The Mittleider Method

Greenhouses

Greenhouse Production Problems and How to Avoid Them

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You can fool Mother Nature, and it's nice, despite what the TV commercial says. Winter may be loved by skiers and snow bunnies–but gardeners traditionally haven't had much use for frozen soil, dormant plants and cold.

As a matter of fact, winter weather and inclement conditions have always been one of the biggest obstacles to increased food production around the world.

Today, however, gardeners can fool Mother Nature by building greenhouses– and food production can continue even with snow swirling outside.

Greenhouse production offers the following advantages:

1. Greenhouses can be constructed over the very poorest soils on very rough terrain.

2. Greenhouse crops are grown in a closed controlled environment which largely removes the problem of insect infestation.

3. Greenhouses provide a unique growing environment for the crop.

4. Greenhouses eliminate many of the risks encountered by conventional growers.

5. Through proper sterilization of greenhouse soils, many diseases common to regular crop production are eliminated.

6. Because of the enclosed environment in the greenhouse, considerably less insecticides have to be used than is the case in the open field.

7. Greenhouse crop production provides accuracy in feeding the crop, eliminating soil diseases, and in effectively and safely controlling the troublesome insects.

8. Greenhouses allow crops to be grown out of season.

9. Greenhouses greatly increase the amount of food which can be grown on an acre of land.

Greenhouse production will increase for a number of good reasons. These include:

1. Almost all the land classified as good farm land is being farmed today.

2. Nearly all the tillable land in the world is infertile. It cannot produce crops without supplements of chemical fertilizers.

3. Nearly all the soils in the world are infested with disease and crop losses from disease are increasing.

4. Crop losses form insects are becoming increasingly more serious.

Conventional farming and gardening will never be replaced by greenhouses, but some crops will always be grown in greenhouses in greater quantities.

The problems in growing food crops are the same everywhere. Especially in at least three major areas: plant nutrition, insect control, and disease control. Other problems exist too, such as, poor soil, poor water, no water, bad weather, too hot, too cold, etc.

In the past, more than the present, greenhouses were used to grow seedling plants, ornamental plants, potted flowering plants, flowers, and special crops in areas where outdoor temperatures either limited or would not allow crops to be grown, such as Greenland.

From the start, crops grown in greenhouses were beset with some special and variable cultural problems. For example: temperature control, watering, soils, plant spacings, light intensity, fungus problems, diseases, and harvesting.

It would be very difficult to say which single cultural practice gave the grower the most trouble because almost all the growing factors are interrelated, and each has a direct effect on the harvested crop.

Greenhouses come in all sizes and shapes. In the past, greenhouses were called “glasshouses” because they were made of a wooden or metal framework covered with panes of glass. In recent years, more and more clear plastic and fiberglass materials are used in place of glass.

A greenhouse is a building for the cultivation or protection of tender plants. Green plants require plenty of light, therefore, the greenhouse must be designed so the plants will have access to maximum light all through the daylight hours. Glass and fiberglass materials have a long-use expectancy, but when they are used year after year, they become stained and dirty and less and less light reaches the plants.

At least once a year glass and fiberglass greenhouses should be washed and scrubbed. The observant grower will quickly realize that the crops in the greenhouse perform much better after the annual scrubbings.

Ventilation

Green plants require oxygen and they grow better where the air is moving or in motion. Remember that crops are normally grown outdoors in the breeze and wind. Strong winds are not necessary, of course, but it seems reasonable to think that gentle breezes moving the leaves provides the exercise plants need to help them produce sturdy, strong stems and healthy frames.

Poor air quality in the greenhouse can be toxic to plants. Areas of smog, steel mills, and smelters are potentially hazardous locations for greenhouses. There are, of course, some very sophisticated modern greenhouses that are equipped to filter all the air that enters the greenhouse, and naturally, these can be used in areas where crops could not be grown normally.

Charcoal filters effectively filter the air, but the economics involved should be carefully studied before such an investment is made.

Water

There seems to be something magic in the way plants grow and respond after a refreshing rain. Even where good quality surface or well-water is used for irrigation purposes a refreshing, soaking rain acts like magic on plant performance.

Even though, in the strictest sense, rain water is not pure water, experts agree that it is very pure compared with surface water or well-water.

