

Pond Fertilization and Liming in Georgia

By Gary J. Burtle, *Extension fisheries specialist, University of Georgia, Department of Animal and Dairy Science*

Introduction

Georgia pond owners who want to maximize fish production should be ready to start fertilization as winter ends and water temperatures begin to rise. Fertilization increases productivity of pond water by providing nutrients for fish food organisms. Increasing food supply for forage fish species, like bluegill sunfish, results in an increase in food supply for predator fish like largemouth bass. The end result should be more and larger bass and bream to catch. However, starting a fertilization program, without a plan to catch more fish, could be a mistake. Phosphorus and nitrogen, added by pond fertilization, increase the potential for algal blooms, algal scums, filamentous algal growth, and aquatic weed growth in the pond and perhaps downstream from the pond. Fertilization should be combined with more fishing and observation of algal bloom density. Also, once fertilization is begun, it should be maintained on a regular schedule or conditions may develop that are favorable to aquatic weed growth.

Ponds in Georgia usually need to be limed to improve fish culture conditions. Many areas in Georgia have acidic soil characteristics that do not provide adequate amounts of hardness or alkalinity for fish production unless the pond is limed. In some cases, the ponds are filled with water from deep wells, and that well water contains enough calcium and magnesium to improve the hardness of the pond water. Other ponds have spring water supplies that originate in limestone formations. However, ponds that depend on rainfall or stream water supply usually need to be limed before fertilizing.

Fertilization produces a "bloom" of planktonic, microscopic algae that are the basis for the food chain in fish ponds. The bloom also creates a certain amount of shade, blocking light from reaching the pond bottom and limiting light for aquatic weed growth. If fertilization is started and then discontinued, the bloom will die, reducing the amount of food for fish and allowing light to reach the pond bottom. The results may include stunting the fish population as well as the development of aquatic weed growth. So, carefully consider long-term lime and fertilizer effects before you start a pond fertilization program.

Choosing to Fertilize

Not every pond must be fertilized and the choice depends on goals the pond owner has made for the pond. In some cases, the pond itself is not suitable for fertilization. Some pond owners may not be willing or able to maintain a fertilization schedule. Others may not want to enrich their ponds. Unfertilized ponds will produce healthy bass and bream, but not as many as when fertilized. Because fertilization will increase fish numbers, a goal of better fishing should be considered.

Fertilization works best in ponds that have little or no outflow of water. Ponds with heavy spring flows or ponds located on a stream channel will not retain the added fertilizer. When a pond is flushed by heavy rainfall



and runoff, downstream waters will get a boost in fertility that can create poor water quality. Liming that type of pond will not last; the phosphorus in the fertilizer would not be available for plants to utilize after the lime flushes away. A common setting in Georgia is a pond constructed at the outflow of a swampy area where acidic swamp drainage runs for most of the year and negates lime and fertilizer program efforts (Table 1). Peat deposits and rotting vegetation release organic acids that counter the effect of liming.

Table 1. Common Pond Conditions and Guidelines for Fertilization or Liming

Watershed Type	Fertilization Guidelines*
Pasture with animals present	No fertilization needed, get fertility from runoff.
Forested woodland	Add N and P and no more than 41 b K/acre.
Woodland with potash above 1.3 mg/L	Add N and P, but no K is needed.
Pond water with hardness below 25 mg/L	Lime before adding fertilizer.
Pond water with hardness above 25 mg/L	No lime needed before fertilizing. More lime will increase the hardness if desired.
Acidic swamp drainage or peat in pond area	Too acidic to lime or fertilize. Excessive amount of lime needed to overcome acidity.
Pond has filamentous algae or aquatic weeds	Control plants BEFORE considering fertilizer.
Pond with water outflow more than 4 months/year	Lime or fertilizer will not be retained.

*N = available nitrogen, P = available phosphorus, K = available potassium.

