INTRODUCTION

Luckily, the first couple years of organic gardening often go well for the novice, as pests and diseases haven’t yet shown up. New gardeners get lulled into a false sense of nature as benevolent. Inevitably you will experience a reprise of that movie Field of Dreams, wherein the underlying theme revealed at the end is “build it and they will come.” You will come up against your own deficiencies in applying the 1st, 2nd and 3rd principles of organic gardening, respectively “Improve the Soil,” “Build Complex Ecosystems,” and “Observe Nature – Don’t Shoot the Messenger.” For our extended treatment of these three principles see our Organic Gardening Primer: (http://www.neo-terra.org/uploads/2/5/6/4/25644359/og__primer_website_2013.pdf).
Faced with the harsher aspects of reality, we can gain relief by revisiting these three principles and employing targeted interventions focused specifically on the particular pests and diseases that have shown up. We arrange interventions we have found useful in four categories: **barriers; traps; bio-controls; and (organic) chemical agents.** We treat each of these in PART 1 for Pests and PART 2 for Diseases.

**PART 1. PESTS**

**BARRIERS**

The range of barriers is wide. We make the greatest use of fencing and netting. Other barriers we have found less effective. Animals habituate to repellants, reflective devices, sonic devices and decoys. Last summer one of our neighbors had great success against deer with a motion triggered water spray. If his success continues, we may give it a try.

**Fencing.** Against the larger pests – for us bear, deer, coyote, dogs, groundhogs, raccoons, rabbits, possums, skunks, and wild turkeys – the best defense is de fence: ([http://www.neotaerra.org/uploads/2/5/6/4/25644359/de_fence.pdf](http://www.neotaerra.org/uploads/2/5/6/4/25644359/de_fence.pdf)).

**Bird netting.** On certain crops such as strawberries, bird netting works well against rodents (especially chipmunks) as well as birds. Our approach for strawberries has two features – a secure bottom edge and a drop-down top to enable easy access for picking.
1. Secure bottom edge. To strengthen the boundary between the ground and the netting, we first install plastic edging which has a tubular top. Next, we sandwich the netting between the plastic and 1x2" pine strips, and screw the strips to the edging using coarse threaded drywall screws and a portable drill. We wrap the netting once around the wooden strips and this provides a neat edge against which we can mow the grass. Make sure the plastic edging is buried in a straight line; otherwise, it will be difficult to screw the straight pine strips to the edging while eliminating gaps for rodents to get in. Occasionally, we have to cut out a chipmunk who persists and gets his head stuck in the netting. Wear leather gloves. For raised bed applications, the upper edge of your boards serves the same purpose as the bead of the plastic edging.

2. Pull down cover. Rather than lift the netting from the bottom, we drop it from the top. The netting is held aloft on 9 gauge wire hoops. We bend a downward loop in the center so that the long edge of netting rests in this loop. We thread garden twine along this edge, and it is the twine that rests in the loops. Wire U-clips (14 gauge wire) hold the two sides together. We harvest by removing the U-clips and dropping the netting to the ground. This exposes the plants, and we pick the berries.

Mesh cages & row covers. These work by denying entry to many insect pests. Row gardeners use row covers. We are bed gardeners, and require something more on the order of a large boxy enclosure open at the bottom. In addition, we have found, particularly in a shady garden such as ours, that row covers block out too much sun and inhibit air flow, causing an increase in diseases such as powdery mildew. Mesh cages are more open to light and air flow. To the left you will find three mesh cages. From left to right these protect collards from the cabbage moth, cucumbers from the cucumber beetle, and Brussels sprouts, also from the cabbage moth. We also use mesh cages on beets and spinach against the beet miner fly and on kale against the cabbage moth. We use emt – electrical metal tubing – for the frames, as these are both durable and smooth, this latter to prevent snagging and tearing of mesh. A finer mesh will be required to keep out flea beetles. We hold the bottom edge close to the soil with flat stones, pipe or 2x2" wood sections.
Here's a summary of sources of mesh:

1. Insect Screen.  http://www.greenhousemegastore.com/category/insect-screen  We might switch to this to replace cages for brussels, collards. 90% light transmission, 75% air transmission. Mesh size: 1.35 mm. (354 holes/sq.in)

2. Proteknet:  http://www.greenhousemegastore.com/category/insect-screen  Light transmission for anti-insect netting is low (80%). UV stabilized. Polyethylene monofilament. Their Enviromesh allows 90% light transmission and 75% air transmission.

