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How Sewage Foam Affects Grass Growth Compared To UAN Fertilizer Or No Fertilizer

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ABSTRACT

The use of human sewage as a fertilizer has received a bad reputation over the centuries due to the fact that sewage from towns and cities has become more concentrated and harder to control because of volume. People started fearing this sludge. Frightened people have complained because they did not realize the benefits that farm ground could receive from being fertilized with this natural sewage. Sewage foam has not been used as a fertilizer until now. This research evaluated a new kind of use for a product that does not have to meet some of the governmental regulations, because technically sewage foam is not considered to be regular sewage. The research tested whether the sewage foam, a byproduct of the wastewater treatment plants, is feasible as a treatment to encourage grass growth as compared to commercial fossil fuel derived fertilizers and/or no fertilizer at all. The research set up 20 plots and took two cuttings over the length of the experiment to determine if the sewage foam was a viable fertilizer for production agriculture. There were no significant differences in the results of the amount of grass that was grown under the commercial fertilizer, the sewage foam or no fertilizer at all. Therefore, the results were neither negative nor positive to the usage of the sewage foam as a fertilizer. Consequently, it would be productive for sewage foam to be researched further with more advanced methods and tests.

Keywords: a*griculture, brome grass, fertilizer, human waste, sewage, sewage foam, urea ammonia nitrate*

INTRODUCTION

Human sewage sludge has been used as fertilizer since the beginning of mankind. Sewage has been a problem in cities since communities of people started becoming concentrated enough that the sewage became a problem. Cities have dealt with this problem several different ways from dumping the sewage into a waterway, to the Roman drainage system, which carried it away from the city. (History channel, 2002)The amounts of sewage became more concentrated, picked up pollutants from business and industry, and, therefore, human sewage as a fertilizer received a bad reputation. Consequently, as people started fearing sewage as a fertilizer, there became more of a problem with the disposal of sewage. Some of the first waste farms that were designed to be only sewage fertilized were not very well managed and were eventually shut down. (Westcot, 1997) This continued to add to the fear people had of human sewage being used as a fertilizer on farm ground. Sewage only becomes sludge after it has gone through the treatment process in a wastewater plant.

Sludge application on land improves the nutrient status, organic matter content, and water holding capacity, and is safe as long as the sludge does not contain harmful chemicals or have too high of a heavy metals content. (Clinger and Skousen, 1993) Animal wastes are applied to thousands of acres of farm ground each year, and yet people get scared when they find out that human wastes are going to be applied to farm ground. Since it takes thousands of years to create top soil, and the erosion that is created both from the modern farming procedures and from wind and water take away this precious top soil, the sewage can help to keep this top soil replenished.

My idea for this project was to apply sewage foam as a fertilizer instead of sewage sludge or regular fossil fuel-derived fertilizer. By applying the foam instead of normal sewage I can get past the mental block that people carry against sewage products. This project was to show whether or not the sewage foam has benefits for the grass that exceed that of conventional fertilizers. Sewage foam is totally renewable as long as there are humans around to produce waste and treatment plants that use processes that produce foam. The foam is not a problem for the treatment plants as they are currently being operated, but with minimal changes, they could be set up to harvest the foam on a daily basis from at least one of the tanks in the system. In the state of Kansas, the sewage foam is not technically sludge, and therefore, it is not required to meet the same government regulations as regular human sewage. (EPA, 1999)

The foam could be vacuumed off of the tanks and could be applied with the same liquid fertilizer farm implements that are used to apply the liquid based urea ammonia nitrate and other liquid fertilizers presently used. This would of course also depend on the fact that the small particles in the foam are consistently small enough in size to go through the equipment. This would also be one of the factors that would apply in deciding if this project could be taken to the next level. I see this procedure of using the sewage foam as a fertilizer, as one that could help to alleviate our dependence on fossil fuels and help to cut down on the amount of end product sludge that remains after the reactor process.

