ORGANIC FERTILIZATION IN CULTURE PONDS

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William A. Wurts, State Specialist for Aquaculture
Kentucky State University Cooperative Extension Program
www.ca.uky.edu/wkrec/Wurtspage.htm

Fertilization is frequently used in the management of sport fishing ponds. However, these ponds are typically fertilized with inorganic compounds. Inorganic fertilizers are formulated using various chemicals containing nitrogen, phosphorus and potassium (N,P,K). These elements, especially phosphorus, stimulate the growth of microscopic plants called phytoplankton, which in turn, serve as food for microscopic animals. Nutrients are applied to increase pond productivity, that is, aquatic life. The greater abundance of plant and animal life supports larger populations of the desired species such as largemouth bass and bluegills.

The wastes produced by farmed aquatic animals usually support substantial phytoplankton blooms in production ponds without adding inorganic nutrients. But, organic fertilization has been used to improve pond productivity for the culture of several species. A wide variety of organic materials have been used to promote the growth of zooplankton and phytoplankton as well as other invertebrates and pond micro-organisms. Organic fertilizers include manure, cottonseed meal, soybean meal, rice bran, alfalfa meal and other processed grains or hays. While the use of animal manure is very effective for stimulating the growth of aquatic plants and animals, it creates a negative image for the average consumer in the United States. People do not like to think about manure in association with the fish sandwich they just ate. As a result, manure is not commonly used in the United States to produce aquatic animals for food. Manure also contains high concentrations of ammonia and therefore, could be toxic to aquatic life if too much is added to a pond.

Organic fertilizers are primarily used to increase populations of aquatic invertebrates such as worms, crustaceans and insect larvae, as well as zooplankton. These organisms provide food for fish and other farmed aquatic animals. Organic fertilization has been used extensively to produce several species of juvenile game fish, including hybrid striped bass, red drum and largemouth bass.

In the early 1980s, the Texas Parks and Wildlife Department (TPWD) used organic fertilization to produce juvenile red drum. Alfalfa meal was the fertilizer applied. Alfalfa is 17 percent crude protein and 27 percent crude fiber by weight. Three days after hatching, larval red drum were stocked into fertilized ponds and allowed to graze on the plankton populations. With alfalfa, supplemental feeding and no aeration, the TPWD could raise sufficient quantities of fish (60,000/ac) for coastal stocking programs.

Earlier studies indicated that larval red drum feed primarily on copepods. Organic fertilizers were found to be effective for zooplankton production, in particular, copepods. Fertilization with alfalfa meal offered fibrous substrate, as well as nutrients, for zooplankton growth. After the initial application of alfalfa, dissolved oxygen concentrations dropped during the first seven days and recovered in the second week. The stocking of 3-day-old red drum was timed to coincide, as closely as possible, with the highest abundance of copepods. It took approximately 10 days post-fertilization for peak zooplankton production to occur.

At the TPWD marine fisheries research station in Palacios, Texas, juvenile red drum were produced in 0.25 to 4.0 acre ponds, 22 acres total. Alfalfa meal was spread over the dried pond bottom (250 lb/ac) just before filling. Ponds were gradually filled over a three week period. The technique was called "puddling." Logic suggested that greater light penetration and rapid warming accelerated the production of zooplankton. Following the initial application of fertilizer, 62 lb of alfalfa meal, 25% of the original amount, was broadcast over the pond surface by hand each week for one month. This 62-lb weekly allotment was divided in into three equal, alternate day applications. Supplemental feed was offered at the beginning of the second week (5 lb/ac/day), and 1.5-inch red drum fry were harvested approximately four weeks after stocking.

Similar practices are used to produce hybrid striped bass fry. Often, chemical fertilizers such as triple super phosphate (0:46:0, N:P:K) are used in combination with organic fertilization to ensure that robust phytoplankton populations are established along with the zooplankton.

Larval fish and post-larval crustaceans are often small, less than 0.5 inch long, and can not travel great distances to find food, such as commercially prepared diets. Initially, the correct amount of feed to offer young fish and crustaceans is small and rations may not exceed 5 lb/ac. However, distributing 5 lb of a finely ground starter diet over a 1.0-ac surface would spread the feed very thin. This might be the equivalent of 10 to 15 feed particles for each square yard of pond bottom. A larval fish or juvenile crustacean would literally have to collide with its food to find it. Imagine a human toddler trying to find a cookie using nose, tongue and hands only, in the dark, on the floor of a 400 square foot room that is over 4 stories tall. And, in an aquatic environment, the cookie would disintegrate, breaking up into minuscule pieces after 30 minutes.

