

"POLLUTION PREVENTION PAYS" CHALLENGE GRANT REPORT

P 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

1. THE PROBLEMS OF WOOD PRODUCT WASTESTREAM POLLUTION AND RESOURCE DIVERSION EXTEND WELL BEYOND THE LEVEL OF ANY INDIVIDUAL FACTORY AND WATERSHED TO AN INDUSTRY-WIDE AND NATION-WIDE MISAPPLICATION OF TECHNOLOGY AND RESOURCES. IF DISPOSED OF BY STOCKPILING OR LANDFILLING, WASTES FROM WOOD PRODUCTS PROCESSING -- PLANT NUTRIENTS AND BIOLOGICALLY HARMFUL SUBSTANCES -- CAN INFLUENCE WATER QUALITY CHRONICALLY, IN SOME CASES ACUTELY.

2. NUTRIENT RUN-OFF FROM UNMANAGED PILES OF WOOD WASTE CONSISTS PREDOMINANTLY OF NITROGEN AND PHOSPHORUS, WHICH COME FROM THE DIE-OFF OF AEROBIC BACTERIA AS THE CELLULOSE IS BROKEN DOWN. IN EXCESS, THESE ELEMENTS ARE POLLUTANTS; SURFACE WATERS ARE MOST COMMONLY AFFECTED. WHEN THIS RUN-OFF REACHES SLOW-DISPLACEMENT, LOW-TURBULENCE BODIES OF WATER, TWO OF THE CONDITIONS NECESSARY FOR BLUE-GREEN ALGAE BLOOM ARE PRESENT: NUTRIENTS AND A STATIC BODY OF WATER. (THE NEUSE RIVER AND LAKE WHEELER HAVE EXPERIENCED SUCH INCIDENTS.) IN SOME CASES, TOXIC PRODUCTION ADDITIVES SUCH AS UREA FORMALDEHYDE RESIN MAY CAUSE ADDITIONAL PROBLEMS. AT ITS MONCURE PLANT, WEYERHAEUSER RETAINS THE WASTE-PILE RUN-OFF IN A CATCHMENT POND AND USES THAT WATER IN THE FIBERBOARD MANUFACTURING PROCESS, IN COMPLIANCE WITH NORTH CAROLINA REGULATIONS AS A ZERO-DISCHARGE FACILITY. HOWEVER, IT IS REMOTELY POSSIBLE THAT CATASTROPHIC RAINS COULD CAUSE SPILLOVER INTO THE ADJACENT HAW RIVER TRIBUTARY AND POLLUTE IT.

ALTERNATE TECHNOLOGIES TO STOCKPILING ARE LANDFILLING AND INCINERATION. LANDFILLING IS INEXPENSIVE IN CAPITAL INVESTMENT -- FOR EXAMPLE, A BULLDOZER ONLY COSTS \$100,000 -- BUT COSTS OF OPERATION ARE SIGNIFICANT: ONE NORTH CAROLINA WOOD PRODUCTS COMPANY PAYS A GRADING CONTRACTOR \$2.00 PER CUBIC YARD TO LANDFILL ITS WASTES; IT COSTS DUKE POWER COMPANY \$4.50 PER TON TO LANDFILL ITS TAILINGS. A COMPANY THAT FACES SUCH COSTS FINDS THE VOLUME OF WASTE MATERIAL OF SUDDEN IMPORTANCE. FURTHERMORE, LANDFILLING IS AN INEFFECTIVE SOLUTION TO THE PROBLEM OF WATER POLLUTION BECAUSE LEACHATE FROM THE LANDFILL STILL CAN LOWER SURFACE AND GROUNDWATER QUALITY. AND WHEN THE NUTRIENT-RICH MATERIAL UNDERGOES ANAEROBIC DECOMPOSITION, OTHER POLLUTANTS ARE GENERATED THAT ARE TOXIC TO SOIL AND WATER LIFE.

INCINERATION OR CO-GENERATION IS AN APPARENT "NATURAL" FOR WOOD PRODUCT WASTES, BUT IT TOO IS NOT WITHOUT DRAWBACKS. CAPITAL EXPENDITURE IS HIGH FOR MATERIALS HANDLING AND BOILER EQUIPMENT. THE ENERGY GAIN IS MODERATE TO BREAK-EVEN IN MANY INSTALLATIONS. WOOD AND MANUFACTURING ADDITIVES MOISTURE MUST BE BURNT OFF BEFORE THE WOOD CAN GO THROUGH COMBUSTION. ALSO, THE RESIDUE WILL CONTAIN SOME POST-COMBUSTION FORM OF UREA FORMALDEHYDE RESIN AS WILL THE VENTED GASES. ENVIRONMENTAL IMPACT OF THESE BY-PRODUCTS WILL BE MORE SEVERE AND UNCONTROLLABLE THAN THOSE OF THE STOCKPILE.

