GRASS ROOTS GRANT REPORT

Investigating the Effect of Banded Compost on Yield in Winter Barley

Grant number: FNE 04-524

Project Leader: Klaas Martens

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Goals

We wanted to find a simple and inexpensive way to band fertilizer with our small grains using equipment that already exists on most Northeast farms.

Banding of chemical fertilizers at planting results in faster and more even crop emergence, increased root uptake of nutrients, reduced fixation of phosphorus and potassium, more efficient nitrogen utilization, and generally higher yields. We wanted to find out if banded organically-approved starter fertilizer can give the same benefits.

We wanted to find out whether banding of pelleted organic compost could have a positive impact on yield in organic winter barley without significantly increasing production costs. We hope to demonstrate that by banding organic fertilizers at planting, the crop produces more biomass in the fall and greater yields of both grain and straw at harvest.

We looked at the yield effect of banded fertilizer with or without broadcast compost and assessed how the various treatments affected our soil fertility levels.

Our overall goal was to improve our small grain yields and encourage other farmers to learn to grow better small grains crops. We hope that our experience will help improve the management of organic small grains crops on Northeastern farms.

Through improved management, we feel that barley could become a good alternative to corn on part of the land in the Northeast now devoted to corn. That could help reduce soil erosion, provide additional bedding for cattle, spread out workloads, and provide land available for spreading manure at times of the year when soils are dry and risk of run-off or leaching is low.

Farm Profile

Klaas and Mary-Howell are full-time farmers growing 1300 acres of a wide range of certified organic crops near Penn Yan New York. Klaas has been a lifelong farmer and Mary-Howell has been a farmer for the past 13 years. Prior to that she worked for Cornell University in the Grape Breeding program and taught Biology at Finger Lakes Community College. They also own and operate Lakeview Organic Grain, an organic seed business and feed mill in Penn Yan.

We host numerous farm tours and speak extensively at meetings and conferences on organic farming. We are members of New York Certified Organic (NYCO), a local group of organic and sustainable farmers that provides support and educational opportunities to interested farmers.

Diverse crop rotations that include small grains are essential to our farm's viability and long-term soil health. Improving our small grain yields will make it more profitable to maintain healthy crop rotations on our farm. Our feed mill, and others in the Northeast, offer a good market for organic small grains in organic dairy feed. The high demand for organic livestock feed has created a strong and growing market for locally grown organic grain. We need to both raise yields and increase grain acreage to meet this demand.

We grow corn, soybeans, dark red kidney beans, oats, barley, wheat, spelt, rye, triticale, sweet corn, snap beans, edamame, hay, grass seed, and field peas on our farm. Our farm is certified organic with ICS/FVO.

Participants

In addition to Klaas and Mary-Howell Martens, this project involved the efforts of

Peter Martens and Robert Hall assisted with field work and helped in making observations of our plots throughout the year.

Christopher Patrick
Agricultural Consulting Services, Inc.
1634 Monroe Avenue Rochester, NY 14618
585-473-1100

Christopher Patrick and other employees of ACS sampled soil and took observations and measurements of stand density, tillering, weed pressure, winter survival, standability, plant health, etc.

Thomas Bjorkman, Ph.D.
Department of Horticultural Sciences
Cornell University
New York State Agricultural Experiment Station
Geneva, New York 14456
315-787-2218

Thomas Björkman helped us interpret the data we collected. He helped determine whether our data supported or refuted our original hypothesis. He also helped us draw conclusions from our data as to how and why our different inputs affected yield response. This was especially important because extreme weather affected our crops and therefore our data in the spring and summer of 2004.

Project activities and Experimental Design

We planted a total of 29 acres of barley in plots receiving varying amounts of broadcast compost both with and without a pelleted starter fertilizer.

The broadcast compost was from Wegmans Egg Farm of Wolcott, NY and was made from poultry manure composted with added woodchips as a carbon source. Analysis of this product – attachment 1.

