

Climate

Chilling Requirements

Pears, like most deciduous fruit trees require a certain amount of winter chill in order to break dormancy in spring and begin growth and flowering. Pears require between 500 to 1500 hours of chilling. Pears grow well in areas with warm, hot summers and low humidity.

Why is winter chill important?

If sufficient winter chill is not received it can result in delayed and uneven flower (and leaf) development that leads to poor fruit set. This can affect yield, fruit quality and harvest duration.

How is winter chill measured?

The three most common models are:

- the **7.22°C and under** model;
- the **0 to 7.22°C** model;
- the **Utah model**;
- the **Dynamic model**.

The **7.22° C and under model** is the traditional model used to record chill units. In this model, each hour below 7.2° C is equal to one chill unit.

The **0 to 7.22°C model** records one chill unit as an hour between 0 and 7.22° C. An hour spent below or above 7.22° C is recorded as zero chill units.

The **Utah model** records chill in 'Richardson' Chill Units. This model recognises the influence that different temperatures have on chill. For example temperatures between 2.5 to 9.1°C are considered to contribute the most towards the completion of dormancy and are therefore given the maximum value of one chill unit for each hour spent in that range. Lower and higher temperatures can have a negative effect on chill unit accumulation and are assigned lower (0.5) or negative values. The following table outlines the calculation of chill units using the Utah Model.

The **Dynamic Model** records chill in units called "chill portions" (CP). It is the most biologically accurate model as it measures chilling on an hourly basis. At maximum chilling conditions, the Dynamic Model accumulates 0.83 CP per day.

See the UC Davis website for more information:

http://fruitsandnuts.ucdavis.edu/Weather_Services/prune_chilling_prediction_about/

Table 1: Calculating Chill Units using the Utah model

Temperature °C	Chill Units
> 1.4	0.0
1.5 to 2.4	0.5
2.5 to 9.1	1.0
9.2 to 12.4	0.5
12.5 to 15.9	0.0
16 to 18	-0.5
>18	-1.0

Table 2: Guide to chill portions in pome fruit

Chilling Level	Chill portions
High	>70
Medium	30 to 70
Low	<30

Info from A. Erez. *Temperate Fruit Crops in Warm Climates*. 2000. Kluwer Academic Publishers.

Winter Chill requirements

European pears require between 500 and 1,500 hours of chilling depending on variety.

Definitive data on the chill requirements of pear varieties in Australia are difficult to find. However, the common varieties grown commercially in Australia can be roughly divided into those requiring, high, medium or low chill.

High Chill – Williams, Beurre Bosc, Winter Nelis, Comice, Lemon Bergamot

Medium Chill – Packham's, Josephine

Low Chill – Corella

How can I determine the winter chill in my area?

An estimate of winter chill for your area can be determined by using this simple Chill Unit Calculator provided by the Department of Environment and Primary Industries, Victoria <Link>.

Frost susceptibility

New pear tree growth is highly susceptible to spring frosts. The financial risk associated with crop loss in an intensive orchard is high so minimising crop loss through frost damage is important. Initially growers need to avoid planting in frost prone areas. Planting sites need to also have good air drainage to prevent accumulation of cold air. For example, avoid planting at the bottom of slopes or in hollows.

When establishing new orchards, installation and budgeting for frost protection infrastructure such as warning systems, frost fans (Figure 1) or sprinkler systems needs serious consideration.



Figure 1. Frost fan

Management of the orchard floor is also important to minimise frost damage. All inter-rows should be slashed as close to the tree line as possible and weeds in tree lines sprayed. The aim is to have most of the orchard soil exposed to warming sunshine during the day so that accumulated ground heat can be released in the early mornings to reduce frost risk. For more information on frost and its management please see further resources.

Wind

Wind can severely damage fruit and reduce fruit quality through rubbing, can increase evaporation and lead to water stress, adversely affect pollination and damage newly planted trees. Support structures for trees should be installed prior to or soon after planting to minimise root damage in young trees.

Water availability

Intensive orchards require secure access to good quality water for irrigation, spraying and possible frost protection and evaporative cooling needs. Good delivery infrastructure is essential. It is often recommended that growers ensure they have at least six megalitres of water available per hectare of orchard.

Aspect

A north or north-easterly aspect is best for providing maximum sunlight during winter months. Slopes facing south are colder and more frost prone.

