State Climatologist Addresses Pittsboro Audience

“Bermuda high” that normally influences our summer weather from the North Atlantic had moved over west Florida. The result was that rain that might normally have fallen over the southeastern United States had left us high and dry while creating floods in Texas.

By winter the Jet Stream had been pushed north by La Nina such that winter storms with their accompanying precipitation were more common in the Ohio Valley than east of the Appalachians.

Boyles was more willing than most weather forecasters to acknowledge how much is unknown. He suggested that summer weather patterns in the southeast are generally not predictable more than a few days out.

Hurricanes can be predicted fairly accurately on a global basis but not very well locally. He observed that predictions for 2007 included 16 named storms in the Atlantic. There were actually 14 with two Category 5 hurricanes making landfall. But none of them affected the United States, inflicting their damage on Central America instead.

Winter recovery from drought is a little more predictable. From a historical basis Boyles sees the possibility of a dry winter ahead, “but it’s too early to tell.”

Boyles concluded by acknowledging that 2007 was indeed the driest year for which we have rainfall records. But much older data from tree ring analysis suggests that our area has seen much drier periods in the past. “If it’s happened before,” Boyles suggested, “there’s the possibility that it could happen again.”
Turfgrass and 60 Days of Drought

Researchers at Texas A&M have spent two seasons evaluating warm season turfgrasses for drought tolerance. The results submitted in February 2008 are available for review at http://itc.tamu.edu/documents/2008FinalReportSAWS&TPT_s.pdf

The studies were conducted at A&M’s Irrigation Technology Center using the Center’s drought simulator, a 5,000 square foot roof that can be deployed or retracted in less than 2 minutes in response to as little as 0.01 inch of rain.

The studies sought to identify warm season grasses capable of surviving a 60-day drought without irrigation 1) on local agricultural soils and 2) on shallow (4 inch deep) soils. There were 4 replications of 25 grasses on the two soil depths repeated in two successive years. Grasses were planted by sodding, established for 9 to 10 months, and then subjected to a 60-day drought starting in July of 2006 and 2007. The study continued with rating the grasses for recovery during the following 60 days.

Grasses used included 8 varieties of Bermuda, 7 of St. Augustine, 9 of Zoysia, and 1 of buffalograss. All were established from washed sod to minimize differences resulting from the soil on the sod at time of planting.

Preparation consisted of light tillage and hand raking for the native agricultural soil with minimal restrictions to root growth. To create a 4-inch soil depth, 4 inches of soil was removed. The subgrade was hand graded and covered with 30-mil plastic. The 4 inches of removed soil was then replaced and graded.

The sites were fertilized according to soil tests prior to planting. During establishment, additional nitrogen was applied, fungicides were used preventively, and the plots were mowed. Irrigation was applied to prevent moisture stress and to enhance establishment. The 4-inch depth plots required more frequent irrigation to prevent stress.

Mowing continued through the induced drought period until no longer needed due to very little growth and to reduce unnecessary stress. After 60 days irrigation was resumed and used such that water was not a limiting factor. Plots were fertilized and mowing resumed.

The study characterized weather during the 60 days in 3 increments of 20 days each. Average daily high temperature for the 3 periods in 2006 was 95.5, 97.9, and 89.1. Temperature was a bit kinder to them in 2007 with averages of 86.9, 90, and 90.

The 60-page report includes a tremendous amount of data on details such as potential evapotranspiration, soil moisture content, overall turfgrass quality, color ratings, leaf firing, percent living ground cover, and uniformity during the induced drought as well as during the recovery period.

So what did they learn?
1. None of the grasses survived and recovered in either year when planted with a 4-inch rooting depth. (This result alone has serious implications for laying sod without tilling first.)
2. All grasses survived and recovered when grown on native agricultural soils. (Taken with the results of #1 above, we can continue our assumptions about preparing soil prior to sodding.)
3. Relative impact of soil depth needs better quantification; the methods of constructing the 4-inch depth may not be consistent with landscape sites.
4. Survival and recovery should be evaluated at both early and late stages for a better categorization of drought resistance and recovery. Not all Bermuda grasses performed as well as expected and at least one St. Augustine variety performed better than predicted for the species.