YET ANOTHER PROBLEM WITH LONG-TERM IMPLICATIONS, WHICH

THIS RESEARCH CAN HELP SOLVE. IS THE ALARMING RATE AT WHICH SOIL FERTILITY IN THE UNITED STATES IS DECLINING, GIVEN PRESENT TECHNOLOGIES AND ECONOMIC PRESSURES, AND THE CONSEQUENT COMPENSATORY DEMAND FOR FERTILIZERS. THE COST AND AVAILABILITY OF MINERAL FERTILIZERS IS LINKED TO THE COST AND AVAILABILITY OF THEIR FEEDSTOCK, FOSSIL FUELS. IN 1973-74, WHEN FUEL COST DOUBLED, SO DID THE COST OF MINERAL FERTILIZERS. AT THE SAME TIME, THE U.S. CONGRESS CONSIDERED LEGISLATION TO CURTAIL HORTICULTURAL USE OF MINERAL FERTILIZERS UNTIL THE FUEL SHORTAGE WAS OVER. HORTICULTURAL USE ACCOUNTED THEN FOR 15% OF THE TOTAL MARKET, AND THERE WAS NO ALTERNATE TECHNOLOGY TO REPLACE CONVENTIONAL MANAGEMENT METHODS.

3. THE WASTE MATERIAL AT THIS SITE IS A GROUND WOOD FIBER AVERAGING A FEW MILLIMETERS IN LENGTH AND TENTHS OF A MILLIMETER IN WIDTH WITH AN AVERAGE UREA FORMALDEHYDE RESIN CONTENT OF 4.5 PERCENT. THE WEIGHT TO VOLUME RATIO OF THE WASTE FIBER IS 405 POUNDS PER CUBIC YARD AT 50% TO 60% AVERAGE MOISTURE CONTENT. THE STOCKPILE HAS ACCUMULATED FOR FIFTEEN YEARS, AND THE ESTIMATED QUANTITY IS AT LEAST 100,000 TONS, INCREASING AT A RATE OF 50 TONS PER WEEK. PRESENT REGULATION OF THE SITE AND WASTESTREAM EFFLUENT IS FOUND UNDER G.S. 143-214.1 (MAY 10, 1979), "NUTRIENT SENSITIVE WATERS." ALTHOUGH WATER POLLUTION IS NOT A PROBLEM AT THIS PLANT, IT WOULD BE IF THE CATCHMENT POND SHOULD EVER OVERFLOW. THE WOOD WASTE ITSELF IS ONLY A NUISANCE INSULT TO THE ENVIRONMENT, BUT FORMALDEHYDE IS TOXIC AND HAZARDOUS, AND AT SOME POINT, THE NUTRIENT RUN-OFF WILL BE MORE HEAVILY REGULATED. TO COPE WITH THE FLOW OF WASTE ANTICIPATED FOR THE FUTURE, AND PERHAPS WITH THE WASTE PILE ALREADY ACCUMULATED, WEYERHAEUSER WANTS TO INVESTIGATE THE PROSPECT OF CONVERTING THE WASTE INTO A COMPOSTED SOIL AMENDMENT.

OUTLINE

1. PROCESS/FORMULAE
2. TESTING
3. FIELD TESTS
4. POTENTIAL APPLICATIONS
 - A. PRESENT
 - B. FUTURE
5. CONCLUSION

PROCESS/FORMULAE

THE PROCESSING OF THE RAW MATERIAL PROVED TO BE AS CHALLENGING AS EXPECTED. THE RAW MATERIAL DID EASILY "AIRLOCK" THE PILE EVEN WITH THE ADDITION OF COARSER MATERIALS. THE TEMPERATURE WAS ERRATIC AND REMAINED LOW WITH THE EXCEPTION OF ONE FORMULA. THE TURNING REQUIRED WAS MORE FREQUENT THAN IN THE PROPOSAL PROGRAM. NONE OF THE EXPERIMENTAL PILES REACHED THE RECOGNIZABLE FINISHED STATE OF COMPOSTED HUMUS TYPE MATERIAL NORMALLY ATTAINED WITHIN TWO TO FOUR MONTHS. ADDITIONAL PILES WERE MADE WITH NEW INGREDIENTS, AND OLD PILES WERE REACTIVATED WITH THE NEW ADMIX BASED ON SHORT-TERM OBSERVATIONS OF THE NEW FORMULA. THE NEW FORMULA SHOWS PROMISE.

