USES OF ORGANIC FERTILIZER AT WIND RIVER NURSERY

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Stu Slayton has asked me to talk to you today on some of our uses of organic material at the Nursery. I believe it was Frank Ter Bush, our State and Private Forestry man from Portland who had us placed on agenda. He knows what's happening over most of the country, and he must think we have something to offer in new uses of fertilizer for Nursery operations. Yes! I believe we do.

Portions of our Nursery have been tree farmed since 1909, close to 70 years. So naturally in some areas our organic content was getting below the required amount for growing trees. Thus, we are constantly on the lookout for sources of organic material. According to our Soils analysis, pH should be between 5.5 and 6.0. Past years reveal that the Nursery has added sawdust, peat, cow, and chicken manure as a means of supplying organic materials and maintaining soil fertility. Presently we use sawdust, peat, Milorganite (fertilizer produced from activated sewage), and our newest material - Fish Digester Sludge. We are also studying this summer in cooperation with Crown-Zellerbach the applicability of wood and pulp sludge mixture as a mulch on top, incorporated into the soil or a combination of both to grow conifer seedlings. In addition, we have recently located a source of chicken manure. Believe it or not, we have a hard time locating a good source of available sawdust. So we continually are on the look out for new organic material. I will discuss primarily the fish sludge and Milorganite, as part of our Nursery fertilization program. They should be of most interest to you as Nurserymen.

I have been involved in this fish sludge project quite closely. It's very interesting and exciting to me. We have only been involved with the "stuff" for 4 months. When we first became involved in this project our thoughts were to use the Fish Sludge in our Nursery Fertilization Program strictly as a slow released nitrogen supplement to the Soil and as a soil conditioner. Later on if it proved feasible, we would apply directly to the trees and cover crop. Contrary to what you may think, this product is almost odorless. It has been run through a primary and secondary digester. Our Nursery folk call it "super sludge". Time will tell whether it really is.

We began hauling the sludge in mid April of this year following consumation of a memorandum of understanding with the U. S. Army Corps of Engineers at Bonneville Dam.

I will now go into some slides to tell the Fish Sludge Story:

Slides 1 and 2 Bonneville Fish Hatchery

I will begin by telling you the fish effluent comes from the Bonneville Fish Hatchery run by the Fish Commission in Oregon. It's mostly water, fish droppings and feed. Heres two shots of the hatchery. It is located right along the Columbia River with the Bonneville Dam and the south shore sanitary facilities run by the Corps of Engineers. This is the real exciting aspect of this project. You don't often see three agencies like the Forest Service, Fish Commission and the Corps of Engineers working together. We have worked long and hard to get this project off the ground.

Slide 3 Bonneville Dam and Columbia River

Some of you have seen this scene of Bonneville. Dam and the "mighty beautiful Columbia". I put in this slide just to note that .the fish or other raw wastes can't be dumped into the Columbia River any more and that is where we came into the picture. One of the Corps of Engineers thought it might be a good fertilizer for Wind River Nursery. They asked Stu and he said yes – we would certainly give it a try.

Slide 4 Slide of Primary Digester

This the Primary Digester which is located right next door from the Fish Hatchery at what is called the South Shore Sanitary Facility. The fish sludge and small amounts of domestic sewage arrives here first. It is 36 feet across and when filled it holds 102,000 gallons. Time spent here depends on per cent of solid material and amount of room available in the secondary digester. When the effluent leaves this primary digester it should be about 1% in solid material.

Slide 5 Secondary Digester

The engineering firm of Kramer, Chin and Mayo did extensive studies on the best method of treatment for the fish sludge. They determined that aerobic digestion was the answer. Aerobic digestion is different from the more conventional anaerobic digestion used in most treatment plants. Both of the Bonneville digesters are open to the atmosphere and are constantly supplied with oxygen through blowers and mixers. These digesters produce no obnoxious odors or methane gas. If the sludge is allowed to sit for a day or two without supplying oxygen to it or mixing, the sludge will become vile and odorous.