The pelleted starter fertilizer was produced by Kreher Poultry Farms, Clarence NY and was made from poultry manure, composted without added carbon and pelleted. Analysis of this product – attachment 2.

We established plots of 14 different treatments, based on (1) presence or absence of starter fertilizer, (2) initial field fertility conditions., and (3) presence or absence of a clover cover crop in previous crop. The treatments and field numbers are described in Table 1.

While we tried to pick similar field conditions for the trial, the plots had somewhat varying levels of fertility at the start of the trial and were tested again after the trial to record the effect of each of the treatments on residual soil fertility. Each treatment plot was an approximately 2 acre field. We tried to use enough land to compensate for normal in-field variation.

We compared two different methods of blending the seed with fertilizer.
(1) We used a drum type fertilizer blender to pre-mix weighed quintiles of fertilizer and seed together and transferred the mixed material to a tender that we used to fill our grain drill.
(2) The other approach we used was to hand-mix the two ingredients together in the grain drill using bagged starter fertilizer and seed.

Hand mixing in the drill is satisfactory for doing small acreages or where a blender is not available but a premixed seed/fertilizer blend was much faster and more accurate. It took careful mixing to get a uniform blend of seed and fertilizer when it was combined and blended in the drill.

We left some seed and fertilizer mixed together for about 3 weeks to see if the fertilizer might adversely affect the seed in any way, if the products would separate, or if mixing it that long before seeding would cause any problems. We did not see any problems using seed/fertilizer blend that was mixed well ahead of using it.

From this, we conclude that pre-mixing and bagging seed and fertilizer for sale or later use may be practical.

Our friend Thomas Harttung, a Danish farmer who raises small grains and vegetables, told us that the wheel tracks of the tractor that pulls the drill can cause yield loss. Seeds planted in the tracks grow in compacted soil and often are not at the desired planting depth. He pulls his drill behind a harrow with a basket roller to avoid planting into wheel tracks.

Because of this, we decided to use a 'track digger' to loosen the compacted soil left by the tractor wheels in our plots. We compared final stand density and yield in the rows behind the tractor tracks with those in between the wheel tracks to evaluate whether the track digger is effective in eliminating this source of yield loss. Stand counts taken shortly after emergence showed that even with the track digger, stands in the wheel tracks were substantially less than between the wheels where the soil was uncompacted. The results of these counts and measurements is included in our report.

Results

Shortly after emergence in the fall of 2003, it was readily apparent that our track remover was not doing the job that we hoped it was doing (Table 3). From a pickup truck window, our stands looked uniform enough but the actual counts told a different story. The rows planted into the wheel tracks were from 25% to 30% lower in population than the rest of the field. We had wasted about 10# of seed per acre or, put another way, our stand was reduced by a little more than 6%. Even if half of this loss was offset with bigger heads or better tillering, we lost about 2 1/2 bushels of yield per acre due to wheel track compaction.

We compared stand counts on the barley in some of the plots with and without starter fertilizer in mid November just before dormancy (Table 4) . We had an average of 20% higher stem count in the barley that was seeded with starter fertilizer than in the controls. Even more impressive, the fertilized barley was taller and looked more vigorous than the unfertilized barley. The difference in tillering and plant size was most pronounced and most clearly visible in the plots that received the highest rates of broadcast compost. Dr Bjorkman said that this indicates that the starter fertilizer helped the seedlings make more efficient use of the broadcast compost for early establishment.

The 2004 growing season was extremely cold and wet with very few sunny days during heading. PSNT readings were generally low but declined even more in late May as grain began to form. Patterns of the drainage lines showed clearly all season with taller, heavier plants. Barley plants in wet spots were noticeably shorter and more yellow.

Yields were measured with a yield monitor on a John Deere 9600 combine. Yields were calculated and displayed every 15 feet across the field. With the notable exception of the low-lime field, yields were closely correlated with fertilizer rate.(Table 1)

1. The no starter fertilizer/ no compost treatment averaged about 57 bushels/A. This was close to the yields of winter barley on other farms in New York 2004.

