




WINTER GROWING SECRETS

What we wish we knew when we started!

GROWING
FARMERS

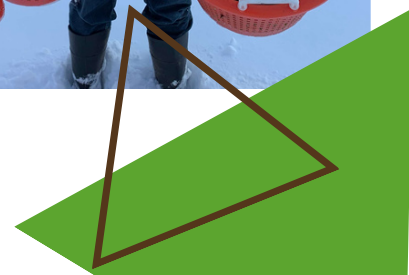


When we started winter growing in 2004 at Kilpatrick Family Farm, we had no idea what we were doing or getting ourselves into. We'd read Eliot Coleman's books and talked to local growers who were growing a few crops year round, but had no experience in doing it ourselves.

We made all the mistakes possible in those first years. Planting at the wrong time, not venting properly, letting aphids spiral out of control...it all happened to us! But we didn't give up. We researched, conducted trials, and collaborated with other growers and extension to figure out what we were doing wrong.

This book is a collection of the techniques that successful growers all across the country are using to make money in their tunnels. By no means is it exhaustive; there are enough other topics for a second or third volume. In the middle of the cold, white winters that much of the US experiences, there is nothing quite like walking into a tunnel full of greens. And there is nothing like getting a suntan in January.

I hope this helps you in your journey to winter profits, be they monetary or culinary.



SUCCESSFUL GROWERS PROPERLY CONSTRUCT AND DESIGN THEIR TUNNELS.



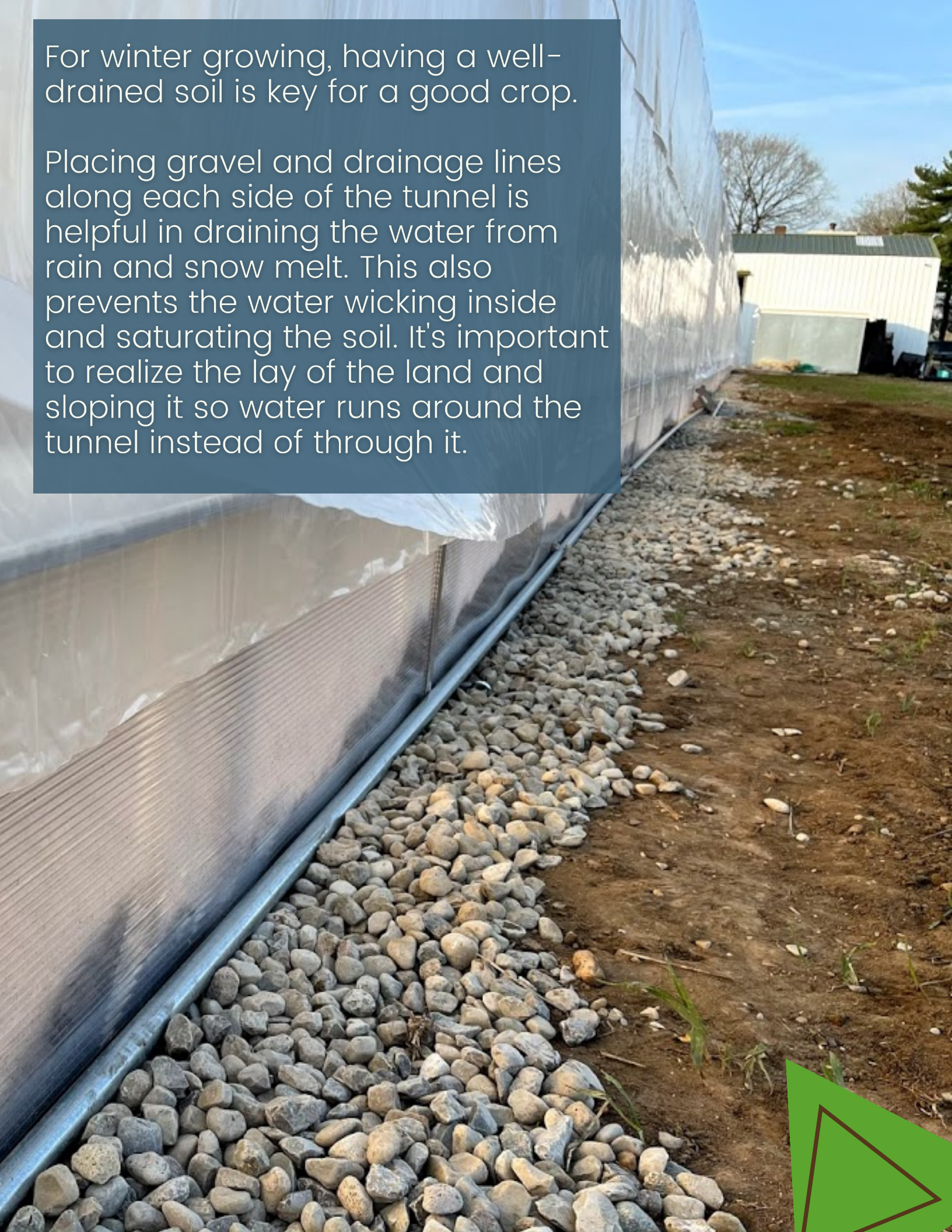
The structures that we grow in are one of the most important keys to a successful winter season. There are 5 common mistakes that I see growers making in their tunnel selection and construction. All of them will affect yield, ease of use, and overall profitability.



Using wood in the construction can cause rot which leads to the failure of key components. A fellow grower used wood hipboards on his tunnel to hold on the plastic. One cold January, a wind storm came up, the rotting wood gave way, and the grower lost an entire tunnel of greens. Building the entire structure out of steel and plastic is key for a long lasting, strong house.

