MODULE 2

SETTING UP FOR THE NEXT CROP BY OPTIMISING SOIL CONDITION & CARING FOR SEEDLINGS.

This section reviews the following key practices that Phuong considers when preparing for his Next Crop:

01. **Soil testing, fallowing and rotating**
02. **Ripping and leaching to improve drainage and reduce salinity**
03. **Fumigating to control soil diseases**
04. **Applying compost and soil conditioners**
05. **Pre-plant nutrient replacement**
06. **Careful sourcing and planting of seedlings**

As we deal with each of these practices we will outline Phuong's knowledge, his practice and inputs and most importantly how he assesses the need for corrective action to optimise his soil condition for his next crop.

01. SOIL TESTING, FALLOWING & ROTATING CROPS

SOIL TESTING

Phuong is very aware of the pressure on growers at times when the market price is high to do all they can to push the plants and maximise picking. The result of this is what Phuong calls 'killing the soil'. He says 'Sometimes we kill the soil by pushing the crop with fertilisers, even though we know better, so we must know how to fix it up afterwards.'

Phuong is an optimist because of his knowledge. He feels that many growers believe they can't change their soil problems, because they do not understand how long term changes occur in the soil – for the worse and for the better. He knows that what the plants have taken out can be replaced and what you may have over-applied can be reduced, if you know how to do it. **But do not let problems build up crop after crop or you will lose 'too much money!**

Firstly we need to know the soil condition by doing some simple soil tests on the farm, and more technical ones by sending samples away.

Important soil knowledge that can be obtained from on-farm testing includes:

> ***Soil texture (sand, clay etc.)*** - important for water holding and cation exchange capacity

> ***Soil structure*** – vital for root penetration and drainage is determined by soil type, compaction, organic carbon levels and cultivation

> ***Salinity and sodium levels*** - affect soil structure and nutrient uptake

> ***Soil pH*** - affects nutrient availability and some diseases

> ***Soil profile*** – changes at depth including impermeable clay layers that block drainage and carbonate layers that will chemically block most trace elements from uptake and limit root penetration.

SOIL TESTING CONTINUED...

The grower also needs to be able to make assessments about:

> Soil disease levels that may require fumigation. Disease levels can be checked by looking for plant and root symptoms – nematode cysts or browning and dieback in roots when the old crop is removed

> Organic carbon levels to support good soil structure and microbial life

> Nutrient levels that may require correction prior to planting.

These last two require sending off soil samples to qualified soil testing laboratories that can give a report with recommendations.

FALLOWING, COVER CROPPING & ROTATING

To help repair soil and reduce disease levels Phuong rests his soil and works on repairing it for a minimum of 6 weeks before replanting. Sometimes for longer if really needed because of major soil issues, but this is no longer likely with his balanced management program, except perhaps if a new soil borne disease enters his property.

Best practice in farming is to leave soil fallow for 6 months or more, possibly even plant cover crops to restore nitrogen and organic carbon to the soil, and to rotate to different crop types to help prevent or reduce a build up of soil diseases and enable healthy soil biology to re-establish. In outdoor fields this also allows time for natural rainfall to reduce the build up of soil salts and any excess fertiliser.

Phuong has tried cover cropping and did find that short cereal crops helped in the early stages of his salt reduction program because their roots opened the soil more at depth, improving drainage. He also tried a sorghum cover crop more recently as a bio-fumigant to reduce nematodes, but thought there was an increase in root disease, probably pythium, affecting the roots of his next capsicum crop. The issue may have been that he let the sorghum grow too big (2 months in ground) so that it took too long to break down. Selecting the right cover crop can be tricky without sound research.

In reality it is not practical for most greenhouse farmers on smaller lots to leave their houses un-planted for long enough to grow a cover crop. **This means that other measures are required such as those described below which are now a regular part of Phuong's standard program to repair his soil for the next crop. These practices reduce salinity, control soil disease and help to maintain good soil structure for healthy roots and good drainage, and encourage friendly biology to support nutrient availability and suppress diseases.**

Best practice in farming is to leave soil fallow for 6 months or more, possibly even plant cover crops to restore nitrogen & organic carbon to the soil.