Fertilizer is usually not needed when runoff or seepage from nutrient sources can enter the pond from livestock, crop, or residential uses in the watershed. Ponds receive nutrients from livestock manure or drainages from composted bedding. Fertilizer can leach rapidly downhill from crops grown in sandy soils. Fertilized lawns and septic tanks give up nutrients that end up in the water down slope. Woodlands provide a source of nutrients—when wood and leaves decompose—that washes into ponds after rainfall. Carefully consider the upstream watershed uses before beginning a fertilization program so that over-fertilization will be less likely to occur.

Fish Population Response to Fertilizer

Fertilizer contains nutrients needed to increase the productivity of a pond. Productivity is described as the growth of all organisms, microbes, plants, and animals that live in pond water. Phosphorus, nitrogen, and potassium are the main nutrients required for bacteria and algal growth. Small fish and fish-food organisms need bacteria and algae as food, so an increase in one benefits the other. Phosphorus is the most limiting nutrient in aquatic environments, and enough phosphorus must be present to meet the needs of plants and animals before productivity can be increased. Both largemouth bass and bream benefit from added phosphorus (Table 2). The resulting nitrogen production from plant growth increases pond productivity by improving bream production. Even more nitrogen can be used in ponds used primarily for bream production.

Fertilization and fishing go together. Without fertilization, 40 pounds of fish can be caught per acre per year. With a fertilization program increasing pond productivity, 25 to 30 pounds of largemouth bass and 100 to 200 pounds of bream can be caught for each acre. When extra fish are produced, it is important to catch enough fish to keep the pond in balance. Under-fishing usually causes the bass population to become crowded and stunted, and the bream population is reduced by heavy predation.

Table 2. Potential Fish Production, All Sizes, After Fertilization of Fish Ponds (in Pounds per Acre per Year)*

Fertilizer	Bass	Bream	Total Fish Production
None	28	94	122
Phosphorus only	52	208	260
Phosphorus and nitrogen	53	297	350
Extra nitrogen	-	360 to 600	420 to 660

*See Boyd et al. 2008 and Boyd 1979 for additional information.

Fertilizer Effects on Aquatic Plants

The pond “bloom” is mostly algae that are suspended as plankton. Fertility affects the bloom first if no other aquatic plants are present. However, competition for phosphorus can occur between the plankton and aquatic plants that are rooted to the pond bottom or floating on the surface. Aquatic weed infestations must be controlled *before* adding fertilizer to a pond.

Once a bloom develops, it creates a certain amount of shade, blocking light from reaching the pond bottom and preventing the growth of rooted aquatic plants. Pond water needs to be at least 3 feet deep for shading to begin to work. Deepen the edges of ponds and reduce the amount of shallow water. Control aquatic weed growth as it begins so that fertilizer will only benefit the bloom.

When a fertilization program begins, the bloom is measured by checking its density. As the bloom density increases, light penetrates a shorter distance into pond water and can be measured with a target or Secchi disc. Lower a white target into the water, and it will disappear. Then you lift up the target until it just becomes visible, and that is the depth of light penetration. As a rule, if light penetration exceeds 18 inches, more fertilizer can be applied. When light penetration is less than 12 inches, enough fertility is in the water to produce a bloom that will shade the pond bottom and increase pond productivity. The best time to measure light penetration is near mid-day, during calm weather and several days after the last heavy rain.

Begin fertilizing in March, as soon as pond water is 70°F, and then continue to fertilize, only if needed, until September. Early bloom development will inhibit aquatic weed growth. Over-fertilization, which leads to very dense blooms or even scums, can be undesirable or even dangerous. Oxygen depletion occurs more frequently when blooms are dense. In a few cases, toxic blue-green algae may grow to form a scum that may harm animals that consume it.