In a little over a page we have summarized more than 2 years of research and 60 pages of analysis. This summary should not be taken as a suitable substitute for reading the entire report. If you are committed to the lawn, there is a lot more that is worth your attention. Note that none of the grasses evaluated were cool season grasses.


Pesticide Collection

Unwanted pesticides will be collected at the Siler City location of Southern States on Wednesday, November 19 from 10:00 a.m. to 2:00 p.m. Chatham County Center of North Carolina Cooperative Extension will cooperate with the NC Department of Agriculture’s Pesticide Disposal Assistance Program to provide this service.

The goal of the Pesticide Disposal Assistance Program is to assist citizens of North Carolina by managing and supervising the safe collection and lawful disposal of banned, out-dated, or unwanted pesticides and to provide an available, affordable, and environmentally acceptable mechanism in which any homeowner, farmer, or institution can properly dispose of unwanted or unusable pesticides.

Residents can only expect this service to be available within the county about once every 3 to 4 years. Persons with pesticides that need to be disposed should reserve this date now. You may want to begin looking in cabinets and storage areas to see what you have and collect it in single location. Pesticide

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Building Soil in Chatham County

Yes, you can! I get lots of questions that seem to assume if we can get just the right fertilizer in our soil, then everything will be fine. Fertilizer is neither food nor medicine for plants. And in fact, fertility is often not a limiting factor for growth in local soils. It would appear from my conversations that soil compaction might be the most limiting factor or at least the one that gives gardeners the greatest difficulty. (See Turfgrass and 60 Days of Drought in this issue for more on limited root zones.) Let me say at the outset that alleviating this problem is neither easy nor quick. It usually takes either deep pockets or a strong back or both plus a long time. So if you’re looking for a quick fix, the best I can suggest is to think small. Imagine an area of soil that you can easily work in an afternoon and save the rest for next year. If you try to do it all at once, it may be so frustrating that you give up in despair. So start small and set yourself up for an early success.

Envision a pile of rubble. Think of small animals like mice or lizards moving in and out of that pile. For them, the significant aspect of that pile of rubble is not the pieces that make up the pile; the significant part is the spaces among the pieces. Soil is similar and roots need the spaces too. If you break soil up into its components, soil scientists suggest that an “ideal soil” might be about 50% soil particles and 50% pore space. The size of the pore spaces affects water infiltration, drainage, and aeration. Curiously enough, the size of the pore spaces is relative to the size of the particles. I won’t go into the numbers but clay and sand are defined by the size of the particles. And as you may know much of the local soil includes a lot of clay.

Clay particles are very small (less than 0.002 mm). It follows that the pore spaces within the clay soil are also very small. Go back to our pile of rubble. If you crush all the pieces down to the size of 2-inch gravel, then the size of the spaces may prevent use by rodents. We’re down to insects or very small lizards. And if the 2-inch gravel becomes pea gravel, the pore spaces again get smaller.

Very small clay particles allow only very small pore spaces. What are the implications of small pore spaces? Water infiltrates slowly (often stands on the surface). Water drains slowly. Aeration is poor. This is not a good situation for growing plants.

Now let’s add another complicating factor. Perhaps you have in your yard or know of a footpath, dog run, or some similar area subjected to regular traffic. Take a shovel and observe how difficult it is to dig that compacted area compared with a lawn or similar area not subject to foot traffic. Many will be able to detect a difference. The particles subjected to foot traffic have been pressed tightly together further reducing the amount of pore space available. That problem is called soil compaction.

Soil compaction is a factor that makes our soil difficult to work. It is likewise difficult for plants to grow roots in compacted soil. Why is it compacted? In many cases soil compaction results from the activities associated with building the houses in which we live.

First there is the land clearing equipment, which may be bulldozers. Soon there will be concrete trucks. And delivery trucks. Delivery trucks unload stuff that will be stacked on the ground – bricks, block, sand, etc. All of this activity tends to press the soil down. And it doesn’t spring back. If you stop to look at a construction site, it’s difficult to imagine that anything will ever grow there. One of my professors once suggested, “There is nothing native to this site.” For many of us it’s difficult to imagine that our home once looked like that. But it probably did.

