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Sand - That Wonderful Stuff

by William Simmonds

Everything you want to know about sand and how it holds water, grass and how to get rid of it, and mulch and where to get it.

The vast majority of Floridians garden in sand. To the casual observer, all sand looks and feels the same, but upon closer inspection, sands differ considerably -even sand from only a few inches to a few feet apart.

Talk to northern gardeners and tell them you garden in almost pure sand. They will pity you, and they will envision that your garden consists of a few sorry-looking specimens of scraggly plants and some sand burrs. If you show them a picture of your lush green yard, they will not believe that it is growing in sand. They think it takes rich, dark soil, loaded with humus, to get lush gardens.

Where Does Sand Come from?

For most of its geological history, Florida has been under water. With the changing sea levels - depending on the amount of water tied up in glaciers, and that of course dependent on global temperatures - parts of Florida have been under water for varying periods of time. The Lake Wales Ridge, which runs north and south along the central part of the Florida peninsula, is the highest part of the peninsula and therefore has been out of the water the longest. But it, as is almost everywhere else, is sand.

Florida sand has a smooth, silky feeling in your hand

While under water, Florida was built out of sediments from the oceans. Limestone built up to form the base, released from the water by chemical reactions. On top of this, what might be loosely called "sandstone" was deposited. As various parts of what is now called Florida were close to, at, or slightly above the surface of the water, wave action began to break up the sedimentary rock formations, gradually reducing them to what we now call sand. This process took millions of years. Sand was constantly stirred by the waves and the sand particles rubbed against other particles, and gradually all sharp edges were worn away. Sand particles, except new ones, are therefore rounded and smooth. It is so smooth that it cannot be used in concrete construction, because the cement cannot adhere well to the smooth surface. "Sharp" or "builder's" sand must be imported or dug up in deep quarries from levels that did not get a lot of wave action. I have some sand that I collected in Wisconsin along 1-94 where a sandstone outcropping was gradually eroding away. Compared to Florida sand, which has a smooth silky feeling in your hand, this sand is very sharp and rough, and of course the particles are much larger because they have not been worn down by wave action.

Soil scientists have surveyed many Florida counties to determine the origin and nature of the soils. I recently looked at a study done of Pasco County that contains detailed aerial maps of the county with the many soil types carefully delineated on them. Since this survey was done after my house was built, I was able to locate my property on the map and learn the long technical name of my special kind of sand. A few hundred yards to the east was another kind of sand. A half mile to the west was yet another kind. Studies like this have been done for many Florida counties and some are available at the library or U.S. Department of Agriculture Soil Con-servation Service.

Growing Grass in Sand

When I moved to Florida, a task of high importance was to completely eliminate grass from my yard. Ever since my father made me begin mowing the lawn when I was about nine or ten years old, I have hated mowed lawns. I threatened at various times to plant green concrete over my northern yards, but the cost was prohibitive.

While I had not really studied lawns, I had learned through the years that they are ecological wastelands, doing nothing

for the environment. I also concluded that they probably were, in fact, detrimental to the environment, and I have confirmed that since living down here. To maintain a lawn in Florida that begins to approach the rich green grasses, primarily Kentucky Blue grasses, found in the north, requires large quantities of three things. First is water. Second is chemical fertilizers. Third is chemical pesticides. All three requirements are detrimental to the long term economic and environmental health of Florida.

1. Using water to compete with your neighbors for the most beautiful lawn is hazardous to our economic well being. Unless you have a private well, water bills can be astronomical. Of course, using all that water draws down the water table. In coastal areas, this can result in salt water intrusion into wells, which ruins the wells permanently. In more upland areas, wells must be deeper and more costly. Finally, there is the very real possibility that we could run out of fresh water in the aquifers.

As much as 50% of the water put on lawns is lost through evaporation, especially if watering is done in the morning after sunrise. Much of the rest is taken up by plants and, through transpiration from the leaves, is evaporated into the air. Another fraction is lost in runoff. My neighbor's sprinkler system sprays a fair amount of water directly onto the street, and a lot more runs off into the gutter in front of the yard. His yard is the high point of the block, and each morning after the sprayers have been on, the gutters in both directions are damp from the runoff, clear to the street corners at both ends of the block. If we run low on water, the value of his house (and ours) will decline dramatically.