If fertilization is started and then discontinued, the bloom will be starved for phosphorus. An algal die-off may cause oxygen depletion. Or, as the bloom density decreases, rooted aquatic plants may begin to grow in the pond soil, which has been enriched by past fertilization. This creates competition between those aquatic plants and plankton so that future blooms will be difficult to establish. Food for small fish will become scarce, and fish production will decrease. Consider stocking grass carp (a sterile triploid) to limit the amount of vascular plant growth while allowing plankton to grow. Grass carp cycle nutrients from rooted vascular plants that they eat to the plankton that use the digested nutrients.

When renewing an older pond that has submerged or floating aquatic plants, control of those plants must occur *before* fertilizer is added. When vascular plants are present, those plants rather than the bloom will use any phosphorus added. In most cases, filamentous algae and aquatic plants will only become worse as fertilizer is added. Fertilization only works in preventing new plant growth from the pond bottom, not in killing existing plant populations.

Choosing a Pond Fertilizer

Inorganic or organic fertilizers can be used in fish ponds. Liquid, granular, and powder forms of inorganic fertilizer are readily available and can be applied with differing amounts of labor. Organic fertilizers, including cottonseed meal, alfalfa pellets, or compost, are generally lower in nutrient content than inorganic fertilizers, so they are bulky in comparison. Some pond managers choose a combination of inorganic and organic fertilizer in their fertilization programs. Regardless of fertilizer type, the rate of fertilizer application is based on the amount of phosphorus and nitrogen in the fertilizer analysis (Table 3). About 3 pounds of phosphorus is applied per acre at each application. Up to 6 pounds of nitrogen can be applied, but 2 pounds is usually enough to apply each month.

Table 3. Fertilizers Commonly Used in Ponds and the Application Amount per Surface Acre Between March and September

Type of Fertilizer	Analysis Percentage (N-P-K)	Pounds per Acre per Application
Fish pond granular	20-20-5	15 to 18
Diammonium phosphate	18-46-0	7 to 10
Liquid ammonium polyphosphate (11 lb/gal)	10-34-0 (or 10-30-0)	9 to 11
Balanced granular	10-10-10	30 to 40
Triple superphosphate	0-46-0	7 to 10
Complex pond fertilizer	12-48-8 and micronutrients	5
Manure compost (dry percent)	(1.0 to 4.5)-(0.8 to 1.0)-(0.5 to 1.0)	300 to 350

Apply fertilizer so that the dissolved nutrients will stay in the pond water as long as possible before entering the pond soil. Granules and heavy liquid fertilizers sink directly to the pond bottom if broadcast straight from the container. Clay in pond soil binds phosphorus and most added phosphorus ends up in the pond bottom eventually. So, dissolve the heavy liquid fertilizer in 10 parts water before application (Figure 1). Position granular fertilizers so they will slowly dissolve from a wooden platform or plastic sheet. Consider using a soluble powdered fertilizer if you want to broadcast fertilizer over the pond surface. Some pond fertilizer is sold with a plastic tray or bucket to hold granular fertilizer until it dissolves into pond water. Liquid fertilizers are very popular because they are usually easier to apply to ponds than granular or powdered pond fertilizers.



Figure 1. Dilute liquid fertilizer 1:10 with water before application to ponds.

Why Lime?

Lime may be needed to improve phosphorus availability in ponds. Lime requirement can be determined by analysis of pond soil or pond water hardness. Liming without fertilization is practiced in ponds where low to average productivity is desired. Liming will release phosphorus already in the pond soil. But, before starting a fertilization program, lime requirement must be met to allow fertilization to work. When a pond is dry, the soil pH method should be used to determine lime requirement. Then agricultural lime can be applied to the dry pond bottom. When the pond is filled, water hardness may be used for lime requirement. Then lime should be applied to the entire pond area by boat. Even application allows lime to reach the entire pond bottom quickly.

After the initial lime application, pond water hardness will change over a period of several months. Rainfall, water from soft water wells, springs, or streams will dilute the hardness in ponds so that liming may need to be repeated. Lime requirement should be checked periodically and lime usually needs to be reapplied every four years.



