attached to get damaged	- Expensive to install - Unable to repair if blocked - Can't see if faulty until the tree dies or suffers stress

Irrigation Summary

As the hazelnut tends to be a surface rooting plant, it is necessary to give the tree sufficient water to force the tree's roots deep down in the soil whilst at the same time getting coverage to maintain a cool and moist environment for the surface (feeding) roots. A surface sprinkler system and the addition of mulch around trees will assist in keeping the roots cool and in conserving moisture.

The Overhead (trellised) sprinkler system appears to have the least disadvantages:

- It keeps the pipes and sprinkler heads out of the way of mowers, sweepers and any other equipment, therefore reducing replacement costs,
- The roots are kept cool by the application of a wetted area covering the whole root system (unlike drippers where the water pattern tends to move towards deep watering over a smaller area)

The most economical way of watering is drip irrigation and then converting to sprinklers as the water demand increases. Although drip irrigation is a marginally cheaper option than setting up sprinklers initially, its efficacy in many areas of Australia is debatable. Unless you can be sure to get good in-soil water movement and retention, drippers are not the most efficient way to water hazelnuts

Pests and Diseases

Besides the perennial problem of birds destroying nuts and rabbits attacking young trees, hazelnuts have relatively few problems.

Hazelnut Blight (caused by a bacterium) was discovered in Australia in the late 1970's and can cause significant problems particularly in a young orchard. It can affect the leaves, nuts and buds and can be controlled with sprays of Bordeaux mixture or other copper-based sprays in the late summer, autumn and early spring.

None of the insect problems which attack hazelnuts overseas, such as Eastern Filbert Blight are present in Australia.

Big Bud Mite is evident in Tasmania but it can be controlled with a preventative spray.

Vermin can be a problem in different areas but can be controlled by good management techniques – fencing, baiting, shooting etc.

Yields

Different varieties have different yield expectations. For example the variety 'White Heart' in New Zealand generally produces annual yields of 1-1.5kg/tree. This is considered to be the industry standard and is accepted. In Australia however, we strive for much higher yielding varieties such as TBC, Barcelona and hopefully Lewis, which are yielding around 5-8kg/tree at year 10. Some of the Italian varieties produce well in excess of 10kg/tree, but have processing problems.

The hazelnut begins to yield at 3 to 4 years old. At 6 to 7 years of age a yield of 3 kg is considered good. You can expect a conservative yield of aprox. 4-5kg at year 10, with yields of 8-10kg from well maintained trees not uncommon. Mature trees have been known to yield up to 40-50kg of nuts, but this is the exception rather than the rule.

The yield is generally affected by the amount of water applied during nut maturation (December to March).

As the weights are taken on the nuts in-shell, it can be expected that on average the kernel weights will be aprox. 40-50% of the in-shell weight (crackout weight). For example if your harvest yields 1 tonne, the weight in kernels (shell removed) will be approximately 400 -500kg.

There are usually a percentage of blanks and shrivelled or underdeveloped kernels which will reduce the final useable weight. These nuts should be removed before sale to keep nut quality high. The removal of blanks is a difficult task. Nuts from cultivars with a high percentage of blanks are usually cracked and not sold on the in-shell market.

Harvest

Unlike other nut crops, hazelnut trees do not require 'shaking' to release the nuts. Hazelnuts fall naturally from their husks to the ground ready for harvest in late Feb/March.

The nuts are harvested either by hand (rake and buckets) or mechanically (sweepers and vacuum harvesters). The picture shows the nuts being wind rowed prior to being vacuum harvested. Harvesting equipment is available to do both operations in one pass.

Nuts usually start falling during late February and early March, with the harvest starting in earnest during March.

Cool nights around harvest time usually assist in the maturation process.

