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What causes algal blooms?

The development and proliferation of algal blooms likely result from a combination of environmental factors including available nutrients, temperature, sunlight, ecosystem disturbance (stable/mixing conditions, turbidity), hydrology (river flow and water storage levels) and the water chemistry (pH, conductivity, salinity, carbon availability…).

However, the combination of factors that trigger and sustain an algal bloom is not well understood at present and it is not possible to attribute algal blooms to any specific factor.

•Nutrients

Nutrients promote and support the growth of algae and Cyanobacteria. The eutrophication (nutrient enrichment) of waterways is considered as a major factor. The main nutrients contributing to eutrophication are phosphorus and nitrogen.

In the landscape, runoff and soil erosion from fertilized agricultural areas and lawns, erosion from river banks, river beds, land clearing (deforestation), and sewage effluent are the major sources of phosphorus and nitrogen entering water ways. All of these are considered as external sources.

Internal origin of nutrients comes from the lake/reservoir sediments. Phosphate attaches to sediments. When dissolved oxygen concentration is low in the water (anoxic), sediments release phosphate into the water column. This phenomenon encourages the growth of algae.

•Temperature

Early blue–green algal blooms usually develop during the spring when water temperature is higher and there is increased light. The growth is sustained during the warmer months of the year. Water temperatures above 77°F are optimal for the growth of Cyanobacteria. At these temperatures, blue–green algae have a competitive advantage over other types of algae whose optimal growth temperature is lower (54-59°F).

In temperate regions, blue–green algal blooms generally do not persist through the winter months due to low water temperatures. Higher water temperatures in tropical regions may cause blue–green algal blooms to persist throughout the year.

•Light

Blue–green algae populations are diminished when they are exposed to long periods of high light intensity (photo-inhibition) but have optimal growth when intermittently exposed to high light intensities. These conditions are met under the water surface where light environment is fluctuating.

Even under low light conditions, or in turbid water, blue–green algae have higher growth rates than any other group of algae. This ability to adapt to variable light conditions gives cyanobacteria a competitive advantage over other algal species.

•Stable Conditions

Most of blue–green algae prefer stable water conditions with low flows, long retention times, light winds and minimal turbulence; other prefer mixing conditions and turbid environments.

Drought, water extraction for irrigation, human and stock consumption and the regulation of rivers by weirs and dams all contribute to decreased flows of water in our river systems. Water moves more slowly or becomes ponded, which encourages the growth of algae.

In water bodies, another consequence of stable conditions is thermal stratification. Thermal stratification occurs when the top layer of the water column becomes warmer and the lower layer remains cooler. When the two layers stop mixing, the upper layer becomes more stable (no wind-induced mixing, convection cells) and summer blooms of buoyant blue-green algae are supported.

When a water body is stratified, bottom waters often become depleted with oxygen (anoxia) which may lead to increased nutrient release from the sediments. Pulses of nutrient from the colder bottom layer may fuel up the algal growth in the top layer.

•Turbidity

Turbidity is caused by the presence of suspended particles and organic matter (flocs) in the water column. High turbidity occurs when a lot of water is running through the system (high discharge after a rain event). Low turbidity occurs when there is only a small amount of suspended matter present in the water column. Low turbidity can be due to slow moving or stagnant water that allows suspended articles to settle out of the water column. When turbidity is low, more light can penetrate through the water column. This creates optimal conditions for algal growth. In return, growing algae create a turbid environment.

Freshwater algal bloom

Further information: Nutrient pollution and Eutrophication

Freshwater algal blooms are the result of an excess of nutrients, particularly some phosphates.[3][4] The excess of nutrients may originate from fertilizers that are applied to land for agricultural or recreational purposes. They may also originate from household cleaning products containing phosphorus.[5] These nutrients can then enter watersheds through water runoff.[6] Excess carbon and nitrogen have also been suspected as causes. Presence of residual sodium carbonate acts as catalyst for the algae to bloom by providing dissolved carbon dioxide for enhanced photosynthesis in the presence of nutrients.

