Western Regional Aquaculture Center

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POND FERTILIZATION: INITIATING AN ALGAL BLOOM

Introduction

Algae are the population of microscopic single and multiple-celled aquatic plants that live in water. While most individual algal cells can only be viewed using an instrument such as a microscope, algal blooms give color to the pond water. When populations of algal cells multiply, thereby clouding or giving color to a pond, it is called an algal bloom. Another term used to describe algae is phytoplankton. The word phytoplankton is derived from the Greek language (phyto = plant; plankton = wanderer). It is a term used to describe plants that are so small that their movement is primarily controlled by the motion of the water. In this publication we will use the term “pond” to describe all bodies of water, including lakes.

Algae produce oxygen through photosynthetic action and are the primary source of oxygen in a body of water. Other sources of oxygen include other aquatic plants and oxygen interchange at the air-water interface, especially caused by wind-driven wave action. Oxygen is also continuously being removed from the pond. It is removed by respiration of aquatic animals, by the biological oxygen demand (BOD) of organisms such as bacteria that break down non-living organic material, and even by a chemical oxygen demand (COD) caused by chemical processes such as decay of dead plants and animals. The presence of algae for the production of oxygen and as a base resource is essential for any healthy body of water.

Why Fertilize a Pond?

Fertilizing a pond with organic or inorganic fertilizer is often done to initiate an algal bloom, which is another term for an increased population of algae. The natural and artificial fertilizers provide principal chemical nutrients necessary for algal growth and reproduction. The principal nutrients are nitrogen (N), phosphorus (P), and potassium (K). The microscopic plants that make up the phytoplankton population take up these chemical nutrients and at the proper temperature undergo rapid population growth.

Algal blooms are encouraged for a number of reasons, including increasing the pond's primary productivity. As microscopic "grass", the bloom is food for microscopic animals (zooplankton) and forms the base of the food chain that supports larger forms of life such as insects and fish. By increasing the base of the food chain, the total productivity of the pond is increased. Blooms are also initiated as a means of controlling initial growth of larger aquatic plants (macrophytes) by increasing turbidity, blocking sunlight and reducing the young plant’s photosynthesis. Fertilizer applications to establish algal blooms to shade older, established aquatic plants are not as effective because the fertilizer more often stimulates growth of the larger macrophytes. Although benefits can be derived

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from any proper approach to pond fertilization, the application of fertilizer and creation of the bloom must be controlled, or it can lead to oxygen depletion in the pond and loss of fish and other aquatic animals.

Choosing Organic or Inorganic Fertilizers

Ponds are fertilized with either organic or inorganic fertilizers, or a combination of both. Each has its own advantage or particular use. Applications of inorganic fertilizers are more exacting as they are applied by formula. They produce more consistent results in the production of algal blooms. Organic fertilizers are less consistent in producing algal blooms because the formulations of organic materials vary. However, they are cheaper and may be used in fish production for the organic food markets, meaning the end products have no exposure to manufactured chemicals. In the strictest application, the organic fertilizer also has no prehistory of exposure to manufactured chemicals. The growing popularity of organic farming in the western states has created renewed interest in the use of organic fertilizers in aquaculture. Organic farmers sacrifice consistency for the use of natural products to achieve the higher-priced product, whereas large-scale aquaculture production often requires more consistent production of algal blooms afforded by the use of inorganic fertilizers. Some western fish producers use a combination of inorganic and organic fertilizers not only to reduce cost, but also to assure more consistent production of the algal bloom.

Organic Fertilizer Basics: Natural or organic fertilizers such as hay, straw, and manure are among the earliest sources of fertilizers and are commonly used throughout the world to initiate algal blooms in pond aquaculture. As the organic material decomposes in the water, varying amounts of nitrogen, phosphorous, and potassium (N, P, K) are released and serve as primary nutrients for the phytoplankton community.

Animal manure is used extensively throughout Asia and Southeast Asia as a source of pond fertilizer. A common practice is to house pigs or chickens in cages above a pond and allow the manure to fall directly into the water. To date, this has not been an acceptable practice in the United States, and raw animal manure is not often recommended as a source of organic fertilizer for ponds. In addition, excess manure applied to a pond can stimulate production of unwanted filamentous and blue-green algae. A more common practice in the western states is to use vegetative material as organic fertilizer.