TEST BATCHES AMOUNTED TO 800 CUBIC YARDS OF TOTAL RAW MATERIAL. THE ORIGINAL BATCHES CONSISTED OF 500 CUBIC YARDS WITH THE FOLLOWING VARIATIONS:

OLD FIBER PLUS NEW FIBER WITH LARGE WOOD CHIPS
 CROSS-PILE ADMIXES WERE:
 LIME
 LIME AND NITROGEN
 NITROGEN
 CONTROL

OLD FIBER WITH LARGE WOOD CHIPS
 CROSS-PILE ADMIXES WERE:
 LIME
 LIME AND NITROGEN
 NITROGEN
 CONTROL

OLD FIBER
 CROSS-PILE ADMIX WAS:
 LIME

NEW FIBER WITH LARGE CHIPS
 CROSS-PILE ADMIX WAS:
 LIME

PROCESS/FORMULAE (CONT.)

WHEN THESE FORMULAE DID NOT PRODUCE THE EXPECTED RESPONSE, TWO ADMIXES AND ONE NEW FORMULA WERE TRIED:

ANIMAL MANURE WITH LARGE CHIPS WAS ADDED TO TWO OF THE PILES IN THE CONTROL AREA. ON ANOTHER PILE A HIGH ANALYSIS NITROGEN FERTILIZER WAS ADDED. TWO MORE BATCHES, MOSTLY ANIMAL MANURE, WERE MADE WITH PROPORTIONS OF NEW FIBER ADDED (TWO HUNDRED YARDS IN TOTAL.)

THE PROCESS RESULTS WERE GOOD WHEREVER THE MANURE WAS ADDED. THE MODIFIED PILES STILL DID NOT ACT IN THE IDEAL PATTERN: HIGH INITIAL TEMPERATURE, INDICATOR BACTERIA THROUGHOUT PILE. LITTLE TURNING NECESSARY. TEMPERATURES WERE ON THE LOW END OF THE COMPOSTING SCALE. HOWEVER THEY WERE CONSISTENT. INDICATOR BACTERIA WERE EVIDENT, BUT ONLY PLENTIFUL IN THE NEW PILES WITH MOSTLY ANIMAL MANURES. TURNING WAS NECESSARY CONSTANTLY TO KEEP PILE AERATION SUFFICIENT TO MAINTAIN BACTERIAL ACTIVITY.

AFTER OBSERVING THE NEW FORMULAE, THE CONSULTANT COMBINED TWO OF THE INACTIVE PILES OF FIBER AND ADDED ANIMAL MANURE IN SUFFICIENT QUANTITY TO REACTIVATE THEM (NINETY CUBIC YARDS.) OBSERVATIONS ARE CONTINUING.

FURTHER OBSERVATION OF THE NEW FORMULAE AND AERATION TECHNIQUES WILL BE MADE PAST THE PROPOSED EXPERIMENT PERIOD.

TESTING

TEST RESULTS INDICATE AN UNFINISHED PROCESS WITH NUTRIENTS UNRELEASED. COMPARED TO A COMPOST OF KNOWN VALUE TO HORTICULTURAL APPLICATIONS THE NUTRIENT LEVELS WERE LOW. THERE WAS A HIGH CONCENTRATION OF SOLUBLE SALTS AS WELL AS POTASSIUM.

THESE RESULTS CAN BE OBSERVED IN ATTACHMENTS ONE THROUGH FOUR:

1. RAW FIBER NUTRIENT ANALYSIS
2. COMPOST SAMPLES TAKEN ACROSS PILE VARIATION SECTIONS
NUTRIENT ANALYSIS
- 3 & 4. SOIL SAMPLES OF SAME PROFILE AS ATTACHMENT #2

ATTACHMENT 5 IS THE NUTRIENT ANALYSIS OF THE NEW FORMULA WITH MOSTLY ANIMAL MANURE.

FOR COMPARISON, ATTACHMENT SIX IS THE NUTRIENT ANALYSIS OF A FINISHED COMPOST OF KNOWN VALUE.

TESTING - CONT.

UREA FORMALDEHYDE IS IN A 7% CONCENTRATION IN THE NEW WASTE FIBER. THIS MATERIAL IS CONSIDERED A POLLUTANT IN AIR POLLUTION REGULATIONS, HOWEVER, NOT IN AGRICULTURAL/HORTICULTURAL APPLICATIONS. AS A MANUFACTURING SITE MANAGEMENT CONSIDERATION, IT IS STILL A POLLUTANT BECAUSE OF THE CONCENTRATION OF SATURATED RUN-OFF AND THE POSSIBLE ENVIRONMENTAL INSULT TO SURROUNDING BODIES OF WATER.

