UT Extension

FWF Update Newsletter

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The Tennessee Wildlife Resources Agency (TWRA) announces the availability of grant dollars to assist cities, schools, community organizations, civic groups, watershed organizations, and conservation groups, etc., with stream clean-up projects for the fiscal year 2009-10.

The grant money could be used to buy supplies, such as rakes, work gloves, and garbage bags. In addition, the funds could be used to pay disposal fees for solid waste and tire removal or to provide promotional items such as project advertisement or T-shirts and refreshments for volunteer support.

Five grants, at $1,000 each, are available for each of TWRA's four regional Aquatic Habitat Protection projects (a total of $5,000 per region). The funds will be obligated as grants, so the grantee must have a nonprofit tax number. The projects are to be completed, the money spent, and a report submitted by June 30, 2010. In order to meet this deadline, TWRA would need to receive the proposals as soon as possible.

Grant proposals should include the applicant organization's name, tax ID number, address, phone, and name of a contact person authorized to enter into contractual agreement on behalf of the organization. The proposal should also include the name of the stream, county or counties involved, and the project area and description.

Please contact David McKinney, TWRA Chief, Environmental Sciences, at (615) 781-6577 or by e-mail at Dave.McKinney@state.tn.us if you have any questions

Recommendations for Ice-Damaged Trees

David Mercker, Extension Specialist, Forestry

Recent ice storms have caused wide-spread and in some cases irreparable damage to trees throughout Tennessee. The loss of healthy limbs, particularly when excessive, is never desirable. This is especially the case with large, old and/or weak trees because their ability to replenish food supply can be diminished beyond the point of recovery. In such cases, trees normally begin a gradual starvation that ends in death. The process of dying can occur in a few short seasons or can languish for several years.

Many homeowners are concerned about their trees, whether to save or eliminate them. Professionals often place distressed trees into a "triage" – those that can be saved, those that might be saved, and those that can't be saved. Knowing which category your tree(s) are in, can be challenging and may require professional input.

Complete removal is a difficult decision, but if mortality is unavoidable, removal is a much better option than spending time and money on futile attempts to revive it. As a general guideline, the criteria for deciding whether or not to remove a damaged tree include: when 40 percent of the crown has been lost or severely damaged (crown refers to live branches), if the tree was already declining, or in cases when the tree has become a hazard as a result of the damage. If in doubt as to whether a tree will or won't make it, allow it to stand and assess progress over the next few years.

Younger trees, those 40 years or less, are more likely to recover from damage than are older trees. The prescription for saving trees is relatively simple: regular watering, fertilize in early spring, mulch, very limited pruning during late winter months, and in some cases, eliminating competitive grass directly under the crown. It is not recommended to indiscriminately "top" trees by cutting the ends of all limbs. This will only add stress to an already strained tree.

Damage always appears worse immediately after the storm. Greening of the trees will occur again, and many will make full recovery.

For additional information on treatment for storm damaged trees, see the following University of Tennessee Extension publication: *Storm-damaged Residential Trees: Assessment, Care, and Prevention, SP 575*. You can download this publication for free at http://www.utextension.utk.edu/publications/spfiles/sp575.pdf.

When it is time to replant, go with those species that are time-tested as being resistant to ice damage. The University of New Hampshire has a concise publication addressing tree features that influence ice storm resistance. Included is a list of species that are recommended for yard settings. It can be found at: http://extension.unh.edu/forestry/Docs/iceresis.pdf.

Fertilizing Oaks for More and Sweeter Acorns: Fact or Fantasy?

Craig Harper, Professor, Wildlife Management

Commonly, recommendations are provided landowners in the popular press to fertilize oak trees for increased acorn production. Some even claim fertilization leads to sweeter acorns. To many, this may seem intuitive. However, there are no data to support such claims. Many factors affect acorn production, and these must be considered before spending time and money on a fertilization program that may produce no effect whatsoever.

Natural Variability and Genetics

Mast crops are extremely variable. In fact, among white oaks, data show there is, on average, only one or two good mast years out of five. Variability in acorn production is attributable to poor pollination following continuous rain and/or insufficient wind, late frosts, and drought. Later in the season, acorn weevil depredation can also be a significant factor in sound acorn availability.

Among individual oak trees, there are good producers, moderate producers, and poor producers. There are also genetic differences in reproductive maturity among individuals. During any given year, the good producers will produce the majority of the acorn crop. In 2006, we identified 120 white oaks in east TN for acorn production sampling. Acorn production per square foot of crown coverage averaged 0.06 acorns in 2006, 0.70 acorns in 2007, and 5.70 acorns in 2008. Each year, there were trees that never produced an acorn, even in 2008, which was a heavy mast year. Among individual trees, 25% of the white oaks produced 90%, 87%, and 67% of the acorns, respectively, 2006 – 2008. There were many trees that did not produce any acorns 2 out of 3 years. Overall, approximately 33% of the trees qualified as good producers, 19% moderate producers, and 48% poor producers.

