# EFFECT OF DIFFERENT NITROGEN SOURCES AND SOIL ON FISH PRODUCTION AND WATER CHEMISTRY IN FERTILIZED PLASTIC POOLS[1]

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## INTRODUCTION

Fertilizing ponds to increase fish production is a widespread management practice. Nitrogen is usually supplied as nitrate, ammonium, or as organic nitrogen. Studies have been made on the comparative effectiveness of organic versus inorganic nitrogen (Hickling, 1962; Swingle, 1947). However, the effects of different inorganic sources of nitrogen have not been measured.

When a pond is fertilized, much of the fertilizer settles to the bottom, is tied up by mud and is not immediately available. Thus, the bottom soil becomes an important factor in studying pond fertilization.

This study was made to measure the effects on water quality and fish production of three nitrogen sources used as fertilizer, and of the presence of bottom soil.

## MATERIALS AND METHODS

Fifty plastic-lined pools 10 feet in diameter (1/555 acre) and 20 to 25 inches deep with a 4-inch drain tile in each as a spawning site were used in the experiment.

Each pool was stocked with 50 adult fathead minnows *(Pimephales promelas)* between March 1 and 7, 1967. At the end of the experiment, October 2, 3, and 4, the fish were poisoned with rotenone, collected, and weighed. Reproduction had occurred in all pools, and only a few stocked fish were among those collected.

Ten treatment combinations, each replicated in five pools, were set up (Table 1). Phosphate was supplied by triple superphosphate. The sources of nitrogen were sodium nitrate, ammonium carbonate, and cottonseed meal (CSM). Fertilizers were applied by broadcasting on the surface at monthly intervals. A 4-inch layer of Cecil soil, a local reddish-brown soil of schistic origin, was used.

Water samples were collected from each pool on April 19, May 29, July 6, and August 14. Samples were analyzed for ammonia nitrogen, organic nitrogen, and total and dissolved organic carbon. Ammonia nitrogen and organic nitrogen were measured by methods described by the American Public Health Association (1965) except that distillates were collected in hydrochloric acid rather than boric acid. Organic nitrogen results from many of the pools were lost on the first two sample dates because of faulty technique. Total and dissolved organic carbon were determined on a Beckman carbonaceous analyzer after acidification and washing with nitrogen bubbles to remove inorganic carbon. Dissolved carbon samples were filtered through a 0.45 micron millipore filter.

## RESULTS AND DISCUSSION

### *Fish Production*

Mean fish production of each treatment is shown in Table 1. Although the presence of Cecil soil was associated with a higher average production in four of the fertilizer treatments, the differences were not statistically significant. Thus, in all further discussions of fish production the soil and no-soil treatments are combined. Mean fish production of unfertilized pools was 37.6 g/pool. The addition of phosphate fertilizer increased production to 187.7 g/pool. Addition of inorganic nitrogen, either as ammonium or nitrate, caused a slight but nonsignificant increase in production. Swingle *et. al.* (1965) have reported similar results. There was no significant difference between the ammonium and nitrate fertilized pools. However, when nitrogen was supplied in organic form as CSM, production increased to 349.7

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## TABLE 1

Treatments, Mean Fish Production and Results of Chemical Analyses in Fertilized Pools.

| *Fertilizer*[1] | *Soil* | *Fish Prod.* *g/pool* | *Total Org. C* *ppm* | *Dissolved Org. C* *ppm* | *$NH_3$ Nitrogen* *ppm* | *Organic Nitrogen* *ppm* |
|---|---|---|---|---|---|---|
| none | none | 26.3 | 33.5 | 28.9 | 0.08 | 0.90 |
| none | Cecil | 48.8 | 12.9 | 9.9 | 0.06 | 0.53 |
| $PO_4$ | none | 164.8 | 44.9 | 37.4 | 0.10 | 1.32 |
| $PO_4$ | Cecil | 210.6 | 35.0 | 27.5 | 0.15 | 1.85 |
| $NH_3$ $PO_4$ | none | 228.8 | 58.9 | 48.0 | 0.19 | 2.32 |
| $NH_3$ $PO_4$ | Cecil | 221.7 | 41.3 | 33.0 | 0.14 | 1.82 |
| $NO_3$ $PO_4$ | none | 154.2 | 83.4 | 53.5 | 0.20 | 2.80 |
| $NO_3$ $PO_4$ | Cecil | 254.4 | 36.4 | 18.5 | 0.21 | 2.33 |
| CSM[2] $PO_4$ | none | 322.8 | 62.5 | 49.7 | 0.20 | 2.43 |
| CSM[2] $PO_4$ | Cecil | 376.8 | 31.6 | 27.2 | 0.16 | 1.78 |

1. Each application supplied 8 lbs. of $P_2O_5$ and 8 lbs. of nitrogen (where applicable) per acre.
2. Cottonseed Meal.

g/pool. Almost any organic fertilizer material is a source of food for some lower organisms in the food chain if not for the fish. Thus, the high production with CSM was probably due to its utilization as food by the fish and fish-food organisms.