3. ProtekNet insect nets (Canada).  http://www.duboisag.com/en/proteknet-exclusion-insect-netting.html  Sold through Johnny’s. Their highest light transmission, 89%, has a 1-3 season life. Not very long. We get 2 years out of tutu cloth. Sturdier material has lower light transmission: 87% light transmission 5 year life (1.9mm x 0.95mm). 14 holes x 25 holes (358 holes/sq.in). However, sold in LONG strips.

4. Tutu-net. (165 holes/sq.in.)  https://tutu.com/collections/tutu-net  Our old tulle fabric is 144 holes/sq.in. but was too flimsy and tore easily. A friend of ours uses tulle to protect his grapes from a voracious insect pest. The vines get tangled up in it. He tosses it out after every harvest. It is cheap. This site also sells tulle.

For the time being, we’re sticking with (4) – tutu cloth. It is durable, resists tearing, but is not UV resistant. Nonetheless, we get 2, even 3 years out of a tutu mesh cage.

I’ve worked out simple designs, cut out the pieces on the living room floor, and sew the pieces together with an old Necchi sewing machine gifted to me years ago by an old girlfriend. Tania does not feel at all threatened by my skill.

**Other useful barriers.** If you see ants crawling up and down your fruit trees or fruit shrubs, suspect aphids. Aphids suck plant juices from leaves, and ants milk the aphids for their secretions. We use Vaseline on duct tape wrapped around the trunks of our peach trees. The ants won't cross the barrier. We wrap the tape two widths wide. You may have to clean the tape and replace the Vaseline during the season. At season’s end, remove the tape. The tree trunk will want to grow, and the tape may prevent that. Further, insects can overwinter under the tape in the bark crevices.
Vaseline also keeps squirrels from climbing our bird feeder pole. They hate the stuff on their paws, and if thick enough, they slide down the pole which is hilarious to watch. Speaking of foils for squirrels, another effective idea is a Chinese hat.

I made one out of a scrap piece of stainless steel some years ago to keep squirrels off the bird feeder, and it has worked well. Could work for you. (Images on left.) Galvanized sheet metal might substitute.

By the way, in the lower left of this image you will see a green plastic box on a green stake. This is a solar deer repeller. These do not work. We had modest luck with two of these using a different frequency against raccoons and possums who would climb the fence when the corn got ripe. It was only partially effective. I found it more effective to bait a Havahart trap with sardines. Got them every time. Try it outside the fence from the suspected direction of travel (or upwind) just as your corn starts to ripen.

Olfactory and chemical repellants. There are many olfactory repellants marketed for use against deer, rabbits, insects (especially ticks). The higher animals habituate to these. Moreover, they tend to wash off with rain and have to be applied repeatedly. Repellants work better against insects. Against ticks we have found Nantucket Spider highly effective. For an extended exposition on ticks (and chiggers), see pages 6-10 of Garden Qs 2018 (http://www.neoterra.org/uploads/2/5/6/4/25644359/garden_qs_2018.pdf). The text on chiggers may shock you.

Diatomaceous earth repels slugs on individual or specimen plants, but washes off with rain or watering, and becomes tedious to apply, say, to a bed of bean plants. Other barriers include kaolin clay on apples to keep off insect pests. Apple orchardist maven Michael Phillips has a great article on using kaolin clay (http://www.groworganicapples.com/organic-orcharding-articles/surround-kaolin-clay.php/).

We have seen paper or cloth bags advertised as a cover for individual apples or grape clusters to keep off pests and diseases. On the first fruiting year of our new Redfree apple we had four perfect apples which we covered with paper bags. Sometime later we checked, and the deer had chomped through all four bags, leaving the debris along with their hoofprints as evidence that (a) they were there; and (b) this didn’t work (for us). A fellow gardener successfully bags his prized French grapes against black rot; however, the leaves suffer horribly from the disease. (More on black rot below under Part 2, Diseases)
Underground sonic repeller. We used this summer and winter (P 7907 battery operated mole repeller). These seem to work better and last longer than solar-operated ones. Some years they worked well, other years (2015) not so well. Voles can produce 15-60 young per year, primarily in spring and summer. In 2016 we tried a combination of the three strategies suggested herein: sonic repeller, windup traps, and snap traps. The windup traps worked best (see next section).