UREA FORMALDEHYDE HAS NOT BEEN TESTED IN THE COMPOST BECAUSE IT WILL BE CARRIED OFF SITE FOR LOW CONCENTRATION LAND APPLICATION DISPOSAL. UREA FORMALDEHYDE IS USED IN AGRICULTURAL/HORTICULTURAL FERTILIZATION CONCENTRATIONS OF BETWEEN 30 AND 60% PLUS, AND MANDATED BY THE FERTILIZER REGULATIONS TO BE IN THOSE CONCENTRATIONS. THEREFORE, THE ENVIRONMENTAL INSULT CREATED BY A DILUTED CONCENTRATION OF 7% IN NEW WOOD FIBER APPLIED TO LAND AT A RATE OF TWENTY TONS PER ACRE WOULD HAVE TO BE JUST AS LEGAL AS APPLYING FOUR HUNDRED POUNDS OF 33% UREA FORMALDEHYDE IN THE FORM OF MINERAL FERTILIZER.

THE CONSULTANT IS AWAITING A RULING FROM THE SOLID AND HAZARDOUS WASTE DIVISION OF THE DEPARTMENT OF HUMAN RESOURCES AND FROM THE DIVISION OF ENVIRONMENTAL MANAGEMENT, NATURAL RESOURCES AND COMMUNITY DEVELOPMENT. A FAVORABLE RULING IS EXPECTED BUT NOT ANTICIPATED.

FIELD TESTS

FIELD TESTS WERE CONDUCTED ON ESTABLISHED SOD AND ON NEWLY SEWN GRASS SEED. THE SHORT-TERM RESULTS ARE FAVORABLE:

- SOD SHOWED GOOD RECOVERY FROM THE WORST DROUGHT IN ONE HUNDRED YEARS (1986, NORTH CAROLINA)
- GRASS SEED GERMINATED IN 35 TO 65% OF THE NORMAL TIME REQUIRED, AN EXPECTED RESULT FROM COMPOST
- GROWTH HABIT OF SOD AND SEED WAS UNIFORM AND SUSTAINED THROUGHOUT WET AND DRY PERIODS, EXPECTED RESULT OF COMPOST

FURTHER TESTING TO BE CONDUCTED INCLUDES:

- CONTAINER MIX POTENTIAL
- SOIL BED APPLICATIONS FOR SHRUBS, FLOWERS, TREES
- MOISTURE AND NUTRIENT RETENTION IN SOIL AND SOIL-LESS MIX

ARRANGEMENTS HAVE BEEN MADE FOR THE CONTAINER MIX AND MOISTURE AND NUTRIENT RETENTION RESEARCH. HOWEVER TO CONTINUE IT, THE COMPOST MUST MATURE TO A USABLE STATE. THE RESULTS OF THE SOIL BED EXPERIMENTS WILL NOT BE CONCLUSIVE UNTIL THE END OF THE GROWING SEASON IN 1987.

POTENTIAL APPLICATIONS

PRESENT APPLICATIONS WILL BE LIMITED TO THE SURFACE OF THE SOIL: TURF TOPDRESSING AND ANNUAL FERTILIZATION OF SHRUB AND TREE BEDS. WITH HIGH THE SOLUBLE SALT CONCENTRATION AND LOW FERTILIZER VALUE, THIS MATERIAL WILL HAVE TO BE ACCOMPANIED BY AMENDMENTS AND ADDITIONAL FERTILIZER.

FUTURE APPLICATIONS WILL DEPEND ON THE ABATEMENT OF THE SALTS AND INCREASING OF THE NUTRIENTS. WHEN THERE IS NO FURTHER THREAT OF SALT TOXICITY, THE MATERIAL MAY BE USED FOR AMENDMENT MIXED WITH THE SOIL IN PLANT BEDS. THIS USE IS THE PRIMARY EXISTING MARKET.

CONCLUSION

ALTHOUGH SEVERAL QUESTIONS ABOUT THE PROCESS AND THE FINISHED MATERIAL STILL EXIST, THE POTENTIAL FOR HORTICULTURAL AND AGRICULTURAL USE IS PROMISING. BASIC CONCLUSIONS ARE:

- THE MATERIAL IS MARGINALLY COMPOSTABLE
- MORE EXPERIENCE IS NEEDED
- GREEN INDUSTRY APPLICATIONS MUST BE MADE AND MONITORED WITH GREAT CARE
- THE MARKET IS LIMITED UNTIL FURTHER RESEARCH AND TESTING IS DONE
- MARKET POTENTIAL IS GOOD BECAUSE OF THE AMOUNT OF MATERIAL AND BECAUSE THE PRODUCTION SITE LOCATION IS CLOSE TO A MAJOR MARKET (THE RESEARCH TRIANGLE.)