2. Where we used 100# of starter alone, the yield increased to about 62 bushels/A.

3. With 5000# of broadcast compost, with and without starter, the barley yielded 75 bushels per acre with the better parts of the field yielding 80 bushels/acre. At this high rate of compost, the starter had no significant effect on yield despite producing a higher stand density.

4. At the highest rate of broadcast compost, 6500#/acre we also saw no increase in yield despite a much higher number of heads per square foot where we used starter fertilizer. The yield in this field ranged from 94 to 104 bushels per acre. A strip that got 3000# of broadcast compost alone per acre yielded 62 bu/acre while the part that got a starter yielded 70 bu/acre.

In general, in this experiment, starter fertilizer gave us the best return at medium broadcast compost levels. At higher compost rates we saw more heads and higher yield potential but it is likely that other factors limited our yield so that we never realized the full potential of these fields.

Despite receiving the same high rate of compost as the other strips near it, the strip that was deficient in lime looked weak all season and produced the lowest yield in the entire trial. The low-lime strip yielded 7 bushels lower than the no fertilizer strip! That certainly demonstrated the yield advantage of proper liming.

An unexpected observation in this trial was that in fields where we plowed down a heavy clover cover crop, we had a very poor seeding of clover in the barley, yet where there was no clover plowed down we got an excellent clover stand in the barley. This leads us to wonder if decomposing clover has a negative effect on newly seeded clover.

The Wegmans compost tested 1.94% N, 4.93% P2O5, and 2.04% K2O on a dry matter basis. The moisture content was 40%. Fields receiving a 5000# rate of the Wegmans compost received about 58lb/A N, 148lb/A P2O5, and 61lb/A of K2O.: All fields were low in potash and were supplemented with 100# / acre of mined potassium chloride.

Where starter fertilizer was also used, the total added fertility from the broadcast compost, potassium chloride and the starter was approximately 63lb/A N, 153lb/A P, 125lb/A K.

Only half of the nitrogen in the compost is expected to be available in the first year after spreading but residual nitrogen from soil organic matter (85# /a) and legumes plowed down in previous years (100#/acre) brought the total estimated nitrogen to over 200# per acre.

While harvesting a 100 bu barley crop only removes about 92lb N, 40lb P and 55lb K per acre in the grain, the crop needs to take up much more than that, especially potassium, during the growing season grow the roots, stems, and leaves. Since we did not harvest the straw from these plots, much of these extra nutrients will be recycled in the field for future crops.

We believe that in 2004, our primary yield-limiting nutrient for barley was nitrogen. This was confirmed by PSNT tests taken in April and May, 2004, both extremely wet months (Table 5) At harvest, the grain tested lower than normal (8.5%) in protein, giving further indication that nitrogen was limiting yield. While there should have been ample nitrogen present, he unusual weather patterns likely depressed the nitrogen availability. The weather was cold and extremely wet throughout the season, slowing the rate of nitrogen mineralization and creating conditions that allowed N leaching and denitrification.

TABLE 1. EXPERIMENT TREATMENTS AND YIELDS

Field #	starter fertilizer	pH	Broadcast Compost	Clover Cover	Yield bu/A
75B	100#/A	6.3	5000#/A	yes	67
	none				66
90A	100#/A	6.7	3000#/A	yes	70
	none				62
92B	100#/A	7.1	5000#/A	no	75
92D	none	7.1	5000#/A	no	75
92F	100#/A	6.9	5000#/A	yes	75
92H	100#/A	5.5	5000#/A	yes	50
92J	100#/A	6.0	none	yes	~~57~~ 62
	none		none		~~62~~ 57
94B	100#/A	6.5	6500#/A	yes	94
	none				104
94E	100#/A	6.9	3000#/A	yes	86
	none				86