Slide 6 and 7 More Slides of Secondary Digester

Both treatment systems are designed to work together. Since the operation of the digester calls for 16 hours of mixing and oxygen, then 6 to 8 hours of settling. At the end of the settling period, they will draw the clear liquid, (called supernatant) off the top of the digesters and pump it into the oxidation ditch and back into the system. It is virtually bacteria free and is eventually disposed of in the river.

We are also looking into the possibilities of using the supernatant which we are told is also rich in nitrogen. The two digesters in the system add flexibility, reliability and additional storage at the site.

The actual reasons for the two digesters are to: (1) Treat and decompose the sludge into an inert, stable material; and (2) to increase the solids concentration thereby reducing the volume of sludge to dispose of ultimately. When the sludge goes into the primary digester, it should be about 1% solids and when it goes to the secondary digester, it is about 2% solids. , The sludge will be approximately 3.2% solids after it leaves the secondary digester (just a slight slurry). Our analyses to date reveal that the solid content is only half this good. We need to work on this aspect as we want to haul as much sold material as possible.

The secondary digester holds 189,000 gallons when filled, It takes about 8-20 days for the sludge to reach proper solid per cent before we haul to the Nursery.

Slide 8 South Shore Facility Operator

This is the fellow that operates this two million dollar Sanitation Plant. He is a wealth of information and has helped us tremendously. The secret of an operation of this magnitude is complete cooperation and open communication. This has certainly taken place in this project. The only complaint we have had is our trouble in interpretation of the analyses we get from the Corps.. We are beginning to zero in on this.

Slide 9 Loading Sludge

Here you see the loading of the fish, sludge at Bonneville, They have devised a special spout with lock which works great, This truck is a rented tractor and the trailer is supplied by the Corps of Engineers, The Corps of Engineers in the agreement supplied all the equipment including two trucks, pump and hose, irrigation pine ,and rain This truck hauls 2,500 gallons and we usually haul four loads or 10,000 gallons a day. The distance to the Nursery is 25 miles, so our driver needs to hustle. Since mid April, we have hauled over 400,000 gallons or enough to cover 40 acres, at a 10,000 gallons per acre application. We have hauled the majority of sludge produced this year. Continued Hatchery expansion could easily double this figure in two years.

Slide 10 Arriving at Wind River Nursery

This is a picture of the Nursery looking toward Bunker Hill, Stock looks excellent this year. So I threw this in to boast a bit,

Slide II Tanker being Hooked up to the Pump

This is a close up of our 2500 gallon tanker being hooked up to our

pump. Our pump is a Wisconsin pump designed for a discharge pressure of 100 PSI (pounds per square inch) or 230 TDH and 136 gallons per minute. This system of having the pump mounted on a trailer has proven to be quite mobile and flexible in the Nursery. Our irrigation crew can easily change location between load deliveries. Presently we are looking for a 4 or 5000 gallon tanker trailer.

Slide 12 and 13 Close-up of Pump Mounted. On Trailer

Here's two close-up shots of the Wisconsin pump mounted on a trailer. It has a 3" suction and 3" discharge hose. We raised the pump 4 inches off the trailer floor. It saves knuckles and is easier to start.

Slide 14 Rain Bird - Rain Gun

On this slide, you can observe the large Rain Gun Impact Sprinkler that sprays on the effluent. The gun can be set for a full circle or close to an acre, a 1/2 circle or a 1/4 circle. The head has a 0.69" straight bore nozzle with 23 degree trajectory. Design pressure at head is 90 PSI at 150' radius, and a flow of 136 gpm water. We operate the pump so the generated pressure at the head is about 55-60PSI. Here it is set up to apply the sludge on our cover crop of Austrian peas and oats. On this shot, it is set up for an 1/2 circle.