2. Chemical fertilizers can be carried deep into the soil and can poison the water supply. They also enter into the runoff and can poison streams, rivers, lakes, and coastal waters. A friend of mine lives on an arm of Tampa Bay in St. Petersburg. When he bought the house about 15 years ago, you could sit on his dock at high tide and see the bottom. Fish were clearly visible. Now, you cannot see the bottom at low tide, and fish are invisible except when they jump out of the water. The water is a murky dark color. This is largely, but not entirely, caused by two things. First is the runoff of chemical fertilizers. Second is the fact that many people dump their grass clippings into the streams and rivers which feed into the bay. Both practices provide nut-rients that stimulate the growth of algae that cloud the waters and prevent sunlight from reaching aquatic plants, which therefore die.

3. Pesticides also can be carried into the aquifers to poison the water. They are dissolved in the surface runoff and pollute lakes, rivers, streams, and coastal waters. They can kill fish and other marine life. They build up in the food chain and result in seafood being poisonous to humans.

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Mowed lawns present a triple threat to Florida's way of life!

From the Grass Down

If you have any mowed lawn, I invite you to get out your trowel and shovel and try to replicate my findings. Do this carefully and I'll bet you find that your yard is much like mine was.

Looking carefully, you can find below the top of the mowed grass leaves a thin layer of dead clippings. Immediately under this may be a thin black layer of soil, which is humus formed by the rotted clippings. The layer of dead and decaying clip clippings is commonly called "thatch" although it isn't. In fact, if you follow the advice of the County Extension Services and cut a maximum of 1/3 of the grass height at a time, the dead clippings quickly decay into humus. This is a natural process and frees nutrients into the sand.

Next you will find the living roots of the grass. Unless you have the new FX 10 grass, nearly all of the living roots will be within an inch or two of the top of the sandy soil. If you have watered frequently and shallowly' the root layer may be only a half inch or so deep. FX 10 was developed specifically for growing in sand, and it puts roots very deep into the sand, supposedly as much as five feet deep, so that the roots can absorb water from below the level where evaporation takes place.

Below and mixed with the lower parts of the living roots will probably be a layer of true thatch. This consists of dead grass, root stolons, and rhizomes. Thatch normally would have been broken down by the action of earthworms and insects living in the soil. If you have used chemical fertilizers and pesticides, worms and insects probably don't exist. You have killed them. Stolons and rhizomes are made by nature to resist rotting, for otherwise they could not function properly under-ground. Even though dead, the thatch does not decay easily and can build up to an inch or more, preventing water from passing, which increases run off and is a perfect medium for fungi and plant diseases to develop. Remove a part of the thatch and you will find that the sand underneath is bone dry, even after a heavy rain.

If you have watered infrequently and deeply, this layer of true thatch may be thin or nonexistent, but most Florida lawns have a noticeable thatch.

If you have any areas, however small, where there is only bare sand, you probably can find a thin layer of soil that is crusted, and pieces of crust as large as an inch in diameter can be lifted off the underlying loose sand. This crust is caused by "fillers" and "binders" left over from fertilizers and pesticides. Remember that 6-6-6 fertilizer you poured on your lawn? Well, the sixes are the percentages of nitrogen, phosphorous, and potassium, so only 18% of this fertilizer, perhaps the most commonly used in Florida, is nutrients. The rest is fillers to make up the bulk necessary for fertilizer spreaders to operate -- they cannot spread dust, so fertilizer must be formed into little pellets. Since straight nutrients can "burn" the grass, fillers serve to dilute the nutrients down to non-burning levels. To hold the pellets together, binders, which act like glue, are necessary. Fillers (such as sand) and binders, together with organic and inorganic material at the soil surface, can form the sandy crust. It acts to prevent water from filtering into the sand and

increases runoff of water. Prove it to yourself. Put a few drops of water on the top of the crust. It will just sit there until it evaporates without ever penetrating the crust, which is only 1/16 to 1/8 of an inch thick. The sand immediately under the crust will be bone dry, even after a heavy rain.