Figure 2. Finely powdered lime (left) and pelletized lime (right) dissolve over several months in pond water.

Phosphate is bound to the soil particles by aluminum and iron but can be released as soil is made more basic by liming. Aluminum and iron phosphates in acidic soils are very insoluble, making phosphorus unavailable to plants and slow to dissolve in pond water. Lime provides calcium and neutralizes acidic soils so that phosphate is released as calcium exchanges with aluminum and iron. Calcium phosphates are more soluble in water than aluminum phosphates or iron phosphates.

Laboratory testing of soil pH can determine the amount of lime needed to neutralize the soil and that is the lime requirement. Observations of water hardness above pond soils allow a measurement of pond water hardness to be correlated with lime requirement (Figure 3). The local Cooperative Extension office can assist in testing for lime requirement.

Adding more lime, when water hardness is above 25 ppm, produces only a small change in the availability of phosphorus in ponds. More lime could be added to increase pond water hardness further, but that is rarely practiced in the management of sport fish or recreational ponds. Ponds with very acidic soils, usually when peat-like soils are present, may require more lime than is practical to apply. In the case of peat soils or acidic swamp drainage, liming is not recommended and a fertilization program should not be started.

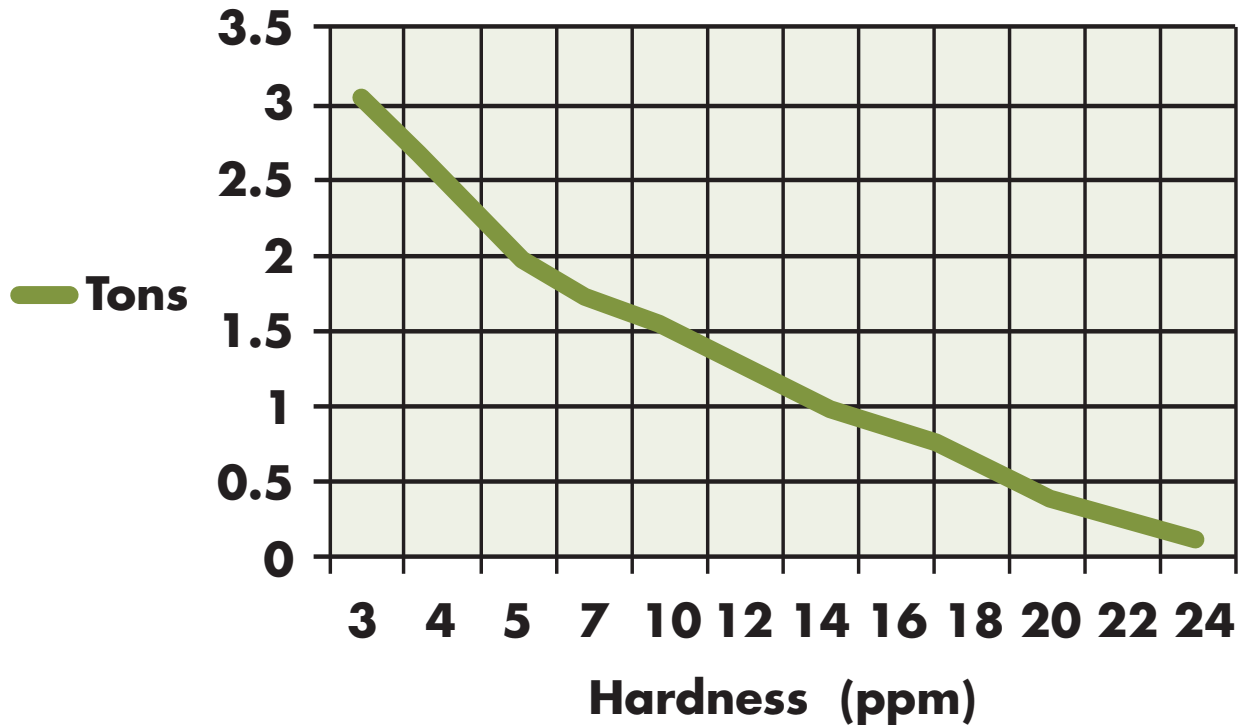


Figure 3. Tons of lime needed to meet the lime requirement at different water hardness measurements.

