ALTERNATIVE STRAWBERRY PRODUCTION WITH COMPOST

FINAL REPORT

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NCDENR

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I. SUMMARY
ALTERNATIVE STRAWBERRY PRODUCTION USING COMPOST

OBJECTIVES

In October 1997, a 3 year study was launched on The Vollmer Farm in an unique cooperative effort by The Vollmer Farm, N.C. Dept. of Environment and Natural Resources - Division of Pollution Prevention, and N.C. State University Cooperative Extension.

The main objective was and is to evaluate the potential of a well managed compost-based production system as an alternative fertility and pest management tool compared to a conventional methyl bromide based system. In addition, the study proposed to assess the economics of the two different systems, and evaluate the environmental benefits of a compost-based production system.

COMPOST-BASED SYSTEM

The Vollmer Farm has been able to implement a compost-based strawberry production system. The system uses compost made according to the Controlled Microbial Composting (CMC) technique recognized as one which produces premium compost. Other important components of the system are intensive use of cover crops and specialized tillage (Dutch made spade plow).

The system strives to create a healthy soil environment that will allow the reduction or elimination of certain environmentally harmful pesticides and reduce reliance on petroleum based fertility products.

CONCLUSIONS

After 1 year of compost making experience and data collection, the following assessments are presented.

1. Yield of marketable strawberries in the compost-based system is 93.4% of the conventional system.
2. Cost of implementing a compost-based system is equal to a conventional system over a 5 year period.
3. Implementation of a compost-based system can result in significant environmental benefit by reduction in chemical use and recycling organic waste materials.
4. No major problem was encountered in the compost-based production system that would prevent widespread adoption by strawberry growers in North Carolina and surrounding states.

FURTHER STUDY NEEDED

The need to assess yields of the compost-based system into years two and three seems worthwhile in view of favorable results of year one. Build up of a healthy soil is seen as a process rather than a single event. There appears to be the possibility that yields of the compost-based system could equal or exceed yields of the conventional system in year two or three. It is, therefore, recommended that the study continue as originally intended.

II THE VOLLMER FARM STORY

The Vollmer Farm is a 4th generation family farm located in the Bunn community of Franklin County. The owners are John and Betty Vollmer.

Tobacco for many years has been the anchor crop for the farm like many similar farms in eastern North Carolina. With the uncertainty of the future of tobacco production, this farm began the process of diversification about 10 years ago. The farm first started with pick-your-own vegetables, then pumpkins and most recently strawberries. There are no animal enterprises on the farm.

Strawberries have become the economic anchor for this farm and plans call for the production and marketing of 100,000 pounds of berries in 1999.

Finding a sustainable and affordable alternative to methyl bromide is important from an environmental and an economic point of view as it relates to this farm's future. A compost-based production system may be a viable alternative.

III INTRODUCTION TO THE PROJECTS; ALTERNATIVE STRAWBERRY PRODUCTION WITH COMPOST

A. Introduction

In the ongoing quest to find crops that can provide alternatives to flue cured tobacco in North Carolina, plasticulture strawberries have been a striking success story. Acreage has grown from five acres in 1983 to 1,200 acres in 1997, most of which is sold at roadside markets or as “pick-your-own” fruit. Strawberries are capable of producing in excess of 20,000 pounds of marketable fruit per acre, which can provide gross incomes of $15,000 per acre if sold for the prevailing “pick-your-own” price of $0.75 per pound. The next logical step for the strawberry industry in North Carolina is to expand acreage and to move into the wholesale market to supply demand for fresh fruit on the East Coast.

B. Situation

Plasticulture strawberries are planted on raised beds of soil that are covered by a thin layer of black plastic film. When the beds are formed, the soil sterilant methyl bromide is injected into the soil to kill harmful weeds and micro-organisms. A thin plastic tube is placed six inches below the surface of the soil through which water and nutrients are pumped during the growing season. The United States Environmental protection Agency (EPA) has classified methyl bromide as a class 1 ozone depleter. The strawberry and agrichemical industry are searching for viable chemical alternatives to methyl bromide, but to date, the available alternatives are less effective or cause equal or greater environmental harm than methyl bromide.

Another element used with plasticulture strawberries is nitrogen. Plasticulture strawberries are fertilized with approximately 125 pounds of nitrogen per acre over the course of the production season.. Studies at N.C. State University have shown that only 35 pounds of nitrogen are removed from an acre of strawberries in the fruit from a 20,000 pound crop. A portion of the 90 pounds of excess nitrogen remains in the crop residue after the crop is plowed in, but the majority of the nitrogen is lost to the environment, primarily into ground and surface water. Nutrient loading has been identified as the primary cause of the decline in the health of the rivers in North Carolina. Harmful organisms such as pfisteria thrive in nitrogen enriched waters and result in fish kills and related water quality problems.

C. Background

Composting is the controlled decomposition process by which organic materials, such as manure and vegetation, are transformed into a humus-like substance called compost. Composting mimics natural processes, and, when applied to agricultural crops, improves soil structure, counteracts harmful soil organisms, and provides a complete source of plant nutrition. Compost is a stable product, and unlike chemical fertilizers and pesticides, is not subject to leaching or off-site movement into the environment.

Composting is an accepted agricultural practice in Europe where it is viewed as a synergistic means of combining waste reduction with environmentally friendly crop production. While composting has become popular in the United States as a means of yard waste processing, it has not been refined to produce a stable end product suitable for recycling into the profitable production of agricultural crops. The Controlled Microbial Composting (CMC) process is the standard for European composting and is being introduced into the United States. The keys to success o the CMC composting process include a program of daily monitoring of the microbial decomposition process and the daily turning of the compost windrows.

D. Objectives

The Vollmer farm of Franklin County, North Carolina proposes to adopt the CMC composting technology to North Carolina conditions. The main objective is to evaluate the potential of a well managed compost-based production system as an alternative fertility and pest management tool compared to a conventional methyl bromide-based system. Locally available farm bi-products are used as a resource rather than viewed as waste products.