Organic fertilizers, including manure, serve as algal nutrients and stimulate production of zooplankton (microscopic animals) that feed on the growing algal population. This technique is often used to prepare new ponds for fry (young fish) such as striped bass that depend on zooplankton in their early life stages. Aquaculturists have not developed an artificial ration suitable for the early life stages of striped bass, so the fish are spawned and fry are stocked into ponds within three days of hatch. The zooplankton serves as the primary food source for about the first 45 days of production.

Popular vegetative organic fertilizers used by organic farmers and to initiate phytoplankton and zooplankton blooms for fry production in western states include alfalfa pellets, cottonseed meal, rice bran and old hay (Table 1).

Table 1. Organic fertilizers commonly used in the Western States and their approximate percent of crude protein.

Organic Fertilizer	Approximate % Crude Protein
Cottonseed Meal	36 to 43
Alfalfa Pellets	17 to 24
Rice Bran	12 to 15
Old Hay	Low and variable
Fine Catfish Mash	32

Organic fertilizers with a higher percentage of crude protein break down to produce higher levels of nitrogen that will be available as fertilizer. They are a good choice as initiators of algal blooms in newer ponds with little or no organic buildup in the sediment. Organic fertilizers with lower levels of crude protein are cheaper and considered good fertilizers for older ponds requiring less nitrogen to initiate algal blooms.

Once organic fertilizers are applied, the pond should be monitored carefully to see that the algal bloom is established and that no associated oxygen depletion problems are created. Oxygen depletion often occurs when excessive amounts of organic fertilizers are applied. As the organic material breaks down (decay) and provides the nutrients that stimulate production of the algal bloom, it also removes oxygen from the water during the chemical process of decay. Oxygen depletion can occur if the decay process removes more oxygen than can be replaced by the developing phytoplankton.

Inorganic Fertilizer Basics: Traditional agriculture has demonstrated that nitrogen (N), phosphorous (as P_2O), and potassium (as K_2O-potash) as fertilizer components are the primary limiting factors in plant production. The same holds true for aquatic plants, including phytoplankton. Secondary nutrients in fertilizers include calcium, magnesium, and sulfur. Trace nutrients may include copper, zinc, boron, manganese, iron, and molybdenum.

The basic fertilizer formulas are based on the primary nutrients of nitrogen, phosphorous, and potassium (N-P-K) and are expressed as a ratio of each in the N-P-K sequence. For example, a fertilizer with a formula of 16-20-1 is interpreted as 16% nitrogen, 20% phosphorous and 1% potassium. Some fertilizers, such as 16-20-0, do not contain potassium. If needed, the potassium is added as straight potash (K_2O-potash).

The formula of a fertilizer also indicates relative concentration. For example, a granular 16-16-8 fertilizer is twice the strength of a granular 8-8-4 fertilizer. If an 8-8-4 fertilizer is recommended but a 16-16-8 fertilizer is the only one available, then the 16-16-8 fertilizer is applied at half the recommended rate. Units of measurement are given in English equivalents, but metric equivalents are provided in Table 2.

Table 2. English-metric conversion rates used in this publication.

1.0 lb = 0.4536 kilograms
1.0 gal = 3.785 liters
1.0 inch = 2.54 centimeters
1.0 acre = 0.4047 hectares
1 C = (F – 32) x 5/9 for Degrees Fahrenheit

Granular and Liquid Inorganic Fertilizers: All granular fertilizers should be pre-dissolved before application. Even when granular fertilizer is dissolved, some microparticles become bound to clay particles and are rendered inaccessible to the phytoplankton. Common inorganic granular fertilizers used in the western United States are 8-8-2 and 20-20-5. The 20-20-5 formula contains over twice the N-P-K as 8-8-2 and this must be taken into consideration when establishing application rates. A 100-pound application of 8-8-2 fertilizer delivers N-P-K at a rate of approximately eight pounds of nitrogen, eight pounds of phosphorous and two pounds of potassium per application (Table 3).