Different lime sources react differently with pond water, and therefore, they can change water hardness at different rates. Some obvious differences are related to variable particle sizes of the lime sources. Other differences relate to solubility because of chemical composition. Local sources of bulk agricultural limestone and dolomitic limestone have been observed to be more soluble than limestone imported from outside Georgia, as long as the particle size was small. Most of the lime should pass through a screen size of 200 meshes per inch. Coarse limestone, 200 to 60 meshes, will dissolve over a longer period of time. Lime that is very coarse, larger than 60 meshes, probably should not be used to lime ponds because of its slow dissolution rate.

Pelletized lime is finely powdered lime that has been cemented with a binding agent. It dissolves like powdered lime, but without the dusty handling properties.

Hydrated lime, calcium hydroxide, is more soluble in water than agricultural lime. It can be used in relatively small quantities to add calcium to pond waters when used with caution. Usually, less than 150 pounds of hydrated lime are added per acre of pond surface, but it is best to apply only 50 pounds of hydrated lime per acre in a single application, and then wait several days to add more hydrated lime, if needed. Fish can be killed when hot spots of high pH are caused by uneven hydrated lime application. Sudden pH increases may cause stress or death to fish and other aquatic organisms, so apply hydrated lime with care. Periodic application of hydrated lime can boost pond water alkalinity and hardness in a relatively short

time compared to adding agricultural lime, but the effect may only last for a few months. Hydrated lime is extremely caustic and causes irreversible damage to human eyes on contact. Protective goggles, dust mask, and gloves are important when handling hydrated lime.

Slurries of lime and water can be mixed and sprayed over the pond surface. When relatively small quantities of lime are added to ponds, a slurry or "liquid lime" application may be used. Agitation of the slurry requires a tank that is connected to a high-pressure pump for spray application. Commercial sources of suspensions called "liquid lime" are available, but they cost more than powdered agricultural limestone. Note that the reported quicker effect of the limestone suspensions, slurries, or "liquid lime" is based on the very fine particle size of the lime in suspension.

Lime application in ponds has a high labor requirement. Platforms on boats or barges are piled with lime, and lime is spread by shovel or washed away with water as the boat moves around the pond. Carefully load boats according to their weight-bearing capacity. Remember to add the weight of workers who will board the boat after lime has been added. Wear eye protective goggles and a dust mask when moving lime, especially hydrated lime. Pond consultants or aquatic plant management specialists are usually equipped to apply lime safely and efficiently. Another option is applying directly from a lime truck to several access points around the pond perimeter. Applying lime at the pond edge or in piles is less effective than when lime is applied to the entire pond area, and piles of lime may remain undissolved for a long time.

Adding too much lime to hard water ponds is possible. Liming, as a pond productivity improvement method, is intended for ponds with acidic water and soil. When ponds already contain calcium (i.e., hard water), then additional calcium can remove phosphorus and limit plant growth. Injection of lime to deep-water areas of a pond or lake can tie up phosphorus and has been utilized to control algal growth in enriched hard waters. Some ponds located in northwest Georgia may have hard water that originates from springs with hardness above 100 ppm. Ponds with salty water, near the coast, also have high calcium content and hard water. Liming is not recommended for hard water ponds.

Summary

Fertilization and liming can improve pond production for fishing. However, not all ponds need added fertilizer or lime. Consider the long-term use of ponds before starting a fertilization program. Test soil and water before liming. A good plan for pond fertility involves considerations of the pond design, water supply, fishing plans, and aquatic plant management. Once started, continue pond fertilization programs on a regular schedule to maintain productive ponds and great fishing.

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