Slide 15, 16, 17 and 18 Applying Fish Effluent

Next, we observe a series of slides showing sludge application in mid June to a cover crop, 1-1 transplants and 3-0 Noble and White Fir seedlings. I don't have a current picture of this area but can tell you the cover crop and seedlings look very green and lush. The cover crop exceeded 3 feet height. This was our first application to our seedlings, although we did have prior approval from DOE and EPA to do so from the start. We proceeded quite cautiously, because we didn't know how our Nursery workers and the general public would react. Everybody urged us to spray directly on the seedlings and cover crop. So we did right away. The effluent landing on the seedlings does not burn or damage the seedling in any way from our current observations.

On this area we applied 10,000 gallons per acre. From present analysis and observation we feel that we can easily double this present amount and apply 20,000 gallons per acre. Present analysis reveals we are applying 100 pounds of solid nitrogen per acre in a solution of 1/2% solids. It's also very possible to run the effluent through our irrigation system. Before we do, we need to find out more about the sludge.

Slide 19 Slide of Same Cover Crop in late June

Slide 20 and 21 Slides of Cover Crop - last week in July

Slide 22 Overall View of Tanker Pump and Supervisors sizing up the Situation

This project has created a lot of interest for everyone. We have had quite a few visitors and some media coverage. Public reaction has been very favorable to this project. I think one reason for this is our country's strong environmental concern. We are taking a product that was formerly wasted and causing pollution and now using it to grow a useful product. In this shot the White and Noble Fir sure looks excellent.

Slide 23 Our Driver Raring to go for another load of Fish "Super Sludge"

This rental tractor cost us about $175 a week. Thus we kept it busy and averaged 50,000 gallons a week.

It is our hope that the Corps of Engineers can get us a 4000 or 5000 gallon tanker. Then we can really make it pay. Our rough calculations compute to a cost of about a penny a gallon. Presently two other hatcheries and one city, Cascade Locks, Oregon have inquired about us using their fish and human waste. We will probably start hauling from the Fish Hatcheries only after we have first fulfilled our Bonneville obligation.

At the peak of the fish rearing season in the spring, May and June, it appears that we need to remove at least 20,000 gallons a week to keep the Bonneville system running smoothly.

Slide 24 Heading Out for Another Load

Slide 25 Wind River Nursery Scenes - Bunker Hill

Our famous land mark in the background.

In general, we are quite satisfied with our first year in the Fish Sludge business. It was strictly an experimental year and we need to find out much more. This we intend to do. Before I leave the Fish Sludge part of my presentation, I would like to mention to you that I will include in my Proceedings Paper, a summary copy of the sludge analysis. I know you are interested in the amounts of metals and other minerals. Presently, the analysis indicates metal amount to be quite minimal. We are quite concerned with this aspect of the sludge and will continue to monitor it closely. We are here to learn and wish to hear from any of you who are using Fish or other types of sludge to grow seedling or other crops.

	COE Lab Sample Data 10 May '77	Columbia Lab Sample Data 10 May '77	COE Lab Sample Data 1 June '77	Recommended Quantities For Irrigation Water (Wet Weight Basis)	Comments
Total Solids	0.40%	3500 ppm = 0.35%	0.35%	--	
Volatile Solids	62.1%	2188 ppm = 62.5%	60%	--	
TKN	54 gms/kg	2.2 ppm = .002 gms/kg*	34 g/kg	(2.2 ppm)	*Is probably NO_3 Nitrogen
Hg	6.006 mg/kg*	.027 ppm = .027 mg/kg	0.029 mg/kg	Not known.	*Highly variable test, possible error.
P	-	.09 ppm = .09 mg/kg	51 mg/kg	-	
Pb	0.25 mg/kg	.10 ppm = .10 mg/kg	0.89 mg/kg	5.0 mg/liter	
Cd	0.075 mg/kg	<.01 ppm = <.01 mg/kg	0.25 mg/kg	.010 mg/liter	
Zn	1.24 mg/kg	2.12 ppm = 2.12 mg/kg	3.95 mg/kg*	2.0 mg/liter 1.0 mg/liter on acid soils	*(appears to be high, questionable data)
K	17 mg/kg	7.0 ppm = 7.0 mg/kg	Trace	-	
As	-	.004 ppm = .004 mg/kg	-	0.10 mg/liter	
Cr	-	.10 ppm = .10 mg/kg	-	0.1 mg/liter	
Cu	-	.51 ppm = .51 mg/kg	-	0.20 mg/liter	

