Liquid Fertilization of Public Fishing Lakes in Alabama

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Abstract: Liquid ammonium polyphosphate fertilizer (Poly N®) was evaluated at state-owned public fishing lakes in Alabama. Initial evaluation indicated that only one-third the quantity of phosphate that would normally be applied in granular fertilizer (9 kg/ha P_2O_5) to fishing lakes was necessary to produce acceptable Secchi disc visibilities ($\leq$ 60 cm) during the fertilization season. Further evaluation at 20 public fishing lakes demonstrated that significant financial savings could be achieved in conjunction with acceptable Secchi disc visibilities with a liquid fertilization program.

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State-owned public fishing lakes in Alabama have been fertilized since the first lakes were constructed in 1949. Granular fertilizers (8–8–2 and 20–20–5) have been used singularly or in combination with triple superphosphate (0–46–0) at a rate of 9 kg/ha P_2O_5 per application.

A fertilization schedule similar to that developed by Swingle and Smith (1939) was used for many years and then modified according to the recommendation by Swingle et al. (1963). Recent efforts have been made to establish fertilizations schedule requirements for individual lakes. A typical schedule would be:

1) Beginning the first week of March and for the following 2 2-week intervals, apply 45 kg/ha 20–20–5 per application.

2) At monthly intervals following the last application of 20–20–5, apply 20 kg/ha 0–46–0.

This schedule, with minor adjustments for individual lakes, generally provides Secchi disc visibilities of less than 60 cm from spring through fall.

Recent work with granular and liquid fertilizers at Auburn (Ala.) University, by Claude E. Boyd et al. has demonstrated that:

1) Phosphorus dissolves from granular fertilizer very slowly. Only 15% of the phosphorus can be expected to dissolve from granules through a 2 m column of water. The remaining 85% will dissolve on the pond bottom, rapidly be absorbed by the bottom muds, and become unavailable to the limnetic system (Boyd 1981*a*).

2) Nitrogen is not needed in pond fertilizers at the same levels as phosphorus. Boyd and Sowles (1978) found that nitrogen combined with phosphorus fertilization did not significantly increase bluegill production over phosphorus only fertilization.

3) Liquid ammonium polyphosphate is superior to granular triple superphosphate as a pond fertilizer because all of the phosphorus from the liquid dissolves immediately in the surface waters and is directly available to phytoplankton (Metzger and Boyd 1980).

4) Liquid polyphosphate provides higher concentrations of filterable orthophosphate in ponds than triple superphosphate at the same rate of P_2O_5 (Musig and Boyd 1980).

5) Use of liquid polyphosphate may be less expensive than granular, 20–20–5, pond fertilizer (Metzger and Boyd 1980, Boyd 1981*b*). Davidson and Boyd (1981) found that 4 times as much P_2O_5 from 20–20–5 as in Poly N (R) was needed to stimulate phytoplankton.

6) Ammonium polyphosphate provides higher initial levels of inorganic phosphorus in water than does diammonium phosphate or triple superphosphate at the same application rates. Inorganic phosphorus levels may remain higher over the fertilization period with liquid polyphosphate fertilizer (Boyd et al. 1981).

Dale County Lake Evaluation

Dale County Lake was chosen to evaluate the use of liquid fertilizers at public fishing lakes. This 37 ha lake was chosen because it approximated the average size of state lakes and the concessionaire was willing and interested in assisting with the evaluation. A total of 9,091 kg or 6,302 liters of liquid ammonium polyphosphate (Poly N (R), Allied Chemical Corp., Houston, Texas) with an analysis of 11–37–0 was purchased for the evaluation. This quantity would provide the same 9 kg/ha of P_2O_5 for an equal number of applications as had been used with granular fertilizers. The technique utilized to apply the liquid fertilizer was based on Boyd and Hollerman (unpubl. data). A venturi tube was attached to the cavitation plate of an outboard motor and fertilizer was transferred from a tank in the boat to the prop wash via a hose.

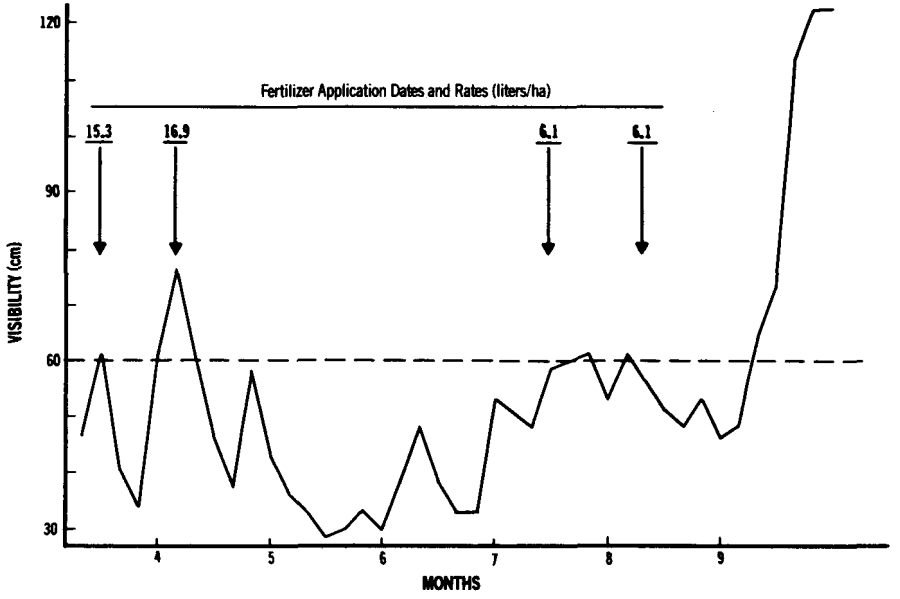

Figure 1. Secchi disc visibility at Dale County Lake from March through September 1981.