COMPOSTING PROJECT AT MONCURE PLANT OF WEYEHAEUSER COMPANY

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ACCOUNTING OF EXPENSES OF WASTEK

MONTH	EQUIPMENT	LABOR	MATERIAL	MILEAGE	TOTAL
JULY	525.00	1903.00	1200.00	120.00	
AUGUST	600.00	1263.00	0	101.00	
SEPTEMBER	960.00	1376.00	220.00	84.00	
OCTOBER	180.00	642.00	0	134.00	
NOVEMBER	210.00	419.00	0	80.00	
TOTALS	2475.00	5603.00	1420.00	519.00	10017.00
	PRODUCTION COSTS		\$ 10017.00		
	MONITORING AND TESTING COSTS		1150.00		
	TOTAL		<u>\$11,167.00</u>		

NOTE: THESE COSTS DO NOT INCLUDE OVERHEAD AND PROFIT FIGURES FOR WASTEK, A CORPORATION.

SUMMARY OF COSTS IN KIND BY WEYEHAEUSER

30 TONS HARDWOOD CHIPS	450.00
1000 CUBIC YARDS WASTE FIBER @ 405 LBS./YD. = 202.5 TONS @ \$15.00/TON	3037.50
16 HOURS 930 CAT FRONT END LOADER @ \$25.00/HR. LABOR COST PROVIDED BY WEYERHAEUSER	400.00
TOM REUDY - 4 HOURS @ \$65.00/HR.	260.00
JOHN STEPHENSON - 8 HRS. @ 65.00/HR.	520.00
BILLY HUGHES - 16 HRS. @ 11.25/HR.	180.00
CHARLES CASHION - 10 HRS. @ 30.00/HR.	300.00
TOTAL	<u>\$5,147.00</u>
WASTEK COSTS	\$11,167.00
WEYEHAEUSER COSTS	\$ 5,147.00
TOTAL PROJECT COST	<u>\$16,314.00</u>

STATEMENT OF POTENTIAL SAVINGS BY COMPOSTING

OF

P 8

WEYERHAEUSER WASTE WOOD FIBER

THERE ARE THREE WAYS IN WHICH WEYERHAEUSER COMPANY CAN EXPRESS THE LOSS WHICH THE 500,000 TONS OF WASTE FIBER REPRESENT:

1. LOST FINISHED PRODUCT
2. LOST FUEL VALUE
3. ADDED COST OF LANDFILLING

THE FIBER REPRESENTS A LOSS IN FINISHED PRODUCT PRICE OF \$300.00 TO \$400.00 PER TON. FINISHED PRODUCT IS WORTH \$400.00 PER TON. HOWEVER, THE WASTE IS REMOVED BEFORE FINAL PROCESSING, THEREFORE COSTING LESS THAN FINISHED FIBERBOARD. THIS LOSS IS EXPRESSED AS PRODUCTION COST.

LOST FUEL VALUE IS \$20.00 PER TON. THE WASTE PILE WILL NOT BE USABLE AS FUEL BECAUSE IT IS MIXED WITH SOIL FROM LANDFILLING AND MUCH WETTER THAN NEW WASTE FIBER MAKING IT LESS COST EFFICIENT TO BURN.

THE MOST EVIDENT SAVINGS FROM COMPOSTING OF THE OLD WASTE PILE AND THE NEW WASTE FIBER GENERATED AT A RATE OF 12,000 TONS PER YEAR IS THE COST OF LANDFILLING. USING THE PRESENT LANDFILL CONSTRUCTION, ABOVE-GROUND WITH AN EARTH CAP, THE MATERIAL COSTS THE COMPANY \$.66 PER TON. THESE COSTS WILL INCREASE IF THERE ARE CHANGES IN LANDFILL CONSTRUCTION REGULATIONS BY THE STATE. NEW FEDERAL REGULATIONS GOVERNING SOLID WASTE LANDFILLS ARE EXPECTED WITHIN THE NEXT YEAR, ALONG WITH NEW REGULATIONS CONCERNING TOXIC AND HAZARDOUS WASTE. THE FIGURE OF \$.66 PER TON DOES NOT INCLUDE THE LAND COST FACTOR.

PROJECTED SAVINGS, THEN, WOULD BE:

LANDFILLING COSTS	.66
PURCHASE OF MATERIAL BY WASTEK	.25
	<hr/>
	\$.91

TOTAL - 12,000 TONS @ \$.91/TON \$ 10,920.00/YEAR

THE FIGURE OF \$.25 PER TON IS BASED ON AN OFFER BY WASTEK IN DECEMBER, 1986. INCOME FROM THE SALE OF THE MATERIAL BY WASTEK OVER THE 12,000 TONS PER YEAR WILL INCREASE THE TOTAL SAVINGS. THEREFORE, SAVINGS WILL BE RELATED TO SALES OF THE MATERIAL. THIS FIGURE IS REDUCED FROM REGULAR COMPOST RAW MATERIAL PRICES BECAUSE:

1. THE PRODUCTION FORMULA HAS NOT BEEN PERFECTED.
2. THE MARKET FOR AN INFERIOR COMPOST NEEDS RESEARCH,
3. THE MARKET NEEDS EDUCATION ON THE USE OF THE PRODUCT,
4. CAPITAL NEEDS FOR A NEW PRODUCTION SITE MUST BE MET.