I will continue on and discuss a product that we at Wind River Nursery think is another good fertilizer and a source of organic material. We continually see the excellent results it produces for us in larger and higher quality seedlings. It is better known as "Milorganite" 6-2-0.

This organic fertilizer is produced by the-Milwaukee, Wisconsin Sewerage Commission. Stu discovered this product when he was a Nurseryman back at Tourney Nursery in Michigan. He observed that it really made golf courses green and lush. Also that it must be quite pure. At Tourney, he obtained good results in producing quality seedlings. Upon arrival at Wind River in 1974, he soon realized that our soil was marginal as far as organic matter was concerned. Thus the use of Milorganite was born at our Nursery. The Nursery began by experimenting with various application rates in 1974 and 1975.

Last summer or in 1976, we applied about 2000 pounds per acre to all 2-0 and 3-0 seedling in 2 - 3 applications. We tried to time this just before a rapid growth period. We use two Farmall Cub 140's with a small Gandy spreader to apply the Milorganite. In addition, we again conducted tests with various rates of application throughout the Nursery on all ages, classes and species

The 2000 pounds per acre application appears to be the best over all rate to use. You can add more or less fertilizer as needed and determined by your species condition and soils analysis. We add ample water after application to hold it in place. Since this is a slow release nitrogen fertilizer, we asked ourselves the question, why not apply it all at once. This will enable the seedling to use it whenever they want and need. It's too easy for us to miss the best period of application. Nature and the plant knows this better than any Nurseryman. So last fall, we applied 2000 pounds per acre to all the 1-0 stock. Thus it was available this spring when the seedling were ready to make their first big spurt of growth in May and June. In addition, this summer we added 1000 pounds per acre to the rising 2-0's. The stock looks real good at the present time.

This year in July, we applied 500-700 pounds an acre to the rising 1-0 seedlings. This fall we will apply another 2000 pounds per acre. So for a 2-0 seedling, we are talking about a total application of about 3500 pounds to 2 ton per acre.

I wish also to stress that in a ton of Milorganite, you get 75% organic matter. This is exactly what we are looking for. Milorganite comes in a granular form and costs us $160 a ton picked up at Portland, Oregon, (this computes to 8 cents a pound or about 40 cents per thousand seedlings). This may or may not sound expensive to you. Let me continue on and I'll point out some other properties of this product.

Milorganite is not a simple product. It is probably the most complex fertilizer known. Experiment stations which have reported better

results with Milorganite when compared to the nitrogen sources have been unable to pinpoint the reasons why. That is just how complicated Milorganite is.

Experiment stations have stated the possibility that the heavy metals, (Mercury, Cadmium, etc.) in Milorganite have direct fungicidal properties. It has been well documented that Milorganite fed turf plots have less dollar spot, snow mold and large brown patch disease when compared with other organic, synthetic and water soluble nitrogen materials. We believe it works in a similar manner in the Nursery, as we have very little disease problems. We also attribute this to our fumigation program.

Other turf management people speculate that the active bacterial populations fostered by the use of Milorganite depresses harmful fungi.. This theory is based on a given volume of soil being capable of only supporting a given amount of organisms. In other words, if the good guys (bacteria) are active, there is insufficient air, water, food, etc., to support the bad guys (fungi).

Let's get back to cost. Many Nursery and Forest people tell us - Yes it's a good product but too expensive for us. Won't the cost of our seedling go sky high? When we tell them it only amounts to about 40 cents a thousand, they feel much better.

The field continues to want larger size seedlings, mainly in the form of larger calipers and larger, more fiberous root systems. If that's what they need, we will give it to them. We are a service unit.