Between the construction activity and the initial purchase of the house, someone will need to make the place a little more presentable. Sometimes that involves what passes for landscaping or even professional landscape work. Some builders have a crew that puts plants in the ground just like a crew that paints. Some builders hire landscapers. And sometimes the homebuyer has the option to be involved in the landscape process. But unless you see what goes on, there’s little reason to assume they did anything to repair all the damage that was done to the soil. That will explain why it’s so hard for you to dig. If it’s hard for you to dig, imagine how difficult it is for plant roots. What can you do?

Strategies for soil remediation: Following are several different approaches to improving the workability of your soil. There is no one best way. Agriculture teachers focus on the concept of “appropriate technology.” Under that theory, I’m not going to suggest you start with a big tractor and a subsoiler (although that may be an option for some of you). I’m going to trust you to figure out what is appropriate for you.

Do nothing. This strategy is for those who have lots of time. Given a few years, the soil will likely sustain a few plants (crabgrass, ragweed, dogfennel) whose roots will probe and gradually make the soil more suitable for other plants. Subterranean insects (such as grub worms) or rodents (such as voles) should be considered a good sign. With ten to twenty years of neglect the soil may begin to be workable again.

Till – compost – till. This is the strategy for those who have more resources than time and want it done now (!). Either you have the energy to manhandle a tiller or the resources to hire someone to do it. Before you till, consider the trees. Look up and imagine that every tree you can see is falling toward you. Any tree that could hit the tiller probably has roots in the soil that the tiller is tilling. The tree will not benefit from having its roots tilled. (The trees didn’t benefit from construction activities and soil compaction either; but tillage may not improve that damage.) There are disadvantages to this approach, but you want it quick. If the trees are more important than getting it done quickly, then you should choose another approach. If not,

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till everywhere that you would like to plant and grow something – vegetable garden, orchard, lawn, flower beds, shrubbery. Till it all. You may never have this much energy again.

Once the soil is loose, cover it with some decomposed organic matter. How much? No more than 50% by volume. How deep does your tiller go? Probably only 6 to 8 inches. So apply 3-4 inches of compost and till again.

The compost does some wonderful things. One of them is to facilitate the formation of soil aggregates or clumps. Clumping of soil is what we call structure. These clumps function as both large particles and small articles in the soil. Remember soil particles and pore spaces? These clumps function as large particles and create large pore spaces. Large pore spaces are good for water infiltration and drainage. Within those clumps we have small particles and small pore spaces. These small spaces are good for water retention.

Voilà! We have good water infiltration, good drainage and good water retention all in one ingredient! It’s amazing but true that organic material – dead and decomposing – is a good addition to poorly drained clay soil as well as excessively drained sandy soil. It’s like magic. Good stuff. Organic material also provides retention of nutrients when you fertilize. But that’s another article.

Compost – wait – till. This is the option for those who have more time and some resources of energy and material. It is a curious thing that nature makes compost for us. If you can just get some of the raw material and put it on the soil surface, it will break down right there. The breakdown is the result of action of worms, insects, fungi, bacteria, and other microorganisms in the soil. The big ones feed on big pieces, digest some, and deposit the rest. Eventually they die, and it’s all deposited. Smaller life forms work on the smaller pieces until you can’t tell any more what the original material was. That’s a good definition of finished compost – when you can’t tell what it used to be.

At this point you have improved the environment for living organisms in the soil. And indirectly that was your goal: a living soil. 6 months to a year after organic topdressing people often report finding earthworms where there were none previously. That’s a good sign. If earthworms can live there, the soil is workable. Plants can live there.

At this point you may or may not decide to till. The tilling will certainly be easier, because the living things have already done the hard work. And actually, this is about as close to natural as gardening gets. People have called this strategy “lasagna gardening” or “sheet composting” as if we invented it. But the process is older than gardening, older than man.

One further thing about organic matter – leaves, grass clippings, compost, manures, etc. You never add enough, and it’s always going away. It continues to break down. The amount of organic matter in the soil is largely a function of climate. The breakdown process is regulated by temperature and moisture. When you quit adding it, the soil will stabilize. But if anything is growing, then there is always some newly dead material to be recycled.

Cover crops. This strategy is for people with plenty of time and not so much energy or other resources. It may also be for people who have places where they don’t care what the neighbors think. Some guides for establishing cover crops sound as difficult as growing anything else. But it can be fairly simple. Scratch the surface, broadcast seeds, wait a few months, and mow. You may or may not till.