Films. We have found films quite effective if applied properly and in a timely fashion. These are useful against pests and diseases, which latter we cover below. Horticultural oils are effective at suffocating aphids and insect scale on shrubs. We use Pyola Kaolin clay is also a film, and we covered that above.

TRAPS

The range of traps is immense, and open to much creativity if not effectiveness.

Live traps for animals. The standard humane trap is a live trap such as Havahart. These come in different sizes, and can have one door or two – one at either end. We use the double-door on the premise that animals can see their way through to the other side and feel safer on venturing inside. Squirrels love our black walnuts or peanut butter on a piece of dried bread, raccoons go for sardines, rabbits for greens, groundhogs cantaloupe. Below is a two-image sequence showing our double-door Havahart trap set up for trapping a groundhog, whose burrow entrance you can see in the upper right quadrant of the left image. To the right you will see “junior” caught the very next morning.
Having caught a rodent in a Havahart trap, the next step is transporting it elsewhere. To calm the critter, approach from the blind side of the trap with a sheet or large cloth and cover the trap. Then grab the handle through the cloth and carry it away.

Skunks pose a challenge. They are night feeders, and if you find one in your trap, it will likely be daytime, and it will be sleeping. Approach gingerly from the blind side with your sheet and cover the trap. If you cart it away, put a tarp or plastic beneath the trap in case it decides to spray. It probably won’t, but be prepared. We generally let skunks go, as these cause minimal damage, mostly digging up grass looking for grubs. Still, if you’re fussy, you may find this upsetting. Small point: if your trap is placed on grass, the skunk will paw through the grating and pull into the trap grass and duff from beneath the trap, creating a nest for itself but a mess for you and a bare spot when you go to move the trap. If I suspect skunks are out, I place a board beneath the trap so it can’t tear up the grass. Yes, I’m fussy.

Squirrels are in a nuisance class all their own, and for them a Havahart trap works well. We tie a whole black walnut in the shell onto the cage underneath the trigger with wire. In attempting to get at it the squirrel dislodges the trigger and finds himself inside. We sprinkle cracked walnut pieces near the entrance to entice them inside. In one good year we bagged 18. Of course, others move in to take their places, but it provides a respite for much of the season.

Don’t overlook the smaller rodents – voles, chipmunks and meadow mice. These are vegetarians and fruitarians and can easily penetrate fencing, causing considerable damage above ground but also below ground to root crops. We have lost up to a third of our carrot and beet crops to these little rascals. Moles, largely blind, with large front paws for digging, are carnivores, eating other insects. It’s their cousins, the voles, which do a lot of damage. Let the moles go. Small rodents feed the snakes. More on snakes later.

For small rodents – voles, mice, chipmunks – your strategy has to be “hit them fast and hard, and keep at it.” In one season we caught 70 small rodents. The very next season we caught 60. Voles, in particular, are fast breeders: http://www.havahart.com/vole-facts. Our favorite live trap is a windup trap. Here are two links:

http://www.farmtek.com/farm/supplies/ProductDisplay?catalogId=15052&storeId=10001&langId=-1&division=FarmTek&productId=15853

http://www.farmtek.com/farm/supplies/ProductDisplay?catalogId=15052&storeId=10001&langId=-1&division=FarmTek&productId=15851
While these traps rely on curiosity, their performance is mightily enhanced by using bait. Voles, chipmunks and mice are grainiacs: they love grains. We use a mixture of rolled oats and birdseed. We sprinkle a small amount in the opening at either end of the tunnel with a spoon, and a small amount inside the chamber. For voles, which have poor sight, place the trap athwart a run, which are easy to spot as pathways where the grass has been matted down, or as tunnels beneath the snow in the late winter. Place traps near root crops. Shift location from time to time. The rustling of one critter caught inside will attract another. Voles have an unmistakable strong odor, and that may serve to attract kin.

Small problem: chipmunks and snakes sometimes get stuck in these traps. Chipmunks are stronger than mice, and try to get out of the trap through the side crevice. Sometimes they choke to death, and it is a job to extricate them. I use rubber gloves. Snakes get stuck going in or trying to get out, and get entangled in the trap. We lost a milk snake one summer this way.

Extermination traps for animals. Snap traps, and various other contraptions for getting rid of small rodents, could also work. The internet is full of creative ideas. Cats could also work, but they have to have access to your garden, and a fence prevents that. Of course, a “cat door” in your fence would allow in larger rodents, so would not be a good idea.