E. Budget

Item	Vollmer Farm/NCSU Match	Pollution Prevention Challenge Grant
Compost site prep	$750	
Compost feedstock	$4,190	
Compost turner	$1,801	$20,000
Lab Equipment	$2,500	
Supplies and Materials	$6,350	
Salaries	$6,000	
Equipment Rental	$800	
Front end loader	$8,944	
Cover crops	$1,000	
Equipment time	$2,000	
Strawberry plants	$3,000	
Harvest labor	$3,600	
Phone/travel	$400	
Total	**$41,335**	**$20,000**

IV. Project Implementation

A. The success of this project is in a large part due to the level of cooperative efforts of the DENR, North Carolina State University personnel and Vollmer Farms. Without the support of DENR through funds for the compost turner and consulting service, the compost could not be made. Vollmer Farms was instrumental in the overall coordination of the project and was responsible for producing the compost and strawberry crop. NCSU compiled detailed data and a final report is included.

B. Vollmer Farms: As indicated in the interim report, the compost turner was not fully functional until October 29, 1997. Therefore, to avoid delay of a field season, CMC produced compost was purchased from Mr. D. Fulks in Fredericksburg, VA. Subsequent compost applications used compost produced on the Vollmer farm premises. We designated and verified a site for compost preparation; experiments with several recipes for preparing the compost and gained much experience in mastering the art of composting.

1. <u>SITE</u>

The composting site was 1 acre in size. After stockpiling poultry manure, dairy manure, clay soil, wheat and oat straw, pumpkins, building two 300 foot piles (windrows) leaving alleys between piles, and turn room on the ends of the piles, the 1 acre site was used up! The solution was to settle on a compost recipe that could be put together off site and trucked in to eliminate storage of feedstock materials. This allowed for the addition of 2 more windrows on the same 1 acre site. The site selection of 1 acre combined with labor and equipment constraints enables us to produce an estimated 400 cu. yds of compost per year over 2 production cycles.

Although much more compost than needed for our small research plot was produced, the process that we went through was important to understand the adjustments that needed to be made if we expected to turn out enough compost to serve an intensive 25 acre produce farm.

One additional site problem was soft soil. The site is well drained (10% slope) but in spite of this, the soil became very soft after rains. The tractor and compost turner (very heavy) traveling in the same path to turn the piles created a "squishy" muddy mess.

The solution implemented was to scrape out the soft soil where the tractor and turner were traveling to get down to the harder compacted layers beneath. It is also our plan to concentrate compost making into two periods during the year where weather conditions are best for making compost. These periods are April, May, June and September, October, November. This spring and fall scenario will avoid rainy cold winters and hot dry summers, neither of which is conducive to making good compost.

2. COMPOST RECIPE

Our initial recipe contained poultry litter which we found to be difficult to work with (Table 1). It is known in composting circles to be a “quick” material and we found that to be true. Our first piles did not have enough total nitrogen to drive the process to completion. The result was that our piles quit working 4 weeks into an 8 week cycle.

The solution that we implemented was to do more up front testing of feed stock materials to determine C:N ratio. In addition, we switched from poultry litter as the primary nitrogen component to dewatered dairy manure. We found the dairy manure gave a more measured response and resulted in a better final product.

Table 1: EVOLUTION OF COMPOST RECIPES

Initial compost Recipe	% By Volume
Poultry litter	20
Oat straw/wheat straw	40
Pumpkin waste	20
Clay soil	10
Finished compost (Fulks-Va.)	10
2nd Recipe	
Poultry litter	20
Dairy Manure	20
Oat straw	40
Clay soil	10
Finished compost	10
3rd Recipe	
Dairy Manure	40
Waste hay	25
Waste silage	20
Finished compost	10
Clay soil	5
Final Recipe	
Dairy manure	30
Waste Hay	30
Waste Silage	30
Finished compost	5
Clay soil	5

3 Mastering the Art

Besides the daily monitoring of the compost making process (moisture, C02, temperature) with instruments, mastering the art of composting was more difficult than expected.

On farm visits by DENR personnel as well as Jon Nilsson, East Coast Compost and George Leidig, Autrusa Company were particularly helpful with both the science and the art of cornposting.

When all is said and done, however, there seems to be no substitute for "just doing it!" The experience of building piles, monitoring, and turning combined with the senses of touch, smell and seeing leads to better compost making technique as time goes on. To become a master of anything takes time .

See Appendix II - Monitoring the compost Environment

C. North Carolina State University Report

IMPLEMENTATION AND EXTENSION OF COMPOST BASED STRAWBERRY PRODUCTION AS AN ALTERNATIVE TO METHYL BROMIDE FUMIGATION

A YEAR-END REPORT TO THE EXTENSION IPM COMMITTEE, DECEMBER 18, 1998

2) **LEADERS:** Frank J. Louws, Gina E. Fernandez and Barclay Poling
Departments of Plant Pathology and Horticulture, NCSU

COOPERATORS: John and Betty Vollmer (Vollmer Farms); Mitchell Wren, strawberry grower and former president of NC-Strawberry Growers Assoc.; Ted Sanderson, field faculty, CES-Franklin County.
Counties/Departments: Franklin County, Dept. Plant Pathology and Dept. Horticulture.

3) OBJECTIVES: Our objectives were: 1) to critically evaluate the potential of a well managed composting system as a pest management tool as compared to MB and one of the leading chemical alternatives, Telone-C35, for commercial strawberry production; 2) to extend the information gained through grower meeting presentations, publications and on site field days.