Post Harvest Handling

Processes:

Collection: Fallen nuts are windrowed by sweepers and picked up by vacuum machines which de-husk and in some machines can grade at the same time.
Depending on how the nuts have been collected, either by hand or by mechanical sweepers or vacuum suckers, removal of loose grass, dirt and dust needs to be undertaken.

Drying: To assist the process of rubbish removal, storage bins with grated bottoms can be used. These types of bins also have the advantage of allowing air to circulate between the nuts allowing some initial drying to occur, especially if the nuts have been collected wet or damp after rain.

Nuts are dried to a moisture content of 10-15 %. Drying is carried out in dehydrators at 35-40ºC, in open racks or by fan forced heat into a large silo or by spreading the nuts out in the sun to dry.

Fan forced drying silos have the advantage over drying racks as they allow the crop to be processed in 3 days as opposed to 3-6 months for drying racks. This allows producers to sell the crop into markets at a hight demand period directly after harvest (March-April)

Grading: The nuts are graded (in-shell) and then either sold in-shell or cracked for the kernel market.

Cracking: This is a process whereby the graded nuts are put through a machine that gently splits the shell leaving the remaining kernel to be used in the fresh market or roasted.

Blanching This process removes the pellicle (skin) from the kernel. The degree of blanching for a given variety can vary due to the situation in which the tree is grown and time lapse from harvest. It has been reported that pellicle removal of hazelnut kernels is influenced by nut maturity.

Roasting: The key flavour component of the hazelnut is filbertone which is formed during the roasting process. Roasting of nuts improves their flavour and texture. The roasting process can lead to changes in the carbohydrates, protein, fat and other substances. Chemical reactions during the roasting process change colour, taste, flavour but also shelf life. Sugar caramelisation is responsible for colour and flavour changes.

Storage: Storage at high relative humidity can result in a breakdown of sucrose to glucose leading to undesirable flavours.

In shell nuts must be stored with great care as the nuts can develop mould without adequate air circulation. It is recommended that nuts be stored in smaller quantities in onion bags or in well ventilated storage bins in layers. Little research has been done using silos with pressurised air flow. Storage times are aprox. 24 months in-shell and 12-18 months for kernels.

As production rises, the need for commercial cracking, grading and storage facilities will become necessary. Commercial pressures will result in facilities ultimately becoming available.

Marketing/Distribution

Australia imports over 2000 tonnes of raw hazelnut kernels (96%) and 90 tonnes (4%) of in-shell hazelnuts annually at an aprox. value of $20 million.

Turkey dominates world production and produce over 70% of the world's hazelnuts – aprox. 300,000 tonnes annually, followed by Italy – 100,000 tonnes, Spain – 20,000 tonnes, USA – 15,000 tonnes, and other regions producing the balance of 15,000 tonnes of a worldwide production of 450,000 tonnes. The world's supply is therefore heavily dependent on the political and climatic situation in Turkey.

At present Australia produces aprox. 50 tonnes annually and would require 2500ha of mature orchard to produce 2000 tonnes of kernels to replace the imported product.

HAZELNUTS
In a nut shell

Given that the climate of mild temperate areas of Australia is comparable to that found in traditional hazelnut growing areas of the world, there is enormous potential for the establishment of an Australian industry with the opportunity of import replacement and possible expansion onto the world market.

As a result of the small quantities of hazelnut presently grown in Australia, processing and distribution is currently carried out by individual growers, or by the use of nut agents through the central market systems in each state. Considerable farm gate sales also occur.

The market for hazelnuts is divided into two segments – the kernel market and the in-shell market. In Australia the in-shell market is small (4%) and is expected to decline in the future. The main market is the kernel market (96%), which is growing rapidly. Kernels have a far greater range of uses:

1. Consumed raw, roasted, as meal (ground), sliced, chopped, diced, or ground into flour or paste. The biggest quantities of kernels are used in chocolate manufacture, confectionery or baked goods.
2. Used to provide flavour in a range of foods such as dairy, bakery, confectionery products, muesli and snack foods.
3. Crushed to produce oil for culinary use and cosmetics.
4. Shells are used for fuel or mulching and in making artificial wood and linoleum.
5. Research has shown that the drug Taxol, which is commonly used to treat breast cancer, occurs in hazelnuts. 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 nuts and plants in the future.