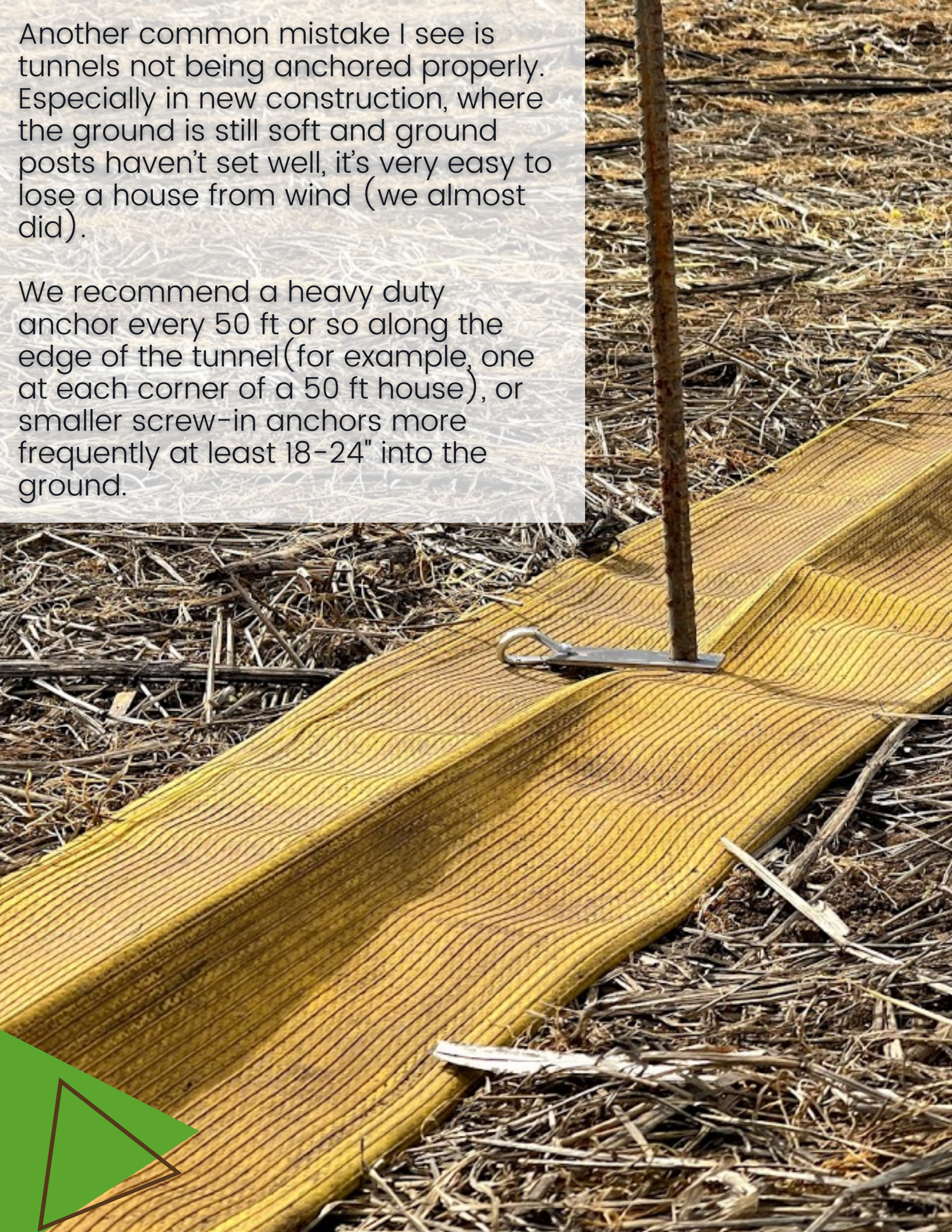
For winter growing, having a well-drained soil is key for a good crop.


Placing gravel and drainage lines along each side of the tunnel is helpful in draining the water from rain and snow melt. This also prevents the water wicking inside and saturating the soil. It's important to realize the lay of the land and sloping it so water runs around the tunnel instead of through it.



Another common mistake I see is tunnels not being anchored properly. Especially in new construction, where the ground is still soft and ground posts haven't set well, it's very easy to lose a house from wind (we almost did).

We recommend a heavy duty anchor every 50 ft or so along the edge of the tunnel (for example, one at each corner of a 50 ft house), or smaller screw-in anchors more frequently at least 18-24" into the ground.





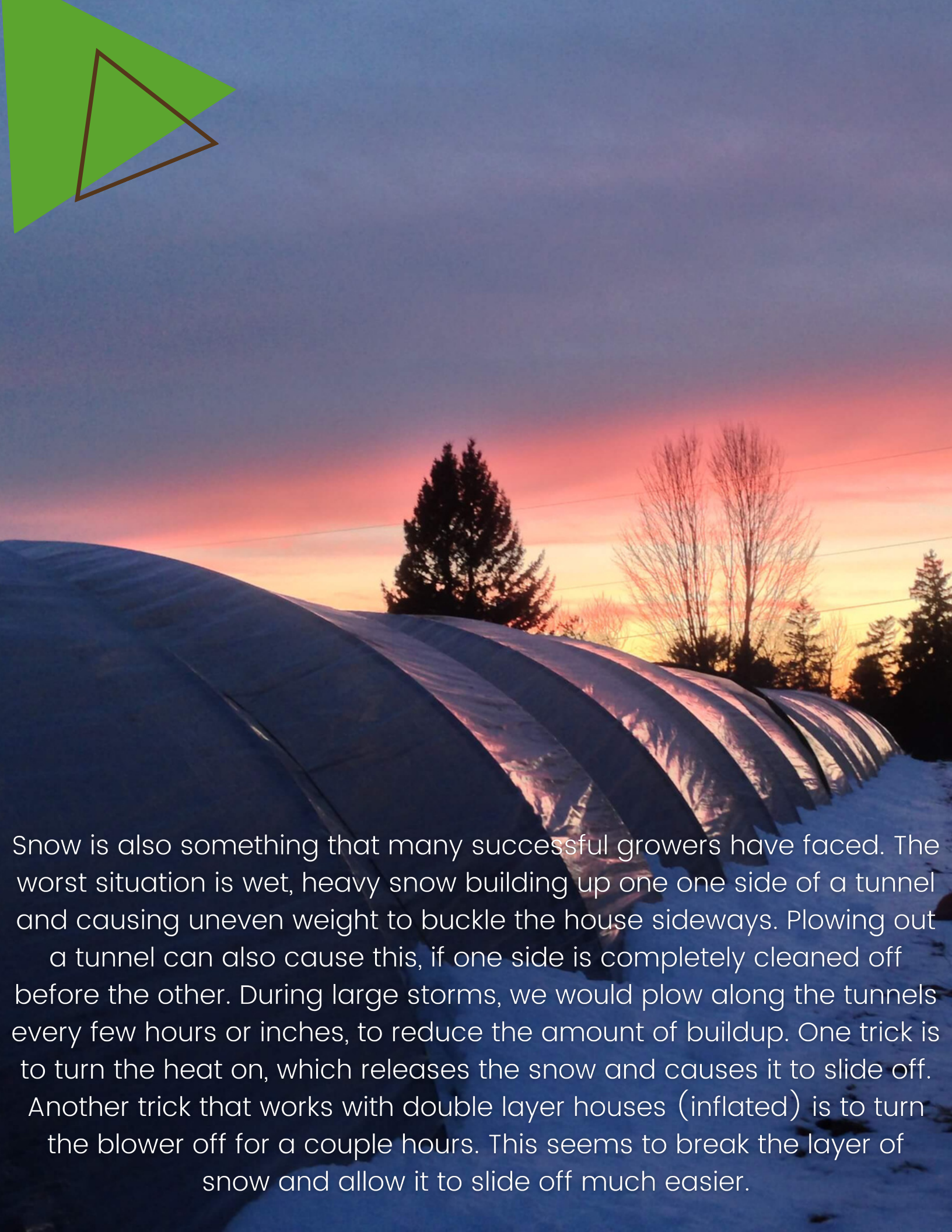
Note the HAF fans for air movement.