The plastic snap traps on the left are an improvement over the earlier standard wooden trap. With the plastic traps, you paste some bait (peanut butter) underneath the upper half of the trap. The rodent cranes its neck under to lick the bait and “WHAM”. Disposal is easy: dig a hole, press open the trap and the rodent falls into the hold. Bait remains in place.

Traps against insects. Against the smaller pests – insects – we encourage you to distinguish between beneficial insects and those that cause damage. The best field guide we have come across is Whitney Cranshaw’s Garden Insects of North America, a full color guide of indispensable value.

For insects you cannot find there, search online. Tania has become good at this. Here is one of her searches that yielded an answer: “yellow fuzzy caterpillars, red feet, images.” First one that popped up was Spotted Apatelodes (Apatelodes torrefacta). She then narrowed the image search to ”spotted apatelodes caterpillar” and discovered they can be white or yellow. Very few people manage to get photos of the comical red feet! And the caterpillar was BIG – 2 ½”.

Another time she entered “shiny iridescent green beetle found on rose bush” which quickly led to Polydrusus formosus. In one season she picked off 50. Apparently it has no predators; moreover, its green color matches the green leaves. The image below right shows it on a rose petal (better color contrast). It eats the leaves, not the petals. By contrast, the Japanese beetles burrow into the blossoms and eat those.
Pheromone traps. Pheromone traps rely on a chemical scent to attract the male into thinking a female is nearby. We use these against Japanese beetles (https://www.rescue.com/latest-buzz/product-points/the-myths-and-facts-about-trapping-japanese-beetles/), the Oriental fruit moth (peaches) and the apple codling moth (shown to the right: notice the tan pheromone plug in the bottom). We have found pheromone traps less effective against cucumber beetles (mesh cages much better).

Farmers use pheromone traps to indicate the size of the pest population as a prelude to a pesticide spraying program. On their much smaller scale, backyard gardeners can use traps to control numbers directly. This particular trap on the right, a wing trap, turned out not to be very durable. Get a sturdier brand. By the way, sometimes small birds try to nest inside and get stuck to the sticky liner.

Sticky traps. Certain colors attract certain insects. In the early years we used these, but have graduated to other techniques which offer much better control. Yellow sticky traps are good for aphids, but using and cultivating beneficials is more effective. Blue sticky traps are good for the beet miner fly, but cages offer much better control.
Organic practices. Amazingly, certain cover crops work against parasitic nematodes. A University of California IPM site mentioned that there are almost 90 species of nematodes associated with damage to carrots. ([http://ipm.ucanr.edu/PMG/r102200111.html](http://ipm.ucanr.edu/PMG/r102200111.html)) Pathogenic nematodes cause roots of carrots to fork. Planting a cover crop of barley or winter rye (not grass seed rye) before carrots "cleans" the soil of the carrot root nematodes by immobilizing them through root exudates and killing them. The cover crop also adds organic matter to your soil, improves soil structure, and adds organic matter to your compost pile when you harvest the stalks. Well-made compost is rich with biological life, and will contain beneficial nematodes that will help control predatory nematodes. Alternatively, you can purchase predatory nematodes ($30 at [http://www.territorialseed.com/product/Predatory_Nematodes/pest_control_insects](http://www.territorialseed.com/product/Predatory_Nematodes/pest_control_insects)).

BIO-CONTROLS

The number of biologic controls has mushroomed since the introduction of the National Organic Program. We are not big users of these, preferring using the three principles of organic growing: improve the soil, create complex ecosystems, and observing nature (don’t shoot the messenger). There is some evidence that overuse of biologic controls breeds resistance. Organic farmers we know use Bt, a beneficial bacteria (Bacillus thuringiensis), against moth larvae such as the cabbage moth. It requires repeated applications, and breaks down in sunlight, so should be applied in late afternoon. I dislike the chore of spraying, but as you will read later, it is necessary for many diseases and certain pests. For larger insect pests, we use mesh cages wherever possible.
For years we used beneficial nematodes to control Japanese larvae in the grub stage, and successfully reduced the population to a reasonable level, which we now manage through a single Japanese beetle pheromone trap and occasional hand-picking. The technique is simple. Make a sudsy mixture in a container, place beneath leaf with beetle, and, startled, it falls right in as it drops to escape. Japanese beetles are social insects, so like to hang out together on the same leaf. With practice, you can get several in one pass. My record is 8.