Table1.Layout of test plots for experimental process

Plot number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Treatment	F	B	U	B	B	B	F	B	U	B	B	B	F	B	U	B	B	B	B	F

There are over 12.3 million tons of nitrogen fertilizer applied each year to keep production agriculture functioning in the United States. (Taylor, 2001) The use of sewage foam could possibly make US agricultural processes more sustainable. This could help our country's strong agricultural base continue to be strong and help to alleviate a growing concern of what to do with the large amounts of sewage produced in the world. Most commercial fertilizers are oil based and this causes a large dependence on fossil fuels, which in turn makes our country more dependent on imported oil (Taylor, 2001).

The feasibility of this project depends on several factors: 1. Does the fertilizer actually work comparably to UAN fertilizer? 2. Is it available in areas where it is needed? 3. Can it be used safely? 4. Is there actually enough of it available to provide sufficient fertilizer to farmers to make it worth the sewage plant's changing their systems? 5. Can the foam be produced and applied economically enough to make it worth doing? 6. Are there benefits besides the nitrogen in the foam that could help the plants? 7. Can a reliable product be assured that stays the same from day to day? If the products cannot be made reliable from day to day it will be much harder to convince agriculturalists of its value to their operations.

The intention of my senior research project was to do the preliminary research to show sewage foam as a fertilizer is effective and is it economically feasible. If successful this project could be the start of a very good thing for the future of agriculture and for the human waste handling industry.

MATERIALS AND METHODS

First an established brome grass field was chosen to use as a test plot area on which to conduct the trial experiment. Then 20 plots of grass were measured out. (Green, Jones, Smith, and Thomas, 2001) The plots were .0004 acres, which is one meter by 2 meters. Plots must be the same size so that the foam and fertilizer are applied at approximately the same application rate. The plots were laid out on the Create Silt Loam, zero to one percent slope, soil type. The plots were clearly marked with wooden stakes to assure that the results will not be confused. Label each plot for identification purposes. Next all plots were mowed to the same level. This helped guarantee that the fresh grass growth which is influenced by the variables and are being changed for the experimental process are equal. Then samples of foam were taken and tested for nitrogen content of foam so that the Sewage Foam and UAN Urea Ammonia Nitrate could be applied at the same rate. The samples were sent to SKI lab in Hutchinson, Kansas for analysis. Sample Bs numbers were used in figuring application rate. In random fashion, a non-fertilized plot, a foam fertilized plot, and a commercial (UAN) fertilized plot were laid out. Then .02 pounds of nitrogen from each sourcewas applied. See diagram below for how actual set up was done. The F stands for Sewage foam applied plot, the B stands for control plots, and the U stands for the UAN fertilized plot.

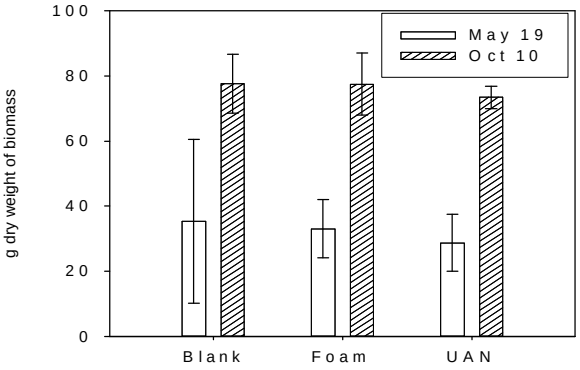
Both fertilizers were applied with a bucket, trying to get an equal distribution. 3 buckets of foam were measured out for each foam plot, which was 34.2 pounds of foam. The full buckets of foam weighed out 11.4 pounds of foam or 13.6 pounds of foam and bucket. One bucket was used to scoop and pour the foam into a second bucket to get it full, then the three full buckets were poured evenly onto the plot.