FOR MORE INFORMATION ON SOIL TESTING SEE:

> Eight simple on-farm physical and chemical soil tests (fact sheet)

> Example instructions for soil sampling to test for nutrients, organic carbon, etc. (fact sheet)

> Example instructions for sending a leaf test to detect nutrient issues (fact sheet)

02. REPAIRING THE SOIL

RIPPING FOR DRAINAGE, GOOD CULTIVATION & LEACHING SALTS

Phuong determines whether or not he needs to leach soil salts based on an expert soil report he pays for.

In many cases irrigation water from salty bores or reclaimed water can lead to a build up of soil salts, especially sodium and chloride (Na & Cl), during the cropping period. Fertilisers also add a range of soil salts if they are present in excess. If these salts are left to accumulate crop after crop they become a major issue for root health, nutrient uptake and eventually reach toxic levels in plant tissues. As salt builds up it leads to an increasing reduction in yield which has been measured for most crops.

Phuong's method of ripping and leaching out salts works very well in his relatively deep soil profile which has improved its structure and drainage over 8 years of careful management.

If your soil has an impervious clay, rock layer or water table at shallow depth this creates major complications for leaching out salts.

NOTE: Phuong has an advantage in his water quality over many growers. His bore water has an EC of about 700-800 which is pretty good, making it easier to leach salt out. The reclaimed water used by most Virginia growers is closer to 1300EC when tested on farm most of the time, so it adds more salt when irrigating and is not as good for leaching. The best option for such growers is to harvest rainwater in a dam and use this for leaching - a very important investment in water and soil quality! Phuong also has a deep soil profile because of excellent long term soil management and no underlying shallow water table which is also very helpful when leaching.

FOR MORE INFORMATION ON RIPPING & LEACHING SEE:

> Ripping to improve drainage
(video of Phuong ripping and explaining how)

> Good cultivation practice
(video showing the right soil moisture to conserve structure)

> Leaching salts
(video of Phuong explaining how he leaches his soil before planting)

> Soil pit workshop
(video showing soil texture and improved soil structure on Phuong's farm)

> Salinity Management
(a set of fact sheets showing how to minimise salt build up)

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03. PESTS & DISEASES

FUMIGATION AND HYGIENE

Intensive protected cropping tends to lead to a build up of soil diseases and root knot nematodes. Although Phuong's consistent compost application is reducing the level of root diseases and nematodes from very high levels 8-10 years ago, he still finds it is necessary to fumigate sometimes, but only when disease pressure warrants the expense and effort. He believes that disease spreads much more slowly now his organic carbon levels are higher. This is due to increased soil microbial activity that favours more beneficial fungi and bacteria that help to suppress pathogenic organisms, as well as improved drainage, aeration, nutrient availability and reduced salinity. These all make plant roots stronger and less susceptible to disease.

Depending on National and State regulations, there are may be several chemical options legally available to growers. Although many growers tend to put chemicals through their drippers Phuong believes that this narrow band of treatment is too limited to give adequate lasting control and can result in constant battles with soil disease issues. Incomplete coverage and frequent applications to maintain control are likely to lead to resistance.

Whatever chemical is used Phuong is convinced that injection throughout the greenhouse, preferably followed by a plastic covering to maximise the evenness and penetration of the chemical is essential. If external contractors are involved in compost spreading Phuong recommends fumigating after applying compost to protect against any diseases the compost spreader may have introduced. Since Phuong has the equipment to do both fumigation and compost application himself he feels confident in fumigating and leaching before composting. This is less damaging to beneficial microbes in the compost.

FOR MORE INFORMATION ON FUMIGATION SEE:

> Fumigating with plastic cover (video)
> Fumigation tips and compliance information (fact sheet)
> Tips for planning for service vehicles to come onto your farm (fact sheet)
> Managing pests and diseases (set of fact sheets)

04. COMPOST

Phuong applies quite high rates of organically certified high quality compost every 2-3 years and has been doing this for 8 years. He has gained a range of benefits from this practice including the following:

> He achieves a higher yield per plant enabling him to reduce plant density by nearly 20% which makes plant management much easier, including picking and spraying
> His plants are using nutrients much more effectively so that the total cost of compost and nutrients is now less than half of what he was paying previously

Compost has improved Phuong's salt management by improving soil structure which has in turn improved the effectiveness of his leaching program.