We used foiled bubble wrap to insulate along the north side of the tunnel- this reflected light and heat back in.

While small tunnels can definitely be used for winter growing, you lose production and protection for greens. Small houses get colder and have larger temperature swings, which can damage crops. Larger houses have higher sidewalls, which means more air mass and even temperatures. One big house has almost double the cubic feet inside because it is taller than the smaller hoop houses.

Edge effect is the 1-3 ft strip along the edge of the tunnel which gets colder than the rest of the house. The larger the house, the higher (and better) ratio of inside warm soil to edge and cold soil. Some growers insulate the edges of their houses to help keep it warmer. When you make one big house instead of two small ones, you lose all this edge effect and gain almost 13% more growing space!





Snow is also something that many successful growers have faced. The worst situation is wet, heavy snow building up on one side of a tunnel and causing uneven weight to buckle the house sideways. Plowing out a tunnel can also cause this, if one side is completely cleaned off before the other. During large storms, we would plow along the tunnels every few hours or inches, to reduce the amount of buildup. One trick is to turn the heat on, which releases the snow and causes it to slide off. Another trick that works with double layer houses (inflated) is to turn the blower off for a couple hours. This seems to break the layer of snow and allow it to slide off much easier.



It's important to clean off the south side of a tunnel to allow light to penetrate. In the deep winter, with the low sun, it is surprising how little light hits the plants.



A quonset (1/2 round shape) tunnel is fine for small hoop houses, but over 20 or so feet, it's better to choose a gothic shape. They are stronger, shed snow better, have nice straight sidewalls for ease of working inside, and keep the crop protected better. Another important point is for your sidewalls to be a minimum of 6 ft high. That way you can walk right along the edge of the greenhouse instead of bending over. We want to be walking in the coldest part of the house, saving the center, warmer area for growing beds.

SUCCESSFUL GROWERS KEEP DETAILED RECORDS

One of my biggest challenges over the years was keeping good track of my seeding and harvest dates, yields, and temperature data. Having 2-3 years of solid records can make it so much easier to plant on the right date for optimal yields. It's also important to know when aphids start to become an issue, or when you are safe to put away those extra thick rowcovers.

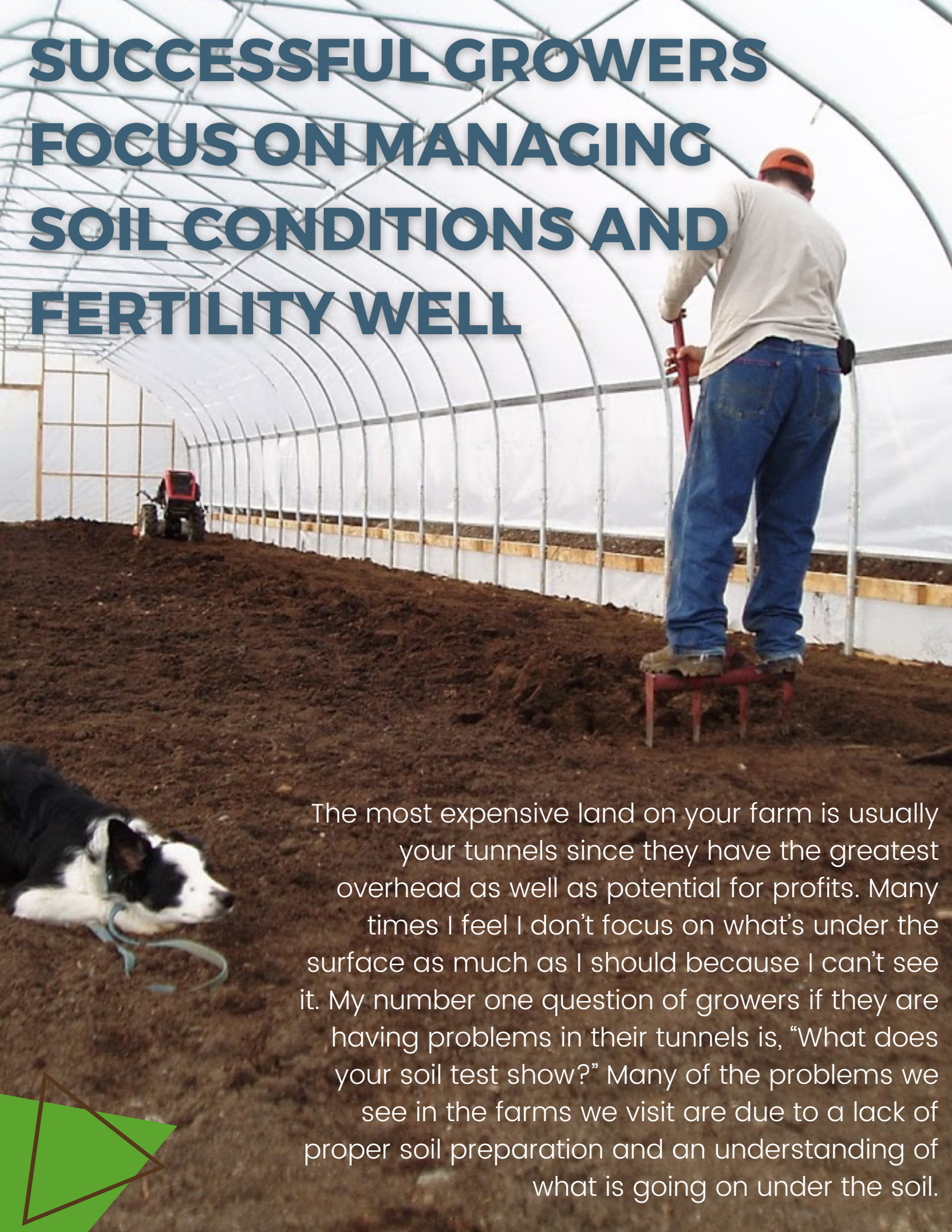


One of the easiest ways to track what has been planted when and where is to simply snap a few pictures each week with a smart phone and upload them to Google Drive. This keeps a permanent record of your tunnels and is easy to refer back to at any time so you know what your lettuce should look like November 1st. Even snapping a picture of your thermometer on an especially cold night, or your variety tags when you plant, can be helpful.