Fertilizer Requirements

In production agriculture, there are very specific fertilizer recommendations with regard to various soil conditions for each crop grown. What are those needs for oaks in relation to acorn production? No one knows. What *is* known is that various oak species are adapted to various soils. And various oak species produce acorns wherever they are found. Forestry research has documented increased tree growth on better sites, but a comparative increase in acorn production has not been shown. Regardless of site, there are still good producers, moderate producers, and poor producers.

For row crops, fertilizer recommendations are fairly precise, and determined after soil testing. Off-the-cuff, general recommendations are not prudent and often lead to wasted time and money. If the application is too low, yield may not be improved. If the application is too high, plant growth may respond negatively; the plant may even die. Weed control is also a major consideration. Without weed control, the crop receives relatively little of the added nutrient and crop yield may decrease as a result of increased weed competition.

Fertilizer applications are much less efficient and effective in acid soils unless soil pH is corrected. Phosphorus, for example, plays a key role in fruit and nut production. Phosphorus, however, forms insoluble compounds with aluminum at soil pH <5.5 and with calcium at soil pH >7.5. Forest soils are often acidic, requiring 2 or more tons of lime per acre to correct pH. Thus, fertilization alone shouldn't necessarily be expected to improve acorn production. Applications of lime may be necessary as well. Of course, pH and nutrient availability are not known unless a soil test is conducted. Even with a soil test, a fertilizer recommendation for oaks would be difficult at best because nutrient requirements, especially as related to acorn production, are not known. Further, it would be a complete waste of money and time to fertilize the inherently poor producers. Thus, identifying the good producers would be essential even if fertilization rates were known and the practice was indeed effective.

What Can You Do?

Acorns are produced near the ends of twigs in an oak's crown. Thus, *by default*, a larger crown has the capacity to produce more acorns than a smaller crown. To help increase acorn production among individual oaks in a closed-canopy stand, kill or remove adjacent competitors to allow the selected oak's crown to expand. The additional sunlight entering the stand will also stimulate increased groundcover, which provides additional browse, forage, and soft mast, and enhances nesting and brood cover.

The Final Evaluation

There is no evidence that fertilizing oak trees leads to increased acorn production. However, if fertilization did lead to increased acorn production, it would be necessary to identify the good producers, and it would be wise to release their crowns as well. And then, any effect of fertilization would most likely be reduced unless soil pH was above 5.5. Thus, liming would probably be necessary. And how much and what type fertilizer is needed? How often should fertilizer applications be made? Every year? Every other year? Regardless, given the natural variability of acorn production, any real effect of fertilization would most likely be masked except during good mast years (only 1 or 2 years out of 5).

So, would the money and time spent be worth the return? It is doubtful. However, time spent releasing select trees is certain to provide benefit, without fertilization.

We plan to work on this issue over the next several years. We will continue to collect acorn production data from the 120 white oaks for another 1 or 2 years. We then will implement fertilization and release treatments to try and distinguish any effect of fertilization from release.

Maybe we'll have an answer in several years!

Treated Wood and Railway Ties in Gardens and Landscaping

Adam Taylor, Assistant Professor, Forest Products

Wood that is put on, or in, the ground in Tennessee is at risk of rapid destruction due to rot and termite attack. For this reason, wood impregnated with protective chemicals ("treated wood") is used for fence posts, deck supports and utility poles. This wood can also be used safely in gardens or for landscaping.

The treated wood that most widely available to homeowners is Southern pine treated with copper-based preservative solutions. The chemicals are chemically bonded to the wood and studies have shown that relatively little preservative comes out ("leaches") from the wood and into the surrounding soil. Furthermore, the chemicals that do leach from the wood do not move far and are not taken up by plants in a raised garden bed. Used railway ties also can be used around the home for retaining walls, steps, etc. The black, oily preservative in railway ties (creosote) can be irritating to skin, so avoid handling or touching the wood directly. A few other tips for working with treated wood:

1. Treated wood can be very corrosive to metal, so ceramic-coated or stainless steel screws and nails should be used.
2. Wood particles (treated or not) should not be inhaled, so always wear a mask when cutting wood.
3. Wear gloves when handling wood.
4. Do not burn treated wood.

Despite that fact that studies have not shown any measurable danger in using treated wood in gardens, some people will still prefer to use untreated wood in areas such as gardens and decks. In these cases, naturally durable wood species such as cedar, black locust, white oak or cypress should be used. The heartwood (only) of these species contains naturally-occurring preservative chemicals that can protect the wood from rot and termites. If untreated, non-durable wood is used, it will need to be replaced frequently.