The fact that plants grow so much faster and look so much better after a soaking rain indicates that the less minerals and metals that the irrigation water carries, the better the crop response will be. The water used to irrigate greenhouse crops should be of good quality and quantity. More water should be applied to greenhouse crops and plants than the greenhouse plants require for normal growth because considerable evaporation occurs in the greenhouse and danger exists that excess salt will accumulate near the soil surface. Also, because of transpiration, especially in the early morning hours, droplets of dew deposit salt on the soil surface near the bases of the plant stems. To avoid problems with salinity, frequent, heavy applications of water should be given the crops to keep the salt from accumulating in the greenhouse soil.

Soils

In the past, before soil sterilization was practiced, good loamy topsoil was hauled into the greenhouse and moderate to heavy applications of chicken or cow manures were mixed in to make the greenhouse soil. Chemical fertilizers were seldom used and included mainly just nitrogen, phosphate, potassium, and lime.

Sometimes the crops grew exceptionally well. Sometimes the crops were very poor–crop failures were rather common. It was customary too, that after a second or third crop in the same soil, the soil was hauled out and new soil brought in and the cycle repeated.

Later, the loamy soil media was replaced, at lease by some growers, with clean coarse river sand (concrete sand), and chemical fertilizers were more heavily relied on to feed the crops. The crops grown in the coarse sand and fed chemical fertilizers were more dependable and easier to grow than were the crops grown in the top-loamy soil fortified with manures for fertilizer.

Some problems remained even where coarse sand was used, and to cope with them the sand too was replaced after the second or third crop. There was no answer, however, to the question of why the crops in the loamy soil fortified with animal manure were more troublesome and variable than was the sandy soil fed with chemical fertilizers.

Later, it was established that germs were plant killers and that soil sterilization kills germs. Then soil sterilization with chemicals or steam was introduced. At first the idea was sneered at, then later it was grudgingly adopted by some. Today soil sterilization is practiced nearly 100% by all commercial growers.

The advent of soil sterilization and increased knowledge in plant nutrition ushered in a new era in greenhouse crop growing.

Greenhouse operators quickly discovered that some soils could be used year after year, if they were sterilized periodically, while other soils were unpredictable even after sterilizing. For example: sterilized sand would grow good crops year after year, if the right chemical fertilizers were used to feed the crop. But when animal manure was mixed with the sand and the sand and manure were

sterilized together, the growth and the crop response were unpredictable– sometimes the results were good, sometimes they were bad.

Another example was with the loamy topsoil. Sterilized loamy soil without animal manure usually produced good crops when chemical fertilizers were used to feed the crop. But when manure was added to the loamy soil and the mixture was sterilized, the results were unpredictable. Sometimes the visual symptoms on the plants resembled damp-off (rhizoctonia) disease, common in unsterilized soils.

Greenhouse soils was an area of considerable research covering many years, as were other factors dealing with plant growth and development. As a result, considerable documentation and valuable information is now available.

It is now known and accepted that all factors essential for plants to grow normally and be healthy are interrelated, and that they must be considered in this respect. Therefore, when considering a suitable greenhouse soil, the choice should be made on the following basis: water holding capacity, rate of water penetration (percolation), air, ease of handling, granulation (particle size), light weight to sterilize easily, effect of sterilization, ease of root penetration, rate of temperature change, ease of feeding with chemical fertilizers, ease of leaching, soil pH, effect of sterilizing on salinity, kind of soil media, low fertility analysis, etc.

In view of the above factors, it is obvious that a greenhouse soil is a very special soil! It, therefore, should be lightweight, porous, uniform, water-absorbent, easy to handle, easy to plant in, easy to sterilize, low in minerals or plant foods, and one that does not bake, crack, or set hard.

Because soils can be sterilized and because crops are now fertilized on the basis of their particular fertilizer requirements, the greenhouse soil used today never need to be replaced. It never wears out. Therefore, the cost of the materials to make the greenhouse soil media can be prorated over several years of use. In the book *Mittleider Grow-Box Gardens* (page 46) a list of materials is given that can be used to make a good soil media for the greenhouse. Several materials and several combinations of materials are listed. Common mineral soils are not recommended and neither are animal manures recommended. There are good reasons why these are not listed.

