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STATUS OF SEDIMENT FROM CATFISH PRODUCTION PONDS AS A FERTILIZER AND SOIL CONDITIONER

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During the commercial production of channel catfish in ponds, the fish are stocked at high density and artificially fed. Standing crops at harvest are in the order of 2,000 pounds of fish per acre. Waste from the fish is in the form of ammonia, urea, and feces. The ammonia and urea undergo nitrification. At least a portion of the fecal material undergoes ammonification and subsequently nitrification. The resulting nitrates are utilized by unicellular algae. A portion of the fecal material and a portion of the biomass produced in the pond along with extraneous settleable materials, produce a sediment that accumulates on the pond bottom. When the pond is drained and permitted to dry the sediment can be separated from the original pond bottom. In connection with fish farm management there are occasions when it is desirable to remove the accumulated sediment. The present study was undertaken to determine the possible value of this sediment as a fertilizer or as a soil conditioner for gardening and similar use.

MATERIALS AND METHODS

Evaluation of the sediment involved chemical analysis for phosphorus, nitrogen, potassium, and organic content. Growth response of 31 Kentucky fescue lawn plots was measured to determine slow release nitrogen. In addition to the fescue plots, pond sediment was furnished to three experienced gardeners for observation as to its value in gardening.

The chemical analyses were based on 12 sediment samples taken from one pond. Samples were taken from different locations and depths within the pond. Samples 1 through 7 were from the shallowest area and samples 8 through 12 were from the deepest area of the pond. Samples were taken April 3, 1974, 1 week after the pond was drained. Sampling consisted of removing a small portion of the sediment from the top 2 in. of the pond bottom and placing the sample in a plastic bag, which was then sealed and stored at −20 C until time for analysis. Total nitrogen was determined by the Macro-Kjeldahl method, total phosphorus by the method proposed by Legg and Black [*3*], available phosphorus by the method proposed by Legg and Black [*3*], available phosphorus by the extractable soil phosphorus technique (Illinois Method), and extractable soil potassium by atomic absorption. Soil organic matter was determined by the wet combustion (colorimetric) method.

The samples used for evaluation of growth response of Kentucky fescue on lawn plots were taken in May, 6 weeks after the pond was drained. The test plots were established June 1 and consisted of five 0.01-acre fescue grass plots, which were part of an established lawn. No treatment was given the control plot. A second plot was treated with ammonium nitrate at a rate of 1 lb nitrogen per 1,000 ft^2, and a third plot was treated with ammonium nitrate at a rate of 0.5 lb nitrogen

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per 1,000 ft². A fourth plot was treated with 12.66 lb of pond sediment, while a fifth plot was treated with 25.33 lb of pond sediment. Assuming 2% nitrogen and 15% moisture content of the pond sediment, treatment rates of the two pond sediment plots were equivalent to 0.5 and 1 lb of nitrogen per 1,000 ft².

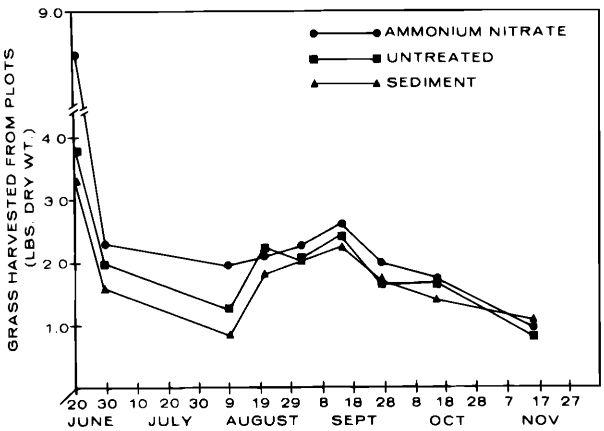
Growth response was measured by weight of dry grass clippings. Comparisons were made between the control and the experimental plots. The plots were mowed nine times during the experiment between the dates June 20 and November 16. Samples for moisture determination were taken at the time of mowing. The samples were dried for 24 h at 80 C and re-weighed.