Wildlife Management Calendar for April

Craig Harper, Professor, Wildlife Management

Habitat Management

Finish burning woods and old-fields to enhance conditions for wildlife
- secure burning permit and develop burning plan with Tennessee Division of Forestry
- make sure firebreaks are in place
- get help from experienced personnel if you don't have experience burning
- burning fields is **much** more beneficial for wildlife than mowing!
- refer to Chapter 6 in *Native Warm-Season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South*, PB 1752, for additional information on managing early successional habitats

Plant firebreaks for additional forage, seed, bugging opportunities
- iron-clay cowpeas, re-seeding soybeans, milo, Egyptian wheat, and various millets provide forage and seed for a variety of wildlife species
- see *A Guide to Successful Wildlife Food Plots: Blending Science with Common Sense*, PB 1769, for seeding rates and additional information

If you won't burn fields, now is the time to mow – just before spring green-up
- for best results for wildlife, disk the area after mowing to facilitate litter decomposition, improve travel for small wildlife and stimulate the seedbank

Spray tall fescue, orchardgrass, and other perennial cool-season grasses
- spray a glyphosate herbicide @ 2 quarts per acre (with surfactant) when grass is 8 – 10 inches tall and actively growing in late March/early April (just prior to warm-season plants germinating or sprouting)
- after grass is killed, burn the field (if needed), then disk to stimulate the seedbank
- when disking in the spring, a preemergence application of imazapic (6 – 10 ounces of Plateau) may be necessary after disking to control johnsongrass, crabgrass, broadleaf signalgrass, and other undesirables germinating in late spring
- eradicating these undesirable grasses will enable the seedbank to germinate and provide better quality forage and cover for wildlife that need early successional habitat
- Refer to Chapter 5 in *Native Warm-Season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South*, PB 1752, for additional information on eradicating perennial cool-season grasses and other undesirable species

Finish fertilizing trees/shrubs for increased soft mast production
- this is for trees out in the open, not those in woods
- fertilizing oaks in woods is a waste of time and money; to increase mast potential for trees in the woods, timber stand improvement practices are needed

Finish erecting boxes for bluebirds
- bluebird boxes should be no closer than 80 yards apart

Build brushpiles along or in old-fields that already provide good cover
- put large stems on bottom, small stems on top
- building brushpiles along a woods edge adjacent to a tall fescue pasture or hayfield may do more damage than good because all rabbits present will then be isolated for predation

Spray weeds in cool-season food plots before the weeds get too large
- most cool-season weeds are best killed when sprayed before they reach 3 – 5 inches tall
- refer to A Guide to Successful Wildlife Food Plots: Blending Science with Common Sense, PB 1769, for herbicide recommendations
- always read and follow directions on the herbicide label before using

Plant warm-season food plots
- refer to A Guide to Successful Wildlife Food Plots: Blending Science with Common Sense, PB 1769, for information on planting and soil amendment

Plant native warm-season grasses and associated forbs
- non-native cool-season grasses (such as tall fescue, orchardgrass, and bromegrasses) should have been killed last fall before planting!
- spraying cool-season grasses in spring before planting nwsg often does not eradicate the csg
- use preemergence herbicides when planting native grasses
- plant before early June
- plant bluestems, indiangrass, switchgrass, and sideoats grama seed **no deeper** than ¼ inch; eastern gamagrass approximately 1 inch
- be patient!
- Refer to Chapter 5 in *Native Warm-Season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South*, PB 1752, for additional information on establishing native grasses and forbs.

Conduct drumming counts for ruffed grouse in mid-April

Collect soil test samples from plots to be planted this fall and lime now as needed
- applications of lime require about 6 months before full effect on pH is realized

Establish salt/mineral licks for white-tailed deer

Wildlife Damage/Population Management

Leave young wildlife alone
- let nature takes it's course; you'll do more harm than good by trying to save "orphans"
- young birds "fall" out of the nest as they learn to fly
- fawns remain bedded in seclusion throughout the day for the first few weeks of life

Check for openings in the attic as nesting season approaches
- helps keep bats and squirrels from getting into places where they are not welcome

Close all entrances to crawl spaces and other areas where skunks are not wanted
- most skunks are born in May
- females are choosing sites to give birth now

Set traps correctly to catch moles!
- make sure runway (tunnel) is active before setting traps
- excavate 6-inch by 6-inch square exposing runway and determine exact depth of runway
- replace dirt firmly, but not compacted
- set trap at exact depth so mole will be caught

Vole activity may be more apparent as there is increased activity planting gardens, flowers, and shrubs. Pine voles, in particular, eat bark from roots, bulbs, tubers, and seeds in and around flower gardens and shrubbery

- flowers may be protected by placing ¼-inch mesh galvanized hardware cloth under and around flower beds
- zinc phosphide-impregnated baits are effective when placed in the runway through the burrow opening
- snap-traps baited with peanut butter and bird seed are also effective; place baited snap-traps under some type of cover, such as an open-ended box approximately 3 – 4 inches in diameter, to prevent catching birds and other non-target species

Put up chicken-wire fence 2 feet high around vegetable gardens to protect them from rabbits

Put up a 2- or 3-strand electric fence (one strand 6 inches above ground and the other 6 inches higher) to keep groundhogs and raccoons out of vegetable gardens

Erect a single-strand electric fence (2 ½ feet above ground) with aluminum tabs attached every 3 – 5 feet to repel deer from vegetable gardens

- smear peanut butter on the aluminum tabs
- deer are attracted to peanut butter; when they touch the aluminum tabs with their mouths, they learn to stay away

Plant "alternative" forages for wildlife on the outside of fencing around a garden to satiate the appetite of deer, groundhogs, and rabbits, further helping to keep them out of the garden refer to A Guide to Successful Wildlife Food Plots: Blending Science with Common Sense, PB 1769, for seeding rates and additional information.

