

Guidelines for Growing Hazelnuts in New Zealand

Bulletin 5: Establishing a hazelnut orchard

Murray Redpath. May 2016

Introduction

The foundation for successful hazelnut growing is laid when the orchard is established. Landowners intending to grow hazelnuts commercially should use accurate and up-to-date information from local and national sources to guide them through the establishment phase. Information required includes:

- suitable varieties for the targeted market and orchard location
- suitable pollinisers for the variety selected.
- suitable tree spacing for the selected varieties and local growing conditions.
- shelter requirements.
- suitable species for the orchard floor.
- irrigation requirements and regulations.
- soil characteristics.

Selection of varieties and pollinisers are covered in Bulletins 2 and 3 of this series.

All major site development (shelter establishment, drainage, ground preparation, irrigation installation) should take place well before the orchard is planted. Lime and any potassium and magnesium requirements should be added during ground preparation so they can be cultivated into the soil.

Pastures on livestock farms are designed to maximise grass growth. If this land is converted to orchards this can lead to high mowing costs, so slower growing grass species such as fescues are frequently used. Herbal leys have been used in some organic orchards – these must be cut very low to ground just prior to harvest.

Shelter

Hazels are easily damaged by strong winds, especially when combined with low humidity and high temperatures. Young plants will struggle to grow satisfactorily in poorly sheltered locations, leading to stressed plants and increased problems with diseases. Persistent winds through the main growth period in spring and early summer can distort the new growth and make it difficult to develop a well balanced scaffold structure.



Fig. 1: Whiteheart plants two years after planting in a well sheltered orchard on fertile soils. The nursery plants were well grown 2 year old plants.



Fig. 2: Whiteheart plants two years after planting on an exposed site on free draining stony soils. The nursery plants were small one year whips and are struggling in the exposed conditions.

Key considerations when planning shelter are:

- Shelter should be sufficiently permeable to allow air to filter through.
- Deciduous species will maximise air flow for pollen dispersal during winter.
- Fast growing species like poplars and willows have aggressive root systems that may require regular root pruning to prevent them competing for water and nutrients.
- Ideally shelter should be planted at right angles to the direction of the predominant damaging winds.
- A shelter belt will provide protection for a distance up to 10 to 15 times its height. Depending on local wind conditions and shelter species selected, shelter rows will need to be 60 to 100 metres apart.
- Shelter rows should be regularly trimmed to maintain a narrow hedge shape with foliage retained to ground level.
- In dry regions, shelter may need to be irrigated to prevent drought induced leaf fall before or during harvest.

Shelter should be established several years prior to planting the hazels to ensure the new plants are adequately protected. Seek local advice on suitable shelter species and layouts for your region.

Irrigation

Locations with an annual rainfall over 900 mm well distributed up until February may not require irrigation, especially on deep silt or clay loam soils. Locations that experience prolonged periods of dry weather between November and the end of January should install irrigation, especially if the soils are free draining (sandy or stony). In summer, up to 5 mm of water per day may be required to replace the evapotranspiration losses.

Drippers and microsprinkler systems are commonly used in New Zealand hazelnut orchards. Water moves rapidly down through free draining soils so microsprinklers should be preferred on these soils to ensure that an adequate area of the root zone is irrigated.

Young trees benefit from regular watering over the first 2 years, even in climates where permanent irrigation may not be necessary. If permanent irrigation is not required, short-term solutions such as tractor towed water tanks or temporary hose and sprinkler systems may be suitable.

Water regulations vary between regions so consult local irrigation experts and your Regional Council for advice on regulatory requirements and suitable irrigation options

Orchard layout

The design of the orchard needs to consider the space needed by machinery used in orchard management, the vigour of the varieties used, expected growth rates for the selected varieties, and the need to provide adequate pollen to the cropping trees.

Tree spacing

The main intention of spacing decisions should be to grow sufficient canopy to produce at least 1 tonne per hectare by the sixth year and 2.5 tonnes per hectare by the eighth year. Modern hazelnut orchards use high density planting to maximise early returns. Usually every second tree is removed in year 11 to 15 when the canopy closes in. Alternatively, growers may choose to implement pruning regimes that limit the canopy size of each tree.