Table 3. Nitrogen, phosphorous, and potassium (N-P-K) ratios of inorganic granular fertilizers often used in the West, and application rates in lbs per surface acre.

N	P	K	Application Rates
8	8	8	100 lbs. per acre
8	8	2	100 lbs. per acre
8	8	0*	100 lbs. per acre
16	20	1	40 lbs. per acre
20	20	5	40 lbs. per acre
20	20	0*	40 lbs. per acre
0	20	5	40 lbs. per acre

***** Potash as source of potassium is optional

Liquid fertilizers are more readily available to phytoplankton than a dissolved granular fertilizer. Common liquid fertilizers are 10-34-0, 10-37-0 and 13-38-0 (Table 4). Liquid fertilizers do not become bound to clay if diluted with a larger volume of water before application. When using liquid fertilizers, the application rates are much less than those recommended for a similar granular fertilizer. The advantage of liquid fertilizers is that the phosphorous is reported to be immediately available to the phytoplankton, especially orthophosphate. When a liquid fertilizer is used, it should be diluted in a larger volume of water and spread evenly over the pond. Liquid fertilizers are heavier than water and will sink and be less effective if not diluted before treatment. Listed below are common liquid fertilizers used successfully in the western United States (Table 4).

Example Calculation for Liquid Inorganic Fertilizers: The following is an example calculation for the determination of the amount of liquid fertilizer needed for a pond of 2.5 surface acres.

Example: Pond = 2.5 surface acres. Using Table 4 set up a ratio-equation in which 0.9 gallons are required for 1.0 acre, and X (representing the unknown) gallons that are required for 2.5 acres. Transpose, and 0.9 gallons times 2.5 (acres cancel out) = X = 2.25 gallons.

$$\frac{0.9\,g}{1.0\,ac} = \frac{X}{2.5\,ac}$$

(0.9g)(2.5) = X

X = 2.25 gallons

Table 4. Nitrogen, phosphorous, and potassium (N-P-K) ratios of inorganic liquid fertilizers often used in the West, and application rates in gallons per surface acre.

N	P	K	Application Rates
10	34	0*	Apply 0.9 gallon per surface acre (3.2 liters/acre) when filling, or in a filled pond.
10	37	0*	This is followed by an application of the same rate, once a week for two weeks.
13	38	0*	On the fourth week the application is 0.45 gal/acre (1.6 liters/acre).**

*** Potash optional**
**** Based on application rate of about 8.0 liters per hectare (metric) initial application**

Fertilizers and the Environment

Ponds that are located in a fertile watershed may not require fertilizer, whereas ponds on a wooded watershed might require fertilizer to maintain a productive algal bloom. If the pH of the water is relatively high (pH = 8 or above), fertilizers containing nitrogen should be avoided as they may be converted to the unionized, toxic form of ammonia (NH_3). If the appropriate fertilizer is not readily available, it may have to be custom-formulated with no nitrogen content (e.g. 0-20-5). It is also beneficial to obtain a soil and water analysis by an appropriate laboratory, then consult with a soil scientist, or the Soil Conservation Service (SCS), for an appropriate fertilizer recommendation.

Topography is also an important consideration when initiating any fertilizer application. Within topography of variable elevations, pond fertilization should be initiated after the rainy season. This strategy avoids potential pond water overflow that can impact ponds at a lower elevation, especially if the impacted property is under separate ownership. Pond fertilization is only recommended for static ponds with no pond overflow that could potentially impact downstream waters and watersheds. Ponds that continuously receive water from a spring seep and overflow can be fertilized without risk to waters of lower elevations if the seep inflow is temporally diverted around the pond during pond treatment.

When to Apply Fertilizers? The first application of fertilizer should be initiated in the spring when pond water temperature increases to about 60° F (15.6 C). Prior to this elevation in temperature the phytoplankton exhibits little growth and the nutrients are not used.

Water temperature readings should be taken in the mid-afternoon and from an area about one foot below the water surface at the deep end of the pond. When the water temperature reaches about 60° F, the fertilization program is initiated. In warmer western states, depending on local climatic conditions and elevation, this may occur in April or as late as mid-May. In cooler climates, this may occur in late May or as late as mid-June.