The original study plan called for the application of approximately 9 kg/ha P_2O_5 at 2-week intervals beginning 15 March 1981. Low visibility readings through March (created by suspended silt; not a function of phytoplankton densities) delayed the second application of Poly N (R) until 10 April 1981 when the lake cleared and the development of a bloom in response to the first application was apparent. After the second application, phytoplankton densities produced Secchi disc visibilities that remained <60 cm until late July (Fig. 1), so further fertilization was delayed until the end of July. Also, the last 2 applications were reduced to 35% of the recommended 9 kg/ha P_2O_5. Visibilities shown in Fig. 1 indicate that an additional application of 6.1 liters/ha in late August or early September may have maintained visibilities less than 60 cm through September.

If this volume of fertilizer is included in the total applied to Dale County Lake, the total volume of liquid polyphosphate needed to maintain visibilities less than 60 cm would have been 1,371 liters or 29.7% of the total volume purchased. The cost of fertilizing Dale County Lake with liquid ammonium polyphosphate would have been $22.67/ha. The cost of using granular fertilizer to maintain visibilities less than 60 cm at Dale County Lake would have required 9 applications of 9 kg/ha P_2O_5 from 20–20–5 and 0–46–0 at a cost of $63.00/ha. By using liquid ammonium polyphosphate, a 65% savings in cost was achieved.

1982 Fertilization

During fall 1981, plans were made to expand the liquid fertilization process to all 20 public fishing lakes. One year's supply of liquid fertilizer was stored at each lake. The lake concessionaire agreed to take weekly Secchi disc visibilities and apply fertilizer evenly over the lake surface according to our recommendations. From the results obtained at Dale County Lake, it was decided to apply an initial application of 18.8 liters/ha (9 kg/ha P_2O_5) the first week of March then apply monthly applications according to results of visibility checks. If the visibility reading was greater than 60 cm, an application of 6.2 liters/ha (3 kg/ha P_2O_5) would be applied. If the visibility reading was less than 60 cm, no application would be made. Fertilizer was not applied when water was overflowing the spillway or heavy rain was expected.

Costs to equip all lakes for liquid fertilizer storage and application included purchasing suitable storage tanks, equipping those tanks with pipes and valves for dispensing fertilizer, and building cradles to support the tanks. Polyolefin plastic tanks and pvc plastic pipe and valves were utilized because of strength and non-corrosive characteristics. A total of $7,951.25 was spent to purchase 25 tanks ranging in size from 418 to 4,180 liters. The cost to equip tanks with a cradle, piping, and valves ranged from $9.00 to $34.00/tank.

Poly N (R) liquid fertilizer with an analysis of 10–34–0 was purchased at a cost of $11,867.00 for 24,947 liters (35,100 kg). Granular fertilizer costs for the same period would have been $50,680.00. The savings during the first year of liquid fertilizer use including storage tank costs were approximately $30,000.00. Liquid fertilizer cost was $17.84/ha.

Problems were encountered with the use of liquid fertilizer. The most frequent problem was associated with storage equipment failure, i.e., providing sufficiently strong cradles to support the weight of a full tank of liquid fertilizer.

Another problem was that applications applied prior to heavy local rains appeared to flush out of the lake and provide little benefit to phytoplankton densities. Granular fertilizer appears to have a longer residual effect by dissolving more slowly than the liquid form.

Liquid ammonium polyphosphate can be purchased in 2 different formulations. The clear-green liquid is prepared from virgin acids; the brown-black form is prepared from used acids and contains extraneous suspended material. Upon storage, the suspended material in the brown-black form will settle and produce a residue on the bottom of the storage tank several centimeters deep. This problem occurred at one of the public fishing lakes and cleaning this residue was laborious and time consuming.

Adjustments to the 1982 fertilization schedule were made and implemented for the 1983 fertilization period. A weekly fertilization application

was initiated at a rate of one-fourth the monthly appilcation rate (from 6.2 liters/ha to 1.6 liters/ha). This change was made to maintain phosphate levels in the lakes between fertilizer applications and to eliminate the "boom and bust" phosphorous cycle in the phytoplankton densities. This situation occurs when all available phosphorus is removed by the phytoplankton. The phytoplankton then begins to die and applications of fertilizer are slow to regenerate abundant phytoplankton populations. So far, this approach appears to reduce these problems.

Summary

The use of liquid fertilizer at Alabama's public fishing lakes will be continued. Additional minor changes may be necessary in fertilization rates or schedules. However, the benefits of lower cost and ease of application greatly outweigh any minor scheduling problems.

Other state or federal agencies may find liquid fertilizer a cost effective management tool. Agencies with limited budgets that are having to reduce or eliminate fertilization can continue a full fertilization schedule with liquid fertilizer. Agencies that have not considered fertilization because of costs may now find that liquid fertilizer allows them to develop fertilization programs.

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