The distance between tree rows must allow efficient harvesting. This may mean evaluating harvesting options before the orchard is even planted and basing the inter-row distance on the harvesting width of the selected machinery. The distance needed to easily turn the equipment at the end of the rows also needs to be considered. Self propelled harvesters or harvesters mounted on the front of the tractor are likely to need less room on the headlands than towed harvesters. At least 5 metres is required; some equipment may need up to 8 metres to turn adequately.

The distance between rows is also important to maintain adequate light into the base of the productive canopy. To maintain light in the inter-row space, rows need to be one metre

apart for every metre of eventual tree height. In general, rows running in a north-south orientation enable most efficient use of sunlight.

A low vigour variety like Whiteheart is usually grown in rows 4 to 4.5 metres apart in regions like Canterbury with slow growth rates, where the trees will take at least 10 years to reach 4.5 metres in height. By contrast, Whiteheart would need rows spaced 5 metres apart in Nelson to maintain the same light levels at the tenth year (Figs. 3 and 4).

The same factors influence the distance between trees within the row. Whiteheart trees are commonly planted 2 to 3 metres apart within the row in Canterbury orchards but need to be spaced 3 to 4 metres apart where growth rates are higher.

Varieties with a spreading branch structure, like Ennis and Barcelona, need greater distances between rows, and between trees within the row, than varieties with an erect branch structure like Whiteheart or Tonda di Giffoni (Figs. 5 and 6).



Fig. 3: Ten year old Whiteheart trees in Canterbury spaced at 5 metres by 2 metres yielding about 1 kilogram per tree or 1 tonne per hectare. The canopy only occupies about 20% of the optimum canopy volume for this spacing. To reach the targeted crop volumes in these growing conditions, the trees need to be spaced at 3 metres by 2 metres, too close for most harvesting equipment. A more vigorous variety that can reach the optimum canopy size by the eighth year may be required.



Fig. 4: Ten year old Whiteheart trees in Nelson spaced at 5 metres by 3 metres yielding about 3 kilograms per tree or 2 tonnes per hectare. These trees are meeting along the rows but still have room to grow into the space between the rows.



Fig. 5: Seven year old Ennis trees in Blenheim spaced at 5 metres by 5 metres, yielding over 6 kilograms per tree or 2.4 tonnes per hectare. Optimum canopy development was reached by the ninth year and major pruning was required by year 11.



Fig. 6: Thirteen year old Whiteheart trees in the same orchard spaced at 5 metres by 4 metres, yielding 3 to 4 kilograms per tree (1.5 to 2 tonnes per hectare). Canopy has not yet reached the volume of the 7 year old Ennis. At seven years old, the trees were producing just over 1 kilogram per tree or 500 kg per hectare. Whiteheart is a low vigour variety and has grown at less than half the rate of the Ennis trees. To achieve the targeted yield, spacing needs to be 4.5 by 2 metres.

To calculate the number of trees required, divide the available planting area by the distance between the rows x distance between the trees in the row. When calculating the available planting area of a block, remember to deduct the area used for headlands and land adjacent to the shelter.

For example, a 1 hectare block with 5 metre headlands and rows 5 metres in from the shelter rows has 8100m² of planted area. At a 4.5 by 3 metre spacing, this requires 600 plants:

$$\frac{8100}{\text{planted area}} \div (\text{row spacing} \times \text{tree spacing}) = 600$$

The table below gives the number of trees per planted hectare required for common hazel spacing options.

Table 1. Typical tree spacing and tree numbers required

Plant spacing	No. of trees/ha.
4.5 m x 2.0 m	1111
4.5 m x 3.0 m	740
5 m x 3 m	666
6 m x 4 m	416

Thinning

Thinning the orchard when the canopy closes involves removing every second tree in a triangular pattern (see Fig. 7). This method maximises the distance between the trees after thinning. For example, thinning a 6 metre by 3 metre spacing (used for vigorous varieties like Barcelona) will result in 6 metres between trees within the rows and 6.7 metres to trees in adjacent rows.