April 10th, was when the UAN fertilizer and sewage foam were applied to the plots designated to be treated with the two different kinds of fertilizers. On May 19th, random grass cuts from all twenty plots was taken, using a 0.1 meter squared marker square, cut grass off level with the ground. Then the samples were weigjhed to obtain wet weight. Samples were dried for 24 hours in the lab oven at 100 degrees and weighed again. October 10th, a second sampling of random grass cuts were taken from all 20 plots. Samples were weighed for wet weight and then again the samples were dried for 24 hours in the lab oven at 100 degrees. The samples were again reweighed. A t-test a =.05 was used for all tests of statistical significance between groups.

RESULTS

The research showed that there was not a significant difference in the grass growth that was treated with the two fertilizers and the grass that was used as controls.

The bar graph shows that there was not a significant amount of difference in the results. The bar graph



displays the differences in grass growth. These results from all three groups fall within the standard deviation for each group.

Figure 1. The differences in grass growth affected by different fertilizer treatments from April 10th to October 10th 2002

The second part of my research was to test whether the sewage foam would test approximately the same from day to day. The results were negative because there was 1670 mg/L difference between the two samples of foam that I took and analyzed for TKN-Total nitrogen, the amount for the first sample was 4270 mg/L and the second sample was 2600 mg/L. There was also over 1230 mg/L difference in organic nitrogen between the two samples, the first sample contained 3810 mg/L and the second sample contained 2380 mg/L.

DISCUSSION

My hypothesis was that the sewage foam would make the best fertilizer, the UAN would be next, and the untreated grass plots would be the least productive.

I was intending for my research to be the primary start and a stepping-stone for future research of the sewage foam as a fertilizer. Therefore, I did my research on an established brome grass field, so that I could take my results from and have real life production agriculture data to show producers. This was not the best way to set up my research, however, and I now understand that, because there is too much lost control of different variables. Some variables in an outdoor research situation that a researcher has no control of include, rain, heat, wildlife, wind and human error. I would have liked to have carried out this experiment over several years and created a much larger scattered plot over the whole field. This would have lessened the significance of the variables in the outdoor test, such as the soil quality variation in a field. If the research were conducted over several years, the significance of the other variables would have averaged out over time to be much less significant, due to weather pattern variations over the years. In the Rosemount Watershed study, which ran for 20 years sludge was applied to ground that corn and reed canary grass were grown on, and the sewage fertilized crops outperformed the crops that had commercial fertilizers applied to them. (C.E Clapp et all 1995)

The best way to have done my research would have been to set up in a greenhouse with soil trays. I could then have planted the same number of seeds of the same variety and same viability in each tray. Each tray would have been treated exactly the same, from clipping date to when they were watered. This would have also allowed for me to see if there were other benefits to the foam application procedure for the soil and the grass. If I had done the research in the greenhouse, I would have taken some of the variation out of the experiment and I could have controlled the procedure better.

The sewage foam needs to be effective in an experimental situation before it should be applied to producing agriculture fields for fertilizer. My research showed that the foam did not harm the grass growth and therefore a sewage plant could currently dispose of foam on a grass field when emergency situations arise. If a sewage treatment plant needed to dispose of the accumulated foam on one of the digester tanks for repairs, then spreading the foam on a grass field would be an excellent and safe way to use it.

The sewage foam was not consistent in content from day to day. Consistency is needed for producers to be able to determine how much nitrogen they are applying to their grasslands. This consistency is also crucial because when producers apply the sewage foam to one field they want their other fields to be fertilized at the same rate and with the same equipment. It would also cost more to fertilize a field with the lower nitrogen sewage foam because you would have to haul more of it to the field to get the same application rate.

The sewage foam did not test the same consistency from day to day as was initially hypothesized. The sewage foam was more affected by the conditions outside of the plant. When it rained, the sewage foam was much more like a liquid than a foam, or if it was dry it had bigger particles that might clog up the nozzles on a fertilizer implement. Therefore, special equipment would be needed to apply the sewage foam to large acreages of grass.

Overall, the end results were that sewage foam was not more effective than UAN as a fertilizer. The sewage foam would still be a viable resource to be investigated further. The sewage foam could be a useful resource to agricultural producers and deserves more advanced research. With more advanced research; methods could be developed so that sewage foam could be applied to farm ground economically and easily.

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