Mil organite has helped us to increase our minimum shipping caliper to 4 millimeters. We can achieve for most species in two growing seasons, just about any seedling height the field desires, dependent upon various cultural practices. Our size for Englemann Spruce and Western Red Cedar has increased and thus we are now producing 2-0 seedlings instead of the usual 3-0's. We have reduced our transplanting program from a 3z million production to less than a million seedlings. Field Foresters have observed and reported informally to us of increased field survival, initial elongation and healthier looking trees upon out planting. We strongly believe Milorganite has really helped out in this success. So to us and for these reason given, the cost is justified. It's too easy to over-simplify this cost factor. We feel whatever the reasons, the over-simplified "cost per unit of nitrogen" formula does not apply to Milorganite. As a matter of fact, unit costs fail to stand up as a very good buyer judgment decision with any fertilizer. You need to weigh the cost against your results and then make a decision whether to use or not.

I like what the Milwaukee Sewerage Commission has to say. I quote from one of their article. "It can no longer be said that a pound of nitrogen is a pound of nitrogen irrespective of source."

Factors to Consider in Selecting a Fertilizer in Relation to Milorganite.

Factors Required	Milorganite
Spreader Calibration	Yes
Watering-in	No
Bad weather application	Yes
Heavy traffic application	Yes
Spreader clean up	No
Sufficient Bulk for Coverage	Yes
Every growth element	Yes
Disease & Nematode suppression	Yes
Water & Energy conservation	Yes
Enhances plants natural growth curve	Yes
Snow & ice removal	Yes
Dormant application	Yes
Low salt index	Yes
Bacterial action	Yes
*Does not burn	Yes
Long lasting	Yes
High analysis	No
Less nitrogen needed	Yes

*Dr. Wilde says a very high application and high moisture might cause ammonia burn.

Most other known nitrogen fertilizers on the market do not have this many positive factors that you need for a Nursery operation. Some don't even come close.

MILORGANITE

What's in a bag of Milorganite?

Milorganite is an unique natural organic fertilizer. It contains 75 per cent organic matter, or 1500 pounds per ton. A composite sample from the 70,000 tons produced annually contains these basic nutrient elements:

	Per Cent	Pound per Ton
Nitrogen		
Total	6.00	120.0
Water soluble	0.28	5.6
Phosphoric Acid (total)	4.59	91.8
Potash (total)	0.80	16.0
Sulphur (as SO_3)	2.69	53.8

	Per Cent	Pound per Ton
Magnesioum (as MgO)	1.68	33.6
Calcium (as Ca O)	1.55	31.0
Iron (as $Fe_2 O_3$)	6.63	132.6

Two University of Wisconsin scientists, Dr. Volk and Rehling, determined some of the trace elements. They are reported in the following amounts:

	Parts per Million	Pounds per Ton
Copper Oxide	430	0.86
Manganese Oxide	327	0.75
Zinc Oxide	163	0.33
Chromium Oxide	2,190	4:40
Lead Oxide	2,250	4.50
Titanium Oxide	830	1.60

Molybdenum, Boron, Iodine, Nickel, Chlorine, Arsenic, Sodium etc., are also present. At the present, we are establishing a monitoring program to alert us to any possible buildup of any elements in excess of our needs.

This isn't an endorsement of Milorganite. We can't do this in the government as you all know. There have been other fertilizers developed from sludge on the market. They are Akra--Solite, Humite, Nitrohumus, Nitroganic, San-Diegonite and Tol-e-gro to mention a few. This paper s only intent is to inform you that this product gives us excellent results,

Up to now I have told you all the good points about Milorganite. I know some of you are thinking about possible disadvantages, The truth is, we haven't found too many in our operation.

Disadvantages we have found are as follows:

1. Very slight odor if handled correctly - (local Ranger thought he had septic tank problems and dug up his tank). Fortunately, his tank needed some work anyway. You can reduce odor by incorporating into the soil with a mechanical weeder.