The prices for kernels and nuts in-shell have been steadily rising since 1994 and with the increased consciousness of health and consequent increase in demand and a reduction of supply, the prices will inevitably keep rising.

Presently, it would not be unreasonable to expect to get $5/kg for nuts in-shell and $8-$10 for the raw kernel. Retail prices for value added hazelnut products vary from $30/kg for meal and flour to $60-$300/kg for nougat.

As hazelnuts become the ‘in’ nutritional product, more and more products containing hazelnuts (in any amount) will be marketed. This can only be a benefit to hazelnut growers!

Hazelnuts have been consumed in various forms in Europe and the Middle East for thousands of years and given the diversification of population throughout the world we are becoming more exposed to different foods and eating habits. Various cultural uses of hazelnuts are opening markets both within our own country and overseas.

10 Year Cashflow Analysis

(As the figures used are conservative, a greater net profit could be expected)

HAZELNUT ENTERPRISE Gross Margin Cashflow - *In-Shell*

30.05.2009

	Per Unit	TOTAL (Incl. GST)	Planting Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Trees Per Hectare at 6m x 6m spacings:	256											
Yield/tree (Kgs)			0	0	0	0.5	1	1.5	2.5	3	3.5	5
Yield TOTAL(Kgs)		4352	0	0	0	128	256	384	640	768	896	1280
Income												
Nut sales - In Shell ($/kg)	$5	$21,760	$0	$0	$0	$640	$1,280	$1,920	$3,200	$3,840	$4,480	$6,400
Total Income / ha		$21,760	$0	$0	$0	$640	$1,280	$1,920	$3,200	$3,840	$4,480	$6,400
Operating expenses												
Ground Preparation (spray, rip, plough):		$280	$280									
Site Preparation (GPS Mapping @ $350/ha):		$350	$350									
Planting costs (Labour, auger hire):		$310	$310									
Mulch (Poppy Trash, straw etc.)		$520	$130	$130	$130	$130						
*1 Fertiliser - Lime (5 t/ha @ $65/t by contractor)		$1,300	$325			$325			$325			$325
*2 Fertiliser - general (slow release, Kelpak etc.)		$1,050	$105	$105	$105	$105	$105	$105	$105	$105	$105	$105
Mowing ($40/ha x 6 - contractor or fuel)		$2,200	$240	$240	$240	$240	$240	$240	$240	$200	$160	$160
Sucker control (chemical-4 appl./yr)		$600	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
Herbicides (grass/weed control)		$800	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80
Fungicide (3 appl./yr)		$600	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
Irrigation operating costs (fuel, power etc)		$1,550	$50	$50	$100	$100	$200	$200	$200	$200	$200	$250
Harvest costs (suction machine @ aprox. $1/kg)		$4,224					$256	$384	$640	$768	$896	$1,280
Total Expenses / Ha		$13,504	$1,710	$725	$775	$1,100	$1,001	$1,129	$1,710	$1,473	$1,561	$2,320
Capital expenses												
Tree Purchases (Excl. GST)	$10	$2,560	$2,560									
*4 Irrigation setup - ('Uniram 17' dripper line/m)	$0.64	$1,418	$1,418									
Tree guards (Springwrap-600mm)	$1.35	$346	$346									
Stakes, ties (1.8m 38mmx38mm)	$0.94	$241	$241									
Total Capital costs / Ha		$4,324	$4,324	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total costs / Ha		$17,828	$6,034	$725	$775	$1,100	$1,001	$1,129	$1,710	$1,473	$1,561	$2,320
Cost / tree			$24	$3	$3	$4	$4	$4	$7	$6	$6	$9
Net Profit/Loss / Ha (Incl. Capital costs)			-$6,034	-$725	-$775	-$460	$279	$791	$1,490	$2,367	$2,919	$4,080
Progressive Cashflow (incl. Capital costs)			-$6,034	-$6,759	-$7,534	-$7,994	-$7,715	-$6,924	-$5,434	-$3,067	-$148	$3,932