Snakes are beginning to appear with warmer days

- clean-up around the house (mow, remove piles of wood, brush, and trash) to repel snakes
- there is no reliable "repellent" for snakes; only "snake oil"

Refer to Managing Nuisance Animals and Associated Damage Around the Home, PB1624, for additional information on wildlife damage management.

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Insects and Fungi are Part of It ... and Important Too!

Larry Tankersley, Extension Forester

Insects, fungi, other arthropods, and bacteria often are overlooked , in catalogs of forest dwellers and in discussions of ecosystem function. Generally inconspicuous, these organisms are abundant and diverse. In most forests they comprise the greatest portion of biodiversity and a surprising portion of the biomass, especially below ground. They influence many ecosystem functions and their populations can fluctuate dramatically to changes in the environment.

Insects and fungi become "pests" and "pathogens" when they interfere with management objectives, damaging or killing valuable plants. They also however, are valued for their essential contribution to the survival and growth of planted trees.

Much has been written about devastating losses to insects and "diseases' and the benefits of mycorrhiza to tree growth. In addition to these traditional views however, it is important to also consider these organisms as part of the functioning ecosystem, and thus better predict their response to disturbances and management activities.

Fungi and insects are important in terms of number of species and ecological and economic impact. Most sites harbor thousands of species of insects and fungi that fill a broad array of often very narrow roles. Fungi are a separate "kingdom" of organisms distinct from plant, animals or bacteria. Insects are the most numerous and diverse of all the groups in the animal kingdom. Both groups are heterotrophic, which means they derive energy for their lives from "food" manufactured by plants through photosynthesis.

Many insect and fungi species are detritivores or saprotrophs, feeding on dead organic matter. In this ecosystem function they are essential for nutrient cycling. Another large group of species are predaceous and/or parasitic and are important mechanisms for regulating prey or host populations.

As forest owners we largely concentrate on the relatively small subset of species that feed on living plants, especially that dominate forests. These phytophagous insects and pathogenic fungi, along with mutualistic mycorrhyizal, along with the trees, other plants and animals are normal components of all forests.

The diversity of strategies for feeding on living trees is great. Some canker fungi and bark beetles are only successful on weakened or dying trees and may spend much of their life on dead material. Other species such as rust fungi and some aphids, prefer vigorously growing plants and die when the host dies. Many live on leaves and needles, but because trees have a lot of leaves, their impact on the whole tree is insignificant, except in years when populations are very large. Others kill trees singly or in large groups, and thus alter the structure and composition of the entire forest.

The success of both insects and fungi is dependent on access to suitable hosts and a favorable environment. The interplay between tree resistance and environmental limitations serves to limit the frequency and extent of damage from insects and fungi. Trees have a diverse array of mechanisms of defense against attack. Most tree species are resistant to attack by most insects and fungi. Susceptibility is the special case, phytophagus insects and pathogenic fungi have necessary specialized behaviors and physiology to bypass host resistance. Most plant-feeding insect and fungi species show strong host preferences. Broad-ranging species like southern pine beetle have no affect on broad leaved trees.

Insects and fungi are often protected from adverse environments by their host trees, but during critical times during reproduction and dispersal they are exposed and vulnerable. Environmental and host conditions normally limit the opportunities for rapid population growth to particular microsites or especially favorable years.

If you would like more information about this report, let me know.

(The preceding discussion is from "*Integrating the Ecological Roles of Phytophagus Insects,, Plant Pathogens, and Mycorrhizae in Managed Forests,* by Timothy Schowalter, Everett Hansen, Randy Molina, and Yanli Zhang.)

Tennessee Forest Statistics: Not Much has Changed in 45 Years

Wayne K. Clatterbuck, Forest Management and Silviculture

The USDA Forest Service, Forest Inventory and Analysis unit has been collecting statewide forest data for Tennessee for many years. The 2007 data are in process of being available and posted in the next few months. Although increases in population and land use have occurred, the total amount of forested land in Tennessee remains remarkably similar, 50 to 53 percent of total land area.

Year	Total Forested Acres (thousand)	Total Forested Reserved Land (thousand)
1961	13,700	263
1971	13,135	316
1980	13,300	429
1989	13,600	337
1999	13,850	390
2004	13,780	530
2007	13,980	534

Forested reserve land is not available for timber production, i.e., parks, wilderness areas, etc. Most of the reserved land is in public ownership. The amount of forest land in public ownership has been increasing. More than 530,000 forested acres are now in public ownership. Changes in the definition of forested reserve land caused the decrease of acres in this category in 1989.