Below the thatch is a layer of gray sand with noticeable flecks of black or gray mixed throughout. This layer may be from 4 to 12 inches thick, but mostly around 6 to 8 inches in Florida, unless the soil has been tilled deeper on a regular basis. What gives this sand its gray color are nutrients that are being washed down into the sand from. the surface. If you were to dig in the soil of a wilderness sand hill (Please don't!), you would find the same gray layer of sand, which proves that the color doesn't come from chemical fertilizers or pesticides. If you dug a wide hole in that wilderness sand, you would find that virtually all of the roots of the trees and plants are contained in the gray layer. Thus the gray layer has the nutrients constantly replaced by decaying natural surface litter and dead and decaying plant roots. These nutrients are moved by water filtering down through the sand.

This article is leading up to the elimination of grass in your yard and its replacement with mulch and native plants.

Under the gray sand is a thick layer of yellow- or tan-colored sand. This is the natural color of the sand, and you will find few if any black or gray flecks of organic material. All the rains and watering simply cannot move the organic material below the top layer of sand.

If you could dig down 10 feet or more, you may run across a thin, black layer of soil. This is called hardpan, an accumulation, built up over hundreds or thousands of years, of the little bit of organic material that is washed down that far. The hardpan is a virtually impermeable barrier to further water movement. If the hardpan is closer to the surface because of erosion of upper layers, the soil can become water-logged. Hardpan is usually found only in areas that are very flat so that surface runoff is limited.

In some areas, a white sand may be found either on the surface or deep in the yellow/tan layer. I have found two explanations for the white color. First, applied mostly to white sand on the top of the soil, is that it is sun bleached. Sand in the Lake Wales Ridge area is very white, and of course has been exposed to the sun for the longest time of any sand in Florida. Second, usually applied to the deeper white soil, is that it is chemically bleached by chemicals dissolved in the water filtering through it. The sources I consulted had no consensus on how sand became white.

Where We Are Going

Now let's turn to the problems of getting water and other nutrients into the sand so that it can provide an adequate medium in which to grow a lush green garden without irrigation, chemical fertilizers, or pesticides. To prepare for this, go into your yard after a heavy rain and do some digging in several places. Examine a place that has turf on it. See how far the rain has penetrated into the sand. You may be surprised to find that the sand is very dry, even dusty. Examine some areas that have been mulched. Did the rain penetrate or is the sand dry and dusty? Try several places, some in full sun, some shaded half the day, close to the house, and under some trees. Record your findings so that you can apply the knowledge to the various areas of your yard.

This article is leading up to the elimination of grass in your yard and its replacement with mulch and native plants. Covering an entire yard with mulch takes a lot of work and, if you have to pay for mulch, it can be quite expensive.

Free mulch is available from the city of New Port Richey and some other cities that recycle yard waste. I understand that if you live in New Port Richey, they will deliver a dump truck load to your yard for free. If you go there during working hours with an open bed pickup truck, trailer, or other truck, they will load it with a front end loader without charge.

And now let's turn to the process of eliminating turfgrass and getting the yard ready for planting trees, shrubs, and flowers. Of course, never planting the stuff is the ideal thing to do, but what do you do when you already have it on your yard?

How to Get Rid of Turfgrass

There are several strategies to get rid of turfgrass. In the process of completely eliminating grass in my yard, I have tried several of them and can report on their relative efficiency.

Mulch alone, spread on top of grass, will not kill it. The mulch simply provides nutrients to the grass, which will grow right through any reasonable depth of mulch. You must cover the grass with some barrier that it cannot grow through or kill it with heat or chemicals.

Any garden center will be glad to sell you a perforated plastic barrier, made of the same material as garbage bags, which comes in rolls. The wrapper says that air and water will pass through the perforations, but weeds and grass won't. In fact, however, the perforations are far too small and too wide apart to let any appreciable amount of water penetrate to the ground. If you lay a piece of this on your yard and pour water on it, the water will just sit on top of the perforations until it evaporates. Inexpensive, but it doesn't do the job!

Another artificial material is DeWitt Weed Barrier (1-800/888-9669 for information and local dealers). This is a black, woven fabric that is very strong and very tough. It easily passes water and air to the soil. However, it is quite expensive. You can see this material at many plant nurseries where it is often used as a weed barrier under potted plants. I have not used this product myself.