TABLE 2. SOIL TEST RESULTS FOR ALL FIELDS, 2004 AND 2005

Field#	year	P	K	Ca	Mg	pH	OM	CEC	K%	Mg%	Ca%
75B	04	20M	79L	1210H	126H	6.3	3.4	8.2	2.5	12.9	74.1
	05	14M	89M	1400H	154H	6.5	2.9	9.2	2.5	14	76
90A	04	14M	49VL	1400H	176VH	6.7	3.5	9.0	1.4	16.3	77.8
92B	04	9L	64L	1750H	230VH	7.1	3.3	10.8	1.5	17.7	80.8
	05	25H	94M	1670H	180H	6.9	3.1	10.2	2.4	14.7	81.6
92D	04	9L	64L	1750H	230VH	7.1	3.3	10.8	1.5	17.7	80.8
	05	16M	74L	1640H	202VH	7.3	3.2	10.1	1.9	16.7	81.4
92F	04	32H	58L	1360H	146H	6.9	3.2	8.3	1.8	14.7	82.1
	05	17M	81M	1720H	199H	7.2	3.2	10.5	2.0	15.8	82.2
92H	04	75VH	42L	401M	39L	5.5	2.0	3.,3	3.3	9.9	61.1
	05	41VH	54L	659M	62L	6.2	2.2	4.5	3.1	11.5	73.3
92J	04	42VH	62L	848H	87M	6,0	2.7	6.1	2.6	12	70
	05	29H	66L	1130H	127H	6,3	2,8	7,7	2,2	13.8	73,5
94B	04	50VH	184VH	1500H	165H	6,5	4.0	10.1	4.7	13.6	74.3
	05	53VH	158VH	1170H	126H	6.2	2.6	8.3	4.9	12.6	70.4
94E	04	10L	78L	2210H	238VH	6.9	4.0	13.4	1.5	14.8	82.3
	05	14L	118M	2370H	238VH	6.9	3.4	14.3	2.1	13.8	82.7

TABLE 3. STAND COUNTS FOR FALL 2003 PLANT ESTABLISHMENT

Field #	9/11/03 Stems/ft	wheel track
92B	18.5	11.7
92D	23	18.7
92F	18.7	12.4
92H	21.8	17.9
92J	22.4	18.3

TABLE 4. EFFECT OF STARTER FERTILIZER ON FALL STAND DENSITY

Field #	10/3//03		11/12/03	
	stems/ft of row with starter	**stems/ft of row without starter**	**stems/ft of row with starter**	**stems/ft of row without starter**
92J	32	28	82	70
94B	42	26	122	92
94E	xx	xx	113	96

TABLE 5. PSNT LEVELS IN APRIL AND MAY, 2004

	April	**May**
92B	17	8
92D	4	6
92F	8	4
92H	2	2
92J	6	4
94B	12	6
94E	4	5

TABLE 6. CALCULATIONS USED IN PREDICTING SMALL GRAIN YIELDS

An internet website belonging to the Baden-Wurtemberg agriculture ministry information service at: (www.infodienst-mir.bwl.de/la/lap/pflqual/nutzpfl/kornbesh.htm) yielded a formula used by German farmers to calculate an estimated yield based on field measurements of plant density, head size, and weight per kernel. This is similar in concept to American calculations that use plant count and ear size to predict corn yield. The formula that was presented was:

[plants/meter^2] x [kernels/head] x [weight(grams) / 1000 grains] x 10 = kg / hectare

we can convert that to bu / acre:

(bu / acre) = (kg / hectare) / (2.49 acres / hectare) X 2.204 lbs / kg)

German target figures given for these measurements were:

(550 plants/m^2) X (30 grains/head) X (47g / 1000 grains) X (10) = 7755 kg / hectare

(7755 kg / hectare) / (2.49 acres / hectare) = 3114 kg / acre

(3114 kg) X (2.204 lbs / kg) = 6863 lbs / acre

(6863 lbs) / (48 lbs / bu) = 143 bu / acre

Our stand counts ranged from 700 to 1000 plants / m^2 with average number of kernels / head ranging from 20 to 30. Our weight / 1000 grains was 25 to 27 grams, much less than the German target weight. Twenty five grams / 1000 grains equals 18100 grains per pound. This is lower than normal for New York conditions also.