4) PROJECT ACTIVITIES: A sorghum cover crop was flail mowed 9 Sep 97 (Figure 1). Mature compost (6-8 wks) was purchased (in 1997; made on site 1998) and applied at 30 cubic yards per acre over a sorghum cover crop that had been flail-mowed. (The high rate of compost was used to “jump-start” the system, maintenance rates may be 10 to 20 cubic yards). All plots were cultivated by thoroughly mixing the soil to a depth of 8-10 inches using a Dutch rotary spading machine.

The field experiment was set up as a randomized complete block design with four replications and four treatments. The treatments included no fumigant or compost (control); methyl bromide (400 lbs/acre broadcast), compost only, and finally a second methyl-bromide treatment which became a Telone-C35 treatment in 1998. Each plot consisted of 4 beds 2.5 ft wide on 5-foot centers and 40 feet long. The methyl bromide and control plots received 1000lbs of 6-6-18 fertilizer prior to fumigation on 26 Sep. Strawberry plants ‘Chandler’ were set 9-Oct. We employed plug plants as opposed to bare root transplants as part of our IPM effort to minimize the introduction of soil-borne diseases. Fertigation was applied in the spring to all plots in a similar manner and according to petiole analysis. Detailed crop phenology data (including the crown number and size, dry weight of roots, shoots and crown, leaf area etc) was collected at the time of planting and then each month until June. Plant growth in the control and compost plots lagged behind growth in the methyl bromide treated plots (Figure 2A-2D). Likewise, early yield in the control and compost plots were less than in the standard treated plots (Figure 2E). Total yield in the control and compost plot was 79.6% and 93.4% of the methyl bromide plots (Figure 2F). Compost and control plots required hand weeding and we documented time required for hand weeding for possible future economic analysis.

Soil samples were collected at planting and sent to Soil Foodweb Inc. in Oregon for determination of active and total bacterial and fungal biomass. In addition, we collected 4 samples from each of our other three experiments across the state to highlight differing levels of indigenous microbial communities. The baseline data did not show dramatic differences among treatments, as expected. However, we will collect a final sample in the third year to determine impact of management system on soil microbial communities.

Marketable fruit, culls and fruit mold incidence was documented through biweekly harvests. At the termination of the experiment, plants from each plot were randomly selected and rated for disease incidence on the roots and crowns. Fungi were identified and compared across the various sites. The Vollmer farm had a predominance of *Rhizoctonia fragariae* strains associated with the strawberry roots (Table 1).

Table 1: Source of and identity of fungi associated with strawberry roots. (Identification conducted by Gloria Abad).

SOURCE/ ISOLATE	*Rhizoctonia fragariae*	*Rhizoctonia sp.*	*Pythium irregulare*	*Pythium sp.*	*Fusarium solani*	*Fusarium sp.*	TOTAL
FLETCHER	30	-	-	3	-	2	-
VOLLMER	11	-	-	4	-	2	1
PLYMOUTH	1	3	2	6	3	-	15
CLAYTO	-	1	13	2	1	-	1

5) PROJECT ACCOMPLISHMENTS: We feel that the time is ripe for this type of on farm research and extension. One of the most common concerns among strawberry growers is the loss of MB as a soil fumigant and this provides a teachable moment to relate the importance of soil biology and management as a key component of pest management. We have used the research on the Vollmer farm as an excellent extension model to demonstrate the principles of compost and soil management. On 5-6 May 1997, we conducted an agent training day with - 17 (strawberry) agents from North and South Carolina and visited the Vollmer farm. Agents became familiar with the strengths and weaknesses of the compost-based system and had opportunity to view the plots and look at data. During that time, we also released beneficial mites (directed by Ken Sorensen) to further demonstrate IPM-based approaches in strawberry production. On 29 May, Ted Sanderson organized a successful field day with several farmers and a number of specialists in attendance. Our personal involvement (faculty/CES agents) has also enabled us to acquire knowledge concerning the potential and issues of compost-based strawberry production systems and extend this information through grower meetings, publications and on-farm agent training or field-day events.

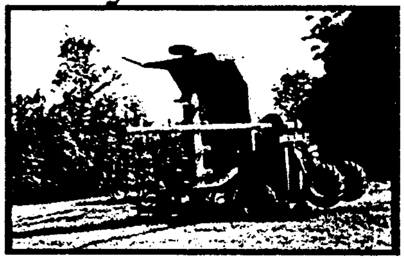
CONCLUSIONS: We have been able to implement a controlled microbial composting (CMC) system for strawberry production in North Carolina. Early plant growth in the compost plots lagged behind growth in the methyl bromide plots. This was the first “soil-building” year and there may be optimism that over time we will see increased yield effects. The compost plots, with no fall applied fertilizers or fumigant produced a 93.4% crop compared to methyl bromide. This experiment has proven to be an excellent mechanism to introduce IPM and soil management concepts to growers, agents and other clientele. We have been able to build on the initial data to substantially multiply the impact of the extension IPM funds received.

Impact of the Extension IPM investment:

Extension IPM funds	$ 6,000.00
Ag Foundation Funding	$40,439.00
Louws unrestricted gifts	~$5,000.00

Based on the first year of data, we have been able to acquire an Ag Foundation grant to support a masters student (Michelle Grabowski) for 2 years. She will look at the basic biology behind a biologically-based system of growing strawberries and thereby complement the Vollmer field work. Likewise, Dr. F. Louws has invested ~$5000.00 to hire a postdoctoral researcher to help identify the fungi and conduct pathogenicity assays. Mr. Vollmer has successfully acquired $20 K to purchase the compost turner and has invested considerable personal time and money in the project. Mitchell Wren has provided fumigation and plasticulture materials and supplies for the project at cost. Therefore, we have been able to utilize the $6000.00 from the IBM program and multiply its impact by a minimum of 11 fold.