When phosphates are introduced into water systems, higher concentrations cause increased growth of algae and plants. Algae tend to grow very quickly under high nutrient availability, but each alga is short-lived, and the result is a high concentration of dead organic matter which starts to decay. The decay process consumes dissolved oxygen in the water, resulting in hypoxic conditions. Without sufficient dissolved oxygen in the water, animals and plants may die off in large numbers. Use of an Olszewski tube can help combat these problems with hypolimnetic withdrawal.

Blooms may be observed in freshwater aquariums when fish are overfed and excess nutrients are not absorbed by plants. These are generally harmful for fish, and the situation can be corrected by changing the water in the tank and then reducing the amount of food given.

Sunset

Sunset -Home & Garden-Garden Basics

A crash course in fertilizers

Fertilizer sections at nurseries, garden centers, and supply stores dazzle the gardener. The shelves are piled with boxes and bottles, the floors covered with bags stacked high. Labels identify the package contents as “rose food” or “vegetable food,” “lawn fertilizer” or “general-purpose fertilizer.” In some stores, you’ll find bins filled with bone meal, blood meal, or hoof-and-horn meal — all labeled “natural fertilizer.” Choosing the right products to keep your plants healthy can often be a bit confusing.

Understanding N-P-K

Regardless of its type, any fertilizer you buy will come with information about the nutrients it contains. Prominently featured will be the N-P-K ratio, the percentage the product contains by volume of nitrogen (chemical symbol N), phosphorus (P), and potassium (K). A 16-16-16 fertilizer, for example, contains 16% nitrogen, 16% phosphorus, and 16% potassium. A 25-4-2 formulation contains 25% nitrogen, 4% phosphorus, and 2% potassium.

All fertilizers contain at least one of these components; if any is missing, the ratio will show a zero for that nutrient (a 12-0-0 fertilizer contains nitrogen but no phosphorus or potassium, for instance). Boxed, bagged, and bottled products display the N-P-K ratio on the label. For fertilizers sold in bulk from self-serve bins, the ratio is noted on the bin; for future reference, be sure to write the information on the bags you fill and bring home.

Complete and Incomplete Fertilizers

A fertilizer containing all three major nutrients is called a complete fertilizer; a product that supplies only one or two of them is an incomplete fertilizer. Using a complete fertilizer for every garden purpose seems sensible, but in fact it isn't always the best choice. If the soil contains sufficient phosphorus and potassium and is deficient only in nitrogen (as is often the case), you can save money by using an incomplete fertilizer that provides nitrogen alone (ammonium sulfate, for example). In some instances, complete fertilizers can even harm a plant. Exotic, bright-blossomed proteas, for example, will not tolerate excess phosphorus: they "glut" themselves on it and then die.

The inexpensive soil test kits sold at garden centers can give you a rough idea of the nutrients available in various parts of your garden; for a more detailed evaluation, you may want to pay for a professional analysis. By revealing which nutrients may be lacking, such tests can help you choose an appropriate fertilizer.

General and Special-Purpose Fertilizers

The various products labeled "general-purpose fertilizers" contain either equal amounts of each major nutrient (N-P-K ratio 12-12-12, for example) or a slightly higher percentage of nitrogen than of phosphorus and potassium (such as a 12-8-6 product). Such fertilizers are intended to meet most plants' general requirements throughout the growing season.

Special-purpose fertilizers, on the other hand, are formulated for specific needs. They're aimed at the gardener who wants a particular combination of nitrogen, phosphorus, and potassium for certain plants or garden situations. These fertilizers are of three general types.

One type, used during the period of active growth, contains largely nitrogen. Such products, with N-P-K ratios such as 16-6-4, are often used in spring, when you want to encourage lush growth or green up your lawn.