2. Humidity affects application rates, (need to check periodically).

3. Need to keep dry - if wet it becomes impossible to work with.

For your interest and information, I will briefly tell you the Milwaukee story and how the treatment plant for production of this product was be, gun.

At Milwaukee, fertilizer manufacture is a part of the plant operation, and not an after thought. The original plant design was made on that

basis. Waste minerial and organic products of no fertilizer value are removed before the treatment process starts. The rotary type driers produce a granular dust free product.

Milwaukee experienced many sanitation, sewage and health problems back in 1913. So they set up a commission to study and remedy the problems. Their engineers investigated many treatment methods, but Milwaukee adopted and pioneered the activated sludge process. It was the most efficient in removing solids and returning water of the highest clarity and purity to Lake Michigan. But it also provided a huge quanity of solids. These had to disposed of in some manner. Before the by-products could be sold, it's value needed to be determined. This was done at the University of Wisconsin in the early 1920's. They discovered the solids were 75% organic matter, high in nitrogen and contained some phosphorous and a wealth of trace minerals. They then tested the waste material as a fertilizer for growing all manner of food, fiber and ornamental plants. Every crop grew beautifully. Milorganite for "Milwaukee organic nitrogen" was horn.

Milwaukee's original 1925 plant accepted 85 million gallons of sewage per day. Today, it receives 200 million gallons of industrial and residential waste daily which is converted into approximately 200 tons of Milorganite. The industrial sewage from breweries, tanneries and meat packers, seem to provide this product with a nitrogen content that other cities with similar plants can't obtain. By having selectivity control of waste inflow, a substantial uniform fertilizer is produced.

Essentially, the treatment involves:

1. Screening to remove large particles
2. Grit (sand and gravel removed by settling)
3. Inoculation with previously activated sludge
4. Aeration
5. Clarifying the effluent
6. Dewatering and sterilizing
7. Bagging and shipping the finished product

Milorganite is shipped in 50 lb. bags which are easy to handle. This size allows for fairly easy application rate calculation. I had thought it would be less expensive to purchase in bulk etc., but discovered it's only sold and shipped this one way.

I would like to mention to you that we feel one of the greatest breakthroughs in bare root stock production is on the immediate horizon through management of soil mycorrhizae. Dr. Trappe of the Pacific Northwest Experimental Station at Corvallis, feels that organic fertilizer can be utilized more efficiently by mycorrhizae. In addition, our phosphorous levels are relatively low and the Milorganite supplements the existing phosphorous for better mycorrhizae utilization.

In summary, if it appears we are going organic at Wind River Nursery, I would say - yes, we are certainly heading in that direction. I think that some of the organic farming techniques the Chinese people have employed successfully for over 4000 years is part of the answer to restoring the fertility and the organic content of our soils. It certainly will help our pollution problems in this country and in the future the scarcity and high cost of synthetic fertilizers.

We will continue to monitor and to use Milorganite at the Wind River Nursery. We don't know of any product presently on the market that can give us the excellent results in the color, size and quality of seedlings that Milorganite is now producing. Unless, perhaps it would be the Fish Sludge. can't add any more. For us, "the proof is in the puddin". It may be what you are looking for.

I now have just a few slides on Milorganite to show to you on its application and results achieved at Wind River Nursery. I invite you to ask questions along the way. Also I do have a few shots of our wood pulp study if time permits.

WIND RIVER NURSERY SOIL MAINTENANCE PROGRAM

Oct-Nov 2-0	Soil sample
Jan-Feb	Analysis is back
Feb-April	Soil prescription for deficiency - P, Ca, Mg, K, OM, N, pH.
April-June	Deficiency work is accomplished
June	Cover crop
Aug	Cover crop plower under
Aug-Sept	Fumigation
Nov	Soil sample
Jan-Feb	Analysis is back
Feb	Analysis is received and prescription for fertilizer is written for spring sowing.
May	Sow seed

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