Many people suggest using newspaper, which is, of course, free. I tried this, and it frankly doesn't work very well. Grass has a strong will to live and grow. It finds the gaps in the newspaper, even if you overlap sheets by up to a foot, and grows right out into the sunlight. I spent several months and a lot of Roundup® trying to suppress this process before finally killing all of the grass covered with newspaper. Another problem is that it really takes two people, one to hold down the newspaper and one to spread the mulch. Otherwise you will spend half your time chasing newspapers blowing around the yard! Finally, while the newspaper will get wet in the rain, not

much water penetrates down to the sand underneath until the newspaper begins to break down. In my judgment, newspapers simply aren't worth the trouble.

Another possibility is to kill the grass by covering it temporarily with plastic sheeting, preferably black. I tried this using two different kinds of plastic. In some areas, I simply used the perforated plastic barrier material that I found unacceptable because it doesn't pass water or air very well. These attributes make it an ideal temporary cover because it gets very hot underneath it, raising soil temperatures high enough to kill the grass and roots. This worked well, but it takes about three to four weeks to be effective. In other areas, I used some transparent plastic drop- cloths. This worked okay, but because it passes light, photosynthesis takes place under the plastic, and it takes longer to kill the grass. This plastic broke down from the ultraviolet light rays and, unlike the black plastic, was not reusable. Since both of these types of plastic blow in the wind, you will have to weight the edges down to keep them in place.

Finally, for those willing to use chemicals, Roundup® works wonderfully well. Providing it doesn't rain for a day or two after application, this will pretty much kill the grass and weeds in two weeks. Some areas may require some spot application after that because the plants were less sensitive to the chemical or because you didn't get enough chemical on them.

If I had it to do over again, I simply would apply Roundup@ to the entire yard. It is quick and easy to apply and the reduction in labor is well worth the additional cost.

You might ask, why not just remove the grass by digging it up? Several reasons. First, it would be an enormous amount of work unless you have a front end loader handy, and then you would have to cart it away somewhere and clog up a landfill. Second, you would expose all kinds of weed seeds to growing conditions andyou soon would spend all your time pulling them. Third, the dead grass has value where it is: it will eventually decompose and provide nutrients to the plants you want to grow.

Where Roots Grow

Except for plants that naturally grow in water, roots require oxygen in the soil to grow. Remove the oxygen by water-logging the soil and roots will not grow. Sand naturally contains a lot of oxygen because of the large pore spaces between grains of sand. The pore spaces are approximately 60% of soil volume for sand. Contrast that with only 30% for clay soils. This is because sand particles are 0.02 to 2.00 min in size so particles do not fit as tightly together as in clay, where soil particles are less than 0.002 mm in diameter.

Never planting grass is the ideal thing to do.

Roots will not grow into soil that is dry. Since the plant gets no reward of water, and therefore no nutrients which are dissolved in water, the roots simply stop growing in the direction of dry soil and increase their growth in wet soil instead.

Remember that bone-dry sand you found in your yard? It contained no growing roots. You could easily scoop up handfuls because of the lack of roots.

How Sand Retains and Passes Water

This section gets a little technical, but with careful reading comes the reward of complete understanding of sand dynamics so you will be better able to manage your garden.

Water in soil is described by three processes that keep it there.

Under normal conditions (as in northern gardens), each soil particle is covered by a thin film of water a few molecules thick. It is held in place by strong attractions between the molecules in the sand and the water molecules. Even plant roots cannot break these bonds and remove this water. The roots stop growing if this is all the moisture in the soil. Sand having only this thin layer of water molecules is what we normally would call "dry". As books written by authors in northern states often say, this thin film of water can be driven off by heating the soil in an oven. In Florida, the summer sun has the same effect on the sand, driving off this thin film of water. The sand becomes truly bone dry and virtually impossible to rewet. This thin film is called "hygroscopic water".

Water moves in soil by two separate processes: capillary action and gravity. Remember the old saying, water finds its lowest level? It simply means that gravity will always move water downhill or down-wards in the soil. Capillary action, on the other hand, can work against gravity. Water will climb up inside a small tube against the force of gravity because of attractions between the molecules of the tube and the molecules of the water. Think of the sand particles as sur-rounded with small capillary spaces, so some water can move upwards in sand against gravity. Because sand particles are so much larger than clay particles, the capillary spaces are larger and work less effectively than the smaller spaces in clay. The water held in the soil by capillary action is called "capillary water".

