



Site Selection : Climatic and Soil Requirements

Main Points

- Avocado trees will tolerate mild frosts down to - 2°C
- Night temperatures during flowering should be above 11°C
- Day temperatures during flowering should be above 17°C
- Irrigation may be necessary for heavy cropping in areas with low summer rainfall
- Soils should be deep and well drained
- The best light conditions are found in north or north-east facing orchards

When considering where to grow avocados it is important that the evolutionary environment in which the avocado tree developed is understood.

Avocados are adapted best to tropical and subtropical rainforest climates. The avocado has evolved as a litter feeder in highland tropical and subtropical rainforest in Central America. As a consequence avocado trees have a relatively inefficient root system where the roots have few or no root hairs and poor water uptake capacity. The root system is also shallow with a high oxygen requirement. In fact, roots usually die following a short exposure to hypoxic (low oxygen) conditions.

Avocados also require high light intensities, any shading results in trees growing shoots in preference to setting fruit. This means that branch length increases and branches have reduced numbers of flower buds. Trees grow tall quickly and the entire crop is borne on the tops of trees. Root and shoot growth occurs primarily as two or three major growth flushes.

This results in trees with a composite canopy of leaves and roots of varying ages with different efficiencies. The potential exists for roots, shoots and fruit to compete with one another for nutrients.

Climate

Temperature

Suitable temperatures for growth and fruit set are the most important requirement to successfully grow a commercial crop of avocados. If any of the following temperatures are experienced the microclimate is unsuitable for the commercial production of avocados:

- Occasional winter frosts colder than -4°C
- Day temperatures consistently below 20°C during flowering
- Night temperatures consistently below 10°C during flowering
- Occasional light frosts after 1 October.

Cooler growth conditions, as experienced over much of New Zealand's avocado production area, result in trees that are more vegetative than reproductive. As temperature rises and light intensity increases the trees become more reproductive (Figure 1). Light intensity conditions in New Zealand are marginal during winter and most of spring.

Warm and relatively dry conditions are required during flowering for proper flower functioning. The guidelines in New Zealand are that canopy temperatures remain above 11°C at night and above 17°C for at least two consecutive days. This is considered a pollination episode, where fruit set should occur.

If these conditions are not met, fruit set can be very low and avocados produce a poor crop resulting in low returns in that area.

The foliage is tolerant of mild frosts (-1 °C to -2 °C). The flower buds are very sensitive to frost. If flower buds are frosted before flowering they will not produce fruit. Frost damage is more severe once the buds have begun to swell, i.e. they are no longer dormant and have lost some of their cold tolerance. Frost damaged flowers will not set fruit even if optimum temperatures are experienced during flowering.

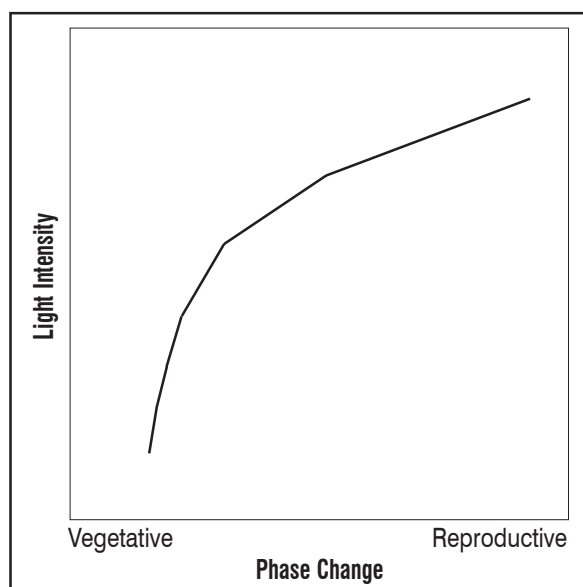


Figure 1: Theoretical relationship between vegetative and reproductive growth versus light intensity in avocado

The Hass avocado is more suited to cooler growing conditions, as experienced in New Zealand, than many other cultivars such as Fuerte or Pinkerton. Relatively high humidity levels in New Zealand ensure that the tree suffers minimal water stress. The cooler temperature allows for very high net carbon assimilation. A consequence of the high air humidity is that there may be problems with the uptake of certain minerals, particularly calcium and boron.