Greenhouse crops require considerable more hand labor than do conventionally grown crops. It is essential, therefore, that greenhouse crops generate more gross dollars per acre than conventional crops. The surest way to accomplish this is to eliminate as many risks as possible and to utilize as many known factors for success as possible.

Mineral soils, except sandy soils, contain variable quantities of chemical nutrients. And they are less ideal in many respects for greenhouse crops than are the recommended artificial soils.

Whatever the soil types used in the greenhouse, none should be used that contain large quantities of organic composted materials or which contain fair to large quantities of animal manure.

Organic materials such as compost and animal manure decompose in the soil. Such decaying processes require nitrogen. Therefore, the first problem encountered when using soils high in organic residues is that the growing crop, at least for a time, starves from nitrogen deficiency because the nitrogen is tied up in the decaying matter. Later depending on soil and weather temperature,

after the decomposition has progressed to a certain point, the nitrogen is released back into the soil. If the temperature is mild, the release of nitrogen may not interfere with crop growth, but if the temperature is high the release of nitrogen back to the soil from decayed organic residue may be so great that the growing crop can be severely damaged from a nitrogen disease called "ammonium toxicity." The disease is caused from excessive amounts of ammonium nitrogen being released too quickly in the soil. "Ammonium toxicity" was one of the mystery diseases of the past, before soils were sterilized and when animal manures were used as fertilizer.

After looking at the list of materials a question sure to be asked is: Peatmoss, sawdust, coffee hulls, etc. are all organic materials; why are they recommended?

More complicated details may confuse the issue still further so a very simple explanation will be given:

All organic residues that decompose within *six months* after they are mixed with soils *should not* be used in greenhouse soils or soil mixes! The careful reader will realize that the organic materials listed for greenhouse soil materials take several years to decompose when mixed with soil; therefore, they are safe to use.

Greenhouse plants require accurate feeding. They soon reveal nutrient deficiency symptoms and symptoms of excess fertilizers. But, the problem is, the crop has already been partially damaged by the time the symptoms appear.

Excess fertilizer adds too much salt to the soil making it "saline." Salinity in greenhouse soils is more serious than in conventional farming because the root area of the plants is greatly restricted in the greenhouse compared with outdoor farming. To combat the problem it is recommended that frequent heavy waterings be given in the greenhouse to make sure that excess salts which tend to build up near the greenhouse soil surface are leached out of the root growing areas.

Greenhouse Seedlings

One of the surest ways to fail with greenhouse crops is to plant inferior plants.

Greenhouse producers should grow and transplant their own seedlings. Some serious diseases are spread from greenhouse to greenhouse and field to field when seedlings are exchanged.

Once some of these diseases have been introduced into the soil they remain as a permanent part of the soil microbes and the only way to destroy them is to sterilize the soil. Sterilizing greenhouse soils is a reasonable process and it should be remembered that if the sterilizing is done properly almost all forms of life in the soils are destroyed including weed seeds. The first organisms introduced into the sterilized soil will grow much faster than those in unsterilized soil because they have no competition from antagonistic organisms.

Therefore, the grower should be especially careful that the seedlings he plants in his greenhouses don't carry disease.

The only really dependable approach to produce disease-free healthy seedlings is to treat all seeds with hot water before planting them. For information on how to treat seeds with hot water, refer to *Food For Everyone* page 546 Step 10. Seed Treatment.

It is very poor economy to sterilize greenhouse soils to kill diseases and then turn about and plant seedlings that look healthy but which are carriers of very troublesome diseases which will re-contaminate the soil and necessitate soil sterilization again to destroy disease.

General Greenhouse Problems

Greenhouse operators are interested in healthy plants and high yield crops. The grower must act as doctor; always looking for tell-tale signs of developing

problems and he must be ready to prescribe the proper treatment–even treating in advance if the need arises.

Assuming that the greenhouse was built properly to provide the ideal growing environment for the crops, the right soil media has been used, and healthy disease-free seedlings have been planted, here are some usual problems that can be expected under normal conditions.

After the crop is planted, the first concerns are proper feeding and watering. Under greenhouse conditions it usually happens that botrytis and powdery mildew molds appear. Botrytis mold is a fungus that attacks decaying plant parts like dead leaf parts, broken stems, flowers, etc. If the botrytis fungus is permitted to grow it can penetrate the growing plant parts and eventually kill the plant.