Thus over the last 40+ years, the amount of forested land in Tennessee has not changed substantially, usually staying within 500,000 acres.

Most of the forested land in Tennessee remains in private ownership at 88 percent. Public lands compose 12 percent of the ownership. Recent divestments of forested land by forest industry (once 8 to 10 percent of total forested land base) have resulted in the majority of these lands being transferred to private ownerships.

Forest composition remains overwhelmingly in the oak-hickory type at 74 percent of total acreage. Decreases were found in the natural stands (not planted) for the loblolly-shortleaf pine and oak-pine forest types. With the interest in planting pines and not relying on conditions conducive for the natural regeneration of pine, the planted pine and oak-hickory types will continue to increase at the expense of the natural pine forest types. Planted pine types increased from 346,000 acres in 1989 to 680,000 acres in 2007. The planted pine acreage represents less than 5 percent of the total forested acreage in Tennessee.

Tennessee's forests are growing and maturing. Excluding the reserved forest land, small diameter trees (seedlings and saplings) compose 1.8 million acres (13 percent of forested land), medium diameter trees (pole timber) compose 2.9 million acres (22 percent) and large diameter trees (sawtimber) compose 8.7 million acres (65 percent) in 2007. The over-balance in the amount of mature timber can have ramifications in various forest health aspects (increased incidence of insects and disease) as well as imbalances in early- and mid-successional habitat for wildlife.

More specific information on the present forest statistics for Tennessee will be forthcoming in future FWF updates as the inventory data are released.

POND FERTILIZATION AND LIMING

Proper fertilization and liming can increase three to four times the pounds of fish a pond will support. Unfertilized ponds stocked with bream, bass and catfish usually have about 100 pounds of fish per surface acre. Ponds receiving adequate amounts of fertilizer typically contain 300 to 400 pounds of fish per surface acre. Fertilization increases fish production by increasing the amount of microscopic green plants (phytoplankton) in the water. Phytoplankton is the base of the pond food chain. The green color characteristic of fertilized ponds, called a bloom, is due to the abundance of phytoplankton. Phytoplankton is consumed by zooplankton (microscopic animals), which is eaten by aquatic insects and small fishes. The small fishes serve as food for the larger predators, such as largemouth bass.

In properly constructed ponds, an adequate fertilization program helps control rooted aquatic weeds. In properly fertilized ponds the microscopic green plants become so abundant that the phytoplankton bloom limits sunlight penetration deeper than about 18 inches. This shading of the deeper water prevents rooted green plants (which must have sunlight to grow) from becoming established.

Most aquatic weeds die or become dormant during the winter. If the pond is properly fertilized and an appropriate phytoplankton bloom is established before spring weed growth begins, the weeds will not become reestablished. If rooted aquatic vegetation has reached the surface (or near the surface) of the water prior to initial fertilizer application, many of the nutrients contained in the fertilizer will be taken up by the weeds. If this occurs, fertilization will encourage the growth of aquatic weeds.

Before beginning a fertilization program, have the alkalinity, total hardiness, and calcium hardness of your pond water tested. Your local Cooperative Extension Service office can help with water testing.

Should Every Pond Be Fertilized?

Although fertilization can increase fish production significantly, it is not the best management practice for every pond. In many cases, increased fish production is not desirable. If a pond serves primarily for watering cattle or for wildlife habitat, fertilization is unnecessary. Pond owners who want clear water should not fertilize either. Unless a pond will be fished more heavily, fertilization to increase fish production is of little value.

> Fertilization alone will not necessarily increase the size of individual fish in the pond. It will increase the total pounds of fishes in the pond. If a one acre pond had 100 pounds of two to three inch bluegills, with few or no largemouth bass, fertilization would probably result in 300 to 400 pounds of two to three inch bluegills.

> Ponds which have excessive water flow cannot be efficiently fertilized. If the total volume of water flowing out of a pond in 30 days exceeds the volume of the pond, it usually is not practical to fertilize. The added nutrients will not be in the pond long enough to promote the desired phytoplankton bloom. All ponds may have excessive water flow in the wet seasons (spring and fall). Ponds which exchange their water volume in 30 days or less in the dry season (summer) should not be fertilized.

> Do not fertilize ponds with extensive areas less than two feet deep. The added nutrients will promote the growth of undesirable rooted aquatic vegetation in areas where sunlight penetrates to the bottom.

> Do not fertilize ponds with no history of weed problems and very light fish harvests. It serves no purpose to increase pounds of fish in the pond if very few are going to be harvested.

> Do not fertilize commercially fed ponds. Added nutrients promote excessive phytoplankton blooms that could lead to dissolved oxygen depletions, resulting in fish kills.

Inorganic Fertilizers

Use only inorganic fertilizers in sportfishing ponds. Use of organic fertilizers, such as animal manures, is discouraged since it often promotes development of undesirable algae. It is also difficult to determine and control the amounts of various nutrients added in organic fertilizers.

