MODULE 1. Essential knowledge

3. Greenhouse design - pest and disease

Pest and disease pressure is a continual problem for greenhouse growers that can be made easier by good design and operation of greenhouse features. This fact sheet presents basic information on the relationship between greenhouse design and climate control.

Greenhouse design and farming practices have focused on simple ways of containing heat and humidity in tolerable ranges and releasing them rapidly when they are becoming too damaging for plant health. This usually means including sides and ends that can open fully for rapid ventilation and then be closed again. Usually these openings are screened with a shade mesh mostly to reduce damage to edge plants from buffeting by the wind. ***But shade mesh is not very effective in restricting entry by most greenhouse pests like whitefly, thrips and aphids.***

Conventional greenhouse designs have not tended to worry about additional pest exclusion features like fine mesh to restrict entry of pests through sides, roof vents and entry doors, partly because this would reduce airflow and make ventilation even harder to achieve at critical times. Below are some pointers on how to use fine mesh and other features to gain a benefit without losing control over greenhouse ventilation.

1) Fine mesh (thrips, whitefly, aphids)

Fine meshes go under various names including ‘anti-thrips’ or ‘anti-virus’ mesh. Fine mesh curtains can significantly restrict entry by thrips and other small flying pests like whitefly and aphids. They can also reduce air-flow through the greenhouse that relies on air movement (wind) outside the greenhouse. This creates a reduction in ventilation that may need to be compensated to maintain good growing conditions for plants and avoid an increase in foliar diseases due to high humidity.

Ventilation options should be considered including:

- Increasing the greenhouse height will improve the uniformity of air temperature and humidity, as air will have more space to flow between warmer and cooler areas improving the climate overall.
- Installing electric wall fans to pass air more rapidly or evenly through the greenhouse/installing internal electric fans to increase air circulation inside the greenhouse
- Increasing the surface area of the greenhouse that is meshed to allow more air flow. You should include an easy cranking system for raising and lowering plastic sheets over the mesh.
- Installing roof vents with mesh covered openings, is another option.

Some growers feel that fine mesh does not keep enough thrips out. **There are two main reasons why fine mesh may not appear as effective as hoped**. Old crops nearby that are heavily infested with thrips will increase the number of thrips making it through any defences! Perhaps an even more important cause of unexpectedly high thrips pressure early in a crop is adult thrips emerging from pupae left in the soil from the previous crop. This is very likely situation especially if thrips levels were high near the end of the crop. Thrips pupae can 'rest' in the soil, or even woven weed mat, for 4 months or more and emerge when irrigation recommences. A third reason that should be considered if there is a rapid build-up of thrips is pesticide resistance leading to control failure. It does not take many thrips to breed into a very large population very quickly in greenhouse conditions.

What about shutting the plastic sides down on warm dry windy days to reduce thrips entering the greenhouse? On windy days many growers leave their plastic sides down to reduce thrips numbers 'blowing' into the greenhouse. Some growers are worried that on very hot days they need to open up and let the heat out, but it may be more important to keep the humidity higher and avoid too much dehydration of the plants which can lead to blossom end rot.

Fine mesh can also be installed as liftable curtain that can be used at peak risk times when you need the sides open, but lifted when you require maximum higher ventilation. Late spring and early summer is probably the highest risk time for thrips flights as they leave dying weeds, depending on the time of year, and what your neighbour might be doing with an old crop.

2) Double entry doors (thrips, whitefly, aphids, caterpillars)

- Have you noticed that whitefly infestations begin near the sides and doorways and slowly spread through the crop? To some extent this is what happens with other flying pests too including thrips, aphids and caterpillar moths, but the progress of whitefly through the crop is easier to spot because of their obvious colour and their tendency to move row by row as their numbers increase.

Double entry door under construction

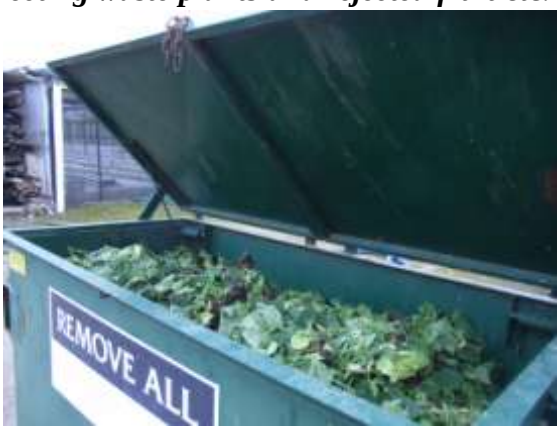
If you have meshed the sides and any roof vents why leave a weak spot at the doors? pest entry can be reduced at doorways by designing and building a suitable double door with a small 'porch' or lobby between each door. The idea is to enter through one, close it and then open the second one. This will reduce the pest entry rate and yellow sticky tape can be installed in the porch to attract and catch thrips, whitefly and aphids as they move through this space.

A reseller in Virginia has built a greenhouse for trialing plant varieties and various crop management practices. ***He has found that installing a double entry door has almost eliminated a severe whitefly problem.***

Key Hygiene and Bio-security design features (all pests and diseases)

There are a number of other important aspects of farm infrastructure that are vital for successful pest and disease management.

1. There should be an accessible well equipped and maintained cleaning station(s) on every farm that makes it convenient to clean or change over tools, buckets, clothes, shoes, trolleys, vehicles etc. after working in a contaminated area.
2. There should be clear signage, policies and information for workers, contractors and visitors to prevent anyone bringing pests or diseases onto your farm, or spreading them from greenhouse to greenhouse as they move around. Areas of concern are clothes, shoes, vehicles with dirty wheels, plants and used building materials. There is strong evidence that soil borne diseases such as root knot nematode and Tobamovirus have been spread either by re-using old timber posts from an infected farm, or by workers moving from that farm to another.
3. There should be plenty of ***portable bins for collecting waste plants and rejected fruit*** etc. rather than leaving them in the greenhouse. Tomato Spotted Wilt Virus infected capsicums lying on the ground will probably also have adult thrips feeding on them which will fly onto other plants and infect them. There should be ***larger bins at a good distance from the greenhouses*** where plant waste is stored and then collected by contractors or disposed of in some other satisfactory manner.



4. Roadways should be firm and clean and clear at all times to prevent pockets of mud and plant waste that can harbor soil borne diseases
5. Drainage around the farm should be designed and maintained to prevent wet areas that become a harbor for soil diseases and weed problems. Good drainage is a further insurance against damaging and persistent flooding during storms etc.

ALWAYS REMBER THAT EVEN WITH AN IMPROVED GREENHOUSE YOU WILL STILL HAVE TO MONITOR AND CONTROL PESTS AND DISEASES SO THAT THEY CANNOT BUILD UP AND CAUSE DAMAGE

Costs and Benefits Related to Greenhouse Design and IPM

Pest and disease losses can be near total, depending on local pest and disease incursion pressure and the threat posed by a particular pest or disease to your crops. Benefit depends on the amount of actual structural and management changes that can be made to reduce key threats. *Most costs are once off or occasional but give a long term return.*

To see Phuong's priorities for change and their cost and benefit, and also create your own Cost-Benefit estimate for making the same changes. Click here for the *Module 4. Cost Benefit fact sheet and 'Capsicum Calculator'* to see what this is about.

Additional Fact Sheets and Videos

Additional information can be found in the '**Resource Index'** under
3. Greenhouse Design - Pest and Disease

This project has been funded by HAL using the vegetable industry levy and matched funds from the Australian Government

Fact sheet produced by Integrated Farming Services
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