We also favored using Google spreadsheets to track many of our records. This was so we could have them right in the field with us on our tablet or smartphone and enter the records there. It was better than trying to remember exactly how many bed feet we'd seeded, or what that trial variety was. Besides spreadsheets, there are a lot of farm tracking software systems out there. When we originally checked them out few could handle year round planted greenhouses, but they are constantly being updated. More and more are being created every year! It's helpful to become familiar with the different ones available.



SUCCESSFUL GROWERS FOCUS ON MANAGING SOIL CONDITIONS AND FERTILITY WELL



The most expensive land on your farm is usually your tunnels since they have the greatest overhead as well as potential for profits. Many times I feel I don't focus on what's under the surface as much as I should because I can't see it. My number one question of growers if they are having problems in their tunnels is, "What does your soil test show?" Many of the problems we see in the farms we visit are due to a lack of proper soil preparation and an understanding of what is going on under the soil.



Using a biannual (twice a year) soil test to understand what is going on in your soil before each crop is key. It's best to do a greenhouse soil test before you plant your crops in the fall. Our goal is to supply 200# acre of nitrogen per acre as well as an organic matter of 6-9%. For amendments, we prefer non-animal based (no blood, chicken manure, etc) like soybean or peanut meal, to prevent the buildup of salts. To fuel our farm, we contracted with the surrounding towns to buy in their leaves each fall. This allowed us to make a high quality compost that didn't have weed seeds or salts. In this picture, you can see what our compost pad looked like in the fall.




Not only is it important to have fertile soil but to maintain good tilth and structure. It is important to not overwork the soil when it is too wet. Also, keep it weed free so you don't have a lot of plant residue clogging up your seeders and regrowing after you plant your crops. You can spend a bunch of time removing crop residue before planting or, to keep weeds at bay, ground cloth is recommended between summer crops and around the edges of tunnels. We would lay drip tape, then lay out our ground cloth, cut X's anywhere we wanted a plant, and plant through it. This reduced our weed pressure and our moisture needs.



HAVING A CLEAN, TRASH FREE SEEDBED IS
MORE ABOUT MANAGING THE PREVIOUS CROP
THAN EXTENSIVE TILLAGE OR PREP.




In our experience, we till the area with our rototiller, hand shovel raised beds and then rake them out. This creates a slightly domed, rock and weed free bed. We then roll it with the Johnny's bed roller, creating a firm, smooth seedbed. It also helps to water. This increases your soil moisture and helps create a firmer, easier to seed bed.



SUCCESSFUL GROWERS USE SPACE EFFECTIVELY IN THEIR TUNNELS

Many growers don't use the space in their tunnels efficiently. Since this is very expensive growing area, we want every sq. ft. possible to be profitable. There are several ways to increase your yields simply by changing your spacing and layout. One common mistake is to make your pathways too wide. We found we could manage with only a 10-12" pathway down the tunnel. This increased our bed space.

Realize the more paths you have, the less growing space there is. We increased our bed width to 48" and decreased the number of paths in the tunnel. For us, this was the widest we could go while still reaching the center of the bed. However, many successful growers make the tradeoff to a narrower bed such as 30". This allows them to walk over them easier and harvest more ergonomically.





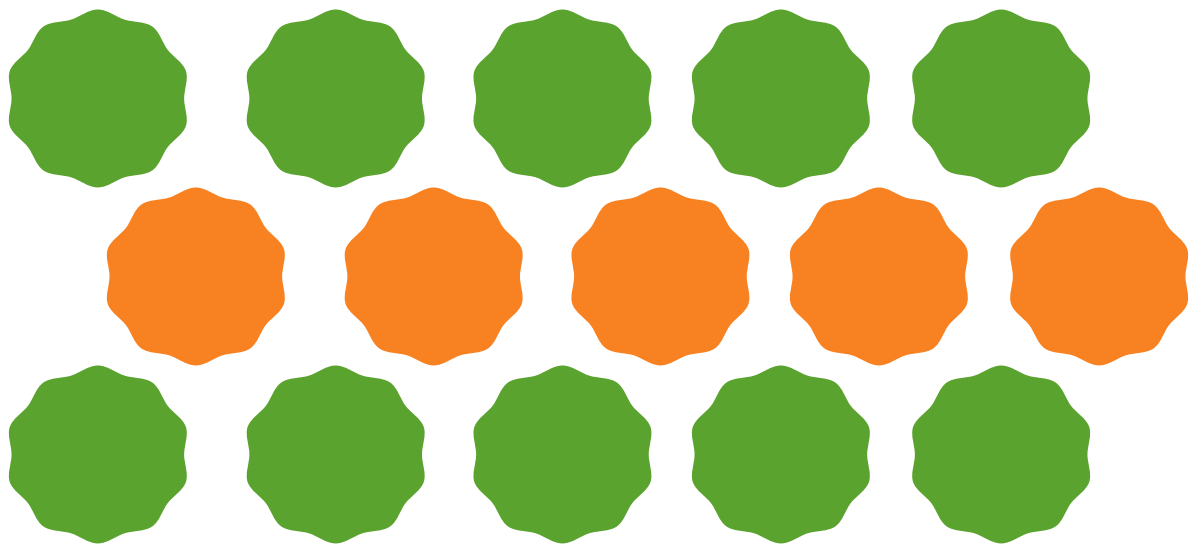
When we did a space audit for our tunnels, we found we never ended up walking in the last 12" or so right up against our endwalls. It made a great place to plant tender perennials like sage, rosemary, and lavender. These also attracted beneficial insects when they flowered.

Interplanting is planting a slow growing crop in between a fast growing crop. For us, this was kale or Swiss chard and Asian greens. The Asian greens grew quickly all winter providing harvestable crop from the bed. Around February, they would start to bolt, just as the Swiss chard would start to wake up and grow. We would rip out the Asian greens and enjoy harvesting the chard for another 6-10 weeks.