When to Avoid Applying Fertilizer? Fertilizing ponds during summer or other warm-to-hot periods is not recommended. The combination of abundant nutrients and higher water temperature more often results in problems associated with excessive phytoplankton blooms. The warm summer water temperature stimulates the reproductive processes of phytoplankton and, if nutrients are abundant, the phytoplankton population can become excessive. An excessive algal bloom has a negative impact on the oxygen concentrations in the pond and algal overpopulation ultimately leads to bloom self-destruction. This happens when the available nutrients are depleted leading to algal die-off and oxygen depletion when the algal cells decompose.

Does feeding fish affect the pond environment? Feeding fish in a pond has a direct effect on the pond environment. If a formulated ration is fed to fish, the uneaten ration particles and increased fish waste will act as fertilizer and produce an algal bloom. In most cases, fertilizing a pond that is receiving a formulated ration is not recommended. However, in some instances where a "fed" pond remains clear, but a bloom is wanted, a starter bloom application of fertilizer is often administered early in the spring. When heavier feeding is initiated and the bloom develops, the fertilizer treatment is discontinued. Because ponds are easily over-fertilized, caution is always recommended if this approach is taken.

Pond Fertilization and Monitoring Pond Conditions

Consistent successful fertilization of a pond requires good judgment and experience with the particular body of water. There is no set formula for success, and each pond will react to treatment differently. The pond's algal response will be influenced by its own soil characteristics, water chemistry, and the nature of the watershed draining into the pond. The pond will also respond differently over the years as it ages and as conditions change. It is recommended that treatment records on a pond be maintained and that the records reflect accurate observations as to the pond's response. This type of monitoring of the algal concentration before and after applying fertilizer is essential both for successful results, consistency and to prevent detrimental algal blooms.

Secchi Disk: The Secchi disk is a 20-cm diameter flat plate that is colored as alternating black and white quarters, and used to determine the depth of light penetration of water (Figure 1). The disk is usually attached to a calibrated line by a centered ring so that when it is lowered into the water the surface of the plate is horizontal to the surface of the water. The disk is used to determine a Secchi Disk Average (SDA), which is an average light penetration measurement used in data to determine condition of a body of water.

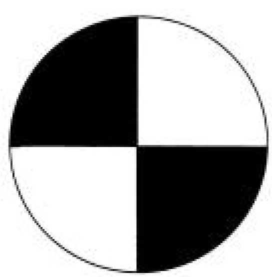

Figure 1. Diagrammatic view of a Secchi disk showing the light and dark pattern.

For our purpose of estimating algal density in a pond, a modified and simplified application of the same principle is appropriate. Because our application of the disk is simply to estimate the relative density of an algal bloom as being either "too heavy" or "too light," we can eliminate the concept of establishing an SDA and use a less sophisticated approach.

Secchi Disk for Recording Algal Density: A Secchi disk can be made from an 8-inch disk of a material such as wood, metal or plastic. The disk is attached to the end of a pole, which is marked in 1-inch increments starting from the surface of the disk. The pole may be attached in the center of the disk or at one edge of the disk to improve visibility. The pole is marked with a highly visible band at the 12-, 18- and 24-inch marks. The marks are used to indicate the level of light penetration and readings should be recorded to learn how the pond responds seasonally, to determine if a pond needs a fertilizer treatment, and how it responds after fertilizer treatments. If the pond has high levels of suspended clay or "muddy water", Secchi Disk readings will not be accurate.

Taking a Secchi Disk Reading: Secchi disk readings will be different among individuals performing the measurements. To remove this type of error, the readings should be taken by one person using standardized procedures. Measurements should be made from the lee-side of the boat or structure, in open sunlight and with the sun behind the observer. Observations should be taken at the same time of day between 9:00 AM and 3:00 PM. Readings taken at different times of day and under different weather conditions more often result in error (Table 5).