*1 Fertiliser: Lime application prior to planting to increase pH and an application every 3rd yr thereafter.
*2 Fertiliser: General fertiliser application - slow release,Kelpak etc. Additional fertilisers may be required.
*3 Irrigation: This includes setup costs within the orchard only (submains, driplines etc).

NB: With larger areas planted, many of these costs will increase minimally rather than proportionately. This will effictivately reduce cost per ha and ttherefore increase the net profit per ha.

Conservative figures have been used. The indicated yield per tree of 5kg/tree is well under the expected 8 kg/tree at yr 10 with the current price per kg at around $8/kg not $5/kg. This is to show that a significant profit of $4080/ha can be made using conservative figures. Using the expected figures, the net profit could be over $13,000/ha.

Summary

Hazelnuts are by no means a hard crop to grow. With careful research into varieties that will provide high yields, compatibility and market diversity, the opportunities for success are enormous.

A break from tradition is not always a bad thing. With experience comes the confidence to look at alternative options to achieve the same result. For example, selecting 3 or so varieties that cross pollinate, are all high yielding and have similar physical characteristics, eliminates the need of 'pollinisers' and makes the entire orchard profitable.

The potential for hazelnut production in Australia has been largely underestimated. Australia is estimated to currently produce between 15 and 20 tonnes which falls a long way short of the 2000 tonnes plus imported annually.

So why hasn't anyone started growing them before? You may well ask!.

The answer probably lies somewhere between there not being a simplified approach for prospective growers, the lack of expertise and support and the change in thinking from growing traditional crops.

This document aims at compiling and simplifying only the relevant information available on growing hazelnuts for Australian conditions. There needs to be a unified approach to this industry to take out the difficulty in selecting varieties, planting layouts and marketing and more research into new varieties and better techniques in producing large amounts of trees.

As there is a lack of expertise and simplicity in the approach to growing hazelnuts, by having a prepared programme in place (selected true to type varieties, planting layout and management advice), growers will embrace this new crop and the industry will start to move towards import substitution. .

Until recently farmers have not really had the need to diversify or bend from traditional crop types. It has not been until recent years that farmers have been 'screwed' by supermarkets and the like to the point where farming is becoming non sustainable. These reduced profit margins have forced farmers to look at other options to remain sustainable. Hazelnuts could well be a viable alternative or addition to traditional farming practices. The management and equipment requirements are similar to other cropping practices and could therefore be easily integrated into the whole farm plan.

One must remember the age of the hazelnut tree – pre ice age. We are not re-inventing the wheel by growing hazelnuts! This industry is not a 'fly by night' industry and with considerable dedication to varietal purity and the desire to break tradition and experiment with polliniser selection and alternative planting layouts, this industry could become a major growth industry.

References

This document has been compiled by Diana French, September 2006.

Information sourced from:

Hazelnut Growers Handbook (Australia).
Hazelnut Variety Assessment for South-eastern Australia - Basis Baldwin, Karilyn Gilchrist and Lester Snare.
Hazelnut Market Assessment Study – Basil Baldwin, January 2003
Heritability of Ease of Hazelnut Pellicle Removal – Shawn A. Mehlenbacher
Growing Nuts in Australia
Various published articles - Shawn A. Mehlenbacher
The Hazelnut Council – Jersey City NJ, USA

Disclaimer:

Whilst every care has been taken in the preparation of this document, no responsibility for the information published herein, or the consequences thereof will be taken by the author.

Information contained in this document is for general information and professional advice should be sought for irrigation and soil management.

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