Powdery mildew is another type of fungus that grows in a damp, warm greenhouse environment. It is first seen on the tops of the recently matured leaves and has the appearance of small blotches of gray to white powder. Allowed to grow and spread; it will soon cover all the leaves of the greenhouse plants with a gray to white powder, killing the leaves so the plant fails.

Both of these fungus diseases can be controlled by removing all dying or decaying plant parts from the plants and greenhouse by allowing the plants maximum ventilation, by keeping the foliage of plants as dry as is practical all the time, by spraying the plants with appropriate fungicide materials. Spraying should be done every 7 to 10 days, thorough wetting of the plant parts is essential. New and better chemicals are introduced so frequently that no specific product or application can be recommended. Your local agricultural officer can properly advise which materials to use.

About the time the crop begins to flower, the grower should be on the lookout for thrips (insects that eat pollen), aphids, and possibly leaf miners. All of these pests are rather easy to control. When they appear, the proper insecticide can be mixed with the fungicide, and one spraying operation will handle both the insects and the fungus disease.

Besides feeding, watering, and spraying the greenhouse crop, other chores are pruning, pollinating, twisting, and tying (training) the plants. These chores must not be neglected nor allowed to get ahead of the work force. There is a proper time to do all the separate chores necessary to produce a crop. For specific information on these operations refer to the book *Mittleider Grow-Box Gardens*, pages 75 to 86.

Following is a partial list of troubles associated with greenhouse crops that are grown in unsterilized soil, and/or planted with seedlings from untreated seeds:

1. Rhizoctonia: A fungus disease that destroys the plants at the soil surface.

2. Pythium: A fungus disease that destroys the roots of the plants.

3. Nematodes: Eel-like worms that are present in almost all field soils. They reduce crop yields.

4. Bacterial cankor: A disease in tomato seeds which is carried on in the growing plants.

5. Stem rot: Similar to bacterial cankor.

6. Fusarium wilt: A very bad fungus disease.

7. Early blight: A fungus disease carried with the dormant seed and in the soil. Early blight affects the leaves but not the fruit.

8. Late blight: A fungus disease carried with the seed and the soil. Late blight affects all parts of the plant, including the fruit.

All of the above diseases are serious and can kill the crop. They are each different, difficult, and nearly impossible to eradicate and control once they are seen on the plants. But, almost every serious disease can be completely eliminated by proper sterilizing of the soil, and by heat treating the seeds before planting to grow the seedling plants.

With respect to the diseases mentioned above, when it comes to effective control practices, it is worth remembering that "an ounce of prevention is worth a pound of cure."

In the last several years soil maggots have become quite a common nuisance especially in the lightweight porous artificial soil used in the greenhouse. Soil maggots come from eggs that have been laid in the soil by certain maggot flies. There are several types of soil maggots, which prefer to do their damage in the cool spring season; but not always, so don't be caught off guard.

Remember that a certain fly lays the eggs in the soil, which hatch in three to seven days into maggots that will attack the stems of almost all vegetable crops, just under the soil surface. The maggots are tiny white worms with black, pointed heads.

They eat their way into the stems of the plants and continue eating out the root crown or centers of the stems. They are very destructive.

Sterilizing the soil destroys the maggots easily, at least those present at the time the soil is sterilized. But clean, sterilized soil that is not properly covered and protected can be re-infected within hours after being sterilized, if the adult maggot fly is there to lay the eggs.

Soil maggots are destroyed easily with soil drench. Only one application is required per crop. Phone your local agriculture agent for information and a list of materials that can be used.

Greenhouse crops must of necessity sell at higher prices than do crops grown the conventional method. Very often the higher prices come automatically because greenhouse crops are usually grown and harvested out-of-season when the prices are higher. But even so, the way the crop is harvested, packaged, and displayed, goes a long way in setting the price the crop will bring.

An inferior product is sometimes sold at higher prices because of the way it is packaged and displayed, while the better product fails to sell even at reduced prices because of poor packaging and poor display.

Don't sell your product for less than it's worth, even if it becomes necessary to hire expert advice on how to sell your product.

For more detailed information on the importance of greenhouses and how to use them more effectively, refer to *Food For Everyone*, chapter 58.

Notes