You can also purchase beneficial insects and release these in your garden. We have never done this, as we noticed that once we stopped using (organic) insecticides, the populations of beneficials improved on their own.

A good example of this is insecticidal soaps. In the early years Organic Gardening magazine recommended this when it first came out. We bought a spray bottle and used it to control aphids on our rose bushes. I would spray one or two infested branches, but then noticed a couple more infestations a few days later. I’d spray those, and within the same period noticed other branches infested. It became an endless battle. A couple years later Organic Gardening reported that, contrary to assertions by the manufacturer, soap sprays actually damaged beneficial larvae, in this case, lady beetle larvae. I stopped using the soap and the following year noticed our first lady beetle larva. We’ve never had an outbreak on roses since then.

Same with lacewings and other beneficials. Stop doing things that harm and start doing things that help. Cranshaw’s Garden Insects of North America is a great compendium with full color photos of eggs, larval and adult stages, with excellent descriptions of habitat and prey preferences. In general, the larval stages are often predatory and the adult stages feed on nectar and pollen. Thus, it is important to cultivate flowers, herbs, and “weeds” that satisfy feeding requirements throughout the growing season. Include early spring blooming flowers in your mix. We planted 50 or so Chionodoxa luciliae bulbs a quarter century ago. These have multiplied to thousands. Bees and other insects go crazy over the pollen, and the sight is spectacular after a long dreary winter. By the way, using Cranshaw, learn to identify eggs or you may be removing eggs of beneficials, e.g., parasitic wasps, spiders (as shown above by
the nest of garden spiders emerging from their eggs amidst a cleft in rocks on one of our garden walls).

Include “nuisance” insects within your category of beneficials: hornets and wasps predate on larvae that eat your vegetables! One of our favorite accounts centers around our earlier yearly fight – before we started using mesh cages -- with the beet leaf miner, which also tunnels through leaves of spinach and flowering plants such as columbine. One hot afternoon the two of us were out squishing larvae when a wasp hovered into view. We pulled back, not wanting to get stung. It landed on a leaf, flipped to the underside, grabbed a larva, and flew off with it. We looked at each other in amazement. We stopped knocking down wasp nests and filling in ground bee nests (unless these are inconveniently located, such as in the grass outside our car door, which happened one year). This illustrates a principle which is easy to grasp intellectually but hard to accept viscerally: unless you have pests in your garden there is nothing for beneficials to eat. A zero-tolerance policy on “bad” bugs is self-defeating.

**Birds** can be helpful, too. However, as with beneficials, they must have something to eat. You will have to work out your arrangement with them. One year we had a flock of wild turkeys visiting our yard who cleaned up fallen bird seed. Another year a cardinal couple built a nest amidst our black raspberry shrubs. Nothing like having breakfast at one’s wingtip! We had to schedule berry picking when parents were away. Nonetheless, one or the other would scold us from a distance.

Birds (and bees) peck at ripe peaches, and their punctures provide entry points for brown rot. This is light damage compared to that which chipmunks and squirrels do. They go for the ripest peach, eat a chunk out of it, drop it to the ground, and go for another nice one. Summer is their time, too. It does make us wonder how organic growers achieve those containers of perfect peaches one sees at farmers markets or in the produce section.

**Bees.** We must mention the role of bees and other pollinating insects. Honey bees have been particularly threatened from ear mites, pesticides, and radio frequencies. Gardeners are turning to the raising of native bees, of which there are 4,000 species by one estimate. We began doing this several years ago, and after great success in the early years, we have realized that either something is also bothering these, or it takes more skills than we have. As with honey bees, native bees also have their pests and challenges. Raising them is also challenging. Below are two versions of raising bees. The “native bee house” to the left is the current method. Paper tubes is shown to the right. For more on native bees, consult Crown Bees ([https://crownbees.com/raise-bees/](https://crownbees.com/raise-bees/)).
Snakes.

Over the last two summers we have been delighted to notice more snakes in our garden, particularly three that predate on small rodents: the black rat snake, the eastern milk snake, and the eastern ribbon snake. Garden snakes hang out in our compost pile, which, it turns out, is not so good, as garter snakes eat worms, which we want in the pile to break down organic matter. When we come garden snakes, we move them to another part of the yard.

Bird netting also ensnares snakes. We had to cut netting away from a black snake recently, so avoid using bird netting indiscriminately as we did last summer to cover an opening in metal fencing erected to protect a black raspberry from deer.