Rainfall

A large proportion of the avocado crop in New Zealand is produced without irrigation, known as a dryland farming system.

The success of a non-irrigated system depends largely on total amount, seasonal distribution and reliability of annual rainfall, as well as drainage and water-storage characteristics of the soil. There is a high requirement for water during flowering, fruit set, fruit growth and during the vegetative growth-flush periods.

Most rainfall in many regions such as the Bay of Plenty and Northland occurs during winter and spring (ca. 70%), while trees require most water during summer and autumn. Under these conditions water stress can be high where optimum tree growth and fruit production is possible only with irrigation (see Irrigation Chapter).

The avocado is very flood-sensitive with even short periods of waterlogging resulting in reduced shoot growth, altered mineral uptake and root death.

High soil-moisture levels favour root rot (caused by *Phytophthora cinnamomi*) development. The effects of flooding and *P. cinnamomi* infection are often cumulative, reducing transpiration and net CO₂ exchange. It is often quite difficult to separate soil-waterlogging effects from those due to increased *P. cinnamomi* root-rot development when there is high soil moisture.

Soil Requirements

The Avocado tree has a shallow, much-branched feeder-root system that requires a well-aerated, well-drained soil for healthy root growth.

The roots efficiently intercept and recycle minerals released from the decomposition of organic matter (primarily leaf litter and composted mulch).

The ideal soil for growing avocados should have the following physical characteristics:

- A depth of more than 1.5m
- High air-fill porosity (bulk density of 0.7 to 0.8)
- Be uniform and free-draining
- Not be compacted or have impervious layers
- Have moderate fertility
- Have a pH between 6.4 and 6.6 (the starting pH can be adjusted to this range with lime).
- The soil should have the following fertility:

Phosphorus (Bray)	40 - 90mg per kg soil
Phosphorus (Olsen)	> 25
Potassium	150 to 250mg per kg soil
Calcium	> 1000mg per kg soil (preferably above 2000mg per kg soil)
Magnesium	100 to 300mg per kg soil
Ca: Mg ratio	about 4: 1
(Ca + Mg) : K ratio	5 to 10

- The soil should also have a high organic component. In many cases this has to be applied as an organic supplement (see Nutrition Chapter).

The commercial production of avocados should not be considered if the soil has one or more of the following characteristics:

- Exhibits periodic waterlogging
- Has been recently and/or heavily contoured
- Has very low pH due to high peat content
- Has a bulk density of less than 0.65 or above 0.85
- Has a high aluminium or sodium content.

Site Suitability

It is difficult to determine or give recommendations as to which sites will or will not be suitable for commercial avocado production without visiting and assessing the property. There may be small microclimates suited to avocado production in districts generally unsuited to the crop. It is best to call in an expert to help assess your situation. The information required will be accurate historical weather, most importantly temperature, information for the specific microclimate and one or two soil inspection pits.

The logical suitability sequence is:

- Winter temperatures
- Flowering temperatures
- Physical soil attributes
- Aspect
- Chemical soil attributes
- Water
- Wind

Areas prone to flooding, even for short periods, should not be used for commercial avocado production.

Southerly slopes or heavily shaded and sheltered microclimates should be avoided. The best light conditions are found in north-east and north-facing orchards.

Some soil and climate attributes can be modified but little can be done to increase winter or spring temperatures. Aspect plays a role in temperature. North and east slopes are warmer than southerly slopes.

The only way that the true yield potential of the avocado can be realised is if the microclimate selection (sometimes after appropriate modification) satisfies all the requirements for optimum growth.

The New Zealand avocado industry will face increasingly competitive forces due to globalisation. If the locality is not climatically suitable then the avocado should not be grown.

FURTHER READING

Bergh, B. 1975. *Avocado*

Janek, J. (ed). *Advances in Fruit Breeding*, pp 541-567.

Whiley, A.W., and Schaffer, B. 1994. *Avocado*. CRC *Handbook of Environmental Physiology of Fruit Crops*.