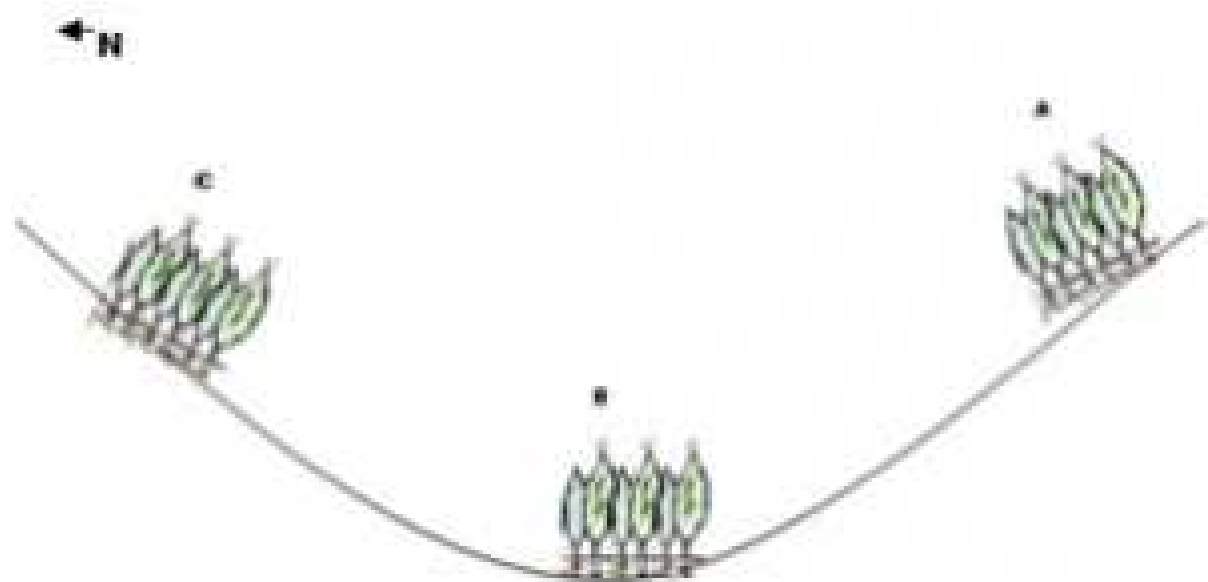


Figure 2: Orchard planting scenarios

In the scenario in Figure 2 the orchard at site A (right) is a warm location and will receive more sun as it is North facing. It will be less prone to spring frosts as the cold air will drain to the lower lying area (site B). Site B at the bottom of the valley will be the most susceptible to spring frosts because of the cold air draining to it from higher up the slopes. Site C (left) is colder and will warm up more slowly than at site A because it is south facing.

Further information

These Australian and international sites may be useful for growers. However they are intended as an information source only. Any specific recommendations may be outdated or irrelevant for Australian conditions and growers should seek local advice.

Australian Resources

Measuring Winter Chill

For information about the importance of winter chill and its measurement please visit any of the following sites:

Chill Units of Stone Fruit – Victorian DPI: <http://www.depi.vic.gov.au/agriculture-and-food/horticulture/fruit-and-nuts/stone-fruit/chill-units-of-stone-fruit>

Winter chill requirement for pears

European Pear Varieties - NSW Department of Primary Industries AgFact:
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0013/120217/european-pear-varieties.pdf

International Resources

Chilling accumulation: its importance and estimation – Department of Horticultural Sciences, Texas A&M University: <http://aggie-horticulture.tamu.edu/stonefruit/chillacc.html>

References (Note full access may incur a fee)

Wayne Boucher (2008) Chilling Requirement October 2008 *Tree Fruit Magazine*:
<http://www.treefruit.com.au/>

Campbell, J. (1995) Winter Chill! – Apples and Pears for Warmer Districts. In *Proceedings of the Sixth conference of the Australasian Council of Tree and Nut Crops*, Lismore, NSW, September 11-15 Retrieved January 2009 from <http://www.newcrops.uq.edu.au/acotanc/papers/campbel1.htm>

Darbyshire, R., Webb, L., Goodwin, I., and Barlow, S. 2011, Winter chilling trends for deciduous fruit trees in Australia. *Agricultural and Forest Meteorology*, 151: 1074-1085.

Kretzschmar, A. A., L. M. Brighenti, et al. (2011). "Chilling requirement for dormancy bud break in European Pear." *Acta Horticulturae* 909: 85-88.