The most difficult task may be the initial soil scratching. It may be possible to do it with a hard tooth rake. You may need to use a tiller just to break the crust. You may be able to do it with a rented verticutter. Scratch the surface enough to allow you to broadcast some seed and rake them in.

What kind of seed. Cover crops are traditionally grouped as grasses or legumes and as whether they grow in a warm or cool season. Legumes have the capacity to take nitrogen from the air and “fix” it in the soil. Grasses and legumes are often used together or in rotation. Warm season covers are grown in summer and cool season covers in winter. (Duh!) For most of us, the crop selected is much less significant than actually planting something!

Warm season grasses include several millets and sorghum-sudan grass. Warm season legumes include lespedeza, clovers, cowpeas, garden peas, and soybeans. There’s also buckwheat, which is neither grass nor legume.

Cool season grasses include annual ryegrass, cereal rye, oats, and wheat. Cool season legumes include crimson Clover, Austrian winter pea, and hairy vetch.

Don’t make a career out of deciding which cover crop to plant. Remember you’re not expecting to harvest anything from these crops. You’re using them for their capacity to improve your soil. There’s a lot to managing them including when to cut (before they set seeds) and whether to till or plant through the stubble. Do find out how tall the cover crop may grow; you may need to mow it more than once to keep it within the capacity of your mower. Many of us don’t have mowers suitable for cutting grass 6 feet high! But you will usually find the soil much more readily workable after the cover crop. And you have a new supply of mulch or organic soil amendment.

You can learn a lot more about cover crops from Sustainable Practices for Vegetable Production in the South at http://www.cals.ncsu.edu/sustainable/peet/cover/cover.html.

Raised beds. I guess the primary reason for raised beds is to improve drainage. Sometimes it’s a way to introduce
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workable soil on top of something like rocks or concrete. Because the beds are raised, there is a height differential that allows excess water to drain out. It’s useful to remember, however, that just as a sponge can absorb water from below, a soil may hold more water than is desirable – even against the pull of gravity. A soil with small particles and small pore spaces may still be poorly aerated – because the pore spaces are still small and retain a lot of water. So elevation alone is not sufficient for good drainage.

And that raises the question of what you use to raise the bed and how. It’s a good idea to first till, or at least loosen, the soil beneath the area to be raised. Usually you’re going to need a working area where you stand or walk around these beds. Soil from these working areas can be robbed to help create your height differential. The bed is raised and the path is lowered. Organic material such as compost can also be added to increase the volume and improve aeration. All of this can be retained with the building material of your choice. Wood, rock, brick, concrete block. If you choose, you can make a seat around the edge. Such a seat makes raised beds excellent for people with bad backs or legs. Sit down gardening! My day is close.

Working with your soil. I have developed an affection for my garden fork. If you are not familiar with this tool, it resembles a pitchfork. But a pitchfork will not do the work it does. It has a short straight handle. The tines, usually 4, are about as wide as your finger and just as thick. Viewed in cross section the tines are nearly square.

This tool is stuck into the soil as far as you can get it with your foot or your full weight. Then rock it back and forth. Don’t try to dig with it like a shovel. Just pull back on the handle and watch the soil rise and crack. (Now you see why the pitchfork won’t do this; and you can see that the cheaper fork with flat tines won’t last long either.)

I use this tool to completely loosen a bed when necessary. A small bed is preferable depending on age and energy level. If the soil is compacted and has never been worked, it may take some effort for small result. OK, it will take some effort regardless.

And the amendments to use. Almost any organic amendment is suitable for soil incorporation as long as you can’t tell what the original material was. Garden compost, commercial compost, rotted manures, leaf mold... The one that I don’t use in clay soils is peat. Peat has its place. In container media it is good because it helps to hold moisture. If you have clay soil, you already have good water retention. Drainage will be more helpful. Peat is also slow to absorb water. You can float it on a bucket of water perhaps for hours. Clay soil is also slow to absorb water. So the characteristics that peat brings are not those that are useful in many clay soils. It’s great for improving water retention or reducing excess drainage in sandy soils.

There’s also a non-organic amendment that you may find useful. It’s not sand; they add sand to clay to make brick as some have discovered the hard way. But you can add pea gravel or some similar product sized about 1/8 to 3/8 inch. These materials provide the big particles that go along with big pore spaces. They improve water infiltration and drainage.