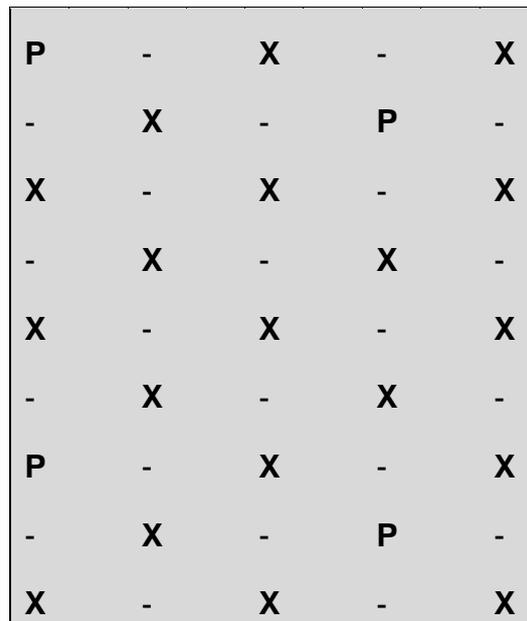


Fig 7. Typical pattern for thinning orchards at canopy closure, using a 6 metre by 3 metre orchard spacing as an example. **X** = crop trees retained; **-** = crop trees removed; **P** = polliniser trees.

Polliniser distribution

Overseas research has shown that pollen density diminishes at 18 to 20 metres from the source. Pollinisers need to be placed in orchards so that no tree is more than 20 metres from a polliniser.

There are two main methods of spacing pollinisers through the orchard. Some growers prefer to plant rows of pollinisers every 20 metres or so through the orchard (Fig. 8). This system has advantages during harvest as all polliniser nuts are in specific rows. The second method places pollinisers throughout the orchard in a staggered pattern. In Oregon, the pattern has pollinisers placed every third or sixth tree (depending on in-row tree spacing) in every third row (Fig. 9).

If thinning is planned, then care must be taken at planting to ensure that pollinisers are not placed in positions where they may be removed during the thinning operation.

Pe	X	X	X	X	Pe	X	X	X	X	Pe	X	X	X	X	Pe
Pm	X	X	X	X	Pm	X	X	X	X	Pm	X	X	X	X	Pm
Pl	X	X	X	X	Pl	X	X	X	X	Pl	X	X	X	X	Pl
Pe	X	X	X	X	Pe	X	X	X	X	Pe	X	X	X	X	Pe
Pm	X	X	X	X	Pm	X	X	X	X	Pm	X	X	X	X	Pm
Pl	X	X	X	X	Pl	X	X	X	X	Pl	X	X	X	X	Pl
Pe	X	X	X	X	Pe	X	X	X	X	Pe	X	X	X	X	Pe
Pm	X	X	X	X	Pm	X	X	X	X	Pm	X	X	X	X	Pm
Pl	X	X	X	X	Pl	X	X	X	X	Pl	X	X	X	X	Pl
Pe	X	X	X	X	Pe	X	X	X	X	Pe	X	X	X	X	Pe

Fig. 8: Orchard layout using specific polliniser rows. X = main variety; Pe = early polliniser; Pm = mid season polliniser; Pl = late polliniser.

Pe	X	X	X	X	X	Pm	X	X	X	X	X	Pl	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	Pl	X	X	X	X	X	Pe	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pm	X	X	X	X	X	Pl	X	X	X	X	X	Pe	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	Pe	X	X	X	X	X	Pm	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pl	X	X	X	X	X	Pe	X	X	X	X	X	Pm	X	X

Fig. 9: Orchard layout with pollinisers spaced throughout the orchard (based on a 6 x 3 metre orchard spacing). X = main variety; Pe = early polliniser; Pm = mid season polliniser; Pl = late polliniser.

Planting

Nursery stock

Good quality trees from the nursery are essential for establishing high yielding orchards. A strong, well balanced root system is necessary for rapid establishment and strong even growth. Nursery stock should have a minimum stem diameter of about 10 mm at the base of the plant and a minimum height of 800 to 1000 mm.

Most hazelnut plants are propagated by mound layering using stool beds. This produces a rooted sucker or whip that is the same as the parent tree. Some varieties do not easily establish roots using this method and are sold as grafted plants. Alexandra, one of the main late polliniser varieties used in New Zealand, is usually sold as a grafted plant.

Plants are often sold as one year whips straight off the stool beds. These are suitable for planting in well prepared sites with excellent shelter. Roots on one year whips are soft and easily damaged, and care must be taken during shipping and planting. Two year old plants are more robust and should be used where conditions are less than ideal.

