KPCS Best Practice Fact Sheet

Pest Free Place of Production

Benefits of cover

Growing plants under cover of any sort provides a greater degree of control over the environment. This control gives the grower many more options in how they can grow and protect their plants. Greater control leads to better disease and plant management. The better the growing facilities, the better plant growing and disease control outcomes.

Superior growing structures that provide the very best conditions would have the following.

1) A full covering of either plastic or glass with lots of space. Typically, sides of at least four metres high and a sloped roof. The greater the covered area, the easier it is to manage the environment. Large, particularly tall structures have more air inside them and they are slower to heat up and slower to cool down. They have a lot of inbuilt buffering.
2) Good ventilation systems which allow the exchange of a lot of air quickly to stop extreme fluctuations in temperature and give options in windy or stormy conditions. Such systems would ideally be automatically operated.
3) Irrigation systems that water without wetting foliage. This can be done by watering through the pots either by drippers or by allowing the pots or bags to take up moisture from below (capillary systems or flooding systems).
4) Ventilation screens to reduce insects and spores entering the growing structures during times of ventilation.
5) Screens to control the level of light entering and heat leaving the structure. This allows control of temperature by increasing shading and reducing the amount of incoming light during night and cloudy conditions by providing an insulation layer preventing heat from moving out of the structure.

These 'superior' facilities make it easier to grow good disease-free plants by reducing the risk of diseases entering and spreading amongst a crop. Keeping plants free of stress and physical damage, as well as avoiding wet and damp foliage, are key components in this process. In a practical sense, less expensive facilities can have the same positive effects. However, the risks become greater and more management inputs are required to achieve the same results.

Options for growing structures

1) **Shadehouse**

   The simplest and least-expensive structure would be a Shadehouse. The top and sides of this structure are covered with a cloth that provides both a reduction in air movement (wind) and light levels.

   A shadehouse provides an improved environment for plant growth by reducing the effects of physical damage from wind and tempest and reduces plant stress by lowering light levels—particularly on very young plants.

   A shadehouse does not give any control over moisture levels. If it rains, the plants get wet. This is a major issue as cold, wet conditions are ideal for infection and spread of diseases such as Psa-V. A shadehouse gives better conditions than those in an open field. However, it is a high risk option for growing kiwifruit plants to the KPCS Standard.

2) **Tunnel Houses**

   These are cheap structures that provide a plastic film cover. They keep moisture off plants and give a dry growing environment. They are made by bending either galvanised or PVR piping into semi-circular shapes which are then secured into the ground and 'skinned' with a plastic film cover. Framed ends can be added or the ends can be left open. The issues with tunnel houses are they are difficult to ventilate and to control humidity. They heat up and cool down quickly, and

there are issues with accessing plants at the sides. Extra ventilation can be achieved by using a cover that doesn't extend right down to ground level. However, this compromises the entry of moisture from driving rain. Tunnel Houses are a low-cost option and if very carefully managed, may produce kiwifruit plants certified to the KPCS Standard.

3) **Crop Cover**
A Crop Cover is a more sophisticated type of structure with either metal or wooden frames which support an overhead plastic film cover. Ventilation is achieved through the ends or sides of the structure which can be either fixed shade cloth or plastic film and can be manually or mechanically rolled up. Height is generally four metres or more, and the taller the structure, the better.

These structures provide a very good growing environment and can be managed to provide suitable ventilation and protection from rain. A Crop Cover is usually manually operated and so less expensive than complete greenhouse structures, yet they provide easy working and a good growing environment. With reasonable management KPCS certified plants could be produced in a Crop Cover structure.

4) **Greenhouse / Glasshouse**
These are fully enclosed structures covered with either horticultural glass or one or two skins of plastic. They are usually of metal construction with a specialised roof and/or side vents which can be manually or automatically operated. In some structures ventilation is by 'forced air' using large extraction fans.

These structures allow for the provision of internal or external screens for shading, or heat retention and insect proof cloth screens on air vents. Also, because of their fully enclosed nature they can be heated and/or cooled mechanically. These are an expensive option. However, they are ideal structures for plant production, allowing for complete moisture and temperature control. Production to KPCS Standard is readily achievable with such facilities.

Watering

Growing kiwifruit plants undercover gives the grower control over how, and how often, the plants are watered. It is possible to water plants from underneath through the pot or the bag by capillary watering and flood irrigation systems. These are ideal systems as the plants foliage does not get wet, as wet foliage is important for the transmission and spread of bacterial diseases like Psa-V.

However, this is often not a practical option. Therefore, overhead watering by sprinklers and hand watering is a reality, and foliage is going to get wet. Simple watering rules need to be applied. It is important that the plants' foliage is wet for as short a time as possible, and is wet during 'safe' times. In simple terms, plants should be watered in the morning so the foliage has time to dry during the day. Plants with wet foliage should never go into slow drying periods like the night or cloudy dull days.

A grower's aim should always be to keep the period of wet foliage to a minimum. Plants that have been trimmed and have fresh cuts are potential entry points for bacterial spores and they should be allowed to dry before overhead watering is applied.

Ventilation

The ventilation of a growing structure is important to control both temperature and humidity. The more sophisticated the structures, generally the more options for venting are available. In simple tunnel houses, venting can be achieved by opening ends or rolling up the sides. The more expensive structures will have extra side-opening options, and others will have ridge and side vents. Fully enclosed structures may use fan forced air ventilation.