In well-drained soils (read that as sand), the largest spaces between sand particles hold water for only a short time before gravity forces it down deeper into the soil. This third kind of water is "gravitational water".

Now I must introduce a few other concepts and your understanding of sand dynamics will be complete. The water content of soil is expressed as the percentage of the dry weight of the soil.

The "permanent wilting percentage" is the point at which plant roots can no longer draw off the remaining molecules of water in the soil. These molecules are the hygroscopic water,, that thin film of water on each sand particle. For sand, this is approximately 3%. At this point, plants permanently wilt (read that as die).

The "field capacity" is the percentage of water when the soil is holding all of the capillary water that it can hold. This is the sum of the capillary water and the hygroscopic water. For sand, this is roughly between 5% and 7%.

The difference between the field capacity (say 7% for sand) and the permanent wilting percentage (say 3% for sand) is called the "storage capacity" of the soil (approximately 4% for sand). To put this in perspective with northern gardens, clay has a permanent wilting

percentage of approximately 20%, a field capacity of approximately 45%, and therefore a storage capacity of 25%, or about six times the storage capacity of sand.

Now remember the gravitational water. When it rains, the uppermost sand absorbs water above the field capacity and, as it reaches saturation, water begins to move downward in the soil by gravitational force, raising successively lower layers up towards saturation, when water will move even deeper into the soil and so on as more and more rain falls. But the soil cannot permanently hold the water above the field capacity. Within a few days of the rain, the excess water has moved, by gravity, lower and lower into the soil and the upper layers are reduced to the field capacity that is being held by capillary action. The downward movement of water stops when all of the soil above has been reduced to the field capacity. All lower soil is dryer than field capacity and no further water will move into it because all available water is being held by capillary action.

How to Get Dry Sand Wet Again

Now remember back to that bone dry sand we discussed earlier, where the thin film of water molecules has been driven off by the heat of the summer sun. It will not absorb water; water will either run off or evaporate.

As any cook can tell you, when you add water to dry ingredients such as flour, the water does not mix in easily. In fact, it will simply sit on top of the flour for hours. Considerable stirring is necessary to blend the ingredients. This simple fact was forgotten on the shuttle flight where the test of making bread in zero gravity failed. They forgot all about stirring the water into the flour in space. The surface tension in the water holds beads of water together rather than allowing the water molecules to infiltrate into the flour.

One thing that soap does is to break up the surface tension of water. Pat Chellman of the Suncoast Chapter adds Ivory dishwashing soap to water before she sprays it on sand in which she is attempting to start plants. By this simple action, water will restore the thin layer of molecules, the hygroscopic water, to the bone-dry sand. When you are preparing bone-dry sand for planting, you should do the same thing.

How To Keep Sand From Losing The Hygroscopic Water

If you leave bare sand in the summer sun, it will dry out. By covering it with 2 to three inches of mulch, you greatly reduce the surface temperature of the soil and it will not dry below the hygroscopic level. Therefore, it will keep absorbing water as it rains rather than increasing runoff.

It is best to apply the soapy water before spreading the mulch, because you won't need to mix and apply so much water. If you killed the grass with heat or with Roundup@, you can apply the mulch directly on top of the dead grass. I found it best to first cut down the stubble with a string weed cutter, but a lawn mower probably would work as well if you set the blade as low as possible. That way the stubble will not stick up through the mulch. If you use newspaper under mulch to kill the grass, you probably should apply the soapy water before laying down the newspaper. Otherwise, you will just be wetting the newspaper and mulch, not the sand.

Why mulch? First, it reduces evaporation from the soil. Second, it reduces soil temperature. Third it helps suppress weed growth.

Now let's turn our attention to mulch. The purpose of mulch is to provide a substitute for the natural litter of the forest floor. If you go into a wilderness community, you will find that there is little in the way of bare soil. Instead the floor is littered with dead leaves, pine needles, fallen branches, dead herbaceous plants, and occasional fallen trees or shrubs. On the average, only about 7 to 10% of the biomass of a wilderness area is consumed by herbivores. The rest falls to the ground and is decomposed by the action of microorganisms and saprophytes. The decomposition releases nitrogen, phosphorous, and potassium back into the soil. Remember that these are the three major ingredients of fertilizer.