RESULTS

The pH of the sediment averaged 6.7. Chemical analysis of the sediment yielded the following average values: organic matter 4.04%, total nitrogen 0.27%, total phosphorus 0.11%, extractable phosphorus 1.5 ppm, and extractable potassium 20 ppm. The average organic matter/total nitrogen ratio was 15.4. The organic matter/total phosphorus and organic matter/total nitrogen ratios were on the average higher for samples from the deeper area of the pond, whereas extractable phosphorus was higher for samples from the shallow portion of the pond. Extractable potassium and total nitrogen exhibited no variation with depth (see table).

At the time of the June 20 mowing the two plots treated with ammonium nitrate exhibited increased growth over the control plot and the grass of these plots was noticeably darker green. Subsequently, the growth of the grass on these plots was similar to the control plot. The plots treated with pond sediment were similar to the control plot throughout the summer, but showed an increased growth of grass during November (see figure). No change in color of the grass was detectable.

The local gardeners who were asked to make observations on the use of the pond sediment in



Relative production of grass on plots treated with pond sediment and ammonium nitrate compared to an untreated plot. Sediment added at a rate of 38.8 lb/1,000 ft², ammonium nitrate at a rate equivalent to 1 lb N/1,000 ft².

Chemical analysis of fish pond sediment at 12 different locations within a 0.5-acre pond

Sample location	Organic matter (%)	Total nitrogen (%)	Total phosphorus (%)	Extractable phosphorus (ppm)	Extractable potassium (ppm)	Organic matter / Total nitrogen
1	4.08	0.330	0.125	2.8	17	12.4
2	3.19	0.301	0.075	2.5	22	10.6
3	5.24	0.433	0.115	2.0	22	12.1
4	2.87	0.240	0.075	1.0	20	12.0
5	3.55	0.214	0.080	1.3	20	16.6
6	2.87	0.184	0.080	1.8	19	15.6
7	4.43	0.257	0.105	2.2	18	17.2
8	4.50	0.246	0.140	1.3	17	18.3
9	4.43	0.231	0.140	0.5	16	19.2
10	4.43	0.246	0.125	0.5	22	18.0
11	4.43	0.246	0.130	0.5	20	18.0
12	4.46	0.308	0.130	1.0	25	14.5
Average	4.04	0.270	0.110	1.5	20	15.4

their gardens reported improved seed sprouting and superior growth in the first few weeks after planting. Two of the three gardeners reported that the sediment eliminated a need for the addition of fertilizer to the soil. None of the three reported a weed problem associated with the sediment.

DISCUSSION

Juday et al. [2] reported the total phosphorus in bottom deposits of Wisconsin lakes to be 0.089%. Sims [6] reported the bottom material for Arkansas ponds used for 2 yr for the production of buffalo fish to have a pH of 5.9, organic matter of 2.8%, extractable phosphorus of 2.07 ppm, and extractable potassium of 25 ppm. Hepher [1] reported the sediment of carp ponds in Israel after 5 yr of production to have an organic matter content of 1.99%, total nitrogen of 0.076%, and total phosphorus of 0.144%. He indicated that most of the phosphorus was in the organic form. The nutrient content of the sediment in the present study was similar.

Average chemical values for temperate region humid surface soils in the United States are 4% organic matter, 0.15% total nitrogen, and 0.044% total phosphorus [4]. On the basis of the values determined for the sediment (table), the organic matter in the sediment is about equal to a typical soil, while nitrogen and phosphorus are higher. Sabey [5] reported extractable phosphorus values for soils in Illinois to vary from 0.5 to 2.0 ppm, and extractable potassium to vary from 5 to 15 ppm. Thus the nutrients were higher in the sediment than in typical Illinois soils.

The results of the grass test plots further suggest that the nutrient content of the sediment is such that it can not be classed as a fertilizer. While the comments from the gardeners who used the sediment were favorable, such evaluation is not quantitative and thus is of limited value. The possible value of the sediment for conditioning the soil surface in gardening should be further evaluated.

In summary, it appears that the sediment at best can be classed as a rich soil. The failure for a buildup of organic material and nutrients to a very high level, i.e., to a level characteristic of other manures, indicates that the waste from the fish is rapidly and completely broken down and thus does not accumulate as a rich manure.

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