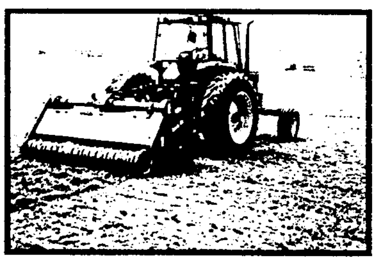
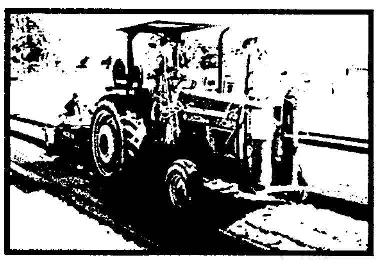
FIGURE 1: Vollmer Study
Outline of CMC System

Poultry manure (1997) clay (10% by volume) and carbon (hay) were combined in windrows and managed to maintain a C:N ratio of 30:1. Moisture content was maintained at 55-60%, using polypropylene tarps. Windrows were aerated regularly and temperature monitored closely to provide a mature compost after 6-8 weeks.


The cover crop was grown for ~ 8 weeks and then flail mowed 9 Sept.


Compost was weighed on site and hand applied over the mowed cover crop.


The cover crop and compost were thoroughly worked into the soil using equipment that essentially double-digs the soil. Plastic and drip irrigation were installed ~ 2 weeks later and other plots were gassed or not treated. After an additional 2 weeks, plug plants were transplanted.


Fruit were harvested biweekly. Mr. Vollmer and Michelle Grabowski are preparing for the 1998 season.

Figure 2A: Crown Dry Weight

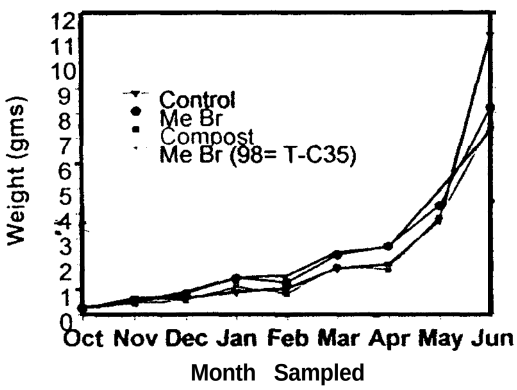


Figure 2B: Leaf Dry Weight

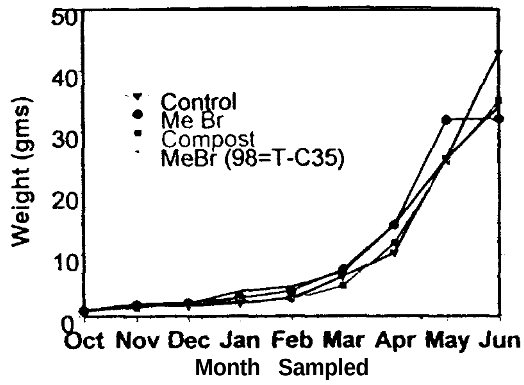


Figure 2C: Total Leaf Area

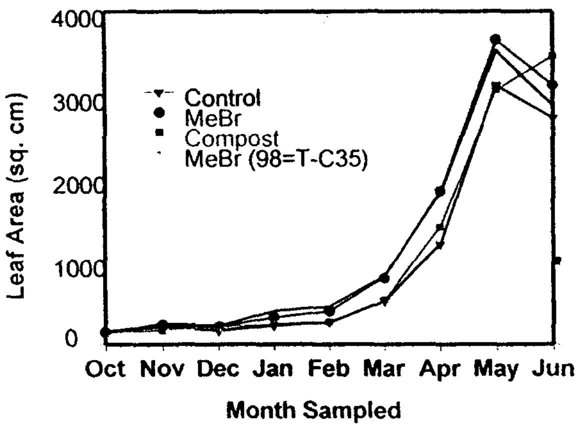


Figure 2D: Root Dry Weight

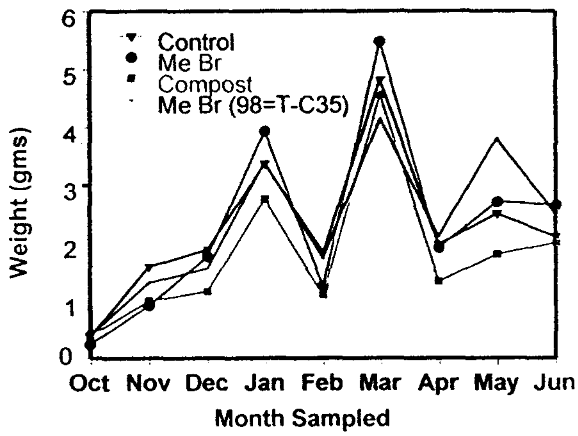


Figure 2E: Total Weight By Harvest Date

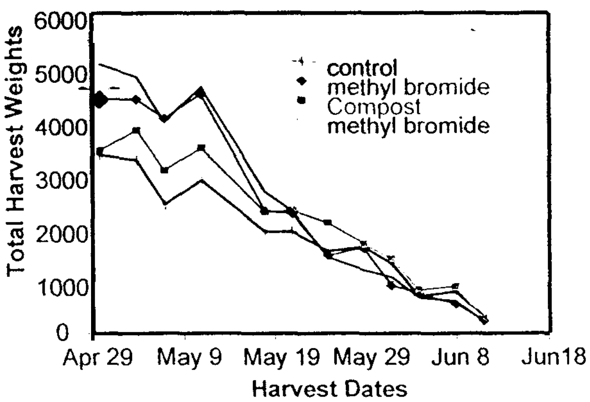
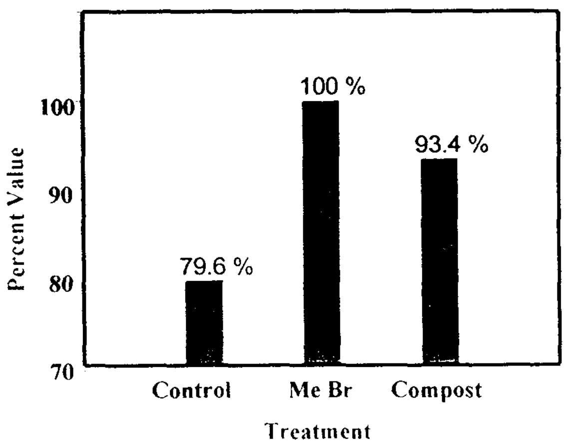