CHEMICAL AGENTS

Ammonia for slugs. A 10% solution of household ammonia in a spray bottle is excellent at controlling slugs. This means 1 oz ammonia plus 9 oz water; the math is 1/10 or 10%. Set the nozzle to thin stream and aim as you would a pistol. You must, however, go out at night. We have found that going out on three successive nights puts a substantial dent in the population. Slugs are more of a problem in the late summer and fall when it’s cooler and wetter (and the slugs are bigger!). Slugs can damage emerging cover crops such as wheat and rye, so practice vigilance. In an especially wet fall we have to replant cover crop seed if we fail to monitor.
Smoke bombs for groundhogs and resistant chipmunks when traps aren't working. Groundhogs can dig tunnels up to 40' long. Where they put all the soil remains a mystery to us. Chipmunks build an elaborate tunnel system up to 25' long with at least one other entrance. To make their entrances look abandoned, the chippies remove the soil around the entrances. How? They pack it in their mouths and cart it off.

Follow instructions. Store in a cool dry place in a zip-lock bag. Last summer it was especially wet from record rain. Cartridges in an open package absorbed moisture and crumbled. Store inside if necessary.

Pyrethrum. Pyrethrum is a natural compound from the dried flowers of the bright pink chrysanthemum (Chrysanthemum cinerariifolium – common name Painted Daisy). We have a few of these in our garden, but have not gone to the step of preparing our own insecticide. (https://eap.mcgill.ca/agrobio/ab360-02e.htm).

Rather, we use a product containing pyrethrum and canola oil (Pyola) (https://www.gardensalive.com/product/pyola-insect-spray-4). The pyrethrum is a knock-down, and the oil smothers. We use it against insects that seem to have no predator in our garden (as yet at least), primarily the voracious saw-fly larvae which affects our gooseberries, currants and columbine. (below left)

We also use Pyola against the Eastern spruce gall adelgid, first in the spring before the female matures and begins laying eggs, and again in the fall to kill overwintering life stages. In the picture below right the gall is the green stem deformation caused by the branch reacting to the infestation by forming woody material around it. In the spring, you prune out these green galls before they ripen and turn brown. The larvae hatch from inside the gall.
Excellent chart of remedies. A particularly good chart on organic methods for controlling pests and diseases can be found at the Peaceful Garden Farm & Garden Supply site. Under “All Categories” in the menu bar click on “Weed and Pest Control”. For the year 2019 this expanded page showed a “Pest Control Solution Guide” on which you could click and view a magnificent chart worthy of deep study. A portion of this is shown below.

PART 2. DISEASES

BARRIERS

Barriers are going through a transformation. Traditionally, horticultural oil was (and still is) used to smother soft-bodied insects such as scale. It works by depriving the pest of oxygen. Summer weight oils are thinner, and can be used to form a barrier that prevents fungal spores or other disease organisms from landing on the plant (usually, tea). We have used it to control powdery mildew on landscape shrubs such as lilac and certain roses. Timing is important: you must apply it before the pathogen lands on the leaves. It works well, but requires reapplication depending on rain intensity. I am hesitant to use it on vegetable crops, as it is a petroleum product. We did try a cottonseed oil once, but it clogged the sprayer. Cotton is reputedly the most chemically sprayed agricultural crop, another reason not to use it.

More sophisticated barriers such as Serenade consist of friendly bacteria. These coat the leaf surfaces, top and bottom, with this bacterial film, depriving pathogenic fungi or bacteria of a
landing spot. We keep it on hand to use on tomatoes at tomato late blight outbreaks (Phytophthora infestans). A similar product is Companion. Serenade is manufactured by Bayer, and since it took on Monsanto in a merger, our supplier, Fedco Seeds, is replacing that product with Companion. We will be using it for the first time this season.

Another barrier against disease is kaolin clay. We mentioned use of this film on apples in the pest section above.

We mentioned in the Pest section above a fellow gardener who bags his prized French grapes against black rot. His leaves suffer horribly from the disease. (More on black rot below under Chemical Agents below.) Our grapes are Concors, three varieties. Turns out Concors are less susceptible to black rot infections. Moreover, as the fruit matures, the skin gets tougher and more resistant to black rot infections. Therefore, pay attention early in the season to control it then; you will save yourself grief later.