Light penetrating to depths greater than 24 inches indicates an inadequate algal bloom, and light penetration less than 18 inches indicates a bloom that is becoming dense and should be closely monitored. As the reading approaches 12 inches, monitoring should be increased and freshwater flushed through the pond to remove some of the algae. A measurement of 6 to 12 inches represents an excessive bloom, and flushing should be increased and nighttime aeration introduced to counter oxygen depletion. The most effective of

Table 5. Secchi disk readings, relative condition of the algal bloom, and management recommendations (Modified from Masser and Wurts, 1992).

Secchi Disk Reading	Condition of Bloom	Pond Recommendation
Greater than 24-inches	Inadequate	Fertilize pond
18 to 24-inches	Healthy	Continue monitoring
12 to 18-inches	Dense	Increase monitoring and periodic flushing
6 to 12-inches	Excessive	Flush with water, aerate, and find cause
Less than 6-inches	Critical	Maximum flushing and increase aeration

aeration methods are water exchange using fresh oxygenated water and supplementary aeration. Readings less than 6 inches indicate a critical condition, possibly resulting in an algal die-off leading to total oxygen depletion and a fish kill. Maximum flushing and supplementary aeration should be implemented until the crisis has passed.

Hand Monitoring: Another method of estimating the density of an algal bloom is to use your hand in place of the Secchi disk described above. It is not as accurate as the Secchi disk, but can be used as a quick measurement. The observer's hand is lowered into the water to about the level of the elbow, and the hand is flexed so that the palm is facing up and horizontal to the surface of the water. In a pond with a "healthy" bloom the fingers may appear hazy, but visible when moved. If the fingers are not visible, the bloom is probably becoming too dense.

Variations in arm length and differences in vision between individuals will affect the determination, but common sense should be employed. A hand is not as visible as a Secchi disk, and the hand test is only a good indicator of heavy blooms. In a "healthy" pond the visibility distance of a hand is about 12 to 20 inches (30.5 to 50.8 cm). Distance between the elbow and the hand of a moderate size arm is about 12 inches, and the distance from the shoulder to the hand is about 20 inches.

Application of Inorganic Fertilizer

The best pond fertilization rates are usually established based on an analysis of pond water, soil, and watershed conditions, as well as a recommendation obtained from the Soil Conservation Service (SCS). If an SCS analysis is not available, the second choice can often be obtained from an experienced fish farmer who is familiar with the conditions in the vicinity of your pond. A third approach is to initiate a pond fertilization program with a common inorganic fertilizer such as 8-8-2.

Example Applications of Inorganic Fertilizer: A good example of the application of an inorganic fertilizer is based on one commonly used in western states. It is an application of 100 pounds of 8-8-2 formula fertilizer per surface acre of pond. Following application in early spring, when water temperature reaches 60° F, an algal bloom may develop within a week, or as late as three weeks. If no bloom appears, water temperatures should be taken to be sure temperatures are still above 60° F. To initiate a more rapid early spring bloom in a relatively clear pond, the first application can be doubled. This can be done with 200 pounds of 8-8-2 per surface acre, which is equivalent to 50 pounds of 16-16-4 per surface acre. Any subsequent applications should be given at the normal 100 pounds per surface acre.

Many growers recommend the initial double-dose application of fertilizer to initiate the bloom. This is followed by weekly applications of fertilizer after the initial double-dose until the bloom appears. After the bloom appears, the application is continued at the standard rate of 100 pounds per surface acre, but reduced to a two-week interval between treatments.

Fertilizers should be applied in the shallow areas of the pond. If the fertilizer is applied to water greater than 2.5 feet deep, it usually sinks and may not become available to the phytoplankton community, which occupies the area close to the water surface. All applications should be in areas relatively free of macrophyte pond vegetation. Several methods of applications are commonly used and are discussed in the following section.

Pond fertilization is discontinued as warm weather approaches. If the pond contains fish that are to receive a prepared fish ration, fertilizer applications are discontinued as soon as feeding is initiated. Again, in addition to good judgment, experience with the pond and its individual characteristics is necessary for consistent success. The goal is to maintain an established, but not excessive algal bloom. To achieve this, monitor the condition of the bloom using a Secchi disk or the hand-monitoring method to prevent oxygen-related problems.