Venting allows for air exchange and the lowering of both temperature and humidity. An important option is to be able to ventilate without causing damaging winds entering the structure as this may cause physical damage to both the structure and the plants. Physical plant damage is a source of entry for disease and needs to be minimised. Usually this is achieved by opening sides away from the prevailing

winds. Having options of how and where to ventilate improves control and ultimately the health status of the plants.

Growing in pots and in the ground

Undercover plants can be grown in either the open ground or containers. From a simple cost aspect, best utilisation is made of space if plants are container grown. From a disease prevention aspect, a free draining surface which limits soil or media splash is ideal. Surfaces which can be cleaned and sterilised, such as concrete or raised benches, are ideal but expensive. Cloth covered surfaces layered with inorganic material such as pebbles or gravel is a more cost effective alternative.

Cost of growing structures

The cost of growing structures will depend on many factors including size, location, aspect and what additional features are included. A specific quoted price for a particular situation is your best guide. However the following is an indication of cost for a 1000 square metre structure.

TUNNEL HOUSE	$30 to $40 per square metre
CROP COVER	$50 to $75 per square metre
GREEN HOUSE	$95 to $120 per square metre.

Case Study: Growing plants undercover in areas of high inoculum

This case study demonstrates that even in areas of extremely high inoculum loads, pest and disease free plants can be produced under cover, providing that a high standard of biosecurity practice is applied to other areas such as hygiene.

Plant and Food Research's Te Puke nursery is located in the middle of the Te Puke growing region surrounded by kiwifruit orchards, most of which have Psa. There are 26 Psa-V positive orchards within one kilometre of this nursery, and 860 positive orchards within 10 kilometres. The map below shows the location of the PFR nursery in relation to some of these positive orchards illustrating the high level of inoculum pressure in this region.

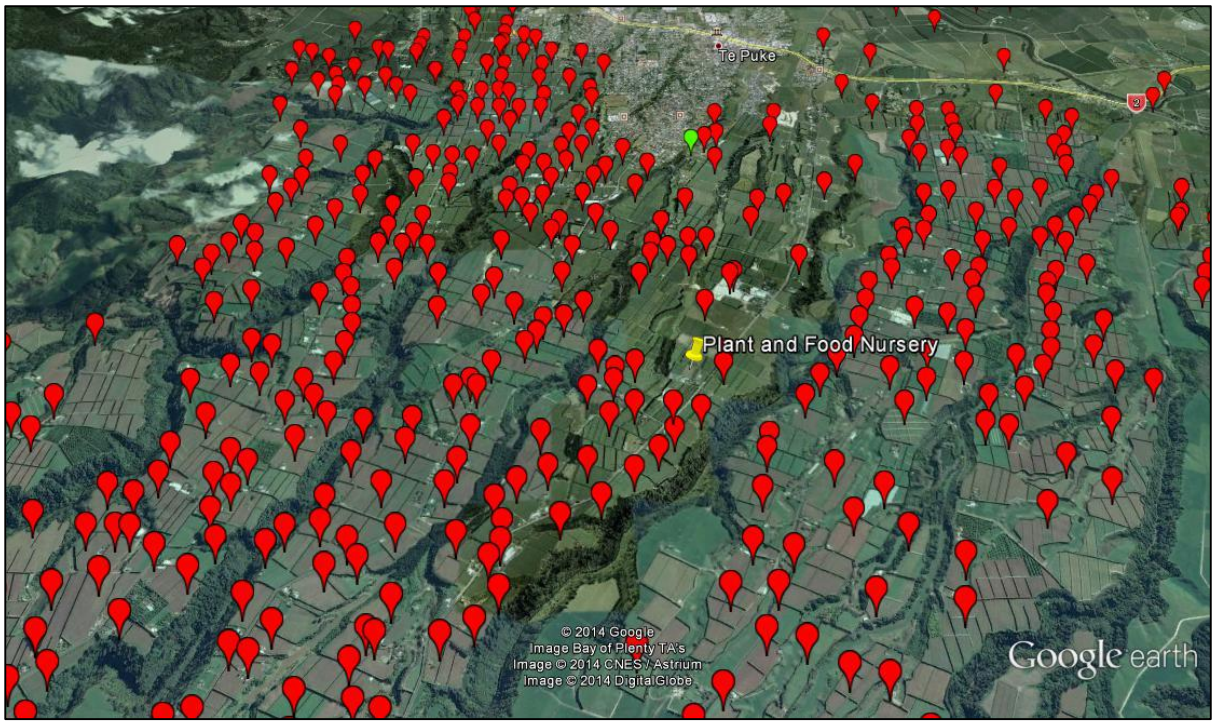

Figure 1. Plant and Food Te Puke Nursery surrounded by Psa positive orchards (red markers represent positive KPINs).

The Plant and Food Te Puke Nursery uses several different production systems. Since 2010 these have been monitored for Psa with levels of infection observed reflecting of the risk profile of each production system. Susceptible varieties such as Hort16A were propagated in each production system to ensure that observable infection would occur if Psa-V inoculum was present.

The level of infection and corresponding risk profile assigned to each production system at the Te Puke site is presented in the table below.

Production system	Level of infection	Risk Level
Outdoor	100% Psa infection	High
Shade cloth	100 % Psa infection	High
Plastic house (fully enclosed with vents)	0 % Psa infection	Low
Glass house (fully enclosed with vents)	0% Psa infection	Low

Despite the high level of inoculum pressure this nursery has managed to consistently keep Psa out of both the plastic and glass house production systems since Psa entered New Zealand in 2010. In comparison, outdoor and shade cloth production systems have not managed to keep Psa out and resulted in 100% infection, clearly illustrating the difference in protection between growing structures.