Mulch is a simple barrier, low tech and natural. (Yes, there are plastic films and shredded rubber-based mulches, but we’re not talking about those.) Common mulches are chipped wood or bark, and straw. We use chopped perennial stalks to good effect around our tomato plants. These prevent backsplash of fungal spores from the soil carrying early tomato blight and septoria blight, to name two examples. Unlike chipped wood, which can form impermeable fungal mats if applied too thickly, chopped perennial stalks or straw provide a breathable relatively open mesh which conserves soil moisture and prevents spread of disease. We bury used mulch under tomatoes or use it in landscape at some distance from the growing area. In the cold northeast, the spores of late blight do not survive. However, the pathogen will survive in a compost pile of rotting potatoes, especially if composted or covered, which retains heat. Bury diseased potatoes.

**TRAPS**

You may wonder how a trap could be used to ensnare diseases. Consider the case of grapes. Grapes suffer from black rot, a fungal infection that damages leaves and fruit. Once inoculated, the grape turns brown, then black, shrivels and turns into a black mummy. Left on the vine or on the surface of the soil this black mummy serves as a source of spores next season to spread the disease. We are attentive to black rot, and pick damaged fruit from the clusters and then scan the ground beneath for fallen fruit. After leaf fall, rake the bed, add minerals and compost, and then mulch. You have entrapped any remaining diseased fruit where it will decompose and be unable to sporulate.

Small note on chipped wood or bark mulch. Mulch decomposes under action of fungi. These form fungal mats, especially if applied too thickly, and prevent penetration of water from rain or hose. More is not better. Aim for 2” or less. Check from time to time. You may have to break up with a garden rake. Second, mulch can be colonized by fungi that propel particles causing damage from tar-like spots on house sidings and car finishes. Be wary of applying mulch too close to the house. ([http://www.personal.psu.edu/users/d/d/ddd2/](http://www.personal.psu.edu/users/d/d/ddd2/)) Damp wood chips also attracts carpenter ants. You don’t want these close to your house, especially if it is of wood.

My advisor in graduate school used a technique which I have adopted. Against your house, install a stone path between the house foundation and the garden bed. This provides a barrier between the foundation and the garden soil which would otherwise splash against the
foundation, staining it. Additionally, it provides a path from which to work the bed from the other side without having to walk on the bed. Of course, if you plant your bed intensively, there is less opportunity for soil or fungal spores to escape.

Another tip: clean perennial beds in late winter to early spring before plants emerge. Add compost and amendments at that time. Mulch immediately. Plants emerge through the mulch, saving you the arduous task of carefully placing mulch among the living plants without damaging them.

**BIO-CONTROLS**

We’ve mentioned Serenade and Companion as two “barriers” above. Moreover, these are also biologically based, so could be included here. This is a burgeoning area, so keep on the lookout for products that may help you.

**CHEMICAL AGENTS**

This is probably the largest category for disease control. Your aim is to kill the fungus or bacterial infections. It helps to know what disease you have. The internet is a good source for determining this. Look for University Extension sites, whose faculty do research and advise farmers. Extension sites are generally oriented toward industrial agriculture, and therefore chemically based, meaning non-organic, but contain valuable information about the disease etiology, characteristics, and treatment options. Usually Extension pages sport great images. We have found the following universities particularly good: Cornell, Ohio State, Penn State, and University of California Davis. But there are surprises. For example, University of Kentucky has a center for paw-paw research. Rutgers has an incredible page on deer resistant plants.

Each state has its own agricultural extension program, so check in with the one from the state in which you live, or a nearby state. Often these programs publish e-newsletters which will keep you up to date during the season on disease and pest outbreaks. In addition, these land grant institutions serve farmers by testing soil samples, analyzing pests, and diagnosing diseases. At Penn State, we send disease samples to the Plant Pathology Lab. The Lab maintains a web page from which you can obtain instructions and forms for submitting plant specimens for analysis.

You can find organic and natural treatment information on organic gardening sites and permaculture sites. We have already mentioned Peaceful Valley Farm and Garden Supply ([www.groworganic.com](http://www.groworganic.com)) whose chart lists OMRI products (Organic Materials Review Institute). ([https://www.omri.org.omri-lists](https://www.omri.org.omri-lists)) Use search terms such as “organic treatments for powdery mildew” for example.

*Powdery mildew* is one of two main mildews of vegetable and ornamental plants. It is prevalent and spreads in hot dry conditions whereas *downy mildew* spreads in cool wet conditions. Both can devastate foliage, reducing photosynthesis, thereby reducing productivity.