Conditions

The growing season was very wet and abnormally cold. Nitrogen mineralisation appeared to be very slow and leaching was higher than normal. Our PSNT test results (Table 5) confirmed this impression. Yields were definitely limited by nitrogen availability. The protein level of the grain was only 8.5% due to the nitrogen shortage. That was much lower than normal. While the weather reduced our over all yields, the barley did respond strongly to higher fertility.

We believe that based on our fall and early spring observations, in a more normal growing condition, we should have seen a larger yield response from the starter fertilizer, especially at the higher broadcast compost rates..

Economics

The 5 bu yield response to the starter fertilizer with no broadcast compost increased gross income by $18/ acre at an additional cost of $10/acre for the fertilizer.

The 8 bu/acre response on field 90A, with ~~300~~ 3000#/a of broadcast compost, increased gross income by $29 at a cost of $10/acre.

None of the higher fertilizer plots gave us a profitable grain yield increase from the starter fertilizer. With Wegmans compost at $30/ton, it cost $45/ acre to apply 3000# of broadcast compost per acre. If we assume that the 18 bu average yield difference between the fields that received 3000# of broadcast compost and the control that received none was due to the fertilizer, then the 3000# of compost increased the crop value by about $65/acre at a cost of $45/acre. The 5000# rate resulted in a positive net return only on field #105. (not included as part of this trial

The 6500# rate resulted in a large net return on field 94B ($83/acre higher net than the cost of fertilizer than our control) if all of the yield difference between 94B and the control was due to the fertilizer. Our guess is that at least part of the higher yield on field 94B was due to a higher initial soil fertility level.

The 2004 soil tests showed that soil fertility had increased between the fall of 2003 and the summer of 2004 on most of the trial plots where we had broadcast compost. If we give a credit for the value of the residual fertility to subsequent crops, we can conclude that all of our compost treatments in this trial were beneficial with the very important exception of field 92H. Field 92H had a low pH with a severe calcium deficiency. Despite a large application (5000#) of compost and banded starter fertilizer, it had the lowest yield in our trial and did not respond to fertilizer like the other fields. This affirms the university recommendation to maintain a good pH. It showed that without adequate lime, other fertility inputs may be wasted.

The increase in levels of phosphorous and potassium indicates that we need to carefully monitor the mineral level of our soils when using large amounts of manure or compost. Soil tests can go up rapidly and create imbalances or excesses that can lead to leaching.

While the banded starter fertilizer increased our profits only at the lower compost rates in 2004, they improved our yield potential in all of our comparisons.

A separate compost response trial in corn that we did with Dr. Bjorkman in 2004 showed yield response curves similar to those found with conventional fertilizer. The soil tests indicated that fertility accumulation was somewhat greater than we would expect from conventional fertilizer and we will test again next year to see whether any further fertility accumulation occurs especially on the higher rate fields.

Based on the data from this barley starter fertilizer trial and our other trial where we generated compost rate/ yield response data, we believe that the most profitable use of fertilizer will result when we:

1) use a soil test
2) lime to recommended calcium and magnesium level
3) use banded starter fertilizer
4) apply compost and other amendments in accordance with crop needs and soil test results.
5) maintain a soil testing program to adjust future soil amendment use to changing soil test results

Assessment

We found that organic barley yield and profit could be improved by banding starter fertilizer. Despite poor weather and generally low yields in our area last year, the barley in our plots produced profitable yields.

Our results confirmed that no one factor could raise yields to very high levels by itself, but a large number of good practices each yielding a small increase can result in a high final yield. Many of the 'small' things that improve yield require attention to detail and careful observations. The yield increases that result are very profitable because they don't increase the cost of growing the crop, while they increase potential profit at little or no risk.