Inorganic fertilizer manufacturers are required to list contents as percent nitrogen (N), phosphorus (P) and potassium (K). For example, a complete fertilizer (one that contains all three nutrients), labeled 20-20-5 contains 20 percent N, 20 percent P, and 5 percent K. An incomplete fertilizer (one in which at least one of the nutrients is missing), labeled 9-30-0 contains 9 percent N, 30 percent P, and no K. A good phytoplankton bloom can be achieved with either granular or liquid inorganic or slow release fertilizer.

Which Inorganic Fertilizer Should You Use?

Phosphorus is usually the limiting nutrient in sportfishing ponds. The percent phosphorus in an inorganic fertilizer is the middle number in the fertilizer formulation. Application rate for granular fish pond (20-20-5) fertilizers 40 pounds per surface acre per application. Application rate for liquid fish pond (9-30-0 or 10-34-2) fertilizer is one gallon per surface acre per application. Depth of water does not matter. The actual amount of phosphorus added using recommended rates of liquid fertilizer is not the same as that added using granular fertilizer. The phosphorus in the liquid fertilizer is more available to the phytoplankton and seems to go into solution more efficiently. If using a slow release pond fertilizer, follow application rates on the label.

Other fertilizer formulations can be substituted for the labeled fish pond fertilizer. At the recommended application rate of 40 pounds of 20-20-5 per surface acre per application, eight pounds of phosphorus is added each application (20 percent times 40 pounds equals eight pounds).

The following formula can be used to determine the amount of other granular fertilizer formulations equivalent to 40 pounds of 20-20-5:

(8 X 100) / Percent of phosphorus application in substitute fertilizer
= Pounds of fertilizer per surface acre per application

For example, if 10-10-10 fertilizer is substituted for 20-20-5, the required rate would be 80 pounds per surface acre per application.

(8 X 100) / 10 = 80 pounds per surface acre per application

Several fertilizer formulations have been substituted for the standard fish pond fertilizer. Table 1 lists other fertilizer formulations and application rates that have been successfully used in sportfishing ponds. Although some of these fertilizers could be purchased in bulk (at least two tons) at considerable savings, most ponds are not large enough to warrant it.

In most new ponds, use a complete fertilizer (one containing N, P, and K). Usually, after a pond has been fertilized for three to five years, potassium builds up and can be deleted from the application. Nitrogen is often "fixed" by algae and this nutrient may be deleted also. If incomplete fertilizers (missing at least one nutrient) do not produce a sufficient phytoplankton bloom within seven to ten days, resume using a complete fertilizer.

Table 1. Some Fertilizers and Application Rates Successfully Used in Sportfishing Ponds

Fertilizer		Pound per Acre per Application
1. Fish pond fertilizer (20-20-5)		40
2. Diammonium phosphate (18-46-0)		18
3. Liquid ammonium polyphosphate (10-34-0)		20
4. Liquid ammonium polyphosphate (13-38-0)		20
5. Ammonium nitrate (34-0-0) plus triple superphosphate (0-46-0)	24 lb 18 lb	42
6. Ammonium nitrate (34-0-0) plus superphosphate (0-20-0)	24 lb 40 lb	64
7. Triple superphosphate (0-46-0)		18
8. Superphosphate (0-20-0)		40

When and How Often Should You Fertilize?

Begin fertilization in late March or early April when surface water temperatures stabilize **above** 60 degrees F. Establish a bloom as early as possible to prevent aquatic weed growth. For initial applications (until a bloom develops) use 80 pounds of granular (20-20-5) or its equivalent, or two gallons of liquid (9-30-0 or 10-342) or its equivalent per surface acre per application. Once a bloom is established, use 40 pounds of 20-20-5 or one gallon of 9-30-0 per surface acre per application.

The new slow release pond fertilizer requires only one application in the spring. This type of fertilizer is resin coated and will slowly release fertilizer during the warm weather months.

Repeat fertilizer applications every two weeks until a satisfactory bloom develops. If a satisfactory bloom does not develop within two weeks after the third application, have pond water analyzed for total hardness (lime deficiency), check for excessive flow, excessive rooted aquatic vegetation, or other possible reasons for lack of response. Once a satisfactory bloom has been established, repeat applications when visibility exceeds 18 to 20 inches. If the bloom is so green that visibility is less than 12 inches, do not fertilize. **Excessive fertilization can lead to oxygen depletions, resulting in fish kills.**

Maintain a satisfactory bloom from early spring through fall. Apply fertilizer until September or October when water temperatures stabilize **below** 65 degrees F. Most ponds require several (six to 10) applications per year.

Each pond differs in the number of fertilizer applications required to maintain a satisfactory bloom. In a properly fertilized pond, visibility should be between 12 and 18 inches. If a shiny object attached to a stick can be seen deeper than 18 inches, apply fertilizer. If the shiny object disappears from view before it reaches 12 inches, the phytoplankton bloom is too heavy and fertilizer should not be added. This visibility method is based on the green color due to phytoplankton. It cannot be used when the pond is muddy or in ponds that have a dark stain because they are fed by blackwater streams.