Bok Choi

**Swiss
Chard**





We would normally underplant tomatoes with greens such as bok choy, lettuce, chard, radishes and hakurei turnips. The tomatoes were planted in late March/early April with beds of greens between them. After about 4-5 weeks, when the tomatoes first need a good pruning and trellising, the greens would be harvestable and pulled out. We would then put down ground cloth to keep weeds down between the tomatoes. Realize that this takes increased management as you are now trying to grow two different cultures together, which can result in higher disease and insect pressure.



Overplanting was usually done with bulbs like onions, garlic or tulips. We would plant the bulbs in the tunnel 3-4 weeks after the recommended field date. Then we would plant a quick greens crop over them such as arugula, mesclun, or microgreens. They would be harvested just before the bulbs started popping up in late February. This was normally done on the edge of the greenhouse and, because of the edge effect, results in an extended harvest.

SUCCESSFUL FARMERS DON'T PLANT THE ENTIRE TUNNEL AT ONCE.



For a winter long harvest, it's important to plant multiple times in the greenhouse. For our lettuce and mesclun, we would plant up to 4 or 5 separate plantings, usually 5 to 7 days apart. A common problem is to plant too early and then have gorgeous greens in the tunnel when you still have good production in the field.

Finding the magic planting date is never easy, and it took us years before we felt we'd even gotten close to understanding the timing. Especially with extreme weather patterns, it's hard even after our 12 years of winter growing to get it right. Here's the super secret formula: for growers zone 5 and colder, most direct seeded greens (spinach, lettuce, mesclun) are seeded 3-5 weeks after your first fall frost date. Most transplanted crops (lettuce, kale, chard, etc) are seeded in the greenhouse 0-2 weeks before the last frost date and transplanted approximately 4-6 weeks later.





SUCCESSFUL GROWERS KNOW THE ADVANTAGES OF USING TRANSPLANTS TO INCREASE VIGOR AND SUPPRESS WEEDS

A major part of your winter greenhouse can be planted in transplants including kale, chard, spinach, lettuce, and Asian greens. There are many advantages for this.


Transplanting allows your crops to get a head start on weeds. Transplants canopy out several weeks earlier, shading the weeds' growth. Also, because your transplants are weeks ahead of direct seeding, you can stale bed your ground while still keeping the same harvest dates.

Another advantage is allowing your summer crops to produce for several weeks longer in the fall. There's nothing like having a great tomato or pepper crop that you have to rip out earlier than you would like to make space for your fall crops. We would let our tomatoes go until October 10 or so, rip them out, and the next day have 4 week old transplants filling the house ready to grow. Planting much later than this would result in too small of plants going into the winter.





The crew at Kilpatrick Family Farm transplant kale and chard through biodegradable mulch. Transplants make it easier to plant into plastic as well. Using plastic has many advantages, including weed control, soil warmth, and crop cleanliness.



Same beds as in the previous picture, only 14 weeks later. The chard and kale (on the left) are growing quickly now and pumping out bunches every week.

Compared to when you direct seed and get a range of plant vigor, transplanting allows you to pick the strongest crops for planting. Many of our transplants for the tunnels are planted multiple seeds per cell, including salad mix, spinach, Asian greens and others.

One word of caution on transplants: if transplants get too mature, the woody base cells can become quite susceptible to cold, destroying the plant.





SUCCESSFUL GROWERS MANAGE CHICKWEED AND OTHER WINTER ANNUALS

Unfortunately, chickweed has always been our best winter crop. To prep for winter production, many farmers rip out their summer crops, rototill, plant their greenhouse, and then water, which germinates all the winter annual weeds, including chickweed. Fortunately, there are many easy ways to reduce winter weeds.

STALE SEEDBED YOUR GREENHOUSE.

We prepare the soil, water, and then close the house up and wait a week. This warms the soil and germinates the weeds (including those pesky tomato seedlings from summer drops). We will then rework just the top inch of soil to kill that first big flush of weeds before we plant. Another option, which is shown in this picture, is to plant and then flame weed the beds just before the crop emerges, being careful not to toast your greenhouse plastic. Realize that any one weed control method is not 100% effective; a combination of different techniques is your best defense.