*Chemical Factors*

Mean results of chemical analyses in each treatment are shown in Table 1. The presence of Cecil soil had no measurable effect on ammonia nitrogen or organic nitrogen in the water. However, pools with Cecil soil had significantly less total and dissolved organic carbon than pools without soil. Pools with soil had an average of approximately 55 percent of the organic carbon that pools without soil contained. Perhaps soil particles adsorbed the organic matter from the water or the soil tied up the nutrients thus allowing a lower level of plankton growth and less production of organic matter.

The relation of chemical factors to fertilizer treatments is more complex. The fertilizer treatments had no significant effect on dissolved organic carbon.

The relationships between fertilizer treatments and the total organic carbon content were:

| Fertilizer treatment | $NO_3$ | $NH_3$ | Org. N | $PO_4$ | None |
|---|---|---|---|---|---|
| Mean total Organic carbon (ppm) | 59.96 | 50.09 | 47.74 | 39.97 | 23.47 |

Means underlined by the same line are not significantly different at the 5 percent level.

The relationships between fertilizer treatments and the ammonia nitrogen content were:

| Fertilizer treatment | $NO_3$ | Org. N | $NH_3$ | $PO_4$ | None |
|---|---|---|---|---|---|
| Mean ammonia nitrogen (ppm) | 0.202 | 0.181 | 0.166 | 0.130 | 0.068 |

Underlining has the same significance as above.

An analysis of the ammonia data by sampling dates showed that only in the first sample (April 19) was the phosphate fertilizer treatment significantly lower than the three nitrogen fertilizer treatments. Data collected on this date account for it being lower overall than the nitrogen fertilizer treatments. Apparently between the first and second sampling dates the phosphate fertilized pools accumulated sufficient nitrogen by nitrogen fixation to become equivalent to pools fertilized with nitrogen.

The relationship of organic nitrogen to fertilizer treatments was obscured by the fact that the data were incomplete; however, the same general pattern appeared. The unfertilized treatment had significantly less organic nitrogen than fertilized treatments. The four fertilizer treatments were not significantly different from each other, although the nitrate and organic nitrogen fertilizer treatments were the highest.

## SUMMARY AND CONCLUSIONS

Fertilization with phosphate only increased fish production an average of five times above that of unfertilized pools. The additional use of inorganic nitrogen, either ammonia or nitrate, caused a small but nonsignificant increase in production. The use of an organic nitrogen source resulted in a significant increase in production to 9.3 times that of unfertilized pools. This was apparently a result of its utilization as food by the fish and organisms lower in the food chain.

The presence of Cecil soil had no effect on fish production or upon ammonia or organic nitrogen. However, the presence of soil decreased the total and dissolved organic carbon in the water.

Three of the four water quality measures, organic nitrogen, ammonia nitrogen, and total organic carbon, were higher in fertilized pools than in unfertilized pools. Among fertilizer treatments the nitrate fertilizer was always significantly higher than phosphate fertilizer. The other two fertilizer treatments were intermediate and usually were not significantly different from either extreme. The fourth water quality measure, dissolved organic carbon, showed no significant differences between fertilizer treatments, or between fertilized and unfertilized treatments.

Water quality measures were not related to fish production even though the unfertilized pools were lowest in both.

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# HEAT TOLERANCE OF ALBINO VS. NORMAL CHANNEL CATFISH

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## ABSTRACT

Two lots of the Arkansas strain of channel catfish, *Ictalurus punctatus,* containing both albino and normal fish, were acclimated in the laboratory at a constant temperature of 30.0°C. Samples of albino and normal fish were exposed to a lethal temperature of 39.0°C. The albinos from both lots had the highest mean survival time, but the differences were not statistically significant.

## INTRODUCTION

There has been a considerable amount of interest shown in the "albino" channel catfish, *Ictalurus punctatus,* and the question of their relative survival and growth in ponds has been raised.

Nelson (1958) noted no significant differences in the growth or survival of albino and normal catfish in hatchery ponds. Prather (1961) obtained similar growth rates in ponds but the survival of the albinos was less. It was suspected this was due to increased susceptibility to predators.

Albinism is generally considered to be selected against. Is this due to ecological factors such as predation or to physiological weaknesses? The purpose of this experiment was to compare the heat tolerance of albino and normal colored channel catfish.

The strain of fish exhibiting this mutation originated in the Arkansas state fish hatcheries where they have been propagated for approximately 26 years (Brady, et. al., 1965). These fish have accumulated many of the characteristics of domestication including color mutations. The "albinistic" condition in these fish was first reported by Nelson (1957) and is now common. These fish have a yellowish-white color and pink eyes. Solid black and pied individuals have also been noted (Brady, et. al. 1965).

Instances of albinistic wild channel catfish are rare but have been reported by Aitken (1937) and Menzel (1944). Albinistic catfish of other species have been reported by McLane (1950) and Atz (1953).

The lack of pigmentation in hatchery and aquarium fishes is quite common. A number of conditions seem to be involved. Xanthism or yellowness is often reported. Whitish fish are less often noted. Haskins and Haskins (1948) working with *Lebistes*

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