Methods of Application

Spread liquid fertilizers over the entire pond surface. There are several formulations on the market. Some liquid fertilizers must be diluted prior to application, while others can be poured directly into the pond. The label will list specific procedures for application. Most liquid fertilizers are heavier than water and if they are applied at one spot, the nutrients tend to sink to the bottom and become bound in mud and sediment.

When applying granular fertilizers, it is important to keep the granules from coming in direct contact with the mud. If granules are in contact with mud before they dissolve, a considerable amount of the phosphorus can become trapped in the mud and is unavailable to promote bloom development. The following application technique is recommended for granular fertilizer:

1. Slit one of the two flat sides of the bag in the form of a letter "H."
2. Peel the resulting flaps back.
3. Lay the bag in shallow water with the open side toward the surface.
4. Disperse bags as much as possible.

Follow label directions for the application of slow release pond fertilizer.

Is It Possible To Over fertilize?

Excessive fertilization can result in a fish kill. Phytoplankton produces oxygen in the daylight through photosynthesis. In the absence of sunlight this same phytoplankton consumes oxygen. In ponds with a heavy phytoplankton bloom, dissolved oxygen levels may be extremely high during the afternoon and drop to near zero just after sunrise. A properly fertilized pond should have visibility to at least 12 inches. If visibility (due to the bloom) is less than 12 inches, the phytoplankton is so abundant that on hot cloudy days it may use more oxygen than it produces. This results in less dissolved oxygen available to fish. Reduce fertilization rates during very hot dry weather.

Liming

The addition of lime increases fish production in soft (low total hardness) waters. Many ponds in the southeastern United States have very soft water and will not develop satisfactory plankton blooms unless lime is periodically added. Agricultural (dolomitic) lime is the best choice for sportfishing ponds. Check ponds for lime deficiency every three to five years.

Lime has several desirable effects on water quality. Addition of lime stabilizes the pH of bottom mud and increases the availability of phosphorus. It increases the production of aquatic insects in mud, providing more food for small fishes. Liming increases the availability of carbon dioxide for photosynthesis. The overall effect of liming is to increases phytoplankton production which results in increased fish production.

Many ponds in the southeast have very soft water, with a total hardness less than 10ppm (parts per million). Often, these ponds must be limed before a satisfactory bloom will develop. In ponds with a total hardness over 20 ppm, adding lime may have little effect on fish production. In ponds with a total hardness of 15 to 20 ppm, the increase in phytoplankton and fish production may be minimal.

It is necessary to measure total hardness ($CaCo_3$) to determine pond lime requirements. **Alkalinity is actually a better indicator of lime requirements**. However, in the southeastern United States most ponds have hardness and alkalinity values of similar magnitude (and hardness is much easier to measure). If total hardness is less than 10 ppm, the addition of at least one ton of agricultural lime per surface acre usually will bring total hardness to acceptable levels. For best results spread the lime over the entire pond rather than dumping it at one location. For larger ponds or ponds that have inaccessible banks, spread the lime from a boat. Specific lime requirements for particular ponds can be determined by county Extension agents, or Soil Conservation Service or Department of Natural Resources personnel.

Although lime can be applied at any time, it takes about two months for agricultural lime to go into solution. **For best results, lime ponds in fall or winter**. This will allow total hardness to reach appropriate levels by the time fertilization begins in the spring. In new ponds, lime can be spread prior to filling. Many times the need for lime is first recognized when the recommended fertilization program fails to result in a plankton bloom. The total hardness of the water can be temporarily raised by applying hydrated (builder's) lime. Although hydrated lime goes into solution quicker, the increased total hardness usually lasts only six to eight weeks. The recommended application rate is 50 pounds per surface acre, spread over the entire pond.

*******CAUTION: OVER APPLICATION OF HYDRATED LIME CAN KILL FISH*******

Kelly Amonett attended a recent training session at Kentucky State University, where the recommendation was to use only ground agricultural limestone. You can use hydrated lime....but use extreme caution!!!

You can use alkalinity as well as hardness for testing. If either is less than 20 ppm, then the pond may need lime. Alkalinity testing would probably be the best indicator for applications of lime.

For more information see ***Liming Ponds for Agriculture***, *SRAC Publication No. 4100* at http://srac.tamu.edu/fulllist.cfm

** This article is comprised from information taken from Bulletin 867, Warnell School of Forest Resources, The University of Georgia., the above SRAC publication and articles from Tom Hill, Professor, Emeritus, University of Tennessee Extension.*

U. T. Extension Recommendation:

Analyze Pond Bottom Mud for Lime Requirements

If you experienced difficulty establishing and maintaining a good plankton bloom in your fertilized bass-bluegill pond this summer, your pond may need to be limed. There are several benefits from this practice, but a greater fish crop following increased microscopic algae (phytoplankton) production is the most noticeable one. After th pH of the bottom mud and the total hardness of the water are raised by liming, availability of phosphorus added as fish pond fertilizer to phytoplankton increases.