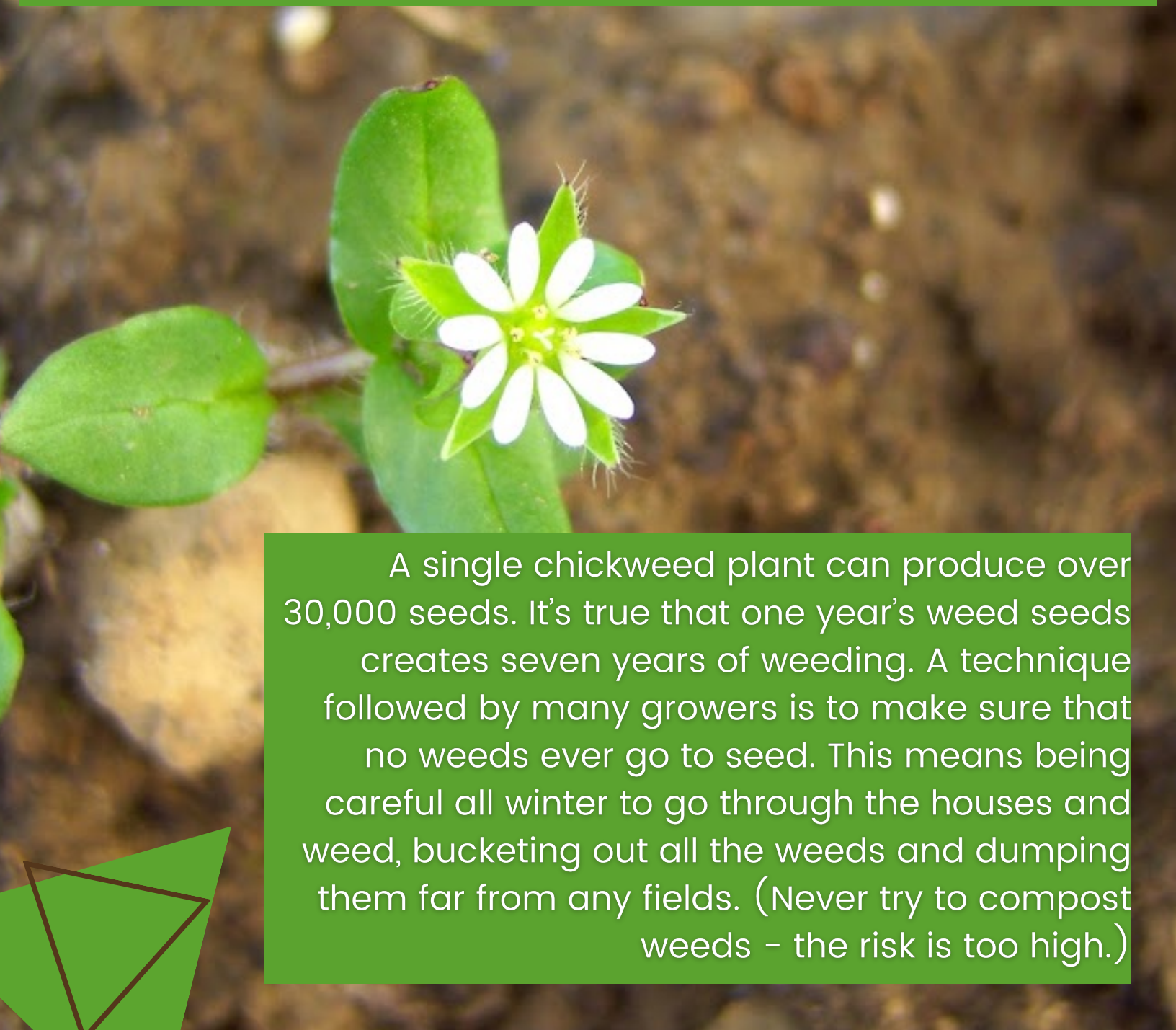
**PRO TIP: USE A WATERWHEEL SETUP TO
POKE THE NECESSARY HOLES IN THE
PLASTIC**



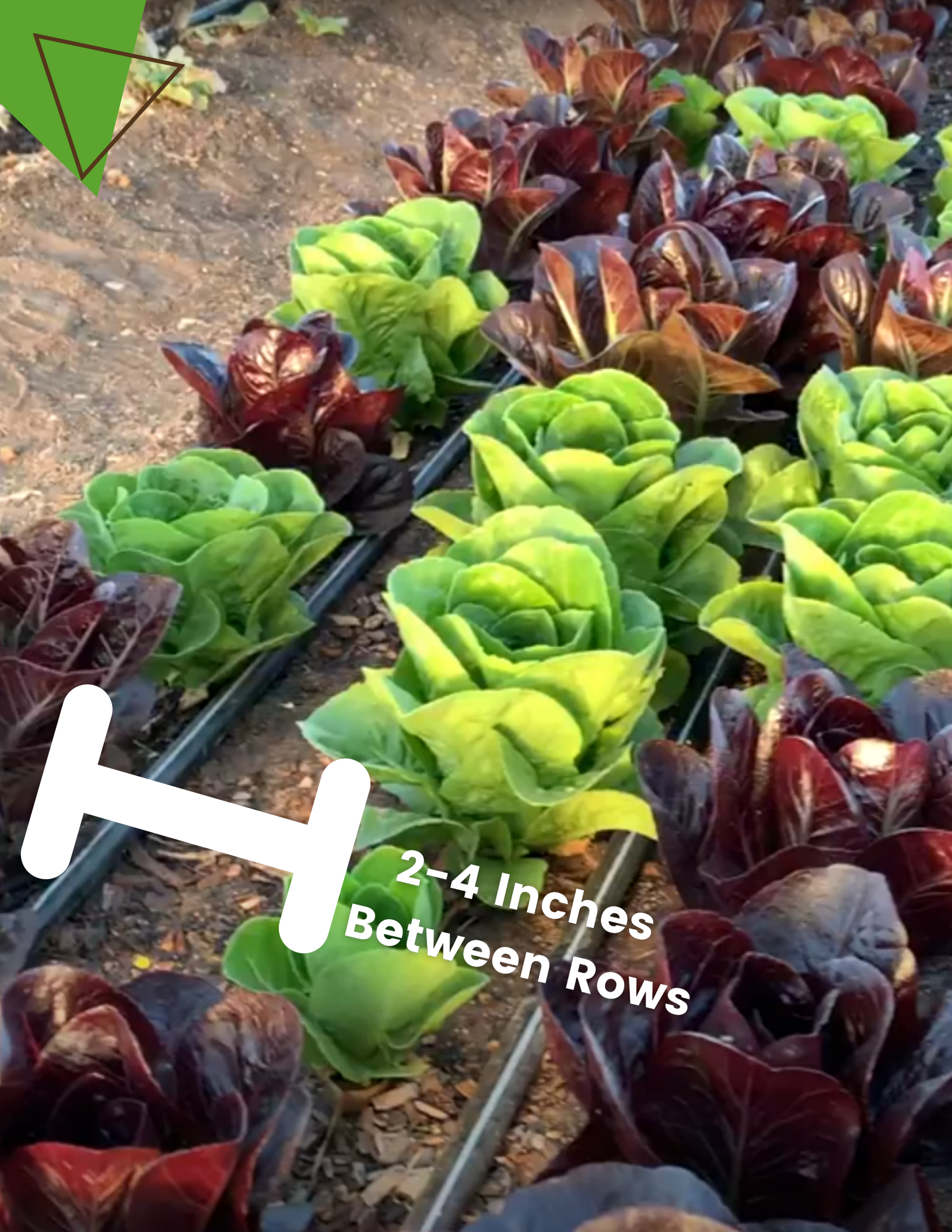
Plant your crops into mulches. For many crops, you can lay down plastic biodegradable mulches and transplant into them. Kale, chard, Asian greens, even spinach and lettuces, grow quite well in this system. We usually lay the plastic by hand so that we can lay the beds extremely close and use the area most effectively. In the paths, we will lay weed-free straw mulch to keep weeds down and keep us clean. We will then transplant 4-7 rows per bed.



It is important to weed at the right time. Weeds are most vulnerable in the white thread stage, when you can't see them. If you run your fingers through the soil a few days after you plant, you can see the white threads of un-emerged weeds. After we plant, we mark the calendar for 5-7 days later. The crop is usually just up at this point or we can tell where it is planted by the seeder markings. This is when we go out with our custom wire weeders, which cut the weeds off but don't disturb the small plants.



A single chickweed plant can produce over 30,000 seeds. It's true that one year's weed seeds creates seven years of weeding. A technique followed by many growers is to make sure that no weeds ever go to seed. This means being careful all winter to go through the houses and weed, bucketing out all the weeds and dumping them far from any fields. (Never try to compost weeds - the risk is too high.)