Application by Hand and Sprayer: Pond operators prefer to apply fertilizer by hand in smaller ponds and by use of a battery-operated pump sprayer in larger ponds or lakes. Hand application usually involves pre-dissolving the fertilizer in a container of water and using a smaller container to broadcast the fertilizer over the pond surface. Liquid fertilizer should also be diluted before application, or it will sink to the bottom and become inaccessible to the algae. Larger ponds and lakes are more easily treated using a pump sprayer to apply the fertilizer from a boat. Both methods provide the operator with maximum control using an exact dosage at a specific time and over a defined area.

Application by Platform: The platform method of applying fertilizers to ponds is performed by pouring solid fertilizer onto a submerged platform positioned in the shallow end of the pond and in an area subject to good water circulation. Smaller ponds of one to two acres may be serviced from a 3-foot x 3-foot platform placed one foot under the water surface. Larger ponds may be serviced by a platform of 4-foot by 8-foot sheet of plywood, and using one platform for every 5-acres of pond surface. The fertilizer slowly dissolves and dissipates in the water. This method also prevents solid fertilizer from sinking into the bottom mud and components of the fertilizer becoming unavailable to the algae. Nutrients such as phosphorous are readily absorbed and inactivated by bottom mud, so the platform assures its availability to the phytoplankton. Use of a platform can reduce the fertilizer requirements by 20 to 40 percent, but a common rule is to reduce the application to about 20 percent of normal and monitor bloom development. A standard recommendation of 100 pounds per surface acre should be reduced to 80 percent. A disadvantage of this method is dependence on water current to distribute the fertilizer away from the platform area and the inexact dosage of the treatment.

Application by Raft: The raft method of fertilizer delivery usually involves floating a perforated bag or container of fertilizer on a raft in the shallow area of a pond. The fertilizer is allowed to leak into the pond from holes in the fertilizer bag and openings in the bottom of the raft. The object of this approach is to allow a continuous application of fertilizer to be used by the phytoplankton community as the bloom increases. Most operators are uncomfortable using this method, and it is not recommended. There is less personal control over the dosage or timing of the treatment. If control over dosage and timing is lost, the pond is easily over-fertilized, leading to problems associated with overwhelming algal blooms.

Applying Liquid Fertilizers: The use of liquid inorganic fertilizers is becoming the predominant application technique in many parts of the West. Liquid fertilizers are easily obtained, easily stored and the active ingredients are pre-dissolved. The liquid fertilizer is mixed with water in a ratio of 10 units of water to 1 unit of fertilizer and may then be broadcast or sprayed on to the pond; or introduced to the pond with a drip system. An application rate of 0.9 gallons per surface acre is recommended.

Applying Organic Fertilizer

Organic fertilizers used in the western states are available in solid forms such as alfalfa, cottonseed meal, and hay or rice bran (Table 6). Like inorganic fertilizers, organic fertilizers are never distributed in the deeper areas or in mid-pond where the fertilizing elements may not become available to the phytoplankton. The material is distributed around the margin of the pond in water one foot or less in depth. As the material decomposes, the fertilizing elements of N, P, K and trace elements are released to the phytoplankton. Also, like inorganic fertilizer, application of the material should not be applied during the warmer periods or in “fed” ponds once feeding is initiated. Application begins when spring water temperatures reach 60° F.

Table 6. Pond fertilization rates for common organic sources.

ORGANIC SOURCE Light Application	ORGANIC SOURCE Heavy Application
Alfalfa Pellets 200 lb./surface acre	**Alfalfa Pellets** 400 lb./surface acre
Cottonseed Meal 100 lb./surface acre	**Cottonseed Meal** 300 lb./surface acre
Rice Bran 100 lb./surface acre	**Rice Bran** 300 lb./surface acre
Old Hay Scattered as Flakes 8 bales/surface acre	**Old Hay Scattered as Flakes** 16 bales/surface acre
Catfish Fine Grain Mash 20 lb./surface acre/day for a week	

Pond owners who stock channel catfish often use a mixture of channel catfish fine grain mash, 32-percent protein mix and water to initiate an algal bloom. The mash provides the necessary nutrients that initiate an algal bloom. The mixture is applied at a rate of 20 lbs per day for a week.