Several studies have demonstrated a positive response of lime application to ponds with total hardness of 10 to 29 ppm. Those pond waters with total hardiness greater than 20 ppm seldom responded to liming. It has also been learned that total hardness and mud pH are related; when mud-water pH exceeds 5.9, total hardness for the same pond usually exceeds 20 ppm and no additional lime is needed.

To determine the need for lime, dip mud samples from the pond bottom in about 10 locations for each acre. Mix the samples together, dry in the sun or in an oven, and fill a soil sample box obtained from your county Extension office. Write “fish pond” on the box and send it to the Soil Testing laboratory in Nashville. The lime requirements will be determined and the results with a recommendation returned to you.

Agricultural limestone is the most satisfactory liming material for ponds, and winter is the best time to apply it. New ponds should have the required amount of lime spread evenly over the bottom before filling with water. For filled ponds, spread the lime over the entire pond surface. Unless and excessive amount of water flows through the pond, a single application of lime may last several years. Liming a pond will not result in increased productivity unless a proper fertilization program is practiced.

Some Common Mistakes

1. **Failure to Maintain Bloom Throughout the Season and From Year to Year**
   A haphazard fertilization program is worse than no fertilization at all. Fertilizing a pond once or twice a year results in sudden increases in the food supply, increases in the weight of fish in the pond, then a rapid decline in available food. This can lead to an unbalanced fish population. Failure to maintain the bloom can promote aquatic weed growth as nutrients are added and the water clears.

2. **Beginning Fertilization Too Late in the Spring**
   If undesirable rooted aquatic vegetation becomes established prior to the initial fertilizer applications, the added nutrients may promote even more weed growth. Rooted aquatic vegetation that has reached the surface cannot be controlled with fertilizer. Treat exposed rooted aquatic vegetation with a herbicide prior to beginning fertilization.

3. **Failure to Check Total Hardness (Lime Requirements)**
   Check total hardness or alkalinity of fertilized ponds every three to five years. If you have eliminated other possible reasons for lack of bloom development, your pond probably needs liming.

Stocking Strategies for Tennessee

recommendations from Tennessee Wildlife Resources Agency

Although the stocking strategy you choose should be geared to the kind of fishing you want, for the best recreational fishing and table fare, the largemouth bass, bluegill, redear sunfish, and channel catfish combination is hard to beat in Tennessee

Other fish combinations a pond owner may choose to stock are:

> Largemouth bass and bluegill at 100 bass/acre and 500 bluegill/acre.
> Largemouth bass, bluegill, and redear sunfish at 100 bass/acre, 400 bluegill/acre and 100 redear/acre.
> Largemouth bass, bluegill, and channel catfish at 100 bass/acre, 500 bluegill/acre and 50 to 100 catfish/acre.
> Channel catfish only at 150/acre.


Channel Catfish
Artwork Courtesy Duane Raver / USFWS

All of the above combinations, except catfish only, must be stocked in ponds larger than 0.25 acres, and preferably in ponds 1 acre or larger. Channel catfish can be stocked alone in any size pond at 150 per acre, without supplemental feeding


Bluegill
Artwork Courtesy Duane Raver / USFWS

Stocking hybrid sunfish can offer a good alternative for owners of very small ponds (less than 0.25 acres) up to ponds 3 acres in size. But it is important for the owner to know that certain conditions are critical and need to be met for the success of ponds stocked with hybrid sunfish.

First, do not stock hybrid sunfish into ponds containing other fish, and never stock them in combination with other bream(bluegill and redear sunfish) species. The reason for this is because hybrid sunfish will crossbred with other bream species and hybrid identity and vigor will soon be lost. Second, hybrid sunfish should always be stocked in combination with a predator fish, such as largemouth bass, to control both the small amount of expected hybrid sunfish reproduction (which is not desirable) and wild fish which may accidently get into the pond. In either case, more food will be available for the stocked hybrids.


Redear Sunfish (shellcracker)
Artwork Courtesy Duane Raver / USFWS

It is important to remember that hybrid sunfish management is for production of large sunfish, and bass growth will be less than desirable. Also, periodic restocking of hybrid sunfish will be necessary to sustain the fishery for more than a few years. Pond owners should keep records of the number of hybrid sunfish removed and if possible, restock with 3 to 4 inch hybrids when 60 to 75 percent of the original stocked fish have been caught and removed. The recommended stocking rate is 750 hybrid sunfish and 50 largemouth bass per acre.

Grass Carp

White amur, commonly called grass carp is another fish species that may be stocked into ponds that have aquatic plant problems. Grass carp feed almost exclusively on aquatic plants and therefore can be an effective biological control method when aquatic plants become a nuisance. Although aquatic plants are beneficial to natural functions in fishing ponds and lakes, they can interfere with the owners preferred use of the pond when allowed to spread unchecked. Grass carp may be stocked with other fish species at recommended rates and may be obtained from commercial fish producers. **Only triploid (sterile) grass carp are legal to stock in Tennessee**, so pond owners should obtain verification that they are purchasing triploid grass carp.

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