Figure 2F: Total Yields-Percent of Methyl Bromide



ECONOMIC ASSESSMENT

This analysis is presented in two parts:

1. Compost making
2. Compost-based strawberry production

1. COMPOST MAKING - 400 cu. yds./year

	Annual $
Site charge (1 acre size)	500.00
Site - preparation and maintenance	400.00
Compost feedstock procurement	4,000.00
Compost turner-ownership @ $21,000 x 10%	2,100.00
Depreciation @ $21,000 x 10%	2,100.00
Maintenance	300.00
Loader charge @ $9,000 x 10%	900.00
Tractor charge @ $38,000 x 5%	1,900.00
Labor charge @ 240 man hours x $7.00	1,680.00
Management charge @ 50 man hours x $20.00	1,000.00
Lab analysis/test instruments	200.00
Continuing education	200.00
	$15,280.00

Cost/yard = $38.20

2. COMPOST-BASED STRAWBERRY PRODUCTION

Discussion: The primary differences in this system compared to a conventional system is the substitution of probiotic compost for antibiotic methyl bromide and inorganic fertility. The compost-based system puts emphasis on the use of cover crops, special tillage equipment, and timely sanitation practices to control weeds and disease. A comparison of these costs are shown below:

Compost-based System vs. Conventional

Input Item	Compost System-$/Acre	Conventional-$/Acre
Compost-30 yds@$38	1,140.00	
Fertilizer-inorganic	10.00	150.00
Methyl Bromide	--	400.00
Cover Crop	100.00	50.00
Tillage	50.00	25.00
Sanitation	400.00	300.00
Fungicides	50.00	200.00
	1,750.00	1,125.00

Difference + $625.00/acre

This analysis is based on 1st year input costs. After soil is built up in the compost system, application rates of compost could be reduced to 15-20 yards/year. Therefore, 17.5yds.avg.x$38=$66500/acre---a reduction of $475.00/acre in years 2-5.

Viewed over a 5 year period assuming an average application rate of 20 cu. yds./year, the two systems compare as follows:

20 cu.yd./acre/year avg. x $38.00=$760.00/acre instead of $1,140.00

Compost-based system (5 year avg.)	$1,370.00
Conventional system (5 year avg.)	1,125.00
Difference	$255.OO/acre

With good management, compost cost could probably be brought down to $30/cu.yd. on the Vollmer Farm. Growers with animal enterprises on their farms could likely achieve compost cost in the neighborhood of $20/cu.yd. Methyl bromide sellers are already saying that the price will be up in 1999 and price hikes are likely to continue in subsequent years along with mandated supply reductions.

A new scenario with compost at 25.00/cu.yd. and methyl bromide at 600.00/acre would compare as follows:

Conventional system	$1,325.00/acre
Compost-based system	1.310.00/acre
Difference	$ 15.00/acre

From a practical farming point of view, the Vollmer Farm sees the two systems as equal. The economic balance may shift toward one system or the other depending on how the cost of inputs change over the next 5 years. Even a difference of $250.00/acre is not significant in the overall scheme of things. To date, this project has not included crop rotation as a component of the production system. We could envision growing strawberries in alternate years. This could provide pest management benefits, but may impact economic analysis.

VI. REDUCTION OF CHEMICAL USE AND ENVIRONMENTAL BENEFIT OF COMPOST-BASED PRODUCTION SYSTEM

Implementation of a compost-based strawberry production system would result in a significant reduction in chemical use. It also would make use of animal and plant waste to directly benefit crop production and reduce purchased inorganic fertility goods. In addition, nitrogen overuse would likely be curtailed. Table 2 provides an estimate of chemical use reduction. Table 3 provides an idea of the shift in the type of fertility and its relative costs.

It should be noted that although the compost-based production system results in the elimination of methyl bromide, hand labor has to be substituted to provide weed control. Experience thus far indicates that there is more than enough savings to pay for this labor provided labor can be found at $6.00/hour.

In making compost, cow manure is easier to work with as compared to poultry litter. The cow manure seems to provide a more measured response in the composting process and results in a better finished product. An on farm visit by David Williams, Craig Coker and Susan Clarke, DENR personnel, in April 1998, was very helpful in sorting out a good compost recipe. It takes about 24,000 pounds of dewatered dairy manure to make 30 cu. yds. of compost. A 1 acre compost-based production system uses 12 tons of dairy waste and reduces chemical use by about 200 pounds.

Another major consideration is the likely reduction in the current overuse of nitrogen. Plasticulture strawberries are fertilized with an average of 125 pounds of nitrogen (60 pounds preplant and 65 pounds drip). Studies at N.C. State University show 35 pounds of nitrogen is removed in the fruit of an average 20,000 pound crop. A portion of the 90 pounds of excess nitrogen remains in the crop residue when the crop is plowed down, but the majority of this nitrogen is lost to the environment, mainly into surface and ground water.

Properly made compost results in nutrients being stored in mainly a water insoluble form in the clay/humus complex of the compost. Microorganisms break down these nutrients and release them to plants. The result is a natural soil balance that is efficient, effective and environmentally friendly.

TABLE 2 ESTIMATED CHEMICAL USE IN COMPOST-BASED PRODUCTION SYSTEM VS. CONVENTIONAL SYSTEM.