WHEN THESE PROBLEMS HAVE BEEN OVERCOME, THE VALUE OF THE MATERIAL WILL INCREASE AND, THEREFORE, THE PRICE TO WEYERHAEUSER. THE PROJECTED FUTURE VALUE COULD BE AS HIGH AS \$ 1.00 TO \$ 2.00 PER TON, AS WELL AS PRODUCTION SITE LEASE AND MATERIAL HANDLING FEES.

PLANT ANALYSIS REPORT

ATTACHMENT # 1

Green Glen Ltd.
Route 5, Box 160
Pittsboro, N. C. 27312

Chatham

REPORT NUMBER:

56

DATE:

July 16, 1986

542-4955

AGRONOMIC DIVISION
North Carolina Department of Agriculture
Raleigh, North Carolina 27611

(919) 733-2656

"THE TARHEEL STATE"

LAB NUMBER	SAMPLE NUMBER	CROP	PERCENTAGE EXPRESSED ON A DRY WEIGHT BASIS						PARTS PER MILLION EXPRESSED ON A DRY WEIGHT BASIS						
			N Nitrogen	P Phosphorous	K Potassium	Ca Calcium	Mg Magnesium	S Sulfur	Fe Iron	Mn Manganese	Zn Zinc	Cu Copper	Bo Boron	Mo Molybdenum	
330-87	W01	Wood Fiber New	2.20	.02	.06	.41	.04	.04	.04	147	146	17	3	14	.05
331-86	W02	Wood Fiber Old	.65	.02	.06	.41	.03	.04	2035	166	13	4	19	.03	
330	NH ₄ =2.17														
331	NH ₄ =0.59														

SUFFICIENCY CODE: D = Deficient L = Low S = Sufficient H = High E = Excess

Recommendations: UNLESS OTHERWISE STATED, ALL ELEMENTS ARE SUFFICIENT FOR NORMAL CROP GROWTH

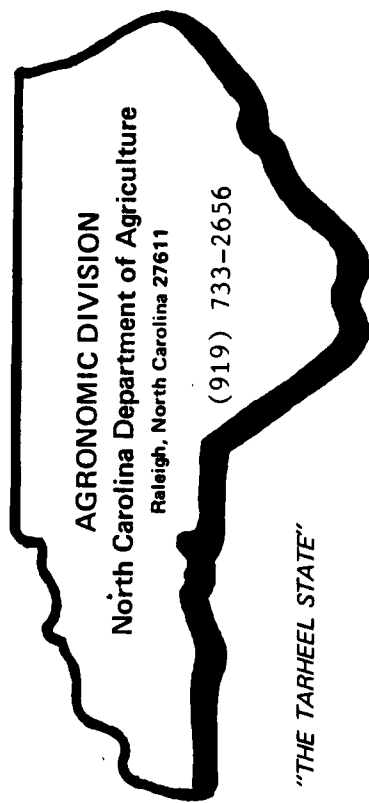
CC: Robin Watson

C. Ray Campbell
C. Ray Campbell
AGRONOMIST

PLANT ANALYSIS REPORT

GROWER: ATTACHMENT # 2
 Glendinning Greenhouse
 Route 5, Box 160
 Pittsboro, N. C. 27312
 Chatham

DATE: November 21, 1986
 REPORT NUMBER: 641



"THE TARHEEL STATE"

LAB NUMBER	SAMPLE NUMBER	CROP	PERCENTAGE EXPRESSED ON A DRY WEIGHT BASIS							PARTS PER MILLION EXPRESSED ON A DRY WEIGHT BASIS						
			N Nitrogen	P Phosphorous	K Potassium	Ca Calcium	Mg Magnesium	S Sulfur	Fe Iron	Mn Manganese	Zn Zinc	Cu Copper	Bo Boron	Mo Molybdenum		
2318-87	W2A	Potting Mix	0.59	0.13	0.12	1.44	0.73	0.12	1530	176	28	5	10	0.30		
2319-87	W2B	Potting Mix	0.84	0.14	0.14	1.51	0.78	0.12	1530	185	27	4	10	0.35		
2320-87	W2C	Potting Mix	0.95	0.15	0.15	1.19	0.46	0.12	1685	190	27	5	8	0.26		
2321-87	W1A	Potting Mix	0.56	0.11	0.11	2.50	1.18	0.12	1810	206	44	5	11	0.33		
2322-87	W1B	Potting Mix	0.63	0.13	0.11	1.67	0.85	0.12	1645	190	28	4	8	0.26		
2323-87	W1C	Potting Mix	0.64	0.13	0.12	0.90	0.24	0.11	1960	214	21	4	11	0.28		
2324-87	W3S	Potting Mix	0.53	0.02	0.04	0.37	0.03	0.03	2255	133	23	3	7	0.13		