We mentioned above using horticultural oil as a barrier on landscape plants. We use it on lilacs and lungwort, both of which are susceptible. It must be applied before the fungus takes up residence, and reapplied as rain reduces its effectiveness. If you’ve missed that window, you will want something that kills the spores. One inexpensive treatment is a mixture of baking
soda and green Palmolive liquid detergent (original formula). Per gallon of solution use 1 teaspoon of baking soda and 2 teaspoons of green Palmolive.

Potassium bicarbonate is a stronger antifungal than sodium bicarbonate, and is used in such commercial products as Milstop and Kaligreen. You can make your own. Use it straight or mix 50-50 with baking soda. Get baking soda from the supermarket and potassium bicarbonate from Amazon. (https://www.amazon.com/Potassium-Bicarbonate-Earthborn-Elements-Pharmaceutical/dp/B07B8W4LFX/ref=sr_1_20?keywords=potassium+bicarbonate&gid=1552169212&s=gateway&sr=8-20) Tania ordered a 2.5 # tub for $20. Will last a long time. Use 2t per gallon of water. You may require a spreader/sticker e.g., commercial or 1-2 teaspoons natural dish detergent/gal water (see note below).

Other remedies for powdery mildew are liquid sulfur emulsion and copper soap. You will read how we use these in our Spray Schedule: (http://www.neo-terra.org/uploads/2/5/6/4/25644359/19spray_website.pdf).

Basil blight. Basil blight is a mildew similar in appearance to downy mildew that infects basil. It appeared for the first time a few years ago in the Northeast as summers became wetter and cooler, and is now endemic. We now plant 3 crops in succession and watch the plants like hawks for signs of an outbreak. When that occurs, we spray with a hydrogen peroxide solution (see Spray Schedule for recipe) but if bad weather continues, the smart thing to do is harvest completely and use, dry or freeze. Avoid spacing plants too closely. Plant in sunny locations where air circulation is good. Tania has had good luck planting one plant in a pot and placing it on our deck for immediate use. Purple ruffles basil is much less susceptible than Genovese.

Brown rot of peaches, plums, cherries and other stone fruit. This is a common disease, particularly in the humid northeast, and requires frequent attention. It is hard to control, but attention to its symptoms and other preventative measures (proper pruning, pruning of diseased shoot tips from which it proliferates, removal of infected fruit) pays dividends. We have a detailed protocol for applying organic principles and practices to the control of brown rot of peaches in our Organic Garden Primer, Part 3, pages 45-48 (http://www.neo-terra.org/uploads/2/5/6/4/25644359/og_primer_website_2013.pdf). We use a liquid sulfur emulsion. Powdered sulfur, mixed in water, clogs the sprayer. Our specific spray protocol is in our Spray Schedule: http://www.neo-terra.org/uploads/2/5/6/4/25644359/19spray_website.pdf.

Black rot of grapes. This is a common disease of grapes in the northeast and also requires frequent attention to control. We have a detailed protocol for applying organic principles and practices to the control of black rot of grapes in our Organic Garden Primer, Part 3, pages 48-50 (link previous paragraph). We use a copper soap, (https://www.gardensalive.com/product/soap-shield-flowable-liquid-copper-fungicide-3) a contemporary version of the traditional Bordeaux mixture. Our specific spray protocol is in our Spray Schedule: http://www.neo-terra.org/uploads/2/5/6/4/25644359/19spray_website.pdf.

Phomopsis. Twig Blight of Blueberry. This is a fungal infection of new shoots and buds leading to necrotic tissue that spreads. On new growth the tops may curl and turn reddish brown. Here’s an advisory from Ohio State: https://ohioline.osu.edu/factsheet/plpath-fru-45. We prune and use a sulfur spray.
Spreader/Sticker. You will notice, when applying chemical agents in sprays, that depending on the formulation of the agent and the leaf surface, the spray may either stick to the leaf or bead and roll off. You want it to cover the surface completely, both top and bottom. What to do in the case where the liquid beads? Use a spreader/sticker. These are sold commercially under such names as Therm X70 (https://www.groworganic.com/search?q=spreader+sticker) and Miller Nu Film. I find a natural dishwashing detergent works well. Try 1-3 teaspoons per gallon of spray mix and then test. Use more if necessary. Record what works for that particular spray combination (which is what we do on our Spray Schedule).

END