Producers who grow fish such as striped bass that depend on zooplankton as a food source during their early stages will sometimes use natural grasses as a source of fertilizer. Zooplankton are microscopic animals such as copepods and rotifers that feed on the phytoplankton. Following harvest and when the ponds are empty, natural grasses are allowed to grow in the pond basin. Prior to stocking with young fry, the grass is mowed, mechanically raked to the pond margin and allowed to dry. The pond is then filled with water to begin the decomposition process in the bottom stubble and the cut grass in the shallow margin. This process initiates an infusion of phytoplankton, followed by development of a zooplankton population. Frequently, the pond is seeded with zooplankton collected from other ponds to accelerate the process.

Applying a Mix of Inorganic and Organic Fertilizers

A number of channel catfish and some striped bass growers in the western states prefer to use a combination of organic and inorganic fertilizers to initiate an early season phytoplankton bloom before they initiate normal feeding programs (Table 7). Frequently used is a combination of about 50 percent of the basic recommendations for each fertilizer source. The practice of using a combination of organic and inorganic fertilizers reduces the cost of using larger quantities of inorganic fertilizers when applied alone. This practice also takes advantage of the availability of cheaper organic fertilizers if the pond operation is closely associated with other integrated agricultural activities.

Liming Ponds

In some incidences, ponds will not respond to an application of fertilizer and an algal bloom will not develop. If this occurs, a measure of the pond water's total alkalinity will indicate the pond's ability to develop an algal bloom following an application of fertilizer. Low alkalinity ponds are characterized by soft, acidic water (less than 20 mg/liter total alkalinity and less than 6.5 pH) and do not respond well to fertilizer treatment. Ponds that do not respond to a fertilizer application after about 5 to 6 weeks should be checked for total alkalinity. If the total alkalinity is less than 20 mg/liter, a treatment with lime should be considered. Water pH may be checked by using a litmus paper test, which can be obtained from a swimming pool supply shop. An application of agricultural limestone to the pond's bottom sediment will ultimately increase water hardness and alkalinity, and decrease acidity. The adjustment in water chemistry will also make a fertilizer treatment more effective.

Common Precautions When Applying Fertilizer to Ponds

At the end of this publication, there is a description of some common precautions to keep in mind when using fertilizers. Although a phytoplankton bloom can increase the productivity of a pond and help control other aquatic vegetation through its shading effect, it can also cause severe problems if not controlled. The strong negative emphasis is presented because failure to accept these precautions more often results in severe negative

Table 7. Mixed organic and inorganic, light and heavy fertilizer application rates per surface acre frequently used in the western United States.

ORGANIC SOURCE		INORGANIC SOURCE
	Light Application	
Alfalfa Pellets		**8-8-2 or 20-20-0***
100 lbs. per surface acre		50 lbs. per surface acre
Old Hay Flakes		**8-8-2 or 20-20-0***
4 bales per surface acre		50 lb. per surface acre
	Heavy Application	
Alfalfa Pellets		**20-20-0**
200 lbs. per surface acre		100 lbs. per surface acre
Old Hay Flakes		**20-20-0**
8 bales per surface acre		100 lbs. per surface acre

*Choice of formula may be dependent upon past performance of the pond impacts.

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Common recommended precautions to be taken when applying organic and inorganic fertilizers to ponds.
DO NOT exceed recommended rates.
DO NOT fail to recheck calculated dosages against the strength of the fertilizer.
DO NOT administer the fertilizer until the water temperature rises to 60° F in the spring.
DO NOT administer the fertilizer if the pond is overflowing.
DO NOT administer a subsequent application if the bloom is heavy and increasing, especially in hot weather.
DO NOT fail to monitor early morning oxygen concentrations during consecutive days of overcast weather.
DO NOT administer a subsequent application after beginning normal feeding with formulated rations.
DO NOT fail to be prepared to administer emergency oxygen measures during extensive overcast days, or if the bloom becomes excessive or dies.