Channel catfish fingerlings are relatively large when stocked and can swim rapidly for distances of several yards. They can orient towards the sound and low frequency vibrations of pellets hitting the water and then locate their food visually. Therefore, broadcasting a commercial diet over the pond surface is an effective feeding practice for catfish. Larval fish and juvenile crustaceans, however, are much smaller and considerably less mobile. Crustaceans are typically bottom dwelling (benthic) and do not rely on eyesight to find food. As discussed above, these animals may find it exceptionally difficult to locate commercially prepared feeds for several weeks after stocking. This can be a critical period when juvenile animals may be weak and more sensitive to stress. Consequently, mortality could be high. An abundance of natural food organisms in ponds pre-fertilized with organics would minimize the importance of finding sparsely dispersed prepared feeds.

Organic fertilization is well-suited to the production of larval fish. This practice may also be a good match for crustacean culture. By promoting growth of large populations of free-swimming and benthic invertebrates, there may be substantially more than 20 organisms per cubic inch, providing ample food for larval fish or post-larval crustaceans. This would be like having an all-you-can-eat buffet for juvenile culture animals at the time of stocking. Live plankton and benthic invertebrates are preferred prey for young fish and shrimp and provide high quality protein as well as other essential nutrients. Organic fertilization could be useful for the culture of freshwater shrimp, marine shrimp and Australian red claw crayfish.

In a low-input farming demonstration, the TPWD fertilization technique was adapted for freshwater shrimp production through the application of 250 lb/ac of alfalfa meal 14 days before stocking. With final feeding capped at 25 lb/ac/day, a low stocking density and no aeration, a Kentucky cooperator produced approximately 400 lb/ac of 13-count shrimp during the summer of 2002. Organic fertilization has also been used to prepare ponds for intensive, freshwater shrimp production. Alfalfa has been added alone or in combination with soybean meal. Some farmers preferred alfalfa pellets to meal. Pellets were easier to spread over the entire pond because of their greater size and weight.

In new or unfertilized ponds, especially those that have been empty for several weeks or months, benthic invertebrates and zooplankton would be sparsely distributed. The pond could be compared to a desert; that is, relatively void of life. Juvenile culture animals would have difficulty finding either natural food items or broadcast feed. To help the culture animals find food particles, relatively high initial feeding rates of 25 lb/ac or greater have been used for intensive culture. Because commercial starter diets are usually high in protein (36 to 48 percent), ammonia concentrations could become toxic. Similarly, the relatively high and instantaneous waste loads may lead to low dissolved oxygen concentrations. All of these conditions could result in poor growth and survival.

However, organic fertilization also stimulates the growth of decomposers such as bacteria and fungi. Bacteria and fungi are critical to the breakdown of the toxic waste products that can accumulate with the use of prepared feeds. Consequently, using an organic fertilizer 14 days before stocking could also help stabilize water quality when the feeding of commercial diets begins.

The technique used by TPWD for producing red drum fry in the early 1980s was elegantly simple. Organic fertilization was remarkably efficient. By providing a carbon and nitrogen pool, virtually all of the essential amino acids, vitamins and essential fatty acids required by the juvenile culture animals were produced by the biosynthetic activity of bacteria, plankton and other invertebrates. The populations of plankton and benthic invertebrates produced were heterogeneous and offered a diversity of foods for larval fish or post-larval crustaceans. A variety of organisms would be more likely to supply the nutritional needs of young fish and crustaceans than any single species of plankton or prepared feeds. Stimulating the development of bacteria and fungi prior to stocking and feeding would enhance water quality by augmenting the breakdown of uneaten feed and other wastes. Organic fertilization may have additional applications for a multiplicity of aquatic species cultured around the world.

Adapting old techniques for use with a modern culture practice may produce unexpected benefits. It could reduce costs, improve water quality, increase survival and enhance growth of farmed aquatic animals, all of which could generate higher profits. While old dogs may not be capable of learning new tricks, perhaps they can pass along some priceless pearls of knowledge from the past, before that knowledge is lost forever. Hail Atlantis.