SUFFICIENCY CODE: D = Deficient L = Low S = Sufficient H = High E = Excess

Recommendations: UNLESS OTHERWISE STATED, ALL ELEMENTS ARE SUFFICIENT FOR NORMAL CROP GROWTH

2325-87	WOP	Potting Mix	0.50	0.01	0.04	0.29	0.03	0.03	2345	115	17	2	8	0.18
2326-87	WOPn	Potting Mix	1.06	0.15	0.16	1.08	0.42	0.12	1380	206	27	4	10	0.26

cc:Robin Watson

C. Ray Campbell
 C. Ray Campbell
 AGRONOMIST

ATTACHMENT # 4

REPORT NO. 10727

11/25/86

TO: GLENDINNING, TOM
RT 5
PITTSBORO NC 27312-

DR RAY CAMPBELL RPT641 RALEIGH

ADRESSES: COUNTY EXTENS ON CHAIRMAN

FARM LOCATION (COUNTY):

CHAITHAM

SAMPLE NO.	PREVIOUS CROP	FIELD INFORMATION			TEST RESULTS														
		APPLIED LIME	FERT. LAST CROP	TA	N	P	K	Ca	Mg	SS	Zn	Cu	SI	NO ₃ N	NH ₄ N	NO ₂ N			
W2A	GREENHOUSE	M-0	0.1	0.31	13.1	100	0.0	5.2	0.89	296	62.6	26.1	189	(164)	131	26	215	0.88	0.4
CROP TO BE GROWN		LIME																	
GREENHOUSE		NOTE 9	1.0M	0	0	0	0	9											

SAMPLE NO.	PREVIOUS CROP	FIELD INFORMATION			TEST RESULTS														
		APPLIED LIME	FERT. LAST CROP	TA	N	P	K	Ca	Mg	SS	Zn	Cu	SI	NO ₃ N	NH ₄ N	NO ₂ N			
W2B	GREENHOUSE	M-0	0.1	0.31	15.8	92	1.2	6.2	1.28	358	57.5	23.6	166	(174)	139	26	292	1.02	0.5
CROP TO BE GROWN		LIME																	
GREENHOUSE		NOTE 9	0	0	0	0	9												

SAMPLE NO.	PREVIOUS CROP	FIELD INFORMATION			TEST RESULTS														
		APPLIED LIME	FERT. LAST CROP	TA	N	P	K	Ca	Mg	SS	Zn	Cu	SI	NO ₃ N	NH ₄ N	NO ₂ N			
W2C	GREENHOUSE	M-0	0.1	0.25	13.8	100	0.0	6.1	1.00	318	62.2	26.3	135	(151)	121	22	358	1.10	0.5
CROP TO BE GROWN		LIME																	
GREENHOUSE		NOTE 9	0.5M	0	0	0	9												

SAMPLE NO.	PREVIOUS CROP	FIELD INFORMATION			TEST RESULTS														
		APPLIED LIME	FERT. LAST CROP	TA	N	P	K	Ca	Mg	SS	Zn	Cu	SI	NO ₃ N	NH ₄ N	NO ₂ N			
W3S	GREENHOUSE	M-0	0.8	0.29	11.5	62	4.4	5.4	0.10	62	52.1	7.0	235	(159)	127	18	097	0.38	0.1
CROP TO BE GROWN		LIME																	
GREENHOUSE		NOTE 9	7.5M	2.5M	0	0	9												

SAMPLE NO.	PREVIOUS CROP	FIELD INFORMATION			TEST RESULTS														
		APPLIED LIME	FERT. LAST CROP	TA	N	P	K	Ca	Mg	SS	Zn	Cu	SI	NO ₃ N	NH ₄ N	NO ₂ N			
CROP TO BE GROWN		LIME																	
GREENHOUSE																			

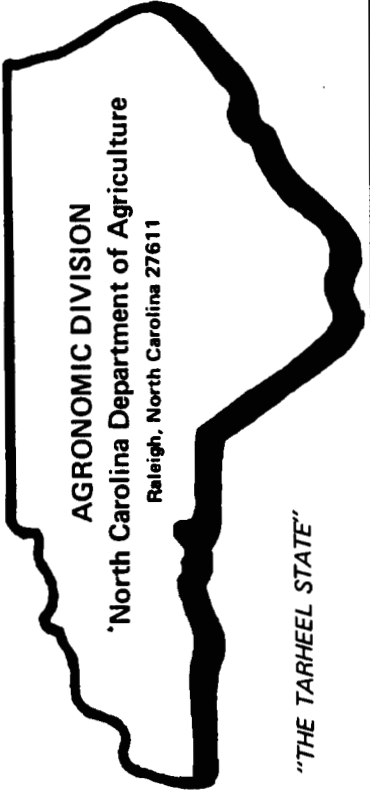
* TEST RESULTS IN C. tests which are not directly comparable to those of other laboratories. For more information, contact the State Laboratory of Plant Industry, Raleigh, N.C. 27619.