Chemical or Chemical Replacement	Compost System	Cost/acre	Conventional System	Cost/acre
Methyl Bromide	--	--	200 lb./A	400.00/A
Captan	--	--	25 lb./A	75.00/A
Rovral	--	--	4 lb./A	90.00/A
Benlate	--	--	2 lb./A	35.00/A
Compost Tea	15 gal./A	25.00/A	--	--
Sulfur	10 lb./A	25.00/A	--	--
Miticide	--	--	3 lb./A	150.00/A
Predator Mites	--	150.00	--	--

TABLE 3 ESTIMATE OF POUNDS OF FERTILIZER MATERIALS USE-COMPOST-BASED SYSTEM VS CONVENTIONAL SYSTEM

Fertilizer Material	Compost System	Cost/acre	Conventional System	Cost/acre
Compost-Preplant	36,000 lbs.*	1140.00/A	--	--
6-6-18 Preplant	--	--	1,000 lb./A	110.00/A
Boron-Preplant	1 lb./A	5.00/A	1 lb./A	5.00/A
Sodium Nitrate	100 lb./A	10.00/A	--	--
Calcium Nitrate	--	--	250 lb./A	

*Based on 1200 lbs./cu. yd. and application at 30 cu. yds./acre

APPENDIX 1

SOURCES OF INFORMATION

High Quality Leaf Composts: A Production Guide. Moody Hill Farms, Armenia, N.Y.

On Farm Composting Handbook, Robert Rynk, Editor, Northeast Regional Agricultural Engineering Service, 152 Riley-Robb Hall, Cooperative Extension, Ithaca, N.Y. 14853

George Leidig, Autrusa Company, Controlled Microbial Compost (CMC) Consultant. P.O. Box 1133, Blue Bell, PA 19422

D.M. Fulks, Belvedere Plantation, Inc. 1601 Belvedere Dr., Fredericksburg, VA 22408

Jon Nilsson, East Coast Compost Consultants, P.O. Box 1016, Leicester, N.C. 27848

Craig Coker, Organic Recycling Coordinator, Division of Pollution Prevention, N.C. Dept. of Environment and Natural Resources, P.O. Box 29569, Raleigh, N.C. 27626

Bill Lord, N.C. State University, Cooperative Extension Service, Louisburg, N.C. 27549

Appendix II

MONITORING THE COMPOST ENVIRONMENT

CONDITION		INDICATES
Moisture		
20-30%	Dry	No bacterial action
40-60%	Moist	Ideal
60-65%	Wet	Danger of going anaerobic
>75%	Juicy	Anaerobic-Possibility of odors
Temperature		
<70°F	Cold	Slow activity
90-110°	Lukewarm	Moderate activity
110- 140°	Warm	Fast activity
140-160°	Steaming	Borderline
175-200°	Dry Hot	Burning, Killing biological activity
Structure		
Loose		With dry heat will burn off organic matter & nitrogen
Crumbly		Ideal
Tight		If cold, needs more air
Sticky		Needs more air. danger of anaerobic conditions
Caked		Avoid, danger of anaerobic coring
Lumpy		Became too wet at first, then dried
Smeary		Too wet or too **much** of heavy textured ingredients
Crusty Surface		Loosen to keep air flow
Color		
Black brown		Ideal
Dark brown		Very good
Black		If wet, anaerobic
Green black		If wet, anaerobic
Green		Too wet, anaerobic
Yellow green		Wet, anaerobic, acid
Yellow		Intermediate stage, needs more air
Brown green		Changing, needs more air
Grey		Good air, but too hot & dry
Light brown		Fair, possibly too tight
White		Mold or fungus
Odor		
Earthy		Ideal
Musty		First phase, may be dry
Sour		Anaerobic, wet, tight & needs air
Sour earthy		Changing toward better

From: High quality leaf composts: a Production Guide. Moody Hill Farms, Armenia, NY.

APPENDIX 111

WINDROW HISTORY WINDROW # __________

Recipe ____________________

____

____

Compost Environment

Date	Temp.	Struct.	Odor	Color	% Oxygen	Comments (date turned, weather, etc.

APPENDIX IV

Challenge Grant Interim Progress Report

THE VOLLMER FARM
P.O. BOX 171
BUNN, NORTH CAROLINA
(919) 496-4540 OR (919) 496-5007

January 8, 1998

Ms. Susan Clarke
Department of Environment and Natural Resources
P.O. Box 29569
Raleigh, N.C. 27626-9569

Dear Ms. Clarke:

Enclosed is the Challenge Grant Interim Progress Report as requested by our contract.

Our project is up and going due to the wonderful support of the group at Pollution Prevention. You should know that I would not have been able to move forward without the grant for the compost turner. My heartfelt thanks to all of you who helped get this composting project started.

Sincerely,

John Vollmer

CHALLENGE GRANT INTERIM PROGRESS REPORT

Contractor: The Vollmer Farm

Contact: John Vollmer 919-496-3076

Project: Alternative Strawberry Production with Compost

INTERIM REPORT SUMMARY

The research plot has been successfully established with cooperation of N.C. State University and The Vollmer Farm. A narrative of this process is provided in the copies of articles that appeared in “Stewardship News” and “The Strawberry Grower”. Details of the plot design and data to be collected are provided in the Plot Design Sheet attached. Our compost turner was delivered 10-4-97. Some missing parts caused a delay in assembly and getting the turner operational. We put together our first compost pile on October 29, 1997.

ECONOMICS

Making good compost is an expensive process. Component procurement (loading and hauling) is an expense greater than envisioned. In addition to building the compost pile, it must be monitored daily and action taken (turned), again more expensive and time consuming than imagined.

TECHNICAL

The main technical problem that we encountered in building our first compost piles was that we did not have enough nitrogen containing components to drive the breakdown process. The result was that our piles stopped “working” at about 4 weeks into an 8-week-cycle. We think we can remedy this situation by testing the components C:N ratio. The C:N ration will then guide how much of the different components will go into the compost recipe. More piles will be guilt in the spring when weather permits.

