

Apple orchard

Orchards protected by hail netting need to rapidly reach and then maintain high yields and packouts to recoup the cost of the netting and support structure.

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High yielding intensive apple orchard systems on dwarf or semi-dwarf rootstocks are particularly suited to protection by hail netting—with high yields of fruit produced in well-illuminated exposed regions of the tree canopy which would otherwise be prone to sunburn without the presence of netting. This is especially the case in Queensland, but also true throughout Australia.

Hail netting is an investment in orchard productivity. It is essential to use the beneficial effects of netting to greatest advantage whilst minimising any adverse effects.

Reduced fruit sunburn, improved fruit colour and skin finish, greater water use efficiency and the elimination of bird damage are all benefits of hail netting that may make it an economic proposition in districts where the incidence of hailstorms is low.

Effects on orchard climate, apple tree growth and productivity

Trials conducted on commercial apple orchards in Queensland, New South Wales and Victoria have measured the effect of hail netting on orchard climate, how trees respond (tree growth, yield, fruit quality) to the environment beneath netting, and evaluated management strategies (pruning, thinning, pollination, irrigation) appropriate to apple trees grown under hail net. Varieties included Royal Gala, Hi Early Delicious, Red Fuji, Granny Smith and Pink Lady™ apples.

The semi-protected environment beneath hail netting is most obviously characterised by lower light levels, with reductions in sunlight levels (PAR) of 12–27% (dependent on net type, mesh size and colour).

Other significant effects include increased humidity (by up to 10–15%), reduced wind (50% lower wind speed compared to outside netting), and a reduction in daytime temperatures (1–3 °C) on warm to hot days.

Although hail netting can reduce sunlight levels by up to 25% or more, the tree canopy itself may reduce light levels by over 95%. Similarly, cloud cover and seasonal changes in solar radiation levels also dramatically affect incident sunlight levels.

In mid April, which coincides with the harvest of mid to late-season apple varieties, light levels on overcast wet days are extremely low, whether or not the trees are netted.

The response of apple trees to hail netting is primarily determined by tree vigour, and is summarised in Table 1.

Hail net most noticeably affects growth, yield, fruit size and fruit colour on vigorous trees that would have shading problems regardless of the presence of netting. Reduced fruit size and increased shoot growth occurred on vigorous trees under hail netting at Stanthorpe, Orange and Drouin. Conversely, fruit size was increased on trees where vigour was under control.

Tree management

The management of apple trees under hail netting must aim to control tree vigour and maintain good light distribution throughout the canopy.

The shoot growth on vigorous trees under hail netting is greater than on identically pruned comparable trees outside net.

Dormant pruning cuts on over-vigorous trees under hail netting must be minimized to restrict regrowth, and mistakes in tree pruning are exacerbated under hail netting.

Large shading effects in the tree are due to vigorous leaf canopy and not the hail netting itself, although on vigorous trees netting may contribute to excessive shoot growth and classic 'shading response' symptoms.

Soil moisture levels tend to decline more slowly under hail net. This is primarily due to lower evapotranspiration, and offers the potential for improved water use efficiency and targeted reductions in irrigation to control tree vigour. With lower evapotranspiration and improved water relations under hail netting, judicious

under hail netting

pruning and crop load strategies can ensure larger fruit size under net, even on vigorous trees.

In our relatively dry environment it is essential that increases in available water, as a consequence of hail netting, are used to maximum efficiency, and directed to and utilised by developing fruitlets, rather than in the production of excessive shoot growth.

Chemical thinning

The consistently lower fruit set of trees under hail net offers a potentially significant advantage in reduced thinning costs.

At one trial site, Hi Early Delicious trees under hail net were not spray-thinned, whereas adjacent uncovered trees received two sprays (NAA and Cylex). In previous years the trees under net received two chemical thinning sprays and required minimal follow-up hand thinning, whilst trees outside the net received three chemical thinning sprays and required significant follow-up hand thinning.

Chemical thinning of trees under hail net can induce greater fruitlet drop than on uncovered trees, and care should be taken to avoid over thinning.

In a thinning trial at Orange NSW, the fruit set following a full bloom NAA spray and a carbaryl spray three weeks after full bloom applied to Hi Early Delicious was always lower on trees under net than on uncovered (open) trees.

Bee counts showed similar bee activity outside and under net, due to the introduction of hives at optimal timing.

The greater shedding of fruitlets from trees under net as blossom density increased is most likely due to

Tree Growth—magnitude of response is dependent on tree vigour	
Shoot Numbers	Greater
Shoot Lengths	Longer
Leaf Size	Larger
Yield, Fruit Quality	
Fruit Set	Reduced, fewer multiple clusters
Yield	Variable effect. Dependent on tree vigour, pollination
Fruit Size	Smaller on over-vigorous trees Similar or larger on dwarf to semi dwarf trees, where vigour is controlled
Colour	Variable effect. Dependent on fruit position & tree vigour
TSS	Inconsistent. Reduced
Sunburn, windrub	Reduced
Russet	Reduced
Bird damage	Reduced or eliminated

Table 1. Apple tree response to hail netting, as compared to similar adjacent trees not covered by netting.

direct competition between developing fruitlets, and reduced bud strength as influenced by light levels and other factors during their initiation and development the previous season. Physiological studies (photosynthesis, source:sink relations) need to confirm this.

Some orchardists in Queensland are hesitant to chemically thin trees of high-value apple varieties under hail net for fear of over thinning. Under netting, no chemical thinners should need to be applied to trees of low blossom density, however, there is potential for chemical thinning to minimise or elimi-

nate the need for follow-up hand thinning on medium to heavy flowering trees under net.

Bee activity

To ensure adequate cross-pollination and fruit set of apple trees under hail netting, four key points in the management of bees should be considered.

- Bees must be introduced under hail netting once flowering has commenced, usually 3–5% bloom.
- Adequate space between the top of the trees and the hail net is essential for optimum bee flight. Where there is little or no gap between the tree top and the net, bee flight is obstructed and an uneven distribution of bees may occur within the block.
- Trapped bees—when hives are first introduced to a fully enclosed environment, some of the foraging field bees may become disorientated and trapped in the apex or gables of the netting structure. Trapped bees eventually die and are replaced by younger bees that have acclimatised to the conditions under the hail net.
- Temporary removal of netting, or sections of it, during flowering is one means of assisting pollination. Opening the hail net covering during flowering will help to:
 - increase light levels within the netted area and thereby encourage bee activity
 - facilitate bee access to the trees and allow bees to forage across blocks
 - reduce the bee numbers trapped in the net.

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