PLANT ANALYSIS REPORT

ATTACHMENT # 5

Green Glen
Route 5, Box 160
Pittsboro, N. C. 27312

Chatham



DATE: Nov. 14, 1986

REPORT NUMBER: 627

542-4955

LAB NUMBER	SAMPLE NUMBER	CROP	PERCENTAGE EXPRESSED ON A DRY WEIGHT BASIS							PARTS PER MILLION EXPRESSED ON A DRY WEIGHT BASIS				
			N Nitrogen	P Phosphorous	K Potassium	Ca Calcium	Mg Magnesium	S Sulfur	Fe Iron	Mn Manganese	Zn Zinc	Cu Copper	Bo Boron	Mo Molybdenum
2294-87		Compost	1.12	0.52	1.00	0.95	0.30	0.30	1675	204	38	9	22	0.63
		SS-5000 umhos/cm <i>10-5 mhos</i>	22.4	10.4	20.0	LBS. 19.0	6.0	OF ELEMENT/TON 6.0	3.35	0.41	0.08	0.02	0.04	0.001
				P ₂₀₅ 23.8	K _{2O} 24.0									

SUFFICIENCY CODE: D = Deficient L = Low S = Sufficient H = High E = Excess

Recommendations:

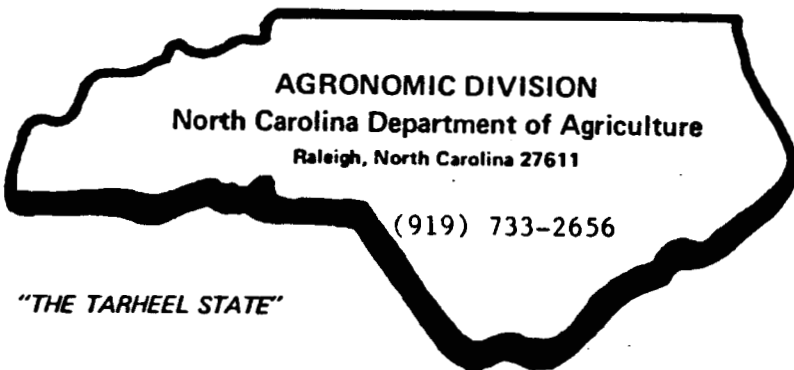
Batch ~~86-1-2~~ 86-1-2 at yard nursery

CC: Robin Watson

C. Ray Campbell
C. Ray Campbell
AGRONOMIST

PLANT ANALYSIS REPORT

GROWER: **ATTACHMENT # 6**
Tom Glendinning
 Rt. 1, Box 63-A
 Pittsboro, N. C. 27312



Chatham
 DATE: **November 2, 1983**
 REPORT NUMBER: **416**

LAB NUMBER	SAMPLE NUMBER	CROP	PERCENTAGE EXPRESSED ON A DRY WEIGHT BASIS						PARTS PER MILLION EXPRESSED ON A DRY WEIGHT BASIS					
			N Nitrogen	P Phosphorous	K Potassium	Ca Calcium	Mg Magnesium	S Sulfur	Fe Iron	Mn Manganese	Zn Zinc	Cu Copper	Bo Boron	Mo Molybdenum
576-84		Compost Pile (dry)	2.17	2.73	2.90	4.40	.93	% = .4761	4761	485 .0485	355 ,0355	459 .0459		

SUFFICIENCY CODE: D = Deficient L = Low S = Sufficient H = High E = Excess

Recommendations: **UNLESS OTHERWISE STATED, ALL ELEMENTS ARE SUFFICIENT FOR NORMAL CROP GROWTH**

The copper level is not high enough to create any particular problem. A Ton of this material would contain .92 lbs of copper. In order to cause a copper problem you would need to apply more compost than you have access to or plan to apply. The nutrients N, P, K, Ca, & Mg are expressed as a percent on a dry weight basis. One ton of this material contains 43.4 lbs of N, 125 lbs P₂O₅ and 69.6 lbs K₂O so the fertility value is good. If you have any further questions give me a call.

M. Ray Tucker
 AGRONOMIST