H

2-4 Inches
Between Rows

SUCCESSFUL GROWERS

ACCLIMATE GREENS TO COLD

The biggest mistake that I see happen to winter growers is not properly acclimating (or hardening off) greens to cold. The combination of rich, fertile soil and warm, still greenhouses causes a fast, lush growth. When exposed to deep cold, this causes major cell damage and the crops breakdown and die. This can be more of a problem the older the plants get, and particularly prevalent in transplanted lettuce. It seems that the core cells are not as hardy as the leaf cells and the plants end up “dropping.” This can be a cumulation of several mistakes:

- Planting too early causes the crop to be too big and not stand cold as well. To fix this, open up the houses, allowing for good air flow, to cool the plants down, slowing the growth rate and toughening up the plants.
- Planting too late causes the crops to go into the winter too small. In response, the grower begins to worry and buttons up the house, trapping in the heat, trying to get maximum growth in the tunnel. However, when cold temperatures come, the weak, lush growth causes the greens to collapse.
- Even if you plant at the right time, you can still cause problems by not keeping the vents open. The goal is to gradually cool down the crop, keeping good airflow at all times. As the fall progresses, we will lower the temperature where the vents close by a few degrees each day. This means that eventually we’re allowing it to frost purposely inside the tunnel, toughening up the greens for the really cold, January nights. If the weather shows a sudden temperature drop, we will even heat to mitigate the cold, so as to not shock the plants.

MANAGING THOSE TEMPERATURES, TWO DIFFERENT SCENARIOS

1

Not managing temperatures, or managing too warm, causes rapid growth and will burn and damage greens with large temperature fluctuations between October and January.

2

Or, we bring the house temperatures down slowly through venting, or when it's super cold we may even heat the house, allowing for greater protection and, ultimately, profit as no surprises means healthy, stable growth through the same time period.

LETTUCE THAT HAS BEEN HIT BY COLD





Notice that we have left the plastic off as late in the year as possible to harden or acclimate the crop to the cold. This should be covered right before snow, or single digit temperatures, to protect it.



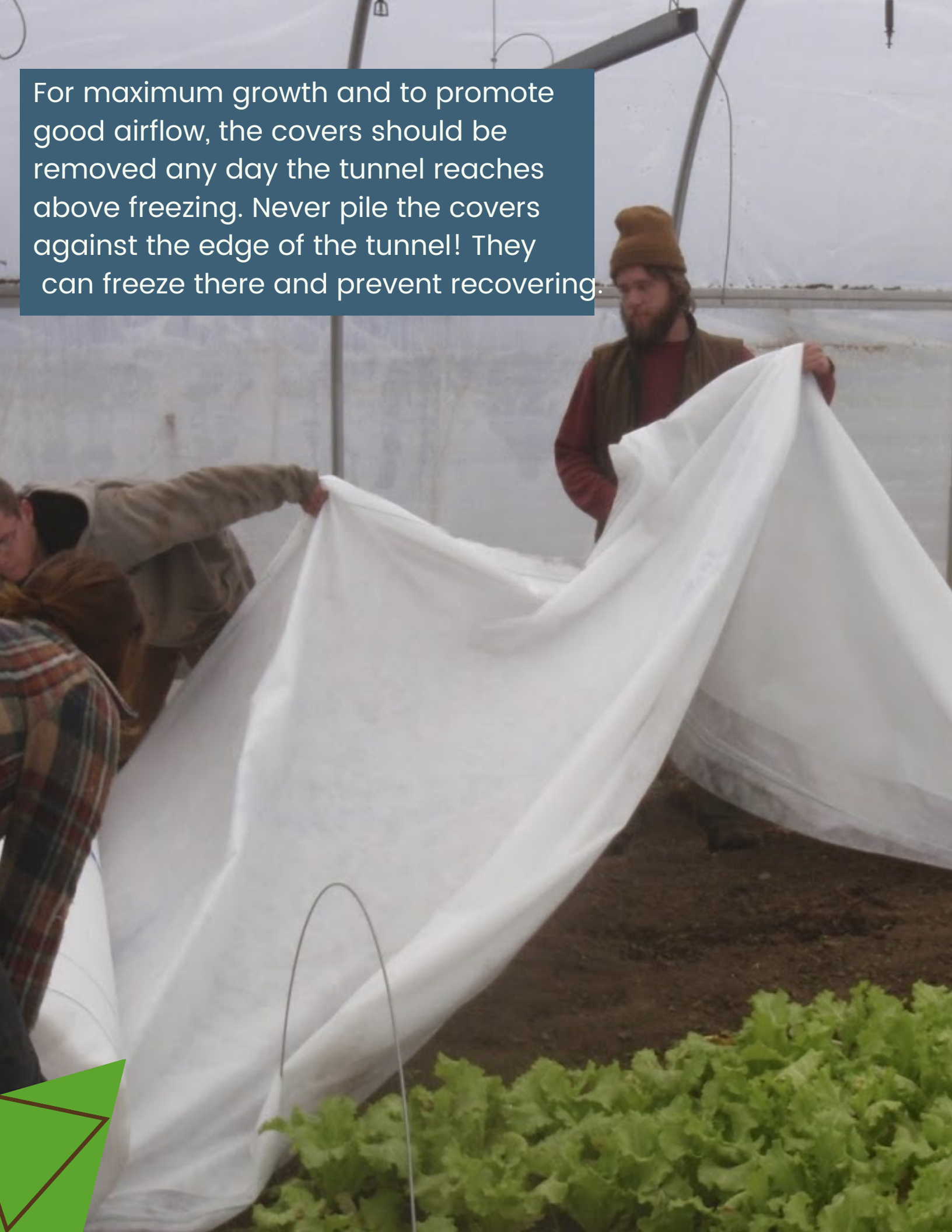
PRO TIP- IT'S THE SECOND COLD NIGHT TO WATCH OUT FOR!

Most greenhouses have enough residual heat to get through one cold night without much damage. What happens though, is by the second cold night, all the heat has left, which allows the temperature in the greenhouse to drop quickly and damage the plants.



Row covers play an important role in protecting crops in winter production. Most growers are using multiple layers depending on how cold it gets. The goal is to keep the covers as close as possible to the crop without touching the crop, which can cause freeze damage.

For maximum growth and to promote good airflow, the covers should be removed any day the tunnel reaches above freezing. Never pile the covers against the edge of the tunnel! They can freeze there and prevent recovering.



SUCCESSFUL GROWERS MANAGE VOLES AND OTHER PESTS WELL



Besides your customers demanding more greens, voles can be one of the worst winter pests in vegetable farming. They love to burrow through your greens, create homes out of shredding your rowcover, and will eat through the greenhouse plastic and hide under the snow outside your houses where you can't get to them.