Many best management practices work synergistically when used together. For instance, the higher fertility levels are more likely to improve yield when there is also an excellent stand, optimum planting date, good pH, etc.

We found that stand density, head size, and kernel weight measurements are a useful starting point for evaluating yield potential and predicting final yield. Our kernel weights in 2004 were low but our stand densities were very high. (see table #6) We need to continue gathering data on stand density, head size, and kernel weight over time to determine our own optimum or target figures for these measurements.

With more reliable target figures for stand density, we can more precisely determine the best seeding rate based on kernels per pound of seed, germination percentage of the seed, planting date, soil fertility, and the knowledge of what we want our optimum final stand count to be.

We need this information to monitor crop progress and be able to predict yield potential more accurately. Such data can help diagnose the causes of disappointing crop yields when they occur.

Planting date is another issue needing further investigation. European research indicates that barley should be planted earlier than is recommended by our universities. A random poll of New York farmers who grow winter barley indicates the need for earlier planting too.

Barley is not affected by the Hessian fly and doesn't seem to be hurt if it goes into the winter with a heavy top growth. Dr Bill Pardee of Cornell University explained to us that the reason for the late planting date recommendation was to avoid barley yellow dwarf, a disease that is more likely to infect early planted fields than late ones.

If this is the a risk, then we need to address the following questions –

- How much more likely is barley yellow dwarf in early stands than in late ones?
- How much yield is it worth giving up to reduce the chance of disease?
- How much does barley yellow dwarf reduce yield?
- Are we better off consistently getting the highest possible initial yield potential and losing some yield to this disease occasionally or to give up some yield for reduced risk?
- Is there a planting date that can give both maximum yield and good protection from barley yellow dwarf?

These questions should be addressed before farmers grow much larger amounts of winter barley in the Northeast.

Adoption

For the winter barley we planted in the fall of 2004, we banded starter fertilizer by mixing the Krehers starter with the seed We did this also with most of our winter wheat, and will use this technique on the oats and spring barley we plant in 2005.

Because of the background study for this project that we did last year, we now know that barley needs far more fertility than we had originally thought. We have increased our frequency of soil testing and make sure we apply enough compost when we have a deficiency to better meet anticipated needs of the crop.

We now plant barley 10 days earlier than we used to. Our grain drill is a relatively late model machine (Great Plains 13-EW) that plants much more accurately than many older ones do. Before the 2004 barley was planted, we replaced all the disc openers and adjusted tension on the new blades. We installed new down pressure springs, seed tubes and rebuilt the clutch. These repairs and maintenance items resulted in more uniform stands and more even planting depth. The discipline of taking stand counts and evaluating the seedings carefully has helped us learn to adjust our drill better and has raised the level of performance we demand from ourselves and our equipment.

Several of our neighbors have adopted or plan to adopt the method of planting with starter fertilizer that we used in our trials. Our neighbor is offering to custom blend fertilizer and seed for other farmers next year with his fertilizer mixer. We hope to offer pre-mixed seed/starter fertilizer to our customers at Lakeview Organic Grain this spring.

Outreach

We have presented the results of our project at two NYCO meetings so far and have scheduled Thomas Bjorkman to present his findings to the March 2005 NYCO meeting.

We presented our data at a workshop at the 2005 NOFA-NY conference on January 29, 2005 and at the 2005 organic conference at the University of Guelph in Guelph, Ontario. We will be discussing the research in our upcoming talk at the Upper Midwest conference in LaCrosse, WI.

Mary-Howell has written a report on our early findings that was printed in 'Tails and Tassels" last summer and has reported on it in her New Farm (Rodale Institute) columns. A more detailed report is being prepared for New Farm magazine at this time and permission has been granted for the PASA'Passages' newsletter to reprint one of our articles about this research.

We have discussed our findings in detail with our local certified crop advisors. Interest and discussion of our method of banding organic fertilizer has been high this fall and winter.