Whatever material you add to your soil it must be incorporated. You don’t want 3 inches of something on top of what you already have. You may find water still doesn’t move readily into the clay beneath. Roots won’t either.

And if you’re buying “topsoil” out of the back of a truck, take what you get. There is nobody (nobody!) mining and selling topsoil within an economical hauling distance. People do clean ditches and things like that and often sell the byproduct. And some compost processors call what they sell “topsoil.” It may be compost or mostly compost. If it’s a bagged product, read carefully to see what is in it. What you already have is possibly topsoil. It may just need to be reinvigorated.


I deal with many questions about lime. Let me start by saying that lime is not essential to plant growth. It is a source of some plant nutrients but not the only way to get those nutrients. We can grow plants without lime, but that isn’t a complete description of the complex roles that lime may play in our soils. In many cases, lime may be an important soil amendment if we are to be successful in our gardening efforts.

North Carolina farmers have used various liming sources for generations. These sources have included mined limestone deposits, oyster shells, fossilized marine deposits called marl, or extracts from Indian shell middens. Farmers understood the benefits of lime well before they knew the how or the why. But as early as 1850, North Carolina’s State Agricultural Chemist James Higgins was laying the groundwork for standardization of liming materials (taken as a given today) and soil analysis prior to application (something at least professionals today take as a given).

Higgins suggested that if the state could show “proper adaptation of particular varieties of lime to particular soils, the State would derive an hundred times

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more benefit from it, than the cost has been for its maintenance.” Today the state of North Carolina does provide standards for lime that is sold in the marketplace and provides soil analysis at no charge. That service is provided because agronomists and horticulturists today understand that when used in amounts proper for the soil to which it is applied, the cost of liming is less than the benefit of its application. How is that so?

Soils in North Carolina tend to be acidic, less than 7.0 on the pH scale. This acidity is a function of geography and climate. Anything we do to alter it will be temporary at best. But for growing plants that are healthy, vigorous, and lacking in major problems there are short-term things we can do that make a big difference.

Of first importance is understanding the problem of acidity. One of the biggest problems is that as the soil gets more acid, the availability of certain essential plant nutrients decreases and at least one known toxin increases. At a pH level below 5.0, aluminum that is naturally present in most soils and toxic to plants becomes much more soluble and is readily absorbed by plants. At the same level many plant nutrients become chemically bound up in the soil and not available for plant use.

Neither the condition of aluminum toxicity nor nutrient deficiency is likely to be fatal. But they will lead to plants that are not healthy or vigorous. Plants instead will be stunted; slow growing; unattractive; and less likely to produce flowers, fruits, and ornamental characteristics.

In Fig. 1, the wider bars across the chart indicate availability of certain elements from the soil. A look at this chart should suggest why we find that most plants perform best at pH levels between 5.5 and 6.5. Note also that you can apply too much lime. When that happens the pH may increase to the point that phosphorous and some of the micronutrients are chemically unavailable for plant use. Too much is just as bad as too little.

![Relative availability of soil elements over a pH range](image)

How do you know how much is just right? As mentioned above (and admittedly in almost everything an Extension Agent publishes) the NC Department of Agriculture will analyze, at no charge, as many soil samples as you care to submit. They will tell you the pH, they measure potential acidity that needs to be neutralized before the pH can be raised, and they will tell you how much lime it takes to do that.

Can you measure the pH yourself? Yes. I’ve never tried the cheap pH devices you find in garden centers. (See GTP, Summer 2007 for more on these kits.) But for about $50 to $75 you can get a good meter, make a slurry with soil and measure the pH. It’s a little messier than just taking a sample, but you can do it. Of course knowing the pH doesn’t tell you how much lime you need. There’s more to it than that. It’s perfectly normal for two samples with the same pH to have different lime requirements due to the potential acidity not included in pH. You can just send your samples to the NCDA Agronomic Lab in Raleigh and let them tell you how much lime you need.

Benefits of lime:
If you need lime, and if you use it properly, you can expect several benefits to result.