ENVIRONMENTAL

The compost site is surrounded by trees for a wind break. It slopes South to North on a 10% grade. After storage of components (dairy manure, poultry manure, clay soil, wheat and oat straw, pumpkins) and building two 300 foot piles, our l-acre site was full! The site is isolated and provides no ““smelly” problems for our neighbors. Stockpiling of manure and subsequent building of piles did create a strong smell that would be offensive if the site were not isolated, and therefore, has to be a major consideration in site selection.

Alternative Strawberry Production With Compost, 1997-98
Franklin County, Bunn, NC
F.J. Louws, Extension Plant Pathologist
North Carolina State Univ., Raleigh, NC 27695
Tel: 919/515-6689 FAX: 919/515-7716

OBSERVERS____________________ DATE:__________

CROP GROWTH STAGE ____________________ TIME:in______ out______

CROP STRESS ______________________________

PESTS______________________________

RAIN (in.) ________ % CLOUD COVER ________ TEMP. (F or C) air __________

SOIL: moisture _____ temp. 4" ____ (F or C) SPRAY/HARVEST NO. ________ WATER pH:______

WIND: mph ________ from _______ ADDITIONAL PESTICIDES APPLIED: __________

CROP VIGOR: good _______ fair _______ poor _______ DEW: heavy ____ light _____ none ______

DATA RECORDED: ______________________________

No. Product	Rate per Acre	Rep-A	Rep-B	Rep-C	Rep-D
1. Check	....	____	____	____	____
2. Methyl Bromide,	240.0 lbs............	____	____	____	____
3. Compost,	30 yds	____	____	____	____
4. Methyl Bromide (97) 240 lbs. Telone C35 (98)		____	____	____	____

HARVEST: Two weekly harvest. Harvest made from two center rows, 15-ft section.

PURPOSE: A project to test the ability of compost to eliminate the need for methyl bromide and commercial fertilizer in plasticulture strawberry production.

COOPERATORS: J.G. Driver, NCSU Plant Pathology, tel: 919/515-5941, FAX: 919/515-7716; Ted Sanderson, Coop. Ext. Service, Franklin Co., tel: 919/496-3344; John Vollmer, P.O. Box 171, Bunn NC 27508, Tel: 919/496-3076, FAX: 919/496-3076.

DATA: (1) disease incidence, (2) plant vigor, (3) marketable, culls, and disease weights, (4) weights taken from 25 berries, (5) phytotoxicity

FIELD LAYOUT & RANDOMIZATION: Plots consist of 4 beds, 2.5 ft wide beds on 5 ft centers, 40-ft long with plants staggered 12-in. apart in two rows 12-in. apart. Each plot contains 320 plants. Treatments randomized in four complete blocks.

Rep-A 1 2 3 4 Rep-B 2 3 4 1 Rep-C 3 4 1 2 Rep-D 4 1 2 3

APPENDIX IV

EXAMPLES OF OUTREACH IMPACTS

STEWARDSHIP NEWS

November – December, 1997 Volume 17, Issue 4

Research Ready To Confirm What We Already Know

By Mark O'Farrell

Why did the chicken cross the road? Before you jump to a hasty conclusion, you may want to consult some of the research base on the subject, such as "The Effects of Carbon Monoxide on Neuro-chemical Transmissions in Gallus Domestica."

Next question: Are healthy plants, grown in healthy soil, really more resistant to insects and diseases? This is a question that many organic growers, through a combination of personal observation, experience and research, have no problem answering in the affirmative. In fact, it might be considered a cornerstone in the foundation upon which an organic system is built.

Scientific inquiry, however, doesn't factor in what many of us might consider common sense. And the healthy soil, healthy plant association has never been proven by scientific standards. "A plant needs nitrogen, and it doesn't matter whether it comes from a bag or the rear end of a cow." Such is the popular wisdom in much of the agricultural and scientific community.

But that may be changing, thanks to a volume of research being conducted at numerous research stations and universities on the topic of suppressive soils and Systemic Acquired Resistance, or SAR. It appears that the scientific community is on the verge of acknowledging, albeit in small increments, that there is more than nitrogen being issued from the rear end of ruminants, and that some of it may figure into a plant's ability to resist infection.

Aside from providing mineral nutrients, manures and other organic matter are used by farmers to increase the biological activity in their soil. Providing a habitat and food supply for a diverse soil ecosystem is considered essential to keeping disease-causing organisms in check. As more evidence is being accumulated about specific soil microbes, organic soil management practices seem more and more credible.

continued on page 4

Grower Trials Methyl Bromide Alternatives

By Debby Wechsler

Last winter, John Vollmer, a strawberry grower in Bunn, NC, saw an article in the December issue of the newsletter of the North Carolina Strawberry Association that caught his attention. The article by D.M. Fulks talked about composting and other "probiotic" strategies as alternatives to the methyl bromide fumigation which is widely used by commercial strawberry growers. "I kept it on my bedside table," recalls Vollmer, "and I kept coming back to it. I knew methyl bromide was due to be banned on January 1, 2001, and that we needed to be looking at solutions. Until I read the article, I'd always thought of composting as something far out, something for the home garden, but here was D.M. Fulks doing it, and enthusiastic about it, and doing it in a scientific way."

Eventually, Vollmer contacted Fulks, and, at his suggestion, went to a composting seminar in Pennsylvania. As he began to put together the components he needed for large-scale, on-farm composting, he realized he didn't have the financial resources to purchase the equipment he'd need. So, with the help of Extension Agent Bill Lord and a letter of support from NCSU Small Fruit Specialist Barclay Poling, he applied for a grant from the NC Department of Environmental Health and Natural Resources Pollution Prevention program, and was able to get funds to purchase a compost turner.

Vollmer has started his trial with this fall's strawberry plantings. "Since I didn't have compost of my own yet," he says, "I was able to buy compost from D.M. Fulks to establish plots this year that we can follow for three years. I really appreciate his helping me get started." Vollmer is conducting his trial in cooperation with NCSU researchers Frank Louws and Gina Fernandez. Some of the expenses are being covered through a 1997 Strawberry Association research grant.