Report Summary

We learned several practices that allow us to increase our barley yields and net profit. We proved to our satisfaction that we could use our existing equipment apply starter fertilizer to our small grains crops by mixing it with the seed and 'planting' it. We found that using an organic starter fertilizer would increase our stand density, yield potential, and net returns per acre.

We found that organic barley yields and profits could be increased substantially by using more precise planting rates and more accurate seed placement. We saw that fertilizing with. Paying attention to the basics starting with a soil testing and liming is essential to good yields.

Even in 'bad years' good barley yields are possible with careful management.

Submitted by: Klaas and Mary-Howell Martens, Jan 31, 2005

07-22-03 03:56PM FROM-Brookside Labs 419 753 2948 T-185 P.003/003 F-536

BROOKSIDE LABORATORIES, INC.

** COMPOST ANALYSIS REPORT **

File Number: 25000
Date Received: 07/18/2003
Date Reported: 07/22/2003

Wegmans Egg Farm
Wadsworth Street
Wolcott, NY 14590

Submitted By: ConsulAgr, Inc.

Lab Number / Description		4021 STORAGE BARN COMPOST MANURE	
	% Dry Basis	% Wet Basis	lbs/ Ton
Moisture		26.90	538.00
Mineral Matter	45.99	33.62	672.40
Lost By Ign (Org M+)	54.01	39.48	789.60
Total Nitrogen	1.94	1.419	28.38
Phosphorus (P)	2.15	1.572	31.44
Phos. as (P2O5)	4.93	3.604	72.08
Potassium (K)	1.69	1.235	24.70
Potassium as (K2O)	2.04	1.491	29.82
Calcium (Ca)	12.97	9.481	189.62
Magnesium (Mg)	1.10	0.804	16.08
Sodium (Na)	0.32	0.234	4.68
Sulfur (S)	0.36	0.263	5.26
Carbon	21.00	15.35	307.00
	ppm Dry Basis	ppm Wet Basis	lbs/ Ton
Boron (B)	33.47	24.47	0.049
Iron (Fe)	4833.45	3533.25	7.067
Manganese (Mn)	497.43	363.62	0.727
Copper (Cu)	67.71	49.50	0.099
Zinc (Zn)	424.33	310.19	0.620
pH		8.84	
C/N Ratio		10.82	

Reviewed by:

BROOKSIDE LABORATORIES, INC.

** MANURE ANALYSIS REPORT **

Kreher's Poultry Farm
5411 Davison Road
Clarence, NY 14031

File Number: 36996
Date Received: 03/01/2004
Date Reported: 03/03/2004

Submitted By: Home Office

Lab Number 0735
Description KPF171

	% Dry Basis	% Wet Basis	lbs/ Ton
Moisture		10.64	212.80
Mineral Matter	43.18	38.59	771.80
Lost By Ign (Org M+)	56.82	50.77	1015.40
Total Nitrogen	5.49	4.910	98.20
Ammonia-N (NH4-N)	0.39	0.350	7.00
Nitrate-N (NO3-N)		< 0.010	
Organic-N	5.10	4.560	91.20
Phosphorus (P)	2.43	2.174	43.48
Phos. as (P205)	5.58	4.982	99.64
Potassium (K)	2.64	2.357	47.14
Potassium as (K20)	3.18	2.839	56.78
Calcium (Ca)	15.44	13.799	275.98
Magnesium (Mg)	0.71	0.634	12.68
Sodium (Na)	0.46	0.413	8.26
Sulfur (S)	0.59	0.529	10.58
Avail. Phosphorus (P)	2.30	2.052	41.04
Avail. Phos as (P205)	5.26	4.702	94.04

	ppm Dry Basis	ppm Wet Basis	lbs/ Ton
Boron (B)	35.59	31.80	0.064
Iron (Fe)	1294.38	1156.66	2.313
Manganese (Mn)	403.69	360.74	0.721
Copper (Cu)	56.79	50.75	0.102
Zinc (Zn)	424.06	378.94	0.758
Nitrogen (Water Insol)	2.40	2.14	42.80

Reviewed by: [signature]