COMPOST CONTINUED...

> Compost has improved his salt management by improving soil structure which has in turn improved the effectiveness of his leaching program
> Plants are stronger with a deeper, bigger root mass. This improves their uptake of nutrients and water and reduces the impact of stressful weather conditions
> Improved soil structure with deeper roots leaves much less moisture on the surface which reduces fungal disease pressure on leaves, especially powdery mildew and botrytis, and produces fewer weeds
> Disease pressure has reduced considerably over the 8 years saving plants, chemicals and time
> His soil is much easier to cultivate and weed, saving time and fuel.

Phuong has used his success to convert many more growers to using compost in a similar way and at similar rates. All those Phuong has advised are very happy with the changes on their farm over several years.

FOR MORE INFO ON THE USE & BENEFITS OF COMPOST SEE:

> Phuong & SARDI researchers discussing the benefits he has seen on his farm (video)
> Soil pit workshop

(video showing improved soil structure, texture, drainage, etc. on Phuong's farm)

> Phuong applying compost - application and rate (video)
> Tips for new users of compost in greenhouses (fact sheet)
> Various Compost for Soils fact sheets (web link)

Plant nutrition is vitally important so any changes in your own practice should be backed up by close observation of plant development.

05. PRE PLANT NUTRIENT APPLICATIONS (if required)

Phuong does not need to add any nutrients to the soil prior to planting as he has kept his plants well fed to the end of the growing season leaving a small bit in the soil for the next crop. He also feels that young plants do not have high needs if the soil is healthy and the seedlings are in good condition. He would rather let the plants establish until they will become more efficient at using nutrients and less likely to be stressed by any excess if they are weak. Phuong believes that there is time to wait and see what healthy young plants need and keep a close eye on them. He does not even need to apply phosphorous which is routinely recommended at planting for seedling establishment.

Plant nutrition is vitally important so any changes in your own practice should be backed up by close observation of plant development and a leaf test just at onset of flowering, ie before setting commences. Another ket time is two weeks prior to harvesting the first fruit as this is the peak time of demand for fertilisers by the plant.Allow turn around time to get results back and make any corrections before fruit set is underway.

PRE PLANT NUTRIENT APPLICATIONS CONTINUED...

Phuong will add gypsum if his soil test recommends this because of high sodium which will block uptake of calcium and trace elements and damage soil structure. Very high potassium or magnesium levels may create the same effect. With his careful composting and leaching program a build up of sodium is unlikely to be an issue, but he never takes his eye off of salt levels, just in case because salt is so damaging to plants and nutrient uptake.

FOR MORE INFO ON PRE PLANT NUTRIENT APPLICATIONS SEE:

> Understanding a soil report with recommendations (fact sheet)
> Managing plant nutrition (fact sheet)

06. OBTAINING & CARING FOR SEEDLINGS

It is important to combine good soil management with healthy seedlings to get the best results. This includes buying plants that are as free of pest and disease as possible, and preferably with low pesticide residues, especially if biological control agents are being used. It is particularly important to know what pesticides have been used to guide subsequent chemical use and keep resistance risks in check by rotating chemical groups that may have been overused in a nursery.

Phuong talks closely to the nursery about these details, reminding them when he needs his plants and that he expects healthy strong seedlings. He follows up this care on farm making sure he has minimised risks for carry over pests and diseases. Fumigation is part of this, but also weed control, cleaning up old crops and controlling people, plants and vehicles entering the farm, as well as designing a sustainable spray or biological control program.

Phuong further protects his seedlings from salinity by his transplant method. He also ensures he does not over or under water. If they get too wet this increases disease risk. If too dry they cannot take up water and nutrients and may easily be stressed by hot or cold weather.

Sometimes seedlings may need a small initial dose of phosphorous at planting, esp. in cooler weather. But if it is warm and the soil is in good condition he feels there should be no worries. Phuong says that you don't want the root too strong because the plant can become vegetative and does not set much fruit.

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FOR MORE INFORMATION ON CAREFUL PLANTING SEE:

> Phuong demonstrating planting technique - limiting salt around seedlings and encouraging feeder roots (video)
> Toxicity of pesticides to beneficial insects (fact sheet)

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