With plots 20 x 40 feet, and four random replications of four treatments, the trial adds about 1/2 acre of experimental strawberries to his regular 2.7 acres of production. The treatments are: 1. methyl bromide fumigation 2. fumigation with Telon C-35 3. compost 4. a control (no compost/fumigation). (Telone C-35 is a new chloropicrin formulation from Dow Elanco, that is not yet on the market. Because of waiting periods, he was unable to use the Telon C-35 treatment this fall and used methyl bromide instead; that plot will be switched over next year.)

He first turned in a summer cover crop of millet. The compost was applied at a rate of about 30 cu yards/acre. (This build-up rate would drop to 15 cu. yards/acre for maintenance.) Composted plots received no additional fertilizer, but he plans to monitor tissue nutrient levels and apply any needed nutrients through his irrigation. "We will measure yields and monitor disease and insect levels on all the plots," says Vollmer.

How does the compost work? Says Vollmer, "The point is to create a healthy environment and improve plant health to where the plants naturally resist disease and insects. We've really brought the soil to a bad place with conventional farming methods."

In his own compost production, Vollmer will create windrows of materials and turn them with his new equipment. Initially, he plans to use wheat and oat straw from his farm, chicken manure and cow manure from neighboring farms, and clay from building a pond, plus a bit of Fulk's compost as a "starter". "We're making plans to adopt the use of compost on all our crops," says Vollmer.

His grant requires that Vollmer share what he learns from his experiments with other growers--and indeed, he is eager to do so, with plans to hold field days at his farm and publish reports on the trial. ✣

Reprinted from The Strawberry Grower, *October 1997, with permission.*

October 1997

THE STRAWBERRY GROWER

Volume 4 No. 9

Grower Trials Methyl Bromide Alternatives

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His grant requires that Vollmer share what he learns from his experiments with other growers--and indeed, he is eager to do so. Watch these pages for announcements of field days at his farm and for reports on the trial. ❖

More on Methyl Bromide...

Are you also concerned about the cancellation of methyl bromide? Alternatives to methyl bromide—both chemical and biological—will be the subject of a session on Friday, November 14 at the Southeastern Strawberry Expo. Our presenter, Dr. Jean Ristaino, is an associate professor of Plant Pathology at NC State University. Her expertise is in the areas of sustainable agriculture, ecologically-based pest management and alternatives to pesticides. She holds a Ph.D. in plant pathology from the University of California-Davis. She was recently a fellow with the American Association for the Advancement of Science and worked in the EPA Office of Air and Radiation as part of the Methly Bromide Program in the Stratospheric Protection Program. Her work has included research on the rates that pathological organisms reenter fumigated soil and on soil solarization.

Come hear what she has to say!

TO: All agents with responsibility for strawberries

From: Frank Louws

RE: “Small Fruit Pest Management” course # 438

This two day intermediate level course will be offered May 5-6, 1998 in the Raleigh/Clayton area and has openings for additional agents who wish to attend.

Components of the course will include an overview of production and some emerging technologies that may assist our growers (e.g. tissue culture, in-greenhouse tip production); entomology (emphasis on mite management and use of beneficial mites with field demo); pathology (current research/mgmnt recommendations for Botrytis and anthracnose; viruslphytoplasma incidence); weed science (biology and ID of major weeds). In addition, we will interact on methyl bromide alternatives, compost-based systems for production (experimental), and developing IPM programs. Two field visits are scheduled 1) Clayton research Farm in combination with a proposed general public field day 2) John Vollmer Farms in Franklin Co.

If you are interested in this course, please reply to Frank Louws (frank Iouws@ncsu.edu) by April 22.

I will send additional information once you reply. As a homework assignment we propose that you select a grower in your county and document their pest management program. This course is an intermediate level course and an approved part of the Horticulture curricula.

Please feel free to contact me if you have any questions. All the best and I look forward to our possible interaction in May.

1998

Strawberry Training Schedule: ~ 15 agents plus 5 specialists

Tuesday May 5

9:00 Welcome and Introductions

9: 15	Eric Bish	Overview of current strawberry production Emerging tip technologies
l0:30	Break	
l0:45	Katie Perry	Frost Protection
11:30	Laura Carver	Biology of Botrytis
12:00 - 1:00	Lunch on Premises	
1:00	Ken Sorensen	Overview of NAPIAP Insect/Mite biology and management on strawberry
1:45	Dave Monks	Weed Management; Biology and weed management practices
2:30	Frank Louws	Disease Management; Biology and disease management strategies

3:15 break

3:30 Group workshop - Compile an IPM Checklist for NC growers

4:30 Head over to Small Fruit Center for Social (Centennial Campus)

5:00 - 6:00 Dr. Barclay Poling; Small Fruit Center

Wednesday May 6

8:30 a.m. Clayton Field Research

- Gordon Miner - plant spacing and nutrition research
- Dave Monks - weed identification/management
- Frank Louws - Disease Id
- Ken Sorensen - Insect ID
- ALL = Fumigation Plots

l0:30 - 11:30 (Return to class)

- Gina Fernandez - Over view of raspberry/blackberry production
- ALL - general discussion of IPM in cane fruits

11:30 - 12:00 Zvesdana Pesic-Van Esbroek; Tissue Culture Program and Virus indexing

12:00- 1:00 Lunch on Premises; Gina Fernandez and Frank Louws

- Current status of Methyl Bromide alternative products and research

1:00 Drive to Vollmer Farms, Bunn, Franklin Co. (May bring your own car)

2:00 Vollmer Farms

- Overview of composting system
- (sneak peak at lettuce production on float systems?)
- Ken Sorensen - release of beneficial mites
- Gina Fernandez, Frank Louws, John Vollmer - compost research plots

4:00 Adjourn (Van will return to Clayton)