In case you're not familiar with some of these terms, biomass means the dry weight of living material; in this case, plants in a forest. Herbivores are animals that eat plants. While we normally think in terms of large herbivores such as deer and cattle, in fact, most by far are insects, and they consume far more than large herbivores do in natural ecosystems. In human modified ecosystems, such as pastures, cattle will consume far more biomass than insects do, more than 10% of the available biomass. Saprophytes are plants that live off dead or decaying organic matter; they usually lack chlorophyll. One example of a Florida native saprophyte is Indian Pipe *(Monotropa uni*flora), found in scrub and deciduous woods.

Why should you want to have a substitute for natural litter? Why mulch? There are several good reasons to use mulch. First, it reduces evaporation from the soil, thus saving water for the use of the plants you want to grow. Second, it reduces soil temperature, which allows root systems to function better. Third, it helps suppress weed growth and makes weeds easier to pull because they are rooted in the mulch, not the soil. Many weed seeds need to be exposed to light to germinate. Whenever you disturb the soil surface, you bring some of these seeds to the surface, and they will germinate if you don't cover them with mulch soon after disturbing the soil. Fourth, mulch decomposes and provides nutrients to the soil. Fifth, because most mulches are very porous, they absorb surface water and therefore prevent surface runoff, conserving the water for your plants and preventing erosion of the topsoil.

The next question is, what kind of mulch should I use? There is not a simple answer because it depends on what is available to you.

Many bark- and wood-based mulches are available commercially. The problem is that some of them are created by environmentally unsound practices. Years ago, before mulching became common, scrap bark and wood from lumber-making was used for mulch. It still is, but the demand for mulch has outstripped this source of supply. Today many mulches are made by cutting down trees to use the entire tree as mulch. Much of the Green Swamp in East Pasco and adjoining counties is being denuded of cypress

trees to get commercial cypress mulch. I personally would not touch this kind of mulch with the proverbial ten-foot pole. Some sawmills sell sawdust and bark chips at modest prices by the cubic yard or truck load. This doesn't harm the environment because the trees are being cut anyway for lumber.

There is one mulch on the market made from whole trees that is, in fact, an environmentally sound product. This mulch is made from the *Melaleuca quinquenervia*, or punk tree. This tree was imported from Australia about 100 years ago to be used to dry up the Everglades. It is now spreading as a noxious weed and doing much harm to the environment, so mass cutting of it is desirable. This mulch has been composted so that no viable seeds remain. You won't get a crop of punk trees when you use this mulch.

You can get wood chip mulches from many tree removal services. Most will deliver you a truck load free. This kind of mulch has several potential problems. First, it has not been composted, so it probably will contain some viable seeds that will sprout. Second, since some of it comes from diseased trees, you run the risk of transferring the diseases to your own yard. Third, since it has not been composted, it will be very slow to break down, and in the short run may take nitrogen from the soil because nitrogen is necessary to start the process of decomposing. Many people use this type of mulch for driveways, parking places, and pathways in the yard because it does decompose slowly. I plan to use wood chips across the front of my lot to provide a parking strip since no street parking is allowed in my subdivision.

It is a sin to discard grass clippings with the garbage!

Some or all of the above mulch types will float in water and may simply float off your yard into the street. Some commercial wood or bark mulches have been treated so they won't float. Check around and you will find them.

Composted mulch from yard waste is available from some recycling centers.

Composting yard wastes from your own yard, particularly grass clippings, will provide considerable amounts of mulch each year, but probably not in a steady supply. Since I have eliminated all grass from my property and leave all leaves and twigs where they fall, I cannot do this. If you are still mowing grass, you should either leave the clippings on the lawn or compost them. It is a sin to discard them with the garbage!

Bill Simmonds started the Nature Coast Chapter in 1992, but died suddenly in May, 1993. This article appeared in three issues of the Nature Coast Newsletter, and is reprinted here with permission of Bill's son, Ed.

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