There are several ways to reduce the damage. Keep areas around and inside tunnels cleaned up and mowed, especially in the fall. Your goal is to make your tunnels an unfriendly place for them to hang out, and expose them to natural predators, and hopefully, your farm dog or cat. Create a scorched earth policy around your tunnels.

Voles can easily be caught by snap traps. Paul Horton, of Foggy Meadows Farm, takes two traps, fixes them to a piece of wood around 2 ft long and slides that into a 30" long 4" inch diameter piece of PVC pipe. The pipe is placed along the edges of the greenhouse where voles love to run, and the dark pipe makes them think they have a safe home. Check them daily for best results.



Use bait boxes and Agrid3, an OMRI approved vole bait. We made boxes 6" x 6" x 4" and drilled two 1" holes in the sides for the voles to enter. We would sprinkle the bait inside and set the boxes where the voles would frequent.

A close-up photograph of a green plant stem and leaves. Numerous small, yellowish-green aphids are clustered on the stem and leaves. A green triangular graphic element is in the top right corner.

APHIDS

can be a very challenging winter pest. For one, they can transfer from the preceding crop and not be noticed until too late. If you don't over-fertilize in the fall and keep the houses open and cool, this decreases your chances of a heavy infestation at that point.

Aphids become a big problem when the soil temperature starts to heat up again in late February. This increases the microbial activity in the soil and releases more nitrogen, causing the plants to start growing quickly and the cells to be large and juicy (an aphid's heaven). Your best defense is understanding when they will start appearing and scouting frequently. Half the battle is catching them before the population explosion and destruction of crop. We would check the underside of leaves and up in the crowns of the plants as well as our wash water in the packing shed. As soon as we saw any, we would start combating them. We managed them with a couple different strategies.



LADYBUG LARVAE

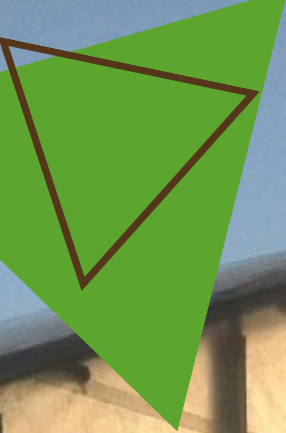
A leading strategy is to purchase in ladybugs and other beneficials and release them into the houses. It's important to let them go late in the day and then immediately row cover for 2 or so days so they realize that your tunnel is home. Ladybugs are great aphid destroyers, but the real killers are their larvae, which many people mistake for a pest.

Some also have luck with watering more heavily once a week starting in March. This flushes the nitrogen down in the soil and slows the plants down making them not as attractive to the aphids.


A green geometric graphic consisting of several overlapping triangles and lines, located in the top-left corner of the page.

SUCCESSFUL GROWERS PREVENT DISEASE PROBLEMS AND NITROGEN DEFICIENCIES BY MANAGING MOISTURE LEVELS.

One of the major reasons for winter diseases is too much moisture in the canopy. Moisture also causes nitrogen leaching, which in turn causes yellowing and dieback of leaves, another great start for disease. If you do need to water, watch the weather for a sunny day, and start the watering as soon as the tunnel thaws out in the AM (try to start by 10 AM). When the watering is finished, open the house up as much as possible while running any fans as well. The goal is to dry out the crop canopy and soil surface before you have to cover again. For established crops, you can also use drip tape on the beds. Run a line every 12" across the bed to get even coverage.



The easiest way to reduce moisture is to vent. On our unheated production houses, we would always keep a small peak vent open year round, even in the coldest (-20 F) times of year. At above 20 degrees, our larger peak vents would open. Above 40 degrees, especially in the fall, we would open our roll-up sides if the moisture levels were too high. A simple test to show if your moisture level is too high is to see if water is beading on the inside layer of plastic in the greenhouse.


A photograph of a greenhouse interior. The structure is made of a metal frame with a translucent plastic covering. Rows of young green plants are growing in the beds. An overhead irrigation system with black pipes and nozzles is visible. A green circular callout with a brown border points to a fitting on the pipe. The text inside the callout reads: "Pro tip: remove the anti-drip fitting from the irrigation nozzle to prevent breakage from freezing weather".

Pro tip:
remove the anti-drip
fitting from the irrigation
nozzle to prevent
breakage from freezing
weather

Although it can increase disease pressure and requires closer management, overhead watering systems take the headache out of tripping over pipes on the soil surface, laying down risers so row cover can be spread, and breaking expensive irrigation fittings.

Uneven watering can also be a problem. This can be caused by sprinkler heads not being placed close enough and dry spots developing. The spinach experienced this and it created gaps in the canopy which became susceptible to chickweed.





Another way disease gets started is having a tight crop canopy which stifles air flow. We prefer to use HAF (horizontal air flow fans) and plan on harvesting crops smaller. Also, create raised beds, which allows air drainage between the beds.



**EARLY SPRING IN THE
GREENHOUSE**



We usually start more transplants, and start re-seeding the greenhouse again, after the winter solstice. Why then? If plants go through decreasing and then increasing light, they bolt much faster, sometimes within weeks of transplanting out.





Once the light and temperature start to increase at the end of February, the growth speeds up exponentially. We would start pulling beds out of winter greens production in early March, replacing them with early head lettuce, carrots, and beets. In our heated tunnels, we would start planting early cukes, beans, flowers and tomatoes.

A close-up photograph of a chef's hands in a white uniform, preparing green leafy vegetables on a dark wooden cutting board. A large chef's knife is positioned horizontally across the middle of the frame, with the chef's fingers resting on its handle. In the foreground, a pile of finely shredded green vegetables is visible. In the background, a single green leaf is partially visible. The background is softly blurred, showing a warm, out-of-focus light source. The text is overlaid in white, bold, sans-serif capital letters.

PRO TIP:

**OVERGROWN AND BOLTED
(EVEN WITH FLOWERS)
GREENS CAN BE BUNCHED
FOR
STIR-FRY GREEN BUNCHES.
THEY ARE SUPER
ATTRACTIVE, AND WITH A
LITTLE GARLIC AND OLIVE OIL,
ARE A GREAT SIDE DISH!**



Growing Farmers is led by Michael Kilpatrick, a farmer, educator, and inventor who lives in Ohio. He is the host of the top rated Thriving Farmer Podcast and Thriving Farmer Summit series which has been viewed by over 50,000 farmers. He has managed large farms and businesses, consulted for industry experts around the world, and spoken at dozens of conferences. Michael believes that anyone can farm by following the simple business and management skills that he teaches in the Small Farm University, our community for thriving farmers.



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