- Reduced toxicity of aluminum and manganese
- More efficient use of fertilizer by plants
- Cheap source of essential magnesium (if you use dolomitic limestone)
- Enhanced microbial activity in breaking down soil organic matter
- Reduced leaching of potassium from the soil

What kind of lime should you use?
As mentioned above, before we had standardized products a number of liming materials were used. We didn’t always know how effective they were. Today commercial products include calcium carbonate (CaCO₃), and dolomitic lime which includes at least 6% magnesium carbonate (MgCO₃).
Pesticide Collection

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containers that are damaged or leaking should be stored in a leak proof container such as a bucket with absorbent material such as kitty litter.

Other waste products will not be accepted. For disposal of other household hazardous waste, please contact Chatham County’s Waste Management Department at 919.542.5516 or visit their web page http://www.chathamnc.org/index.aspx?page=526

For questions about pesticide disposal please call the Chatham Extension office at 919.542.8202 and ask for either Sam Groce or Al Cooke.


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Pure calcium carbonate provides a standard of comparison of liming materials and is rated at 100 percent. Other liming materials are assigned a calcium carbonate equivalent that may be greater than or less than 100. Because dolomitic limestone is slightly more efficient than pure calcium carbonate, it may be rated higher than 100. These materials may be sold as a pulverized material that may fly like dust on the wind. Or, to facilitate distribution, they may be coated to form tiny pellets. The same limestone is available in both forms. The difference for the consumer includes cost, ease of use, and one additional step – pelleted lime should be watered to dissolve the coating before it is tilled into the soil.

Quality of lime:
North Carolina regulates the quality of lime sold on the basis of calcium carbonate equivalent and on the basis of particle size to help you get what you pay for.

There is no minimum calcium carbonate equivalent, but the package must give you a comparison to the state standard of 90%. For example, a product with a calcium carbonate equivalent of 80 would bear a statement to the effect that “2,250 pounds of this material equals 1 ton of standard agricultural liming material.” As the equivalency number goes down, more of the product is required to have the same effect in the soil.

Lime will be more readily effective if it is pulverized (better than crushed) to very small particles. So North Carolina requires that 90% of the product must pass through a standard 20-mesh screen. For dolomitic limestone, 35% must pass through a standard 100-mesh screen; for calcitic limestone, 25% must pass through a standard 100-mesh screen. Screen numbers refer to the number of wires per inch. The more that passes through and the finer the mesh, the higher the quality of the product for soil amendment. Cheaper may not be better.

How to use lime:
Lime is effective only in the soil where it is placed. It is poorly soluble in water, so we cannot expect it to move down into the soil. Surface applied lime works on the surface and may take years to move down into the root zone. For that reason, it is always preferable to apply lime and till it into the soil prior to planting.

Most effective applications are made uniformly over the soil surface and tilled into the soil. Because spreaders are inconsistent at best, it is generally best to apply ½ the recommended amount first, then apply the second ½ at right angles to the first application. When using this procedure, you can apply the full amount – just be sure to till it in.

What if you can’t till it in? For surface applications that will not be tilled (such as an established lawn), never apply more than 50 pounds of lime per 1,000 square feet. If your soil needs more than that, wait at least 6 months before making a second application. In some cases, 3 or more applications are necessary at a minimum of 6-month intervals. Applying in excess of 50 pounds may result in an elevated pH at the soil surface and an excessively low pH an inch or two down.

If surface applications do not move down into the soil for years, should you do it at all? If it takes years to grow a tree, is that reason not to plant one? The longer it takes, the more urgent it is for you to get started if you care about the results in plant growth. If you’re willing to take what you get in terms of less vigorous plants and more weed, insect, or disease problems, OK.

For applications that will not be tilled in core aeration may help. A core aerator opens holes about ½ inch in diameter and 2 to 4 inches deep. Core aeration is a standard maintenance operation for many lawns in clay soils. Better core depth results from aeration done when soils are moist. Aeration holes may allow some of the lime to penetrate deeper into the soil.

Summary:
• Your soil is probably naturally acid.
• Very acid soils usually inhibit plant absorption of essential nutrients and provide uptake of aluminum in moderately toxic amounts.
• A free soil analysis will tell you how acid the soil is and how much lime will improve your soil’s ability to support plant life.
• Lime – if needed – should be applied and tilled into the soil as soon as possible. If lime is needed, there is no better time than right now.