Planting

Hazels are deciduous trees and are planted over winter when dormant. Hazel roots grow through the winter whenever soil temperatures are above 4.5°C so planting as early as possible enables the plants to develop a working root system before bud burst.

Ensure that the roots are kept moist at all times. If trees cannot be planted immediately, heel them into well cultivated soil or sawdust.

Holes should be dug slightly larger than the size of the tree roots. Trim any damaged or long roots. Spread the roots out in the bottom of the hole, add soil and give the roots a gentle shake to ensure the soil is distributed among the tree roots. Fill the hole and gently firm the soil around the tree. Ensure that the top roots are below the soil surface allowing for some settling of the soil.

Large orchards are often planted using tree planting machines. Care must be taken with plant preparation when using planting machines to ensure that roots are not swept back along the line of the furrow. Roots need to be trimmed to ensure they are not swept upwards when moving through the machine. It may be beneficial to plant slightly deeper than the final depth and pull the plants up gently to straighten any bent roots.

Trees should not need to be staked if the site has adequate shelter.



Fig. 10: Planting with a tree planter.

Post-planting management

Protection

Trunks of young hazelnut trees are susceptible to sunscald and frost damage in the first few years after planting. Painting the stems with a diluted white water based paint helps to protect the trunk. The paint can be diluted up to 50% (equal volumes of water and paint). Paint the stems right down to just below the soil surface to allow for soil settling.

Plastic tree guards and spray guards are often used to protect the trunks of young trees. These provide shade to the lower trunk,

protection from spray drift from herbicides used down the rows and protection from attack by rabbits and hares. However, the guards create a warm moist environment at the base of the tree and this may provide ideal conditions for bacterial blight. Control of suckers growing inside tree guards is also more time consuming.

Weed control

It is important to control weeds for at least the first three years after planting, to minimise the competition for water and nutrients. Application of good quality mulch 5 to 10 cm deep helps to retain soil moisture and assists with weed control close to the plants. Keep the mulch away from the lower trunk.

Pruning young trees

Young trees need to be pruned back to compensate for damage to the roots during transplanting. Cut the trees back to 70 to 120 cm high. Leave 4 to 6 buds at the top of the whip and carefully rub out the remaining buds lower on the stem. Spray the stem with copper to help protect any wounds from infection with bacterial blight.

Tree shaping depends on whether growers choose to grow a multi-stemmed bush or a single trunk tree. Hazels are naturally a suckering plant forming multi-stemmed bushes and this growth form is used in commercial orchards in Turkey and parts of Italy where 4 to 6 stems are retained to form the productive

canopy. Research indicates that there is no significant difference in yields between multi-stemmed and single trunk trees.

Most modern orchards grow hazels as a single trunk trees because it allows easier access for field operations and machinery. Nuts can also become trapped within the base of multi-stemmed plants.

If a single stem tree is planned, the main object of pruning in the first few years is to create an open vase shape with 3 to 5 main scaffold branches.

After the first year's growth, select the limbs that will become the main scaffold branches. Ideally choose limbs which are evenly spaced around the tree, with 10 to 15 cm of vertical separation. Remove all other limbs and shorten the selected limbs to 60 – 80 cm, cutting back to an outwards facing bud. If there is insufficient growth in the first year to select the required number of scaffold branches, then remove all unwanted shoots to stimulate new growth and select the scaffold branches in the second winter.

Once the main scaffold branches are selected, pruning should be restricted to removing shoots that compete with the scaffold branches. This includes strong vertical shoots, side branches that threaten to become more dominant than the main scaffold branch, and branches that cross over adjacent scaffold branches.

The "Guidelines for Growing Hazelnuts in New Zealand" bulletins were produced by the Hazelnut Growers Association of NZ with financial assistance from the Ministry for Primary Industries Sustainable Farming Fund and the NZ Tree Crops Association.

Murray Redpath is Chairman of the Hazelnut Growers Association of NZ.

Photographs: Figs 1 to 6: Murray Redpath. Fig 10: Sarah Shore

Disclaimer

While the author has taken all reasonable skill and care in assessing the accuracy of the information in this report, none of the organisations involved accepts any liability, whether direct, indirect or consequential, arising out of the provision of information within this report.