Another type is meant to stimulate root growth, stem vigor, and flower and fruit production. Fertilizers of this sort contain little nitrogen and higher levels of phosphorus and potassium; the N-P-K ratio may be 3-20-20, for example. These products are applied at different times and in different ways, depending on what you want to achieve. When you prepare a new planting area, for instance, you'll work a dry granular fertilizer of this sort deeply into the soil, putting the phosphorus and potassium where roots can absorb them. The nutrients help strengthen the new plants' developing stems and encourage the growth of a dense network of roots.

To promote flower production and increase the yields of fruit or vegetable crops, you apply the same sort of fertilizer to established plants after they've completed their first flush of growth. You can use either dry granules, scratching them lightly into the soil, or apply a liquid formula with a watering can or a hose-end applicator.

A third group of fertilizers is designed for use on specific plants. These feature the N-P-K ratios determined to elicit the best performance from the particular plant, as well as other elements proven valuable to that plant. Such fertilizers are named according to the plant they're intended to nourish. Especially useful are formulas for citrus trees and acid-loving plants such as camellia and rhododendron.

Recently, other such plant-specific fertilizers have appeared on nursery shelves, each claiming to be the best choice for a certain plant or group of plants; you may see several sorts of "tomato food" or "flower fertilizer," for example. The jury is still out on the benefit of many of these products, and you will often do just as well to use a general-purpose type. The main distinction is often the price: the "special" formulas are usually costlier than general-purpose kinds.

Synthetic and Organic Fertilizers

Some fertilizers are manufactured in the laboratory, while others are derived from natural sources. Each has certain advantages.

Synthetic fertilizers. These products are derived from the chemical sources listed on the product label. They're faster acting than organic kinds and provide nutrients to plants quickly, making them a good choice for aiding plants in severe distress from nutrient deficiencies. Synthetic fertilizers are sold both as dry granules to be applied to the soil and as dry or liquid concentrates to be diluted in water before application. In dry form, they're usually less expensive than their organic counterparts. In some of the dry granular types (those known as controlled-release fertilizers), the fertilizer granules are coated with a permeable substance; with each watering, a bit of fertilizer diffuses through the coating and into the soil. Depending on the particular product, the nutrient release may last anywhere from 3 to 8 months.

Some synthetic products are packaged for special purposes; you'll find spikes and tabs for container plants, for example.

Note that synthetic fertilizers usually do not contain any of the secondary or micronutrients — but in most cases, these nutrients are already present in the soil. If a test indicates that some are missing, look for a fertilizer that provides them.

Organic fertilizers. Organic fertilizers are derived from the remains of living organisms; blood meal, bone meal, cottonseed meal, and fish emulsion are just a few of the many available types. Organic fertilizers release their nutrients slowly: rather than dissolving in water, they're broken down by bacteria in the soil, providing nutrients as they decompose. Because these fertilizers act slowly, it's almost impossible to kill lawns or plants by applying too much (overdosing with synthetics, in contrast, can have potentially fatal results). Some manufacturers combine a variety of organic products in one package, then offer them for general-purpose or specialized use.

Two commonly used soil amendments — compost and manure — have some nutritive value and can be used as part of an organic fertilizing program. The N-P-K ratio of compost varies from 1.5-.5-1 to 3.5-1-2. Chicken manure's N-P-K ratio ranges from 3-2.5-1.5 to 6-4-3; that of steer manure is usually a little less than 1-1-1.

Fertilizers containing seaweed are gaining favor with many gardeners. Besides providing nutrients in a form immediately available to plants, seaweed contains mannitol, a compound that enhances absorption of nutrients already in the soil, and various hormones that stimulate plant growth. And the carbohydrates in seaweed break down rapidly, nourishing soil-dwelling bacteria that fix nitrogen and make it available to plant roots.

Mixed with water and sprayed directly on foliage, seaweed-containing fertilizers can have dramatic effects in a matter of days. Plants green up and begin to produce new growth, and those that are weak stemmed and straggly straighten up and become stronger.